UNIVERSITÉ DE STRASBOURG

ÉCOLE DOCTORALE SCIENCE HUMAINE ET SOCIALES
PERSPECTIVES EUROPÉENNES

Société, Acteurs, Gouvernement en Europe, UMR 7363

THÈSE présentée par :

Nóra RÉVAI

soutenue le : 2 décembre 2021

pour obtenir le grade de : **Docteur de l'université de Strasbourg**

Discipline/ Spécialité : Sociologie

The dynamics of teachers' professional knowledge in social networks

THÈSE dirigée par :
M NORMAND Romuald — Professeur, Université de Strasbourg

RAPPORTEURS :
Mme PROITZ Tine — Professeur, Université du Sud-Est de la Norvège
Mme TUBARO Paola — Directrice de Recherche, CNRS, Université Paris Saclay

AUTRES MEMBRES DU JURY :
M CORDAZZO Philippe — Professeur, Université de Strasbourg
Mme POORTMAN Cindy — Professeur Assistante, Université de Twente (Pays Bas)
M TULOWITZKI Pierre — Professeur, Haute École Spécialisée de la Suisse du Nord-Ouest FHNW

INVITÉS : (le cas échéant)

Université de Strasbourg

Nóra RÉVAI

The dynamics of teachers' professional knowledge

Abstract

The thesis explores the role of networks and social processes in the dynamics of teachers' knowledge through two main research questions. First, how can we characterise the different dynamics underlying the transformation of teachers' professional knowledge? In particular, the thesis investigates how teachers mobilise and construct knowledge collectively, and how this knowledge is shared and diffused within their community of practice, as well as in their wider network. Second, how do social processes influence teachers' knowledge dynamics? The work focuses on highlighting the complexity of social interactions and processes, and unpacking the ways in which these contribute to the different dynamics of teachers' knowledge. A mixed-method empirical investigation was conducted in the context of a supra-network of schools in one region in France. The quantitative component consists of two surveys – one targeting teachers, another targeting school leaders. Data is analysed using structural equation modelling and an ego-network analysis of schools. The qualitative component consists of case studies conducted in two schools, to provide a deeper understanding of quantitative results.

Résumé en français

La thèse explore le rôle des réseaux et des processus sociaux dans les dynamiques du savoir des enseignants à travers deux questions de recherche. Premièrement, comment peut-on caractériser les différentes dynamiques qui sous-tendent la transformation du savoir professionnels des enseignants? En particulier, la thèse examine la façon dont les enseignants mobilisent et construisent du savoir collectivement, et les mécanismes à travers lesquels ce savoir est partagé et diffusé au sein de leur communauté de pratique, ainsi que dans leur réseau plus large. Deuxièmement, comment les processus sociaux influencent-ils la dynamique du savoir des enseignants? Le travail s'intéresse à mettre en évidence la complexité des interactions et des processus sociaux et la manière dont ceux-ci contribuent aux différentes dynamiques du savoir des enseignants. Une enquête empirique à méthode mixte a été menée dans le cadre d'un supra-réseau d'établissements dans une région de France. L'élément quantitative consiste en deux questionnaires – un qui adresse les enseignants, l'autre qui adresse les chefs d'établissement. Les données sont analysées à l'aide de la méthode d'équations structurelles et d'une analyse du ego-réseau des écoles. L'élément qualitative consiste en des études de cas menées dans deux écoles, qui fournissent une compréhension plus approfondie des résultats quantitatifs.

Acknowledgements

First and foremost, I would like to thank my supervisor, Romuald Normand, for having accompanied me on this journey. He tirelessly conveyed the essence of the world of research, the specificities of the language and the approaches. Romuald also generously introduced me to his wide professional network and, as a result, I was able to establish valuable and long-lasting relationships, and had the chance to communicate my work in the research community.

I would like to express my gratitude to the staff of the Academy where I conducted my empirical research: the two rectors leading the Academy during these years for their support, and the key co-ordinators of the network under study for their insights and continuous help with data collection. I equally thank all the teachers and school leaders who took the time to fill in the questionnaires. Special thanks to those who agreed to give me an interview in the selected schools and in the region.

I owe huge gratitude to my colleague, Hannah Ulferts, who taught me and guided me through the quantitative research. Thank you, Hannah, for reviewing my questionnaires, for dragging me in the world of structural equation modelling, for your invaluable advice on data analysis, and for all the helpful suggestions on the drafts throughout their development. You have been my genuine co-supervisor for the quantitative part for years, investing a lot of time and showing a great deal of patience with me.

I extend my thanks to Philippe Cordazzo and Pierre Tulowitzki who were following the progress of my research year by year, for their encouragement and advice. In addition, I would also like to thank Mathias Lebargy and Alex Paniagua for reviewing pieces of my work and providing constructive comments. I am also very grateful to my colleague, Gábor Fülöp, who did calculations for me based on the TALIS database. I must extend my thanks to the statistics and data (“geek”) community around the world: researchers and programmers invest time and energy to provide answers to questions on stackoverflow, geeksforgeeks, researchgate and other forums. One can find an answer to almost any question today and the international network of professionals has become a major source and space for informal learning.

I would also like to express my gratitude to my colleague, Matthew Gill, who helped pull together the myriads of documents in the last phase, ensuring coherence and visual appeal.

Last but not least, I would like to thank my husband Gaetan, and my children Aron and Lena Stawinoga who were patient for years, who put up with me working on weekends and holidays, and occasionally being stressed and overwhelmed. Without them I would never have had the force to finish.

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Why teachers' knowledge? – Introduction and rationale

Teaching as a social practice is embedded in a rapidly and continuously changing environment. Societal megatrends, such as digitalisation, globalisation, climate change, growing inequality and demographic changes are transforming education. Navigating this complex environment means that teachers need to constantly adapt to change, in particular by developing their competences continuously. At the same time, social pressure on teachers has been increasing in the last decades. Society sets complex expectations for them: teachers need to meet the individual needs of increasingly heterogeneous groups of students, develop transversal competencies or "21st century skills", collaborate with their colleagues as well as with other professionals, and work with parents. In order to understand the transformation of the education system and of education policies, it is key to question the nature and dynamics of teachers' knowledge and the new conditions for their professional learning in light of emerging social configurations.

Educational research and education policies stress the key role of teachers in the success of school systems. International organisations, think tanks and consultancy companies describe teachers as "knowledge professionals" who need to learn continuously in order to make informed professional judgements that support students' learning on a daily basis (Barber and Mourshed, 2007[1]; European Commission, 2015[2]; Schleicher, 2016[3]; OECD, 2005[4]). Research studies offer various conceptualisations and models of teachers' knowledge and learning, and measure their "effectiveness" or "quality" based on these. When these studies gain international scale, they potentially create a competitive and normative pressure for teachers (such as the Programme for International Student Assessement [PISA] of the OECD) (Lawn and Normand, 2015[5]).

Previously, most studies used simple proxies for teachers' knowledge such as qualifications, degrees earned or years of experience. More recently, research started to develop direct measures of teachers' knowledge. Building on these, some recent initiatives – such as the Teacher Education and Development Study in Mathematics (TEDS-M) study conducted by International Association for the Evaluation of Educational Achievement (IEA) or the Teacher Knowledge Survey developed in the Centre for Education Research and Innovation (CERI) at the OECD – assess teachers' knowledge. These international assessments, however often focus on what is "easy to measure", i.e. the cognitive knowledge of teachers, for example related to their content knowledge in a school subject, or their knowledge of pedagogy, whereas they rarely investigate teachers' social knowledge and skills. For example, the seven

areas of teacher knowledge in Shulman's typology (Shulman, 1987[6]), which is a commonly used framework for investigating teachers' knowledge, do not include essential intrapersonal skills such as intellectual openness, work ethic or conscientiousness. Moreover, skills such as collaboration and leadership, the importance of which is underlined today by numerous studies, are rarely taken into account in these various conceptualisations and typologies.

Finally, most international comparative studies investigate teachers' individual knowledge. While this is still relevant, collective knowledge interpreted in the context of a community or a professional network, becomes increasingly more important with the transformation of society. Understanding this shared or collective knowledge, studying how it interacts with teachers' individual and social characteristics, and how it relates to the social environment is only in early stages of research. Due to the significance and high stakes of models and conceptualisation of teachers' knowledge in the paradigm of the 21st century "knowledge society", they deserve a sociological investigation.

The debate on teachers' knowledge does not stand in a vacuum; it is part of a larger discourse on the profession and professionalisation. Analysing the discourse on professionalism is a powerful tool for understanding professional and social transformations (Evetts, 2009[7]). What are the underlying norms involved in redefining the expectations from teachers as professionals? How to account for new arrangements between research, policy and practice?

The *first objective* of this thesis is therefore to *investigate what the broad context of the teaching profession and discourses on professionalism imply for teachers' knowledge* and *how models and conceptualisations of teachers' knowledge translate into various educational contexts.* To open a critical space, I will explore the contributions, but also the limitations of these models. I will also investigate how knowledge manifests in areas that are more difficult to codify such as collaboration, leadership, organisations and networks. This research intends to contribute to a more comprehensive understanding of professional knowledge within the broader context of the restructuration of education systems and policies, and its effect on a professional group with a history and a unique identity (Sachs, 2010[8]).

Teachers' knowledge, whether we consider the individual knowledge of a teacher or the collective knowledge of a professional community or the profession, is however not static. It is continuously shaped by initial training, professional development and experience, but also through social processes such as collaboration and networking. Some of the key questions that have been troubling the education research and policy community in recent years are in one way or another related to these dynamics of knowledge.

The dynamics of knowledge have been approached from different aspects. First, an influential line of thought advocates for teaching to become an "evidence-based" profession that systematically integrates emerging evidence into professional practice. Accumulating and systematising research to build a strong evidence-base on "what works" in teaching, i.e. what practices produce higher outcomes, has been an attractive narrative in the early 21st century's political context (Hargreaves, 1996[9]; Goldacre, 2013[10]). It has been taken up by education policy in increasingly more countries, and particularly strongly in the Anglo-Saxon world. The evidence-based paradigm builds on a straightforward logic: research establishes

what works, teachers use this evidence base, and student outcomes will increase. Governments therefore invested considerable amounts into "brokerage agencies" that were tasked with translating and transferring evidence to teachers. However, many of the early initiatives assumed a linear knowledge transmission model, which did not take into account the complex patterns of relationships and the nature of interactions between diverse actors (Best and Holmes, 2010[11]). A number of education research studies started to examine how knowledge, emerging from research, is disseminated and mobilised among teachers. As a result, linear models have been revisited during the last decade, and recent policy frameworks try to build on more complex models. At the same time, many critiques of the evidence-based paradigm have pointed to the narrow conceptualisation of "evidence" and its conflict with professional judgement, as well as the moral and ethical dimensions of teaching (Biesta, 2007[12]; Hammersley, 2005[13]). Today, the world of researchers is largely split between strong advocates of narrow understandings and fierce opponents of the paradigm. While teachers are increasingly more pressured to keep up with research on teaching and learning, to date research has not been able to offer meaningful conceptualisations of the relationship between research and professional practice.

Second, generating and scaling innovation have become dominant demands for educational services in the past decades. To respond to the complex set of challenges outlined above, teachers and schools constantly need to develop local solutions and also adopt innovations from others (Paniagua and Istance, 2018[14]). As knowledge is a fundamental element of innovation (Dankbaar, 2004[15]; Salling Olesen and Ellström, 2010[16]), the "innovation imperative" have major implications for the transformation of teachers' knowledge: How do teachers construct new knowledge locally?

Organisational management literature addresses the question of knowledge creation with the objective to make firms and organisations more productive and capable of innovation. One key focus is knowledge management, which involves understanding the dynamics between codified and tacit knowledge (Cowan and Foray, 1997[17]; Johnson, Lorenz and Lundvall, 2002[18]; Kimble, 2013[19]), and how these relate to creating new knowledge. While organisational management studies have contributed with useful insights into the functioning of business and industry firms, they fail to account for some of the specificities of schools. In particular, they do not consider the intensity of interactions between teachers and students, and the ways in which these affect teachers' knowledge. They also fall short on understanding the impact of the context, i.e. the ways in which schools and teachers are embedded in a wider socio-political field. In addition, they often build on normative and functionalist assumptions that are not directly relevant for education such as productivity, innovation and growth.

The *second objective* of this thesis is therefore to *examine the conceptualisation of the dynamics of teachers' knowledge within the context of the transformation of education systems and schools*. It will seek to explore the complexity of interactions and exchanges between the various educational actors – teachers, researchers, policy makers, etc. – with a view to proposing an alternative for the normative and prescriptive models of the interrelations between professional knowledge and practice.

As part of the issue of strengthening teachers' knowledge, education scholars and international experts are calling for greater collaboration between the world of research in education and the world of practitioners. New social relations are developing both within the professional community of teachers and between different communities, which transform teachers' work environment. These increasingly involve boundary-crossing between institutions (e.g. schools), as well as professions. Networks are therefore becoming popular forms of social organisation. More and more networks in education are established to facilitate change (Brown and Poortman, 2018[20]; European Commission, 2017[21]). For example, networks of schools can develop and test new curriculum, or schools can work in partnership with teacher education institutions to train new teachers. Networks also emerge as a result of professional development programmes or around particular pedagogies (Paniagua and Istance, 2018[14]).

While networks are becoming the new social and policy imperative for teachers and schools, little is known about how they affect the profession. Network research in the field of education has been growing over the past few decades, but to date there is limited understanding on how networks influence teachers' knowledge and learning, e.g. how knowledge is generated and diffused in networks. For example, what do teachers' interactions with communities of different epistemological backgrounds (e.g. researchers or social workers) imply? How does their knowledge transform through such interactions? How does the social context of the network – such as hierarchical versus horizontal organisation – influence knowledge processes? Studying the dynamics of teachers' knowledge in networks is highly relevant in today's social policy context.

In light of the above, this thesis set out to go beyond the school as an organisation *and investigate teachers' professional knowledge*, in particular, *the mechanisms underlying the dynamics of this knowledge in networks*. It will seek to explore and critically examine the conceptualisations of knowledge and learning, and propose a theoretical-conceptual framework that is capable of accounting for the complexity of processes. It will equally seek to empirically study the dynamics of teachers' knowledge in networks. This theoretical and empirical investigation can not only reveal new perspectives of teacher professionalism, but can also usefully inform policies around the design of teacher learning. It can be relevant for designing development interventions or upscaling local innovations through identifying factors that facilitate and that hinder knowledge dynamics.

Thesis structure

The thesis consists of two main parts. **Part I** is a **theoretical-conceptual exploration** comprising four chapters:

Chapter 1 addresses the context of the principal theme of this thesis – teachers' knowledge – in the sociological literature on professions and professionalism. Based on a number of influential documents by international organisations and national policies, in this chapter, I examine the evolving policy and expert

discourses. I highlight their implications on teachers' knowledge and learning, and point to the ways in which these discourses limit an appropriate scientific understanding of these concepts.

Chapter 2 reviews different conceptualisations of knowledge, and the processes and factors affecting its dynamics. I explore cognitive, management and social approaches to conceptualising knowledge. I highlight the contributions of each of these fields to understanding teachers' knowledge and learning, and point to their limitations. The critical analysis of the various theories leads to identifying the most suitable theoretical and conceptual basis for the empirical investigation of this thesis.

Chapter 3 describes three major and strongly interrelated paradigms that have had a substantial impact on teachers' social environment and practice over the past two decades: evidence, innovation and networks. I briefly review the research underlying the three paradigms and show how they manifest in policy. I use critical policy analysis to explore the tensions emerging from implications of these policies for practice.

Chapter 4 draws on the conclusions of the first three chapters and develops a theoretical-conceptual framework that is appropriate for empirically studying teachers' knowledge as embedded in the social environment. I discuss the theoretical underpinnings of the framework, and how relevant areas of social and educational research can be incorporated to form a coherent theoretical basis. I formulate the main research questions and hypotheses for a sociological investigation of knowledge.

Part II of the thesis presents an **empirical research** in six chapters:

Chapter 5 presents the study design and methodology. It is a mixed method study composed of quantitative and qualitative elements. I present the development and methodological considerations of the quantitative survey of teachers and school leaders. I describe the target population and the sample, and analyse this latter in terms of representativeness. In this chapter, I also present the analytical choices and discuss analysis methods for both the quantitative and qualitative components.

Chapter 6 presents the social and policy context of the study. Based on qualitative data collected in the exploratory phase of the research, this case study explores the two highest social levels: that of the region (Academy) selected for this study and the formal network put in place in this region. Following the conceptual framework's three main dimensions – network context, devices and characteristics – I describe the functioning of the network and point to the tensions between regional governance and local dynamics. I conclude by highlighting the uncertain effects of networks and the gaps between the intended and actual knowledge processes.

Chapter 7 investigates the two main research questions by analysing teachers' perspectives collected through the questionnaire. In the first part of the chapter, I characterise the dynamics of teachers' knowledge through providing insight into the types of knowledge teachers engage with and the ways in which they mobilise, construct and diffuse knowledge. I apply multiple approaches to validate this new conceptualisation of knowledge dynamics. First, item analysis with descriptive statistics of teachers' knowledge dynamics, whenever possible, compared with prior research. Second, scale analysis and a test

of the structural validity of scales with factor analysis. In the second part of the chapter, I investigate the links between social dynamics and teachers' knowledge dynamics through structural equation modelling.

Chapter 8 explores the second research question – How do social dynamics influence teachers' knowledge dynamics? – from the perspective of school leaders. I examine social structures and the nature of social ties in a network, and how these relate to school leaders' perceptions of the networks' potential for teachers' knowledge. To do that I analyse data collected through the school leadership questionnaire. The chapter also explores relationships between the social interactions between schools and teachers' knowledge dynamics by linking the teacher and school leader datasets.

Chapter 9 examines the two main research questions through analysing qualitative data collected in two schools. The two case studies provide a deeper understanding of processes underlying teachers' knowledge dynamics. In particular, I explore the ways in which knowledge mobilisation, construction and diffusion plays out in teachers' work, the social processes teachers and school leaders engage in and the ways in which these drive the dynamics of teachers' knowledge.

Chapter 10 brings together the results from all the different sources of data: theoretical and desk-based research, quantitative and qualitative. I discuss the two research questions and their corresponding hypotheses in view of the different data sources. The discussion extends to reflecting on the conceptual framework of the thesis, considers the validity of the quantitative instrument and suggests improvements. In this chapter, I also interpret the conceptual and empirical relationships of social and knowledge processes, and propose a framework for understanding these. In addition, I reflect on the implications of my research for "networked leadership". Finally, I highlight some important limitations of my research and suggest directions for future research.

Chapter 11 briefly summarises the research in view of the main objectives described in this introduction. As concluding remarks, I highlight the contributions this research offers to the field of sociology and some potential practical applications.

Part I. Theoretical investigation: From teachers' learning to knowledge dynamics

Chapter 1. Discourses on teacher professionalism in education research and policy, and their implications for teachers' knowledge

This chapter[1] contextualises the themes of investigation of this thesis by situating the principal theme – teachers' knowledge – in the sociological literature. The chapter first provides the readers with a short review of the sociological literature on professions and professionalism. I will examine the evolving policy and expert discourses on teacher professionalisation and professionalism, and highlight their implications on teachers' knowledge and learning. Importantly, I will point to the ways in which these discourses limit an appropriate scientific understanding of knowledge and learning. The policy discourse analysis is based on a number of influential documents by international organisations and national policies.

1.1. Teaching as a profession and teacher professionalism

Identifying what constitutes a profession and defining teacher professionalism are subjects of a heterogeneous body of both academic literature, and political and ideological debate, which have not yielded a conclusive consensus (Sachs, 2010[8]). In the following sections, I highlight some of the sociological theories and policy discourses that have become prominent in recent years. Finally, I discuss the role of knowledge in these discourses.

1.1.1. Sociology of professions

A dominant line of thought defines professions based on a set of attributes. Howsam and colleagues, for example describe a set of characteristics to distinguish between professions and semi-professions (Table 1.1). According to this theory, "professional culture" – referring to a common body of "knowledge, skills, behaviours, attitudes and values that constitute the basis for professional expertise and decision-making" in Lortie's sense – is the most fundamental characteristic of professions (Howsam, Corrigan and Denemark, 1985, p. 23[22]). The role of preparation and induction is then central in acquiring

[1] This chapter draws on my work published as a Working Paper: (Révai, 2020[51]).

this body of knowledge. Importantly, the authors consider that autonomy to govern the profession through training, registration, licencing and performance standards is a key characteristic of professions (Howsam, Corrigan and Denemark, 1985[22]). Based on their set of attributes, Howsam and colleagues classify teaching as a semi-profession contending that it lacks a common body of knowledge and skills based on scientific disciplines. The authors argue that teaching is based on conventional wisdom and personal experience rather than validated professional knowledge.

Table 1.1. Characteristics of professions and semi-professions by Howsam et al.

	Professions	Semi-professions
1	Professions are occupationally related social institutions established and maintained as a means of providing essential services to the individual and society.	Lower in occupational status.
2	Each profession is concerned with an identified area of need or function (e.g. maintenance of physical and emotional health, preservation of rights and freedom, enhancing the opportunity to learn).	Shorter training periods.
3	Collectively and individually the profession possesses a body of knowledge and a repertoire of behaviours and skills (professional culture) needed in the practice of the profession; such knowledge, behaviour and skills normally are not possessed by the non-professional.	Lack of societal acceptance that the nature of the service and/or the level of expertise justifies the autonomy, which is granted to the professions.
4	The members of the profession are involved in decision making in the service of the client, the decisions being made in accordance with the most valid knowledge available, against a background of principles and theories, and within the context of possible impact on other related conditions or decisions.	A less specialised and less highly developed body of knowledge and skills.
5	The profession is based on one or more underlying disciplines from which it draws basic insights and upon which it builds its own applied knowledge and skills.	Markedly less emphasis on theoretical and conceptual bases for practice.
6	The profession is organised into one or more professional associations, which, within broad limits of social accountability, are granted autonomy in control of the actual work of the profession and the conditions that surround it (admissions, educational standards, examination and licensing, career line, ethical and performance standards, professional discipline).	A tendency for the professional to identify with the employment institution more and with the profession less. (Note that it is not the condition of employment rather than private practice, which makes the difference. Rather it is the identity relationship.)
7	The profession has agreed-upon performance standards for admission to the profession and for continuance within it.	More subject to administrative and supervisory surveillance and control.
8	Preparation for and induction to the profession is provided through a protracted preparation programme, usually in a professional school on a college or university campus.	Less autonomy in professional decision making with accountability to superiors rather than to the profession.
9	There is a high level of public trust and confidence in the profession and in individual practitioners, based upon the profession's demonstrated capacity to provide service markedly beyond that which would otherwise be available.	Management of organisations within which semi-professionals are employed by persons who have themselves been prepared and served in that semi-profession.
10	Individual practitioners are characterised by a strong service motivation and lifetime commitment to competence.	A preponderance of women.
11	Authority to practice in any individual case derives from the client or the employing organisation; accountability for the competence of professional practice within the particular case is to the profession itself.	Absence of the right of privileged communication between client and professional.
12	There is relative freedom from direct on-the-job supervision and from direct public evaluation of the individual practitioner. The professional accepts responsibility in the name of his or her profession and is accountable through his or her profession to the society.	Little or no involvement in matters of life and death.

Source: (Howsam, Corrigan and Denemark, 1985, pp. 6-9[22]).

Attributional approaches tend to agree that practitioner autonomy, training in higher education, knowledge-based practice, a self-governing professional body and a code of ethics are key criteria for an occupation to be a profession (Hoyle, 2001[23]). The existence of a robust and validated body of knowledge is the ultimate consensus among these approaches. Hoyle (1995[24]) recognises the importance of knowledge gained through experience, while emphasising that professional judgements are underpinned by a body of systematic knowledge. It is on these grounds that most attributional approaches do not consider teaching as a "full" profession arguing that it lacks this systematised body of knowledge (Hoyle, 1995[24]; Freidson, 2001[25]; Howsam, Corrigan and Denemark, 1985[22]).

Attributional approaches have however been widely criticised since the mid 1960s. Some argued that these approaches represent a functionalist view, in which a high status is accorded to an occupation in return for offering specialised skills in the public interest (Hoyle, 2001[23]). Others contended, to the contrary, that some occupations achieved their high status by controlling the market for a service, which led to social exclusion and closure [(Larson, 1977[26]) cited in (Hoyle, 2001[23])]. Despite the criticism, the criteria of attributional approaches have become benchmarks for teaching in public debates, and resulted in the discourse of "professionalisation" held by both practitioner organisations (teacher unions) and policy makers.

As an alternative theory, Evetts proposes to focus on professionalism as the central concept rather than on professions or professionalisation (Evetts, 2011[27]). Evetts (2011[27]) distinguishes between professionalism conceptualised as an occupational value ("occupational professionalism") and as a discourse ("organisational professionalism"). In her analysis of this latter, she points to the shift from a focus on social relationships, such as partnership and collegiality, and professional discretion and trust to managerialism, bureaucracy, standardisation, assessment and performance. Evetts also underlines that the discourse differs across occupational groups. Some occupations are characterised by a "professionalisation from within" [in McClelland's sense of the term (McClelland, 1990, p. 107[28]) cited in (Evetts, 2011[27])]. This means that the occupational group constructs itself an appeal to professionalism, its own identity and successfully promotes its image towards clients. Such a self-constructed occupation benefits from its own discourse on professionalism, and often remains mostly self-regulatory and independent of the state. In contrast, for most service occupations, professionalism is forced "from above", by actors external to the occupational group. When the discourse of professionalism and professionalisation is constructed from above, it often promotes occupational change and imposes regulations on professional conduct. While Evetts acknowledges that these occupations can benefit from such an externally-constructed discourse (e.g. increased occupational status and rewards), she highlights the negative effects on the workers themselves. Practitioners in these occupational groups – and teaching belongs to this group – are controlled by organisational objectives and managers, which define most aspects of professional practice, including practitioner-client relationships, achievement goals and performance indicators. This control limits professional autonomy and discretion (Evetts, 2011[27]).

Sachs (2010[8]) proposes a similar conceptualisation, distinguishing democratic and managerial professionalism. Managerial professionalism builds on two assumptions: efficient management can solve any problem, and private sector practices can be applied to the public sector. Sachs suggests that education policies in Australia and United Kingdom – in particular as a result of the New Public Management movement – brought about a shift towards managerial teacher professionalism. In this managerial discourse, the dominant notions are market, accountability, economy, efficiency and effectiveness. Such a discourse has shaped teachers' identity and led to an externally defined "entrepreneurial identity", which is individualistic, competitive, controlling and regulative. In contrast, democratic professionalism focuses on collaboration and cooperative action between teachers as professionals, and other educational stakeholders such as students, parents and members of the community. Democratic discourses are the cradle of an "activist professional identity", characterised by collaborative cultures embedded in professional teaching practices. The development of this identity in Sachs's view is the result of an effort to develop a transformative, future-oriented attitude, and to eliminate the domination of some individuals or groups over others. In this theory, "activism" is an inherently internal process of the profession, in which teachers develop and share self-narratives, which leads to a new collective identity. Sachs sees professional collaboration and the development of communities of practice as a consequence of democratic discourses. Similarly to Evetts' occupational and organisational professionalism, a major difference between democratic and managerial professionalism is that the former emerges from the profession itself, while the latter is imposed by employing authorities (Sachs, 2010[8]).

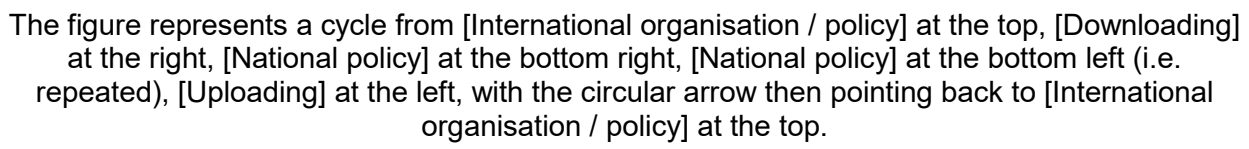
1.1.2. Policy discourses

"The quality of education systems can never exceed the quality of teachers" (Barber and Mourshed, 2007[1]) is a renowned phrase of the 2007 McKinsey report, which has been taken up by international organisations and national policies, and provided grounds to a whole new body of discourses on teacher professionalism. International organisations such as the OECD, the World Bank, the European Commission as well as private consultancy firms such as McKinsey or the Brookings Institute have all been placing a major emphasis on promoting teaching as a profession in their work in the past decade [see for example, (European Commission, 2015[2]; 2017[29]; Béteille and Evans, 2019[30]; OECD, 2005[4])].

From among these, the OECD has had a leading role in shaping national policies on teachers through its major surveys as well as its growing involvement in direct country work. Its impact on national policies has been widely studied (Lawn and Grek, 2012[31]; Carvalho and Costa, 2014[32]; Dolowitz, Hadjiisky and Normand, 2020[33]). More recently, Tine Prøitz (2015[34]) proposed a new perspective by investigating the impact of national policies on the OECD's discourses. This research emphasises the bidirectional nature of policy impact through the notions of downloading and uploading policies. Downloading refers to the process of integrating international organisations' recommendations in the design of national policies, whereas uploading designates the process through which national policies influence international discourses (Figure 1.1) (Prøitz, 2015[34]). This latter is very relevant in the case of the OECD, which is a member-driven organisation, whose work is governed by committees constituted of

national policy makers and experts. Because of this dual influence, reviewing the OECD's conceptualisation of certain policies also gives a good indication of a wide range of domestic policies across the world.

Figure 1.1. Sequential approach of policy downloading and uploading



Source: (Prøitz, 2015, p. 72[34]).

In this section, I will thus focus on the way the OECD have been conceptualising teacher professionalism. The analysis is based on a rapid review of a number publications (Table 1.2). While the discourse on teaching and professionalism could be the object of analysis of an entire thesis, I simply intend to give a short overall picture to better understand the context in which any investigation on teachers' knowledge and learning is embedded.

Table 1.2. Selected OECD projects and publication series on the teaching profession

Publication Series and Projects	Description	Reference
Education at a Glance	System-level indicators on the structure, finances and performance of education systems in OECD countries and partner economies: • the output of educational institutions; • the impact of learning; • access, participation and progression in education; • the financial resources invested in education; • teachers, • the learning environment and the organisation of schools.	https://www.oecd.org/education/education-at-a-glance/
Country Review Series: • School Resources Reviews • Evaluation and Assessment Reviews	Country-specific and comparative analysis to support quality, equity and efficiency in education. • Analysis and policy advice on the use of financial, physical and human resources in school systems. • Analysis and policy advice on evaluation and assessment policies in education.	• http://www.oecd.org/education/school-resources-review/ • http://www.oecd.org/education/school/
Centre for Education Research and Innovation (CERI) work: • Governance: Governing Complex Education Systems; Strategic Education Governance • Teachers and Pedagogies: Innovative Teaching for Effective Learning; Innovative Teaching for Powerful Learning	CERI provides and promotes international comparative research, innovation and key indicators, and explores forward-looking and innovative approaches to education and learning. It also facilitates bridges between educational research, innovation and policy development. • Effectiveness of models of governance and knowledge systems in complex education systems; support countries in developing flexible and adaptive governance processes. • Research and survey development to improve the quality of teachers and teaching; create evidence-informed frameworks to understand innovative pedagogies, and how to develop, apply and scale them.	http://www.oecd.org/education/ceri/
Teaching and Learning International Survey (TALIS) • TALIS – the survey • Initial Teacher Preparation Study • TALIS Video Study	• Data and analysis on teachers' and school leaders' working conditions and learning environments. • Reviews and analysis of effective and innovative policies to improve initial teacher preparation systems. • Pilot methodologies to capture real teaching practices to provide insights from classroom observations in an internationally comparative fashion.	http://www.oecd.org/education/talis/
Programme for International Student Assessment (PISA)	Measures 15-year-olds' ability to use their reading, mathematics and science knowledge and skills. It collects data from students, teachers and school leaders.	https://www.oecd.org/pisa/
International Summit on the Teaching Profession (ISTP) reports 2011-2019	High-level policy event organised every year by the OECD. It brings together education ministers and union leaders from education systems around the world to review how best to improve the quality of teachers, teaching and learning.	https://www.oecd-ilibrary.org/education/international-summit-on-the-teaching-profession_23127090

Source: OECD iLibrary, https://www.oecd-ilibrary.org/education/international-summit-on-the-teaching-profession_23127090.

Unlike sociological and educational research studies, professionalisation for the OECD is not the process through which an occupation becomes a profession, but rather it is centred around professionalising teachers themselves. In this functionalist perspective, the ultimate goal of "professionalisation" is to raise the quality of education systems. This manifests strikingly in the reports on The International Summit on the Teaching Profession (ISTP), which are based on various work strands of the OECD on teachers. Titles such as "Valuing our Teachers and Raising their Status", "Teaching Excellence through Professional Learning and Policy Reform", "Building a High-Quality Teaching Profession" clearly reflect the OECD's strong emphasis on issues around the teaching profession and

teachers' professionalisation. The main elements of the discourse of professionalism and professionalisation emerging from a rapid review of the key publication series and projects of the OECD are summarised next.

1. *Raising the status and prestige of the teaching profession*

The Teaching and Learning International Survey (TALIS) collects data on teachers' perception of the societal value of teaching, their job satisfaction, sources and levels of stress and how these relate to working conditions. Working conditions include the various responsibilities of teachers (e.g. number of teaching hours, administrative tasks, time spent on planning lessons and correcting student work). The organisation has also been placing a strong emphasis on the financial recognition of teachers. Education at a Glance provides a range of financial indicators every year, including a comparison of public and private investment in education, and teachers' and school leaders' salaries across countries.

In addition to capturing aspects of the profession through quantitative data, the OECD also frames its country-specific policy recommendations in a global discourse on increasing the status and prestige of the teaching profession. It is important to note that whether teaching is a profession is not questioned in OECD documents. Teaching is discussed and presented as a profession de facto, and this approach has undoubtedly been influencing the consideration of teaching in societies across many education systems. CERI publications on teaching are the only ones that present the sociological discussion around the status of teaching as a profession (Guerriero, 2017[35]; Sonmark et al., 2017[36]). This work takes an explicit stance on the issue by considering teaching as a "knowledge profession" and embarking on an investigation of teachers' knowledge base.

OECD documents see the state as playing a critical role in increasing the status and prestige of the teaching profession by creating the conditions (work, salary). This however has an explicit function: attracting and retaining "high-quality, motivated" teachers, who can achieve the ultimate objective: increasing student learning.

2. *Raising teachers' qualifications and strengthening the quality of initial teacher education*

The prevalence of qualification and training is captured by a more specific formulation of the importance of teachers in education systems: "Highly qualified and competent teachers are the key for excellent education systems." [Van Damme in (Guerriero, 2017, p. 3[35])]. Increasing and improving teachers' qualifications and training are seen by the OECD as part of raising the status of the profession. Schleicher highlights the linkages between different aspects of the profession as follows:

> *Our message has been consistent: the quality of a school system cannot exceed the quality of its teachers and principals. But what this new volume of TALIS adds is that the quality of teachers and principals cannot exceed the quality of their training, their opportunities to collaborate and develop, and the quality of their working conditions. [Schleicher, A. in: (OECD, 2020, p. 4[37])]*

To mark the importance of training in teachers' professionalisation, the OECD dedicated a series of country reviews specifically exploring initial teacher preparation systems in seven countries (OECD, 2019[38]). In the final report of this study, the OECD distinguishes the status of teacher education itself, and recommends a systems perspective to improving teacher preparation. By formulating recommendations for different levels and actors – national policy, teacher education institutions and schools – it envisages that the state and educational actors at various levels govern the training aspect of the profession collectively. The OECD generally advocates for high academic autonomy for higher education institutions training teachers, accompanied with state control and accountability mechanisms.

A discussion on teachers' knowledge has also become part of the OECD discourse on teacher professionalism recently. Teachers, similarly to other "knowledge professionals", should acquire their profession's knowledge base in lengthy periods of higher education. Through CERI's "Innovative Teaching for Effective Learning" project, the OECD states that teaching must have a strong knowledge base and advocates for delineating this. It promotes the new approach of the "Learning Sciences", which should regroup all research and theoretical knowledge on teaching and learning (Guerriero, 2017[35]; Kuhl et al., 2019[39]). Delineating the knowledge base is directly linked with the movement that set out to establish robust evidence that can systematically underpin teachers' professional practice. This is discussed in detail in the next section.

3. *Standardisation and accountability: professional teaching standards and evaluation*

The OECD has long been promoting a managerial approach to education policy governance, in which standards and accountability mechanisms play a crucial role. Its evaluation and assessment reviews clearly advocate for a very strong accountability culture that should regulate teacher education, certification, selection into teaching and ongoing appraisal. The encyclopaedia-size synthesis report entitled "Synergies for Better Learning" (OECD, 2013[40]) is the alpha and omega of this discourse. Professional teaching standards, and external examination and evaluation mechanisms are at the heart of many country recommendations. These are intended to serve both a formative purpose to identify development needs and inform ongoing teacher training, and a summative purpose to inform selection and promotion decisions.

Without investigating whether this is policy uploading or downloading (undoubtedly both), this approach to professionalising teaching has been adopted in many countries across the world. It has been particularly strong in Anglo-Saxon systems such as England, Scotland, Canada and Australia. We have seen that attributional approaches to professions distinguish between two forms of accountability: external (regulated and imposed by an external authority, usually the state), or internal by the profession. These approaches classify only internally-regulated occupations as professions. In many systems however, it is difficult to disentangle these two forms. What often happens is that the state (ministry of education) establishes an agency to be responsible for developing and managing accountability mechanisms (e.g. developing teaching standards, accreditation standards for teacher education institutions, conducting monitoring and examinations). The extent to which such agencies can operate as professional bodies

varies across countries. For example, the General Teaching Council for Scotland (GTCS) became an independent professional body (GTCS, 2018[41]). The Australian Institute for Teaching and School Leadership (AITSL) is governed by an independent Board of Directors appointed by the Minister for Education and Training (AITSL, 2017[42]). Entirely independent professional bodies, which internally govern membership, education and training, registration and certification are rare. Some countries such as Finland and the Netherlands, can be better described by a professional responsibility rather than an accountability culture. This is characterised by a generally high prestige of teaching reflected in a selective teacher education process and a systematised professional development and collaboration culture coming from within the profession (Sahlberg, 2010[43]; Darling-Hammond and Lieberman, 2012[44]). These countries are clear examples of Sach's democratic discourse with an activist identity.

In relation to the sociological theories reviewed in the previous section, the OECD's policy and policy-shaping discourses represent a normative and functionalist approach, which seems to correspond to Evetts' organisational professionalism (reflecting its recent shift), and Sach's managerial professionalism at first sight. There are however some internal tensions emerging.

As the OECD's country reviews are addressed to national policy makers (ministries of education), there is a more or less implicit assumption that the state has to and will play a major role in establishing the recommended accountability systems. However, in parallel, the organisation emphasises inclusive policy making increasingly more. CERI work related to education governance advises education ministries to develop accountability tools involving all stakeholders in the process (Burns and Köster, 2016[45]; Viennet and Pont, 2017[46]). Going even further, Schleicher states that the teaching profession should be self-governing and should transform "from within" (Schleicher, 2011[47]). This indicates a view of occupational professionalism for teachers, which contradicts to most recommendations of the organisation that clearly give the state a strong governing role. Perhaps this internal tension is due to the special position of the OECD: having a role to give policy advice, i.e. work with policy makers directly, while at the same time, paving the way towards a more networked approach to governance (Theisens, 2016[48]).

Seemingly contradictory discourses can also be the result of parallel development. For example, recent research conducted by CERI presents a much more subtle view of teaching standards. Révai (2018[49]) analyses the teaching standards and teacher education curriculum in three systems, and concludes that a strong and direct alignment of these is not possible. This challenges the more normative and managerial recommendations underlying country reviews and the "Synergies for Better Learning" approach. This CERI Working Paper instead suggests that standards should serve as communication and reflection tools for the profession (Révai, 2018[49]). This is just one example for the different nature of the research and innovation work taking place in CERI, which is sometimes in tension with work in other parts of the organisation. It certainly requires time – even within the same organisation – for new ideas and research developed in one part of the organisation to be integrated in policy advice.

Internal tensions can manifest not only between different work strands, but also within one single definition. TALIS – the flagship project of the organisation claimed to represent the voice of teachers – is

the only project that provides a conceptualisation of teacher professionalism explicitly. TALIS defines five pillars of teacher professionalism:

1. *Knowledge and skills* – shared and specialised knowledge, captured through standards for access to the profession, pre-service training and in-service professional development

2. *Career opportunities* – working regulations, such as contractual arrangements offering security and flexibility, competitive reward structures commensurate with professional benchmarks, appraisal systems or mechanisms, and room for career progression

3. *Peer regulation and collaborative culture* – self-regulated and collegial professional communities that provide opportunities for collaboration and peer feedback to strengthen professional practices and the collective identity of the profession

4. *Responsibility and autonomy* – degree of autonomy and leadership that teachers and school leaders enjoy in their daily work to make decisions, apply expert judgement, and to inform policy development at all levels of the system, so that professionalism can flourish

5. *Prestige and standing* – captured through the ethical standards expected of professional workers, the intellectual and professional fulfilment of the job, as well as its perceived societal value and standing relative to other professional occupations (OECD, 2020, p. 26[37]).

This definition takes concepts related to professions and professionalism from various sources of literature, and mixes these with dominant policy concerns and strategies. Knowledge and skills – as discussed – is present in all major conceptualisations, prestige and standing is part of most attributional approaches (although the term “standing” is not typically used), whereas “career opportunities” is a policy strategy to raise the prestige or status of the profession. The definition is also contradictory in terms of the role of actors. While references to regulations suggest a central role for the state, autonomy and self-regulation are also present. These latter however seem to be restricted. A “degree of autonomy” suggests that the profession does not have full autonomy over its own operation. In addition, the definition does not specify whether it is the profession itself, or an external authority such as the state that sets the ethical standards, defines appraisal procedures and criteria, and carries out control mechanisms. Self-regulation is only mentioned explicitly with respect to collaboration. It seems that the definition sees the state and the teaching profession existing in a co-dependent relationship, in which some aspects of the profession are regulated by the state, while the profession is expected to inform policy development, and provide a high quality service for the public good. Overall, the TALIS definition of professionalism as a composite of these five aspects seems like an incoherent patchwork conceptualisation.

With regard to Sach’s concepts, the TALIS definition cannot be clearly categorised as either managerial or democratic professionalism. It certainly contains a number of managerial elements, such as standards and evaluation mechanisms. However, point three “Peer regulation and collaborative culture” is precisely the core feature of democratic professionalism. In fact, promoting collaboration and networking has become a strong element of both international organisations’ policy discourses (European

Commission, 2017[21]; World Bank, 2013[50]; Révai, 2020[51]) and national policies. In some countries, such as the United Kingdom, the state has dedicated significant amount of funding for collaboration between teachers and school leaders within and across schools (Muijs et al., 2011[52]). Such mechanisms do not simply facilitate, but rather impose collaboration from above, as schools become dependent on funding. Therefore, Sach's definition of democratic professionalism has to be reinterpreted in this context. Collaboration and communities of practice are not self-directing mechanisms within the profession, but externally imposed requirements by the state. While Sachs recognised that there can be movement between entrepreneurial and activist identities over time (Sachs, 2010[8]), what recent policy discourses suggest is rather a hybridisation of both the discourses and presumably, the identities. Indeed, core features of one or the other can be recontextualised to an extent that they cannot be interpreted anymore in the context of internal (democratic or occupational) and external (managerial or organisational) professionalism. The question is then: to what extent can peer processes, collaboration, communities of practices become teachers' own identity on the one hand, and fulfil external expectations on the other.

1.2. Professional knowledge and learning

While the body of academic literature, political and ideological discourses and arguments around teaching as a profession and professionalism are diverse, the centrality of teachers' knowledge is common in all of these. Professionalism as an occupational value is based on the belief that professional practice requires specialised knowledge and skills that are founded on abstract concepts (Freidson, 2001[25]; Brante, 2010[53]). Acquiring and maintaining such knowledge and skills throughout the career are drivers of improving professional practice in both the occupational and organisational paradigms of professionalism (Evetts, 2011[27]). For Sachs, the democratic discourse on professionalism promotes collective knowledge creation through teacher enquiry and a collaboration between teachers and researchers (Sachs, 2010[8]). Furlong [in (Barton et al., 2000[54])] also highlights the interdependency of knowledge, autonomy and responsibility. Professionals need autonomy to apply their specialised knowledge, and they need to act responsibly to develop appropriate values.

The general consensus about the importance of knowledge however is accompanied by varying degrees of understanding and conceptualising this knowledge. The most prominent, but also superficial understanding originates in comparing the teaching profession to the medical profession. This comparison – common in educational research and policy discourses on professions and professionalism – is based on the analogy that in both public service sectors, professionals bring about change in "patients" or "clients". In the case of doctors, the purpose is to cure the patient, in the case of teachers, it is to induce learning in students. Following this analogy, many have argued that contrary to the medical profession, which has a robust knowledge base underpinning professional practice, teaching does not have this. Doctors have knowledge of the sciences of the human body and its mechanisms, as well as the procedures and know-how of healing, while teachers don't have an agreed-upon body of scientific knowledge to build their practice on (Brante, 2010[53]; Mehta and Teles, 2014[55]; Hargreaves, 1996[9]).

Many have however raised concerns with regard to professionalising teaching on the basis of the medical model. These opponents argue that in the field of education the diversity of contexts requires flexibility of intervention approaches, i.e. there are no universal fixes that can be equally effective for such a diversity of contexts and of children. Mehta and Teles (2014[55]) for example, describe a profession's knowledge base as either monopolistic or pluralistic in nature. They propose to consider teaching – contrary to the medical profession – as pluralistic. Pluri-professionalism means that different branches of the profession have different knowledge bases representing various traditions and schools, rather than one standard knowledge base that all practitioners share as a whole. The authors cite psychology as another similarly pluralistic profession, with a diverse knowledge base including cognitive-behavioural therapy, psychoanalysis and humanistic psychology; architecture with different aesthetic traditions of building and arts (Mehta and Teles, 2014[55]).

On the other hand, some consider the comparison of teaching and the medical profession legitimate, but reject the traditional description of the medical profession as monopolistic. Within the sociological literature, for example, Bernstein classifies medicine in the same category as architecture, as a "region", i.e. a domain which re-contextualises a number of different disciplines (Bernstein, 2000[56]). In this sense, the medical knowledge base can be compared to teachers' knowledge in that it is also evolving, has various traditions (e.g. alternative medicine), and doctors' professional judgement also requires taking the context into consideration. Empirical research on professional knowledge in the medical field underpins this theory (Greenhalgh et al., 2004[57]).

Such debates have not included a profound understanding of the nature of a profession's knowledge base. Attributional approaches offer a normative view on professional knowledge and learning, in which the cognitive (knowledge) and the social (learning in higher education) aspects are confounded and both reduced to simple attributes (Brante, 2010[53]). Swedish sociologist, Thomas Brante, argues that the social and cognitive dynamics require separate investigations and points to a lack of conceptualisation of knowledge in the attributional approaches (Brante, 2010[53]). He explores the nature of the "professional" knowledge base, i.e. what distinguishes knowledge that can form the basis of a profession (Brante, 2010[53]). Drawing on the Foucauldian concept of truth regime, Brante argues that the distinctive feature is the existence of an ontological model that constitutes the basis for theory-development on the one hand, and the basis for professional intervention on the other. The ontological model provides the basic theoretical concepts – "the template" of the discipline (Brante, 2010, p. 852[53]). Professional knowledge thus involves a break with everyday or common knowledge and requires professionals to understand and use "codes" (Brante, 2010[53]). Brante's definition of professions comprises both the cognitive and the social element:

> *"(i) occupations that set out from scientifically based ontological models by which their objects can be constituted so that they are understood, explained and treatable, (ii) socially recognised, i.e. members of the professional complex, which in turn is linked to 'generalised cultural values'. (Brante, 2010, p. 875[53])"*

Taking a socio-linguistic approach, Bernstein (1999[58]) captures different forms of knowledge through characterising the discourses in which these are realised. A horizontal discourse manifests in everyday language and expresses common-sense knowledge related to practical goals. Such a discourse is context-specific, concrete and related to particular practices. It can often be contradictory across contexts. In contrast, a vertical discourse is coherent, explicit and context-independent. It is either hierarchically organised, or horizontally through a series of specialised languages (Bernstein, 1999[58]). Teachers' professionalisation can be translated as a requirement for a vertical discourse for teaching. Bernstein (2000[56]) also describe three different representations of knowledge structures using the concepts of singular, region and generic. These concepts have been applied to understand teachers' knowledge in a recent volume by Geoff Whitty and John Furlong (2017[59]):

- *Singular*: "a body of specialised knowledge that has a discrete discourse with its own intellectual field of texts, practices, rules of entry, etc., and is protected by strong boundaries and hierarchies" (Whitty and Furlong, 2017, pp. 20-21[59]). Examples: physics, chemistry, history, economics, psychology, sociology.
- *Region*: "made up of a number of singulars that are re-contextualised into larger units; [they operate] both in the intellectual field of disciplines and in a field of practice" (Whitty and Furlong, 2017, p. 25[59]). Examples: medicine, engineering, architecture, cognitive science, management, business studies, communication and media.
- *Generic*: "a particular form of knowledge that is constructed and distributed outside, and independently of disciplinary traditions" (Whitty and Furlong, 2017, p. 30[59]). Generics draw on local, organisational and workplace discourses, and focus on performance. Typically they are produced by governments or employers through an analysis of tasks, skills and practice (Hordern, 2017[60]). Examples: competence frameworks and standards.

Whitty and Furlong propose to understand teachers' knowledge base through looking at how education studies are designed in universities in different countries. Drawing on Bernstein's concepts described above, the authors identify three knowledge traditions in initial teacher education (Table 1.3). This mapping shows that teachers' knowledge is conceptualised differently across countries. Those following an academic tradition view education as a set of disciplines taught either in a disconnected way or contextualised for teaching and learning situations. The practical tradition views knowledge as local and mostly constructed and transmitted by practitioners or practice experts. The integrated tradition sees teachers' knowledge as a blend of academic and practical knowledge. To cultivate such an integrated tradition, specific knowledge construction and transmission methods have been developed, such as practitioner enquiry or the clinical model, which build on the analogy with medicine.

Table 1.3. Knowledge traditions in the study of education

	Examples
Academic knowledge tradition	"Singulars" within the field of education: 1. Disciplines of Education (composed of distinct disciplines with different epistemologies) 2. German Educational Theory (normative approach to educational theory addressing philosophical and moral questions)
	Education as a "region": 3. Applied Educational Research and Scholarship (applied research focusing on a specific educational topic [e.g. education policy studies, early learning, leadership] originating from different methodologies and disciplines) 4. The "New Science" of Education (rigorous research to establish "what works", e.g. through randomised control trials)
Practical knowledge tradition	Education as a generic: 5. Education as a "generic" (competency or standards frameworks becoming the curriculum) 6. The "normal" college tradition of teacher education (moral approaches, field-based, action-oriented knowledge, craft view) 7. Liberal education + craft knowledge (a general culture and academic "mind" combined with the craft of teaching, i.e. contextual, implicit, embodied knowledge, e.g. "Teach for All" programmes) 8. Networked professional knowledge (context-specific knowledge [with academic elements] produced by practitioners in networks of schools and other institutions)
Integrated knowledge traditions	9. Pedagogija (Latvia) (pedagogical science: a multidisciplinary science with philosophical and normative views based on various influences such as Dewey's child-centred view and Vygotsky's social learning) 10. Practitioner enquiry/action research (situational research, collaborative and participatory involving practitioners, with a self-evaluative focus) 11. Research informed clinical practice (medical model for developing novice teachers, integrating research-based knowledge and practice) 12. Learning sciences (interdisciplinary "design science", a development of the New Science of Education model)

Source: Adapted from Whitty and Furlong (2017, p. 20[59]).

Winch, Oancea and Orchard (2015[61]) identify three interconnected and complementary aspects of teachers' professional knowledge: situated understanding, technical knowledge and critical reflection. *Situated understanding* draws on Polanyi's notion of tacit knowledge and literature on professional expertise (Eraut, 2000[62]). It refers to teachers' ability to act in practice ("know-how") without being able to articulate their knowledge. Situated understanding has also been described as "phronesis" or "practical wisdom", which is teachers' knowledge that incorporates an understanding of a particular situation and their moral or ethical judgement to act towards a value-based objective (Winch, Oancea and Orchard, 2015[61]). Proponents of this view, such as Biesta (2012[63]) and Carr (2006[64]), tend to question the role and relevance of education research – or educational theory in the case of Carr – for teaching practice, while others, like Flyvbjerg (Flyvbjerg, 2012[65]), suggest that research should be brought closer to practice. Winch and colleagues' draw on Aristotle's "techne" to describe teachers' *technical knowledge*. This procedural knowledge is what enables teachers to design and execute a process towards a certain goal, as well as to define criteria for success and measure effectiveness. For example, teachers' knowledge of the content of the curriculum and how to deliver it is technical knowledge (Winch, Oancea and Orchard, 2015[61]).

The third aspect, *reflection*, refers to teachers' ability to "review thoughtfully and systematically what they have done in the past with a view to sustaining or improving their practice in the future" [idem. (p. 206[61])]. Winch and colleagues identify three approaches to reflection. The first is Donald Schön's (Schön, 1984[66]) "reflective practitioner" model, which presents reflection in action as a cycle of practice,

reflection during and after practice, and its recursive effect on future practice. Schön does not consider research and theoretical knowledge as the basis of this reflective process, although he acknowledges the role of theory in subject knowledge. The second approach is that of scholarship, i.e. reflection based on the theory of teaching. What this theory consists of varies across systems and changes over time. The third approach is systematic enquiry, i.e. teachers' research on their own practice. Systematic enquiry implies a teacher-researcher identity, where the teacher conducts a certain form of education research. The research question relates directly to the practitioner's problem in their classroom practice and has the purpose of studying the action taken to solve this problem. In this view, represented for example by Carr, (2006[64]), educational theory is only relevant when generated through such enquiry (Winch, Oancea and Orchard, 2015[61]).

The different conceptualisations of teachers' knowledge strongly determine national policies related to teacher education. Building on the above aspects of teachers' knowledge, Kuhlee and Winch (2017[67]) describe three conceptions that underlie teacher education policies:

- *Teacher as craftworker*: an emphasis on the situated understanding, in which teachers' knowledge is context-specific and their manual know-how and situational judgement dominate. This notion implies that learning to be a teacher is best achieved through apprenticeship.
- *Teacher as executive technician*: a technical knowledge view dominates, teaching practice is controlled by protocols, which are derived from a theory. It implies that teacher learning involves acquiring the know-how through training and practice in the protocols.
- *Teacher as professional technician*: builds on a more complex conceptualisation of teacher knowledge, incorporating a body of systematic knowledge, as well as an ability to make appropriate judgements in a classroom situation based on that knowledge. In this view, learning requires in-depth education in higher education (Kuhlee and Winch, 2017[67]).

A number of policy studies have looked at the different models and development of teacher education policies in various countries. Kuhlee and Winch track the dominance and development of the craftworker versus the professional (research-based) model in England and Germany. In England, an analysis of key policy documents, such as the 2010 white paper, the 2013 teacher standards, the 2015 Carter Review and the 2016 white paper show a relatively clear dominance of the craftworker model until 2016. Similarly, Beach and Bagley (2013[68]) note a movement towards an apprenticeship model of teacher education in both England and Sweden. They describe these movements as a process of de-professionalisation, and strongly argue for a reconceptualisation of teaching as a research-based profession (Beach and Bagley, 2013[68]). Kuhlee and Winch note a turn with the 2016 white paper issued by the Department for Education in England, in which the importance of research seems much more prominent (Kuhlee and Winch, 2017[67]).

In Germany, there is a strong tradition of educational disciplines, with an underlying notion of teaching as a professional endeavour (Kuhlee and Winch, 2017[67]). However, the increasing pressures

towards accountability and standardisation represented by the OECD for example (discussed above) led to an increasing emphasis on the technical aspect (Kuhlee and Winch, 2017[67]; Tatto and Hordern, 2017[69]). Nevertheless, the disciplinary tradition together with high professional autonomy in Germany is so strong that the professional knowledge view is unlikely to disappear in favour of an instrumentalist approach (Tatto and Hordern, 2017[69]).

Increasingly more countries and teacher education institutions are moving towards a "professional technician" model, which is best achieved in teacher education that presents an integrated knowledge tradition. An OECD report on the initial teacher preparation system of seven countries highlights examples for an integrated knowledge tradition in Australian and American universities, which adopted the research-informed clinical practice approach based on the analogy with preparing medical professionals (OECD, 2019[38]). Other countries such as Wales, are implementing a practitioner enquiry / action research-based integrated model (OECD, 2019[38]). The learning sciences-based approach is increasingly spreading in France for example (Ministry of National Education and Youth of France, 2018[70]).

1.3. Conclusions

In this chapter, I traced the evolution of sociological analysis of professions and professionalisation. In particular, I presented Evetts's notions of occupational and organisational professionalism, and Sachs's concepts of managerial and democratic professionalism. As a way to capture policy discourses, I analysed a number of OECD documents and publications applying the above-mentioned sociological notions to them. I demonstrated that while international organisations' discourses tend to be normative and functionalist, and primarily in line with organisational and managerial professionalism, the different forms of professionalism often co-exist sometimes in a self-contradictory way.

In the second part of the chapter, I discussed the place "knowledge" occupies in the professionalism literature and presented the ways in which sociological and educational literature conceptualise knowledge. The various theories represent different epistemological traditions: ontological (Brante), socio-linguistic (Bernstein) and practical-analytical (Whitty and Furlong focusing on knowledge traditions, and Winch, Oancea and Orchard focusing on aspects of knowledge). Finally, I illustrated the impact of the different conceptualisations on education policies.

Overall, this overview and analysis demonstrated that much of the policy debate is characterised by a lack of profound understanding of knowledge and learning, and a variety of different models and traditions. In order to engage in a sociological investigation on teachers' knowledge, it is necessary to review the various scientific understandings of these concepts, and critically examine their strengths and limitations.

Chapter 2. A review and critique of conceptualisations of teachers' knowledge and learning

Studying how the knowledge of the teaching profession, or any profession for that matter, evolves is not possible without first understanding the nature of knowledge. Theories of knowledge fall within a vast literature involving many different disciplines: cognitive psychology, sociology, information science, economics and philosophy; each of which has their own unique, yet overlapping conceptual approaches, typologies of and reflections on knowledge.

In this chapter, I review literature on the different conceptualisations of knowledge, and the processes and factors affecting its dynamics. I will start with cognitive approaches that view knowledge as the property of an individual. Although this view has been critiqued and a more social approach to knowledge now prevails in theoretical literature, it is still dominant in empirical education research. Next, I discuss two main areas of literature that conceptualise knowledge as a social attribute. The first is organisational management literature, primarily concerned with "knowledge management" as a factor of organisational effectiveness and innovation. The second is sociological literature that investigates knowledge as embedded in social processes and the social environment. I will highlight the contributions of each of these fields to understanding teachers' knowledge and learning, and point to their limitations. The critical analysis of the various theories leads to identifying the most suitable theoretical and conceptual basis for the empirical investigation of this thesis.

2.1. Cognitive approaches: individual cognition and learning as acquisition

In approaches originating from cognitive psychology, knowledge has a definite form and is viewed as a property of an individual mind, while learning is primarily a cognitive concept and is understood as growth in knowledge, or knowledge acquisition (Paavola, Lipponen and Hakkarainen, 2004[71]). This view, which has dominated learning and cognitive sciences, imagines the mind as a container of knowledge and learning as the process that fills the container (idem). The focus of interest is to understand the ways in which the individual mind "operates with knowledge". Although recent cognitive science literature acknowledges the importance of broadening this view (Anderson et al., 2000[72]), a number of concepts

and typologies of knowledge are still widely used. In the next sections, I will present some of the typologies and their applications to teachers' knowledge and learning.

2.1.1. Declarative and procedural knowledge

In the domain of cognitive psychology or the cognitive sciences in general, a distinction is made between 'declarative knowledge' and 'procedural knowledge.' Simplistic conceptualisations of declarative and procedural knowledge define these as 'knowing that' (e.g. knowledge of the facts of teaching) and 'knowing how' (e.g. knowledge of how to teach), respectively. In reality, the issue is more complex, and essentially has to do with how knowledge of skills is stored and organised in memory and how it is used and developed into mastery performance (Anderson, 1982[73]).

More specifically, the distinction between declarative and procedural refers to how knowledge is stored in long-term memory, and as such, cognitive scientists use the word 'memory' rather than knowledge. Declarative and procedural are the two main types of long-term memory. Declarative memory stores what cognitive psychologists traditionally consider to be knowledge, that is, facts (e.g. through textbook learning) and events (e.g. through experiential learning). Declarative knowledge is symbolic knowledge that can be articulated, or 'declared'. Procedural memory is memory of a skill, i.e. it stores how to do things. Knowledge stored in procedural memory is required for physical activities like cycling or swimming, but also for skills such as playing chess (Ten Berge and Van Hezewijk, 1999[74]). Anderson and Corbett, who study student learning, define declarative knowledge as factual or experiential knowledge and procedural knowledge as goal-oriented knowledge that mediates problem-solving behaviour (Corbett and Anderson, 1995[75]). The distinction of declarative and procedural knowledge has largely influenced the world of educational research both with regards to students' and teachers' knowledge and learning.

Learning in cognitive psychology focuses primarily on the acquisition of knowledge and skills by individuals. Whether the initial learning is from a textbook or experiential, information enters the brain and is stored at a surface level in declarative (or explicit) memory and then consolidated into deeper, implicit memory stores (Gluck and Myers, 1997[76]). Performance of a skill (e.g. teaching) improves through repeated practice as both declarative and procedural knowledge are strengthened. In recent decades, the increasing use of brain imaging techniques are providing significant insights into the operation of the brain, and neuroscience research has contributed greatly to understanding knowledge and learning according to an individual cognitive approach. The cognitive psychological concepts of declarative and procedural knowledge have implications for understanding teachers' knowledge and learning.

2.1.2. Teachers' knowledge from an individual cognition perspective

The individual cognitive approach often focuses on two forms of the individual teacher's knowledge: theoretical-scientific knowledge and practical knowledge. The former is usually understood as formal academic knowledge of theories, whereas the latter refers to highly contextualised knowledge (Wilson and Demetriou, 2007[77]; OECD, 2000[78]). For example, the OECD Centre for Education Research

and Innovation (CERI) Teacher Knowledge Survey defines theoretical-scientific knowledge as “formal, systematic, ordered and context-independent knowledge”, while practice-base knowledge requires professional judgement applied in classroom context-specific situations (Sonmark et al., 2017[36]). These definitions make it clear that theoretical-scientific knowledge refers mostly to declarative and explicit, while practical knowledge rather to procedural knowledge.

The cognitive approach contributed to studying the dynamics of knowledge from various perspectives. First, it served as the basis for research investigating the change in teachers’ individual knowledge as a result of learning in teacher education. Second, it allowed for investigating the interplay between different types of knowledge such as declarative and procedural or theoretical and practice-based knowledge. I will now illustrate the applications of the individual cognitive model in educational research on teachers’ knowledge.

Content domains of teachers’ knowledge

Educational research in the cognitive approach is concerned with describing what teachers’ knowledge consists of and how it changes. An area of this research defines content dimensions of teacher knowledge (Shulman, 1987[6]; Ball, Thames and Phelps, 2008[79]); and looks at how individual teachers acquire and use these dimensions. The most influential taxonomy was developed by Shulman (1987[6]). It comprises the following categories of teachers’ knowledge:

- general pedagogical knowledge (principles and strategies of classroom management and organisation that are cross-curricular)
- content knowledge (knowledge of subject matter and its organising structures)
- pedagogical content knowledge (knowledge of content and pedagogy)
- curriculum knowledge (subject and grade-specific knowledge of materials and programs)
- knowledge of learners and their characteristics
- knowledge of educational contexts (knowledge of classrooms, governance and financing of school districts, the culture of the school community); and
- knowledge of educational ends, purposes, values, and their philosophical and historical grounds (Shulman, 1987[6]).

This taxonomy heavily influenced educational research conducted on teachers’ knowledge and it has been further developed in various ways. The most prominent of Shulman’s domains are the first three – general pedagogical knowledge, content knowledge and pedagogical content knowledge. Shulman’s taxonomy has served as the basis for national and international empirical investigations that aimed at exploring the relationship between teachers’ knowledge, teaching practice and student outcomes (Guerriero, 2017[35]). Many of these studies focused on pedagogical content knowledge (PCK) of mathematics or science teachers. This latter was considered as the most fundamental element of teachers’

knowledge in terms of its impact on teaching practice and student learning (Ball, Thames and Phelps, 2008[79]). These studies contributed to the idea that teachers hold a unique form of "technical" knowledge available only to the profession of teachers (Depaepe, Verschaffel and Kelchtermans, 2013[80]). While general pedagogical knowledge has been less of a focus of empirical investigations, a recent systematic review by the OECD explored its impact on teaching practice and student outcomes (Ulferts, 2019[81]).

Studying teachers' knowledge and learning in the individual cognitive view fits in the performative policy agendas and managerial views of the teaching profession (see Chapter 1). The most recent example for this is an assessment of teachers' knowledge designed by the OECD. The Teacher Knowledge Survey is based on a framework that assesses teachers' general pedagogical knowledge along three dimensions (Table 2.1). The study aims to establish knowledge profiles that depict the relative strengths and weaknesses of the pedagogical knowledge base in a certain country. According to the study's description, the knowledge profiles are not intended to assess individual teachers, instead they provide objective data that – together with contextual information – can be used to help determine whether and where improvements are needed at the system level. Thus, the profiles are meant to inform education policies on:

- "whether teachers (including new teachers) are sufficiently prepared for 21st century teaching, for example teaching diverse classrooms or using modern pedagogical approaches
- on the strengths and weaknesses of teachers' current pedagogical knowledge base
- the ways in which teacher education – both initial education and continuing professional development – can be improved to ensure a robust knowledge base in the profession in line with national policy priorities" (OECD, 2020, p. 1[82]).

Table 2.1. OECD CERI Teacher Knowledge Survey assessment framework

Dimension	Sub-dimension	Description
Instructional process	Teaching methods and lesson planning	Productively utilising instructional time through use of various teaching methods (e.g. direct instruction, discovery learning), knowing when and how to apply each method to promote students' conceptual understanding of learning tasks (Voss, Kunter and Baumert, 2011[83]), and structuring learning objectives, lessons, curricular units and assessment (König et al., 2011)
	Classroom management	Maximising instructional time through awareness of all classroom activity, handling multiple classroom events concurrently, pacing lessons appropriately to maintain momentum, providing clear directions and maintaining student attention (Voss, Kunter and Baumert, 2011[83])
Learning process	Learning and development	Fostering individual learning through knowledge of various cognitive learning processes, including learning strategies, impact of prior knowledge, memory and information processing, causal attributions, effects and quality characteristics of praise, and opportunities for increasing student engagement (Voss, Kunter and Baumert, 2011[83])
	Affective-motivational dispositions	Knowledge of motivational learning processes (e.g. achievement motivation) and strategies to motivate a single student or whole group (Voss, Kunter and Baumert, 2011[83]) König et al., 2011)
Assessment	Evaluation and diagnosis procedures	Knowledge of different forms and purposes of formative and summative classroom assessments, and how various frames of reference (e.g. social, individual, criterion-based) impact student motivation (Voss, Kunter and Baumert, 2011[83]), and quality of assessment
	Data and research literacy	Knowledge of interpreting, evaluating and using research and data to inform the teaching and learning process (e.g. relevance, validity, reliability)

Source: (Sonmark et al., 2017[36]).

This assessment reflects a "professional technician" view of teachers' knowledge (Kuhlee and Winch, 2017[67]) in that it tries to incorporate practical knowledge requiring a situated understanding and professional judgement while promoting the idea and relevance of a systematic body of theoretical knowledge. Such assessments necessarily take a narrow approach to teachers' knowledge by focusing on aspects that are relatively easy to measure. Knowledge content domains alone however are unable to account for the social complexity of teachers' competence. In the next section, I explore some of the dimensions of professional competence that go beyond knowledge domains.

Beyond knowledge

The above taxonomies of teachers' knowledge ignore important social aspects of what teachers are required to know. In addition to the knowledge of the subject and pedagogy, teaching practice is also shaped by teachers' attitudes, beliefs and decision-making skills. A number of scholars, such as Baumert, Blömeke, Gustafsson, Shavelson, therefore describe professional competence as a multi-dimensional concept (Baumert et al., 2010[84]; Blömeke, Gustafsson and Shavelson, 2015[85]). According to Blömeke (2017[86]) affective-motivational characteristics consist on the one hand of beliefs and attitudes about content and instruction, and factors such as job motivation (orientations and goals), personality and anxiety on the other. Furthermore meta-cognitive competences like self-regulation have been shown to be important facets of teachers' competences, yet in many studies they are not recognised at all (Blömeke, 2017[86]). Motivational and affective characteristics are recognised in the most recent empirical investigations such as the Teacher Education and Development Study in Mathematics (TEDS-M) or the

Teacher Knowledge Survey and the Teaching and Learning International Survey (TALIS) developed by the OECD.

Knowledge and affective-motivational competences however still do not account for the social complexity of the teaching activity. A teacher must be able to make rapid decisions in the classroom that may be based on their knowledge and affective-motivational characteristics, but that also require special skills. In particular, teachers must be able to analyse and evaluate specific classroom situations, in combination with contextual and situational factors (e.g. students' prior knowledge, ability level, motivational factors, lesson objectives, curriculum goals). They then have to be able to connect all this information to their knowledge of the teaching-learning process in order to guide subsequent teaching actions (Blömeke, Gustafsson and Shavelson, 2015[85]). Such situation specific skills that mediate between teachers' knowledge and teaching practices must be taken into consideration (Baumert et al., 2010[84]; Blömeke, Gustafsson and Shavelson, 2015[85]).

Theoretical frameworks developed in the field of expertise research use the concepts of noticing, perception, reasoning, interpretation, decision-making and professional vision to describe these situation-specific skills. Teacher's ability to identify classroom situations that are decisive for instructional practice is often referred to as "noticing" or "perception". Once the specific situation is identified, teachers need to process and interpret the events to which their attention is directed. "Reasoning" refers to the process and act of interpretation based on their knowledge of teaching and learning. Seidel and colleagues (Seidel et al., 2011[87]) distinguish three facets of the reasoning process:

- the ability to describe what has been noticed
- higher-order processes to connect the observed classroom event to prior knowledge and understanding of teaching and learning
- knowledge-based reasoning processes to evaluate and predict what might happen as a result of connecting the observed situation to prior knowledge of teaching and learning.

These skills can be referred to as decision-making and professional judgement more broadly. The most common methodology to empirically study them is through direct or videotaped lesson observations. Such studies have analysed the link between decision-making and professional judgement, and knowledge. They demonstrated that noticing and reasoning require a high level of pedagogical knowledge about teaching and learning processes on the one hand, and the ability to apply such knowledge for planning and implementing instruction to a specific situation on the other (Stürmer, Könings and Seidel, 2013). Shalem (2014[88]) also highlights the importance of theoretical knowledge in teacher's judgement and argues that locating teachers' judgement in their practice would mean neglecting the role of a formal and systematic knowledge base.

Although incorporating situational and affective elements in the concept of teacher competence provides a broader perspective of teacher professionalism, it still remains a strongly individual cognitive

approach, which entirely ignores the fact that teachers' professional practice is embedded in a social environment.

2.1.3. Limitations of the individual cognitive approach

Individual cognitive approaches consider learning as the acquisition of knowledge by an individual mind (Paavola, Lipponen and Hakkarainen, 2004[71]). In this sense, teachers' learning is an outcome of teacher education including initial teacher preparation and professional development. Teachers' learning in this view can be represented as linear relationships between three components: learning sciences (well-established and emerging theories relevant for teaching and learning), teacher education, through which theories get incorporated in individual teachers' knowledge.

Teachers' learning in this view is associated with a growth of both theoretical-scientific and practical forms of knowledge, as well as the broadening of knowledge in the different content domains described in the section above. Thus, teachers acquire theoretical-scientific knowledge in initial teacher education and professional development courses, while these also develop their practical knowledge for example through teaching practicum and induction. Increasingly more teacher education programmes place emphasis on creating links between these forms of knowledge, reflecting an "integrated knowledge tradition" as described by Whitty and Furlong (2017[59]) (see Chapter 1). For example, a teacher candidate learns about the concepts and purposes of formative and summative assessment (formal theoretical knowledge), as well as when to use and how to design such forms of evaluation (practical knowledge). Teaching practicum and induction provide opportunities for them to deepen practical knowledge and reflect on how theoretical-scientific knowledge is applied in practice. In addition to acquiring knowledge, learning in the individual cognitive approach can include developing affective-motivational characteristics.

While these mechanisms are indeed important for teachers' learning, they fail to capture some crucial elements. First, teacher learning also takes place in informal settings, through work experience, collaboration with colleagues and other actors, or through accessing and engaging with resources individually and collectively. Empirical studies report inconsistent and mostly low correlations between formal learning opportunities and teachers' pedagogical knowledge (König et al., 2017[89]; Sonmark et al., 2017[36]), and some do not report any relationships (e.g. there is no analysis in TEDS-M). This suggests that teachers' knowledge is also shaped by other social processes than formal learning.

Second, learning conceptualised as acquisition of already existing knowledge fails to take into account the emergence of new knowledge, for example from practitioners' social interactions and practice itself (Putnam and Borko, 2000[90]; Mason, 2008[91]). Yet, teachers' involvement in collective reflection, collaborative curriculum design or other innovation processes, often result in new knowledge (Voogt et al., 2011[92]), and this is part of their learning process.

Third, the individual cognitive approach tends to capture knowledge and learning in a linear way. It assumes a series of linear relationships between the different elements: teachers' formal learning opportunities results in a growth in their knowledge, which changes (ideally improves) their

decision-making and professional judgement, which yields changes in instruction, which in turn results in enhanced student learning. However, in reality, these elements are in a continuous and dynamic interaction with one another. Teachers' learning about practice is enhanced through their consciousness of the interaction between teaching and learning in classroom practice (Loughran, 2013[93]). For example, teachers' professional judgements are influenced real time as they consciously observe and reflect on student learning in the classroom. This dynamic process itself is part of their informal learning. Teachers' knowledge both informs teaching strategies and is being generated as a consequence of an active and ongoing process (Loughran, 2013[93]).

Social theories of knowledge are necessary to account for some of the more complex, non-linear and social mechanisms that much of the cognitive approaches fail to acknowledge. Recognising the fundamental role of the social and cultural context in the development of cognition has made a huge impact on thinking about knowledge and learning (Putnam and Borko, 2000[90]). Concepts developed in social psychology have been applied in different domains of research in parallel. In the next section, I describe the ways in which organisational management literature has developed views of knowledge and learning.

2.2. Management approaches: knowledge management and organisational learning

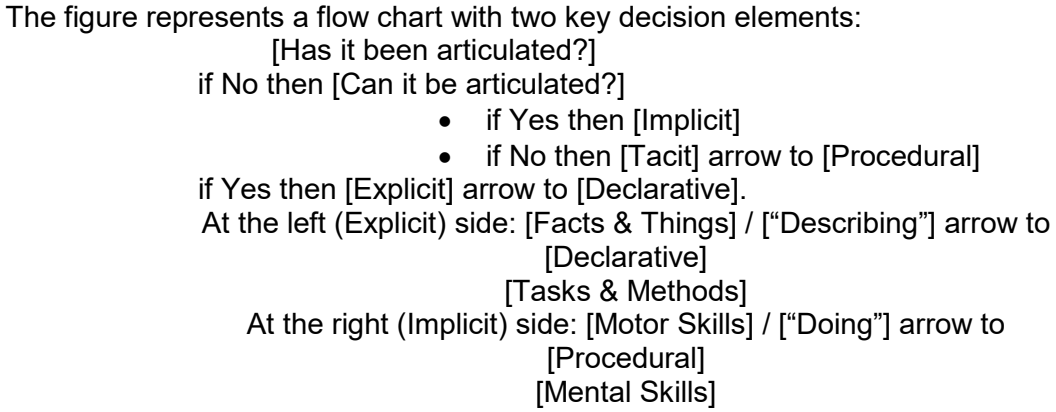
Conceptualisations of knowledge also find their roots in economic theory and philosophy, and in the last few decades, increasingly more from the fields of management and information sciences. In these latter domains, knowledge is conceptualised in terms of information, data, messages and codes. According to Hess and Ostrom, "Knowledge is assimilated information and the understanding of how to use it" (Hess and Ostrom, 2007[94]). Here, information refers to organised data that is understood in its context (Davenport and Prusak, 1998[95]). While these definitions seem distinctly different from psychological and sociological theories, information and management sciences have contributed with some key concepts of knowledge that have subsequently been adopted in sociological and educational research. In this section, I present some of these concepts and the ways in which they have been used to study knowledge processes in organisations (including schools).

2.2.1. Tacit and explicit knowledge

Information science and economics often draw on a distinction between tacit and explicit knowledge. Explicit knowledge is conceptualised as knowledge that can be expressed in words or other symbolic representations (e.g. text) in a way that can be comprehended by another person (Bennet and Bennet, 2008[96]). Tacit knowledge, on the other hand, is specified into two types: (1) knowledge that is not articulable, that is, knowledge that is impossible to describe in propositional terms and (2) knowledge that is implicit or articulable but with some difficulty (Kimble, 2013[19]), thus suggesting that implicit knowledge is potentially codifiable.

Nickols (2000[97]) brings the two above described typologies together in a framework (Figure 2.1). According to this framework, there are strong connections between explicit and declarative knowledge, as well as between tacit and procedural knowledge. Nickols also suggests that declarative knowledge forms the basis of procedural knowledge. However, this has been contested by scholars who – drawing on constructivist theories of learning – argue that some low-level procedural skills can develop prior to learning declarative knowledge (Kumar, 2006[98]).

Figure 2.1. Nickols' framework for thinking about knowledge in knowledge management



Source: (Nickols, 2000[97]).

2.2.2. Codification of knowledge – knowledge management view of learning

The distinction between explicit, implicit and tacit knowledge led to new understandings of learning. Information scientists use the concept of codification, i.e. the process by which knowledge is converted into transmissible messages (Cowan and Foray, 1997[17]). Codification thus involves making implicit knowledge explicit. The costs and benefits of codification constitute the primary focus of economic investigations such as that conducted by Cowan and colleagues. Learning is primarily seen here as the transmission of explicit knowledge, for which codification is a prerequisite. For Cowan, David and Foray (2000[99]) most knowledge is potentially codifiable, while non-codifiable forms of knowledge are negligible.

However, this conceptualisation raises a number of concerns. In particular, the benefits of codification is debatable. While the use of new technology spreads more easily when knowledge required for its use is mostly codified [e.g. (Edmondson et al., 2003[100]; Janicot and Mignon, 2012[101])], the extent to which codification is possible is unclear. Johnson, Lorenz and Lundvall (2002[18]) highlight a number of limitations.

The first problem is that in much of the discussion on codification, including work of scholars such as Robin Cowan and Dominique Foray, tacit and explicit knowledge are seen as a dichotomy, that is, knowledge is either tacit or explicit. Johnson, Lorenz and Lundvall (2002[18]) point to the problematic nature

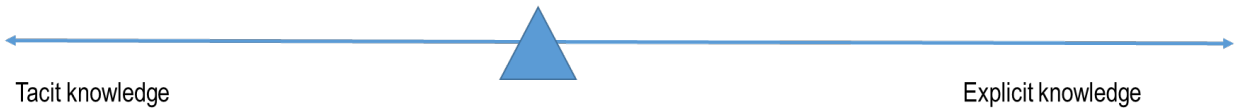
of such a dichotomist view. They contend that most forms of relevant knowledge are mixed, rather than being either explicit or tacit.

Second, the authors argue that the discussion around codification should distinguish different types knowledge. In addition to “know-what” and “know-how” knowledge, they also distinguish “know-why” (knowledge about principles and laws of motion) and “know-who” (information and social relationships such as being able to locate reliable experts). Know-what and know-why together would correspond to simplistic conceptualisations of declarative knowledge, whereas “know-how” and “know-who” would belong to the domain of procedural knowledge. While for Johnson, Lorenz and Lundvall, procedural knowledge can also be codifiable, the authors contest that such knowledge can be completely codified, arguing that much of know-how type of knowledge loses its original characteristics through the process of codification. They also estimate the body of non-codifiable tacit knowledge much more considerable than Cowan, David and Foray.

Last, the authors challenge the normativity of codification, i.e. the implicit assumption that codification always represents progress. Cowan and Foray (1997[17]) themselves recognise that the process of codification is never complete, because codification involves the construction of new tacit knowledge. For example, new codes (e.g. specialised language) need to be understood and interpreted by the person accessing the codified knowledge. Thus, codification does not necessarily reduce the absolute amount of tacit knowledge. Johnson, Lorenz and Lundvall also point out that codified knowledge is not automatically transmissible because of the context-dependent nature of some knowledge (Johnson, Lorenz and Lundvall, 2002[18]).

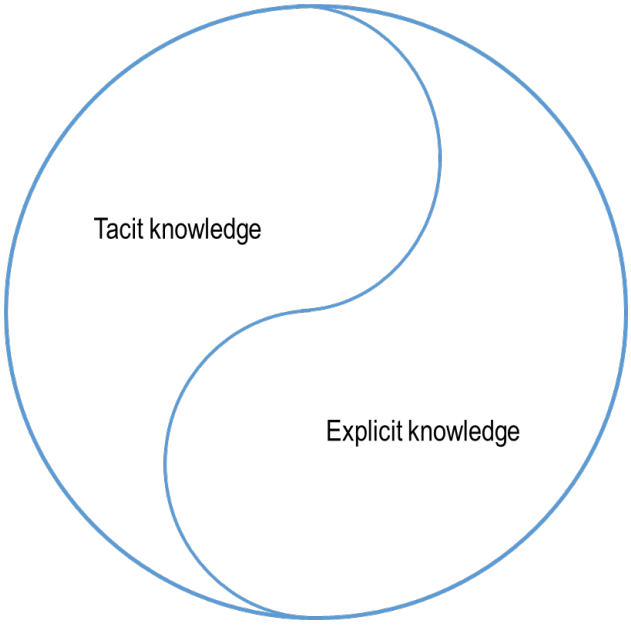
In view of such considerations, many scholars prefer conceiving the concepts of explicit and tacit knowledge as a continuum with entirely tacit knowledge at one extreme and purely explicit knowledge at the other (see Figure 2.2 (Nonaka, 1994[102]; McInerney, 2002[103]; Kimble, 2013[19]). This view suggests the existence of a spectrum on which one can move from tacit to explicit.

Figure 2.2. Tacit and explicit knowledge as a dichotomy



The assumption of a continuum underlies arguments about the need or desirability of making tacit knowledge explicit to increase its transferability. However, when Polányi originally theorised about tacit and explicit knowledge as a duality, he conceived of one existing in symbiosis with the other: there is no explicit knowledge that could exist independently of the tacit knowledge of the individual (Polányi, 1962[104]). As Polányi formulated '*we can know more than we can tell*' (Polányi, 1962, p. 4[104]) referring to "personal knowledge" or the tacit dimension of a person's knowledge.

Figure 2.3. Tacit and explicit knowledge as a duality



Polányi's view could perhaps best be illustrated by the yin and yang model. In Chinese philosophy, yin and yang "describe how apparently opposite or contrary forces are actually complementary, interconnected and interdependent in the natural world, and how they give rise to each other as they interrelate to one another" (Wikipedia, Yin and Yang[2]). This description fits the dualistic approach, which emphasises that tacit and explicit are complementary dimensions of knowledge rather than disjoint parts of a knowledge stock (Johnson, Lorenz and Lundvall, 2002[18]).

Differences in interpreting these types of knowledge also have significant consequences for understanding learning. While economists, in particular in the domain of knowledge management, focus on learning as the transmission of explicit knowledge, a dualistic approach is also more consistent with the

[2] http://en.wikipedia.org/wiki/Yin_and_yang

issue of transferability of tacit knowledge. Thus, the tacit dimension of knowledge (rather than tacit knowledge), which is thought to be more personal, can only be transmitted through direct contact with the person possessing the knowledge. Bennet and Bennet (2008[96]) describe four types of tacit knowledge: embodied (kinesthetic and sensory), intuitive (sense of knowing without reasoning), affective (connected to emotions and feelings) and spiritual (knowledge based on matters of the soul such as morality). They illustrate how these can be learned: for example, embodied tacit knowledge can be learned (i.e. transferred) by mimicry and behaviour skill training (Bennet and Bennet, 2008[96]).

2.2.3. Codification and teachers' knowledge

The concepts of explicit, implicit and tacit knowledge have also been applied to teachers' knowledge. Interestingly however, very little research is available on knowledge codification specific to the education sector. For example, a search in the Education Resources Information Centre (ERIC) database for "codified knowledge" or "knowledge codification" resulted in only 22 peer-reviewed papers (search conducted on 05 September 2021). In parallel, some argue that teachers' practical knowledge is largely tacit (OECD, 2000[78]). This claim has led to policy discourses around the necessity to codify teachers' knowledge in order to transfer them more effectively between communities. Codification in the context of teachers' knowledge can involve, for example, the efficient management of knowledge within a school by teachers who attend a formal professional development course. Teachers will interpret the information they hear during the course as it applies to their own context. Codification is the process by which they transfer this interpreted information to their colleagues. Another example is how a member of the teaching staff, after observing a colleague's lesson, will then articulate what he/she observed about the colleague's practice into a "coded message", which thus becomes "codified knowledge". A vignette of codification is presented in Box 2.1.

An ultimate goal of codifying teachers' knowledge expressed by international organisations and policy makers is to establish a formal knowledge base for the teaching profession (Guerriero, 2017[35]). According to these arguments, one of the ways in which teaching can become professionalised is by exploring and documenting (i.e. transforming into storable and transmissible information) the knowledge behind daily professional decisions, much of which seems to be difficult to articulate, i.e. is tacit. This process is believed to contribute to constructing a knowledge base for teachers that could be easily shared or learned and could in turn enhance professional practice. Thus, for example, whether and how a teacher intervenes when he/she experiences "inappropriate behaviour" in the classroom – a professional decision teachers are facing on a daily basis – could be analysed and coded.

Box 2.1. Vignette: Codification of teacher knowledge through professional collaboration among teaching staff.

The English as a Second Language (ESL) teachers of a school noticed through discussions in the staff room that their error correction strategies differed to a large extent. They thus decided to organise a departmental workshop to discuss error correction and feedback strategies. They all corrected the same assignment written by a student, which they then analysed.

Sarah's copy corrected by Mr. Johannson and Mrs. Binn respectively:

~~In the~~ last weekend I went to do ~~a~~ shopping with my friend to buy ~~for~~ myself a dress. The dress, ~~that~~ which I will also wear in my sister's wedding, has flowers on it.

In the last weekend [preposition] I went to do a shopping [article] with my friend to buy for myself [preposition] a dress. The dress, that I will also wear in my sister's weding [spelling], has flowers on it.

Extract from the discussion:

"Mr. Johannson: Jane, why didn't you correct "that" in the relative clause in this copy?

Mrs. Binn: This class hasn't yet learnt relative clauses, so Sarah couldn't have known how to say it correctly.

Mr. Johannson: Yes, but it is still wrong. She won't learn English if you don't tell her what is correct and what is wrong.

Mrs. Smith: Sarah was actually experimenting with the language. Why would we want to discourage her from doing that?

Mrs. Binn: Actually, this mistake doesn't even impede on understanding the meaning of the sentence, so it is not so important to get it right at this level.

Mr. Johannson: Well, I still think accuracy is crucial in language learning. Do you have any evidence proving that not correcting everything will result in better learning?"

The teachers found that they could not answer Mr. Johannson's question and thus decided that they would look for evidence in the field of error correction for the next session. During the second meeting, they discussed Sarah's copy again in view of the evidence found. They determined the type of each mistake using typologies found in literature (e.g. local vs. global errors, treatable vs. untreatable errors). They also identified and defined error categories specific to the native language of their students. A third workshop session opened the floor for discussion and agreement about feedback and correction strategies based on literature and experience, and resulted in a document on a "framework for correction and feedback".

However, this thinking reflects a dichotomist approach of tacit versus explicit knowledge. In view of the duality approach presented in the previous section, however, the individual knowledge of a teacher

that forms the basis of his/her reaction to, for example, disciplinary problems in the classroom, has both tacit and explicit dimensions, which are hardly separable. The teacher may have explicit knowledge about, for example, the effects of punishment or reward on student motivation and many other psychological and pedagogical processes, which merges with their tacit knowledge, for example, of how they interpret psychological theories for themselves and how they translate them to a particular context and situation. As the duality approach contests the normativity of codification, it also questions the belief that the ultimate policy goal of establishing a formal knowledge base for the teaching profession can be achieved through codification. Current theoretical understandings on codification make it clear that it is not a simple, linear process through which a codified knowledge base for teachers is developed.

Nevertheless, codification processes exist in teaching communities and they influence the dynamics of teachers' knowledge. We have seen that codification can happen in various forms during initial teacher education, professional collaboration and development or during teachers' involvement in research. These processes shape teachers' knowledge base even though these dynamics cannot be as simply conceived of as "the reduction of tacit knowledge and a way towards a codified knowledge base". They can also increase the shareability, transmissibility and accessibility of knowledge within the teaching profession.

However, the conditions and circumstances under which codification processes achieve these effects are yet to be explored and clarified. Within the field of educational research, it is unclear how codification could improve the professional practice of teachers; in what ways and at what level would it be meaningful to codify teacher knowledge; and under what conditions could codification facilitate extended access to knowledge for teachers. New technologies (including artificial intelligence) open new dimensions in codification (Kabir, 2013[105]), which could also be considered for teaching. In addition, it has been suggested by economists that a more interdisciplinary approach to the issue of codification, namely including research on teaching and learning could make a valuable contribution (Johnson, Lorenz and Lundvall, 2002[18]).

While theories and results on codification from the field of economics and information science haven't been sufficiently considered and integrated in educational literature, aspects of knowledge management and organisational learning theories have gained traction. I will describe this field next.

2.2.4. Knowledge management and organisational learning

A large number of case studies investigate how knowledge is managed in a company, firm, organisation with a view to induce greater productivity or facilitate innovation. Organisational learning and knowledge management are two strongly related concepts that take their roots in social constructivist and situated learning theories. They have developed in parallel and often mutually refer to each other in their definitions (Wang and Ahmed, 2003[106]).

In social constructivist and situated learning theories, knowledge is not an individual property, nor an outcome. Rather, knowledge can only be interpreted as part of the situations where it "takes place"

(Lave and Wenger, 1991[107]). Learning in the knowledge management literature is usually defined based on information science concepts. For example, Bierly, Kessler and Christensen define learning as "the process of linking, expanding, and improving data, information, knowledge and wisdom" (Bierly, Kessler and Christensen, 2000, p. 597[108]).

Brown and Duguid's work on organisational learning (Brown and Duguid, 1991[109]) and Peter Senge's research on learning organisations (Senge, 1990[110]) are the two most influential lines of thought in this field. Peter Senge proposed five characteristics of learning organisations: personal mastery, mental models, shared vision, team learning and systems thinking (Senge, 1990[110]). Senge defined learning organisation as follows:

> *people continuously expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning how to learn together (Senge, 1990, p. 3[110]).*

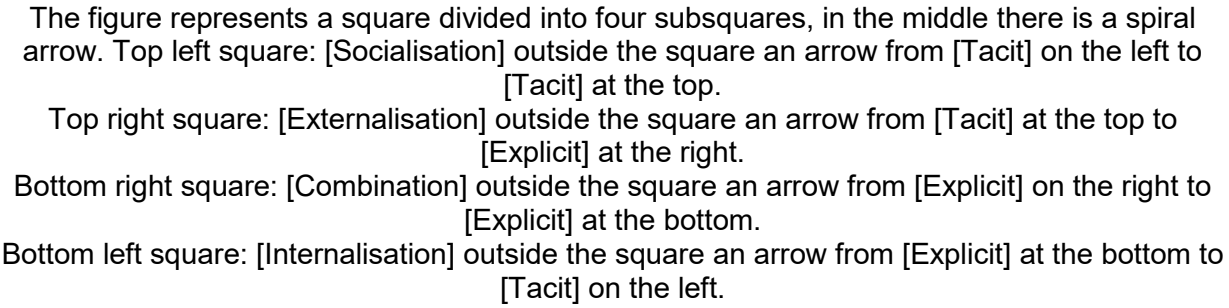
Several organisational learning theorists stress the importance of the individual, and view managing the individual development of employees as one of the key foci of learning organisations (Wang and Ahmed, 2003[106]; Senge, 1990[110]; Argyris and Schön, 1978[111]). In addition to individual learning, collective learning, which may occur independently of individual learning processes, is also recognised. A learning organisation in this sense is the sum of all individual and collective learning. However, Wand and Ahmed's review of organisational learning (2003[106]) points to tensions arising from unclear distinctions between individual and organisational learning. In particular, the authors highlight the danger of "anthropomorphising organisations". They argue that subsuming the organisation and the individual may result either in ignoring or obscuring the individual and its learning processes, or neglecting organisational complexities and interpreting organisational learning simplistically as an extension of individual learning. Explicitly distinguishing between individual and organisation is important to be able to account not only for interactions between individuals, but also between the organisation and its contexts, and organisations themselves (Wang and Ahmed, 2003[106]).

Knowledge processes play a key role in developing learning organisations. In fact, organisational learning is described as the changes that occur in knowledge, and involves knowledge acquisition, diffusion, refinement, creation and implementation (Wang and Ahmed, 2003[106]). Therefore, practical management science has focused on understanding and developing structures, procedures and tools that facilitate these knowledge processes. These include repositories and knowledge sharing, mostly supported by increasingly more sophisticated technological solutions.

While in the early stages of organisational learning theories, researchers focused more on knowledge acquisition, diffusion and implementation, the attention later turned more and more to knowledge creation (Wang and Ahmed, 2003[106]). The most influential model was developed by Japanese researchers, Ikujirō Nonaka and Hirotaka Takeuchi, who studied the processes of knowledge transfer and creation in Japanese firms. This knowledge management model aims at understanding how firms innovate,

taking Polanyi's (Polányi, 1962[104]) concept of tacit (personal) knowledge as its theoretical basis. Nonaka and Takeuchi (Nonaka and Takeuchi, 1995[112]) describe knowledge creation as a spiral on four levels: starting at the individual level, then "ascending" to the group, organisational, and inter organisational levels. The basic source of innovation in this model is tacit knowledge. This needs to be made explicit in order to be transformed into knowledge that is useful at the levels of the group and the whole organisation. Nonaka and Takeuchi (1995[112]) identify four phases of the "knowledge spiral", each of which represents a transformation of the type of knowledge (Figure 2.4).

Figure 2.4. SECI model with examples in the education context



Source: Adapted from (Nonaka and Takeuchi, 1995[112]).

In their influential SECI model, the first phase – *socialisation* – describes how tacit knowledge is transmitted between employees, for example, by sharing their experience in meetings, perhaps observing each other, brainstorming about issues. The transmission of tacit knowledge usually requires face-to-face presence or direct interaction. A typical example for socialisation is apprenticeship, when trainees learn skills through direct observation, exchange and practice, rather than from a manual.

The second phase – *externalisation* – involves a conversion of tacit to explicit knowledge. This corresponds to codification (described above), i.e. by articulating hitherto tacit knowledge, and documenting it in explicit forms such as manuals. This process often involves the creation of new concepts or symbols.

The third phase – *combination* – captures processes through which the various pieces of explicit knowledge are combined, often to create new knowledge. The sources of knowledge include internal organisational knowledge, but can also incorporate external knowledge brought in from other organisations or knowledge sources. New explicit knowledge can then be diffused across the organisation.

The fourth phase – *internalisation* – encompasses processes in which the new knowledge is internalised by the individuals in the organisation through "learning by doing". Internalisation involves connecting ideas, recognising patterns through individual and collective reflections, and eventually transforming the explicit knowledge again in tacit knowledge held by the individuals. After the fourth phase, the cycle starts again, but at a higher level, which now includes a wider organisational knowledge base (Nonaka and Takeuchi, 1995[112]).

Several critiques of knowledge management models relate to the problematic conceptualisation of knowledge. These claim that such models often take a strongly information-based view of knowledge. Wilson (2002[113]) underlines that while information, data and information resources (collections of information) can indeed be managed, knowledge cannot. Wilson understands knowledge as "what we know" involving "the mental processes of comprehension, understanding and learning that go on in the mind" (2002, p. 1[113]), and argues that this can at best be managed by the individuals, although even they have little control over it. An information-based definition of knowledge is also problematic, because it represents a non-personal view of knowledge. This implies that learning is basically limited to acquisition and assimilation (Lave and Wenger, 1991[107]). It is important to note here, that while Nonaka refers to Polanyi's notion of "personal" or tacit knowledge, in reality this model builds on implicit knowledge (i.e. potentially codifiable knowledge), and not tacit in Polanyi's original conceptualisation.

2.2.5. Limitations of the management approach

The main focus of management theories and models is on industrial firms that are embedded in a competitive market-based context. While there are many similarities in how a public sector organisations, such as hospitals or schools work, there are also significant differences.

First, the ultimate objective, as well as the social and economic context of innovation and knowledge management are inherently different in the two sectors (Djellal, Gallouj and Miles, 2013[114]; Lekhi, 2007[115]). While in the industry, this is about selling a product, obtaining a competitive advantage in the market, filling a market gap, etc., in the public sector, the objective is more altruistic and human-centred: teachers' and schools' primary goal is to help students learn. One could argue that in many policy contexts schools are also in competition with each other, particularly in countries that have moved towards a New Public Management model for public services. Indeed, in such contexts, innovation and knowledge creation in schools and among teachers can also have the objective of getting a competitive advantage. For example, in per-capita-based school funding models, being able to recruit more students and through that obtain public funds can be an important objective. In performativity-oriented policy contexts, schools are often implicitly encouraged to recruit students from higher socio-economic backgrounds in order to obtain better results, and higher rankings in league tables. Nevertheless, data has been consistently showing that what drives teachers and schools is most often altruistic social goals (OECD, 2020[37]). The concept of "knowledge management" is functionalist, being based on the idea of optimising processes in order to drive performance and productivity. This idea may however be in conflict with the social and altruistic nature of education.

Second, learning is defined in management theories in terms of information processing. This is a narrow view that does not sufficiently reflect the complex nature of knowledge, particularly as it is shaped by social processes taking place in a professional community. In addition, we have seen that the normative understanding of codification is problematic in itself. The creation of knowledge in most management models is conceptualised as a smooth and non-problematised process, which does not correspond to

workplace reality, in which new knowledge most often emerges from questioning current practice and therefore involve conflicts between beliefs, traditions and practices (Engeström, 2001[116]).

Third, industrial firms often bring together people with different training and expertise. Education on the other hand, is characterised by a much more homogeneous body of employees. The dominant proportion of school staff is teaching faculty. Teachers have the same or similar disciplinary background acquired through teacher training institutions and belong to the same epistemological community. Therefore, the difference in their knowledge bases may be more limited than differences we could find in a company across for example, back- and front-end engineers and developers, marketing, sales and human resources units. There is also less international mobility among teachers, further contributing to the homogeneity. Clearly, this difference has to be acknowledged when studying social processes.

In the next section, I turn towards sociological theories focusing on social interpretations of knowledge and learning.

2.3. Social approaches: social cognition and situated learning

Social theories of knowledge can explain some of the more complex, non-linear and social mechanisms that much of the cognitive and management approaches fail to take into account. The concepts of social psychology have been greatly used and researched in the field of sociology. To the extent that some key concepts such as communities of practice, professional learning communities and networks have become a truly interdisciplinary area of research, extending from psychology to educational sociology, knowledge management and political sciences. The development of some of these key concepts are thus reviewed next.

2.3.1. Knowledge and learning in social constructivism

Cognitive constructivism is one of the most influential learning theories of the 20th century. It originates from John Dewey's philosophy and was elaborated by Jean Piaget and later Jerome Seymour Bruner. Rejecting repetitive, rote memorisation-based learning, Dewey proposed that education should be grounded in real experience (Dewey, 1938[117]). In his method of "directed living" students engage in real-world, practical activities that provide them with opportunities to think by themselves and articulate their thoughts. Similarly, Piaget rejected the idea that learning was the passive assimilation of knowledge. Instead, for him learning is a dynamic process comprising successive stages of adaption to reality during which learners actively construct knowledge by creating and testing their own theories of the world (Piaget, 1972[118]). Piaget's theory however, does not consider the social context of the learner and learning. Lev Vygotsky (1978[119]) in contrast, posits that learning cannot be separated from its social context. This idea is considered as the foundation of social constructivism. In addition to the importance of the cultural and social context, social constructivism emphasises the collaborative nature of learning, believing that cognitive functions originate in social interactions. Learning in this sense is not simply the acquisition of knowledge; rather it is the process by which learners are integrated into a knowledge community.

Recognising the fundamental role of the social and cultural context in the development of cognition has made a huge impact on thinking about teachers' learning as well (Putnam and Borko, 2000[90]). An important body of research originating from social constructivism views knowledge as being distributed over groups of individuals and their environment, and emphasises the situated nature of learning. Learning in this sense is based on participation in social groups and is primarily seen as sharing and co-constructing knowledge in these groups (Putnam and Borko, 2000[90]; Paavola, Lipponen and Hakkarainen, 2004[71]). The way teachers share and construct knowledge in their social-professional environment has been captured in numerous studies and through varying methodologies. Research in this domain includes the investigation of teacher collaboration, communities of practice, teachers' activity and professional learning, and learning organisations, to mention a few examples [see e.g. (Gherardi, 2008[120]) for the development of an important branch of such research, coined "practice-based studies"].

The common ground of these studies is that they focus on activities ("knowing") rather than on outcomes or products ("knowledge"). Learning and knowledge being situated in a social context, the object of analysis in this view is discourse, interaction, activity and participation, rather than acquisition, integration or accumulation (Paavola, Lipponen and Hakkarainen, 2004[71]). The fundamental questions are: how situated "knowing" can be transferred and how it is transformed through social interactions; what characterises those collaborations, communities, social networks that successfully share/transfer knowledge. The nature and structure of social interactions are thus the principal focus when exploring teachers' learning in this perspective.

2.3.2. Communities of practice to professional learning communities: The social context of teacher learning

A rich field of practice-based studies explore knowledge as a process taking place within situated practices (Gherardi, 2008[120]; Gherardi, 2009[121]). Within this vast field, Lave and Wenger's situated learning theory (Lave and Wenger, 1991[107]) together with Brown and Duguid's work on organisational learning (Brown and Duguid, 1991[109]) were among the most influential in education by establishing the notion of *communities of practice* (CoP).

Work on communities of practice (Lave and Wenger, 1991[107]; Wenger, 1998[122]; Brown and Duguid, 1991[109]) is among the first to focus on socially constructed knowledge. Research in this area includes analyses of different social processes through numerous case studies, and the concept has also served as a model for knowledge management to enhance organisational performance (Cox, 2005[123]; Davenport and Hall, 2002[124]). In his review of four influential studies on communities of practice – Lave and Wenger (1991[107]), Brown and Duguid (1991[109]), Wenger (1998[122]) and Wenger, McDermott and Snyder (2002[125]) – Cox (2005[123]) reveals a number of differences between how the term is used and what the focus of interest is. Cox notes that the book by Wenger, McDermott and Snyder stands apart being a manual for practitioners to popularise the idea of community of practice. The main differences Cox identifies in the first three are the following:

1. Lave and Wenger reject the linear and mechanistic understanding of learning as cognitive transmission, and propose rather to focus on informal and situated social interactions. Their primary interest is in the socialisation of a new member in the knowledge of a community through participating in practice, which they coin "peripheral participation" (Lave and Wenger, 1991[107]). They argue that the participation of newcomers to a community is important ("legitimate peripheral participation"), as with new and different insights and experiences they can contribute to knowledge building in the community.

2. Brown and Duguid focus on the creation of new knowledge through narrative and improvisation (Brown and Duguid, 1991[109]). While they also study work-based learning like Lave and Wenger, their assumption is that "getting the job done" always requires locally developed understanding. Therefore, instead of looking at how existing knowledge is reproduced, they look at how informal groups form to develop solutions to novel problems.

3. Wenger (1998[122]) focuses on identity, and looks at individuals' trajectories through different levels of participation in a community, tensions when they are members of multiple communities, and the nature of boundaries between these communities. Instead of "legitimate peripheral participation", he analyses the tensions between a number of dualities. These are: participation and reification (i.e. meaning making), designed and emergent (i.e. pre-planned and emerging activities), local and global (boundary-crossing between communities), and identification and negotiability (power and belonging in identity formation). Wenger defines a community of practice as a group of people with shared concerns who deepen and create knowledge through 'mutual engagement' in an 'indigenous' enterprise. Wenger also establishes a number of indicators that describe CoPs.

Similarly to Wenger, Davenport and Hall understand community of practice as "the level of the social world at which a particular practice is common and coordinated, at which generic understandings are created and shared, and negotiation is conducted" (Davenport and Hall, 2002, p. 172[124]). While these early conceptualisations focused on analysing the phenomenon of informal groups that are organically forming around shared concerns and common goals, the concept of CoPs has also become used as tools for knowledge management (Blankenship and Ruona, 2007[126]). An example for such a normative use is Wenger, McDermott and Snyder's book. This manual stems from the authors' belief that CoPs are a valuable structure for creating and codifying knowledge, while the authors also point to potential pitfalls of CoPs such as clique formation, exclusiveness in membership or the limitation of innovation (Blankenship and Ruona, 2007[126]). Similarly, in Saint-Onge and Wallace's work (2003[127]), the authors use CoPs as tools to improve individual and organisational performance (Blankenship and Ruona, 2007[126]).

A closely related concept to community of practice is that of *professional learning community* (PLC), to which, similarly to CoPs, multiple definitions exist. This concept is based on Peter Senge's influential work (Senge, 1990[110]) that marked the development of the notion and theories of learning organisations (see section 0). The first appearances of the concept of PLC can be traced back to Myers

and Myers (1995[128]) and Myers (Myers, 1996[129]) who used it as a new alternative to "professional development schools" – an education policy initiative in the United States associated with teacher education reforms in the late 80s and 90s. Shortly after, two more seminal works marked the uptake of PLCs: Shirley M. Hord's white paper entitled "Professional Learning Communities: Communities of Continuous Inquiry and Improvement" (Hord, 1997[130]), and Richard DuFour and Robert E. Eaker's book "Professional Learning Communities at Work" (Dufour and Eaker, 1998[131]).

Blankenship and Ruona compare six models of CoPs and PLCs, including the most influential ones mentioned above, along five dimensions: theoretical base, membership, leadership, organisational culture and knowledge sharing (see Table 2.2 for summary). The three models of PLCs used – Dufour and Eaker (1998[131]), Murphy and Lick (2004[132]), Hord (1997[130]) – are all education-related. The three CoP models – Brown and Duguid Wenger, McDermott and Snyder, Saint-Onge and Wallace – are general organisational or workplace models.

Table 2.2. Characteristics of Communities of Practice and Professional Learning Communities

	Communities of Practice	Professional Learning Community
Theoretical base	Situated cognition, social learning, and knowledge management	Learning Organisation
Membership	Community: individuals working together for a common purpose within the organisation; voluntary participation	Community: the whole organisation or larger group; membership is by virtue of status as a member of the faculty
Leadership	Internal to the collaborative teams; distributed leadership with both formal and informal leaders	Often strong emphasis on the role of the school principal in the formation and functioning of PLCs
Organisational culture	Shared vision, emphasis on collaboration and trust, exception: Brown and Duguid's model, where CoP can run counterculture to the organisation, though they call for organisational recognition of CoPs.	Shared vision, emphasis on collaboration and trust
Knowledge sharing	Occurs within the community, socially constructed knowledge, emphasis on the social aspect of learning	Through mechanisms such as collective enquiry, study group meetings and logs, reflective dialogue, peer coaching, etc.

Source: Based on (Blankenship and Ruona, 2007[126]).

The idea of PLCs and developing schools as learning organisations has travelled quickly and was taken up by education policy in a number of countries. In the United States, Dufour and Eaker see the creation of PLCs as a tool for school improvement:

> *If schools are to be significantly more effective, they must break from the industrial model upon which they were created and embrace a new model that enables them to function as learning organizations. We prefer characterizing learning organizations as "professional learning communities" for several vital reasons. While the term "organization" suggests a partnership enhanced by efficiency, expediency, and mutual interests, "community" places greater emphasis on relationships, shared ideals, and a strong culture—all factors that are critical to school improvement. (Dufour and Eaker, 1998, pp. 15-16[131])*

In Canada, the Ministry of Education in Ontario promoted the idea of PLCs and defined the ideal characteristics of such communities (Ontario Ministry of Education, 2005[133]). The OECD has also recently

taken up the concept of “schools as learning organisations” (Kools and Stoll, 2016[134]), and developed a programme to support the Welsh government in promoting learning organisations (OECD, 2018[135]).

Blankenship and Ruona note that the way these authors look at knowledge development and dissemination vary, and none of them provide detailed analysis of these processes. In the PLC models, knowledge development and dissemination are mostly discussed at the individual and group level, and less attention is paid to disseminating the knowledge created within the PLC to outside the community. All PLC models describe structures that facilitate knowledge development, and Murphy and Lick (2004[132]) also propose ways in which knowledge can be made available to the larger organisation. However, there is no discussion as to how knowledge can or needs to be transformed in order to be accessible for actors outside the PLC (Blankenship and Ruona, 2007[126]).

Stoll and Seashore Louis (2007[136]) propose that PLCs should extend beyond a group of teachers and involve a broader set of stakeholders to be able to bring together divergent knowledge bases. Stoll and colleagues define PLC as: “a group of people sharing and critically interrogating their practice in an ongoing, reflective, collaborative, inclusive, learning oriented, growth promoting way, operating as a collective enterprise” (Stoll et al., 2006, p. 223[137]). This definition refers heavily to the nature of the knowledge processes taking place within a PLC (reflective, collaborative, inclusive). Understanding these processes are the main object of analysis in the volume edited by Stoll and Seashore Louis, which investigates the various tools and mechanisms used in PLCs, and how these contribute to the PLCs’ impact on teachers and students.

Online communities of practice

While CoPs were originally conceptualised as situated learning happening in a co-located setting, with the spread of internet in the 21st century, CoPs in virtual settings have started to develop rapidly (Kirschner and Lai, 2007[138]). Yet, it took some time to accumulate research evidence on this particular type of CoPs and PLCs. In a 2007 special issue of Technology, Pedagogy and Education, the editors, Kirschner and Lai, collected five studies on online communities.

Similarly to offline professional learning communities, these studies focus on understanding how CoPs function as tools to improve professional practice. In particular, they involve investigations on the following areas:

- The formation, development and sustainability of online learning communities.
- The role of written communication in online communities of practice, in particular in facilitating reflection and the development of participants’ professional identity.
- Collaborative knowledge building in CoPs by grouping online dialogs into five “zones”: sharing, comprehending, analysing, synthesising and transforming.
- The way in which the development of CoPs can be supported by various tools such as e-portfolios and web 2.0 technologies.

- Supporting beginning teachers' in their professional tasks and teaching practice by using online CoPs as mentoring tools (Kirschner and Lai, 2007[138]).

In terms of underlying theoretical grounds, online CoP literature often originate from situated cognition and social learning theories, similarly to traditional CoPs. In many studies on online CoPs and PLCs the focus is on designing these communities in a way to facilitate teacher learning. Emphasis is placed on developing tools, including the communication platform itself, and ways of accompanying participants in their professional development through the help of peer-reflection, moderation and coaching. It is also worth noting that the methodologies vary, including participatory action research, interviews, as well as social network analysis (Kirschner and Lai, 2007[138]).

Studying teachers' online community of practice in Taiwan, Tseng and Kuo (Tseng and Kuo, 2014[139]) showed that closer connections among members lead to greater commitment to helping others, which in turn facilitates knowledge sharing in the community. In addition, the authors showed that teachers' membership in the online community fosters a pro-social attitude that increases their willingness to share resources and help other teachers.

Schlager and Fusco (2003[140]) examine the design approaches to online CoPs, in particular professional development interventions in the United States. The authors define professional development as "a process of learning how to put knowledge into practice through engagement in practice within a community of practitioners" (Schlager and Fusco, 2003, p. 205[140]). Professional development is thus considered as a socio-organisational system, in which stakeholders communicate and cooperate to ensure the sharing of knowledge, norms of practice, and generate and diffuse new knowledge. The question the authors raise is: what are the socio-cultural and socio-technical conditions in order that such a socio-organisational system in an online community truly becomes professional development? In terms of socio-cultural requirements, Schlager and Fusco draw the attention to the importance of building on existing local communities when designing online platforms or using any digital technology to facilitate CoPs. They note that in many cases, regional or local professional development intervention projects view CoPs as artefacts to be built specifically for the intervention. This often implies that they are dissociated from existing local practices and practitioners who do not participate in the intervention. Schlager and Fusco argue that eliminating this artificial distinction, i.e. aligning the community inside and outside the intervention can catalyse the effect of the CoPs. Importantly, the authors examine the socio-technical conditions, and highlight that the way teachers interact with the technical environment – tools, technologies and artefacts – matters for their learning and knowledge generation. For example, when new tools are introduced, teachers first need to get familiar with those and figure out how they will serve the actual focus of the activity, i.e. their professional learning. Schlager and Fusco point to a lack of empirical research on the socio-technical aspect of CoPs (Schlager and Fusco, 2003[140]).

Interestingly, the number of studies on online communities of practice of teachers is not particularly high and most of these report on specific single case studies. At the time of writing this thesis, no comprehensive and systematic review is available on this issue, and literature in other sectors such as

healthcare is more abundant. At the time of the covid-19 pandemic in 2020-2021, when over 100 countries around the world closed all schools, online professional communities for teachers became a necessity. This key research gap will soon be filled and new understandings of online communities emerge. It has never been more relevant to think about online professional collaboration than at the moment when these lines are being written – in confinement in Paris.

Relevance and limitations of CoPs

CoPs and PLCs are useful concepts to study social and cultural sharing, and how the social practice of teachers is shaped. This latter is often conceptualised as teachers' (or in some cases, other actors' such as school leaders') professional learning, understood as the process of reflecting on and improving teaching practice. In addition to practice, these concepts also help understand the development of professional identity.

Nevertheless, a substantial application of the CoP literature within the domain of education has a strongly performative perspective, offering checklists for developing higher performing communities (Davenport and Hall, 2002[124]). Such performance-driven accounts carry the risk of idealising communities of practice and ignoring some of the inherent tensions within and between individuals. Such tensions could be seen as detrimental to the performance of the community, while in reality, they can play crucial roles in knowledge creation (Engeström, 2001[116]). Interpretative rather than performative approaches (Davenport and Hall, 2002[124]) are more useful to understanding processes.

A further concern regarding the CoP literature is that they tend to focus too much on local processes, neglecting the wider context. Although some authors engage in some analysis of the boundaries of CoPs (Davenport and Hall, 2002[124]), the majority of the studies remain focused on the local, failing to take into account the wider network in which CoPs are embedded, and how these influence and reshape them. For example, Fox highlights the temporality of communities: new links can be created, and links can also be broken, and learning is in fact one of the processes, which can transform the network (Fox, 2002[141]). A network approach might thus account for some of the fundamental phenomena around learning and knowledge.

2.3.3. Social capital and social network theory: knowledge and learning in networks

In addition to the social cognitive approaches discussed above, another major sociological theory, namely social capital theory, is also highly relevant to studying teachers' knowledge and learning in its social context. After introducing some key ideas of social capital theory, I will focus on social network theory that captures social capital in social networks, and summarise some empirical findings of this theory in the domain of teachers' knowledge and learning.

Social capital theory

The idea of social capital builds on Marx's classical capital theory, in that it considers capital as a surplus value, which requires investment and is expected to yield returns. A number of scholars, such as Pierre Bordieu, James S. Coleman, Robert D. Putnam, Nan Lin, Ronald S. Burt, Peter V. Marsden and Hendrik Derk Flap, have contributed to forging the concept of social capital and offering a unique aspect of social capital theory. Lin (2001[142]) provides a summary of the common grounds as well as the differences of focuses of these scholarly works. The premise of social capital theory is that an investment in social relations will have positive returns (Lin, 2001[142]). Lin summarises four explanations for this premise:

- Social relations facilitate the flow of information. For example, they can give access to information on particular opportunities or choices.
- Social ties can exert influence on the agents who play a role in decisions about the individual. For example, "putting in a good word" in a decision about promotion.
- Social tie resources can be considered (by the organisation or agents) as social credentials of an individual. For example, one's social ties are seen as a guarantee that one can add value through these resources.
- Social relations reinforce identity and recognition. For example, belonging to a social group can provide emotional support and public acknowledgement (Lin, 2001[142]).

While most social capital scholars share the basic assumptions, including the fundamental role of the individual in establishing and maintaining social capital, they apply different lenses to these. Lin distinguishes two main perspectives: one view focuses on the benefits for the individual, while the other on the return for the collective (Lin, 2001[142]). The former view is exemplified by the work of Lin, Burt, Marsden and Flap among others, which investigate how individuals invest in social relations and how they exploit these resources for their own benefit. The latter perspective is present in Bourdieu's, Coleman's and Putnam's work for example, which focus on how groups develop collective social capital and how they turn this into collective profit (Lin, 2001[142]).

In order to clarify what social capital theory can bring to the understanding of how society functions, Lin discusses four major controversies. First, he argues that the relational asset (social capital) needs to be separated from other collective assets such as culture, norms, trust (Lin, 2001[142]). These latter can be seen as outcomes or antecedents of social capital, i.e. the relational asset, but should not be confounded with them. Second, Lin criticises Bourdieu's notion that social closure, i.e. dense, closed networks constitute greater social capital. Bourdieu was primarily interested in understanding how the dominant social class maintains its privilege and, from this perspective, social closure was seen as fundamental social capital. Coleman also held the view that network closure is social capital, because it maintains trust, norms and culture. However, other scholars, such as Burt (1992[143]) and Granovetter (1973[144]), have put in evidence the importance of open networks, weak ties and structural holes in other types of outcomes,

such as access to jobs. Third, Lin calls for the clear separation of antecedents and outcomes going against Coleman's functional definition of social capital (2001[142]). By defining social capital as a social structure resource that brings return for an individual, Coleman confounds the predictor and the outcome according to Lin. Linked to this third controversy, Lin's fourth argument concerns measurement, stating that social capital can only become a useful quantitative concept if the predictor / antecedent, i.e. the social capital embedded in a structure of relations, is measured independently from the effects / outcome, which can be the individual's return such as power, wealth or other physical or emotional benefits (Lin, 2001[142]).

To model social capital, Lin identifies three processes: the investment in social capital, access to and mobilisation of social capital, and its returns or outcomes. Regarding this latter, he distinguishes returns to instrumental action, such as wealth, power and reputation, and to expressive action, such as life satisfaction, physical and mental health (Lin, 2001[142]). Lin, Burt, Putnam and other scholars have contributed hugely to conceptualising social capital theory and turning it into an operational research methodology. In parallel, a number of researchers were working on theorising social structures. The emerging theory of social networks can not only be useful for operationalising social capital theory, but also for extending it in various directions.

Social network theory

Social network theory started to proliferate in several disciplines in parallel from the 1930s. However, its foundation can be traced back to much earlier. Freeman identifies Auguste Comte's work as the earliest traces of social network theory, Comte being the first who proposed to study society in terms of the interconnections among social actors in the early nineteenth century (Freeman, 2004[145]). Ferdinand Tönnies (1855-1936) contributed to the field by distinguishing between two forms of social groups based on the types of social ties that constitute them. Communities (Gemeinschaft) are characterised by social ties based on direct personal interactions and the underlying shared values and beliefs, whereas society (Gesselschaft) is constituted by formal and impersonal social interactions (Tönnies, 1887[146]). Then, Durkheim's notion of social fact points to the existence of a social sphere beyond the individual that cannot be explained solely by the properties of the individuals (Durkheim, 1894[147]). Georg Simmel was the first who explicitly proposed to study the society in terms of spatial and temporal patterns of interactions between individuals (Simmel, 1971[148]). His student, Leopold von Wiese, first used the terms "system of relations" and a "network of lines between men" (Freeman, 2004[145]; von Wiese and Mueller, 1941[149]). These and some other early sociologists were concerned with characterising the different types of social ties in different social configurations, and thus had a structural perspective (Freeman, 2004[145]).

Social network theory helped clarify key dimensions of social capital. In particular, it helped analytically separate structural and relational social capital. The former arises from the "position" an actor occupies in a social network. This position is based on the patterns of incoming and outgoing social ties the individual has and the overall "structure" that emerges from the pattern of ties across a network (Wasserman and Faust, 1994[150]). The latter, relational social capital, refers to the quality of ties among

actors (Bourdieu, 1986[151]; Coleman, 1990[152]) and the ways in which these influence the flow of resources [in (Liou and Daly, 2014[153])].

In parallel with theoretical development, a number of scholars started to study social structures empirically including the Swiss naturalist Pierre Huber, the American lawyer-anthropologist Lewis Henry Morgan and the English John Atkinson Hobson (Freeman, 2004[145]). The birth of graph theory led to the development of network analysis in mathematics. Within the field of sociology, it was the development of sociometry by Jacob Levy Moreno that marked the real beginning of the empirical study of social networks. Freeman identifies four key features that define modern social network analysis (SNA):

1. "[It] is motivated by a structural intuition based on ties linking social actors.
2. It is grounded in systematic empirical data.
3. It draws heavily on graphic imagery.
4. It relies on the use of mathematical and/or computational models" (Freeman, 2004, p. 3[145]).

By analysing actors (nodes) and ties (connections) between them, social network analysis allows for describing patterns of relationships among actors, the structure of these ties and can help identify their effects on people, organisations, interactions and collaboration (Wasserman and Faust, 1994[150]). A review of research (Borgatti and Foster, 2003[154]) characterises network analytical approaches along the following dimensions:

- direction of causality: whether it is about the causes or the consequences of network structures
- levels of analysis: whether it investigates the dyadic level, actor or network level – (micro and macro level network research are theoretically and methodologically similar)
- explanatory goals/styles: whether it is directed at modelling variation in performance and other value-laden outcomes, or homogeneity in actor attitudes or practices
- explanatory mechanisms: whether it is structuralist (e.g. looks at the configuration of ties) or connectionist (e.g. focuses on resources that flow through social ties).

Social network analysis developed a number of fundamental concepts that serve as the subject of analysis (see Box 2.2).

Box 2.2. Fundamental concepts of social network analysis

Actor: The social entities under study that can refer to discrete individual, corporate or collective social units. Network nodes are however not necessarily people or organisations, they can also be material objects or abstract concepts, such as events, websites and documents.

Relational tie: The social ties through which actors are linked to one another. Network ties between individuals can refer to relations such as similarities (membership in groups, attributes), social relations (friendship, collegial relationship), mental relations (likes, knows about), interactions (talks to, seeks advice from) or flows (information, belief) (Borgatti and Ofem, 2010[155]). Ties between organisations such as schools, agencies and businesses can also refer to many kinds of relationships: sharing resources, selling or buying products, collaborating, etc.

Dyad / Tryad:. Dyad is a pair of actors and the (possible) tie(s) between them. A subset of three actors and the (possible) tie(s) among them are tryads. Dyadic and tryadic analyses look at the properties of relationships in these small subsets.

Subgroup: Any subset of actors and all ties among them. Social network analysis is often concerned with identifying and studying subgroups based on some criteria.

Group: The collection of all actors in a bounded set that belong together by pre-defined theoretical, empirical or conceptual criteria. Network analysis studies the ties of this finite set of actors.

Relation: The collection of ties of a specific kind among members of a group, such as friendships among children or diplomatic ties among nations in the world. Among the same group of actors several different relations can be measured.

Social network: A finite set(s) of actors and the relation(s) defined on them. A mathematical definition of a social network is, more generally, a set of objects (called nodes or vertices in mathematical terms) that are connected (by edges).

Source: (Wasserman and Faust, 1994[150]).

Theoretical approaches to studying networks can be classified according to whether they aim to understand the impact of social networks on the characteristics of individuals or collectives, or vice versa: the impact of individual or collective characteristics on social networks (Table 2.3) (Borgatti and Halgin, 2011[156]).

Table 2.3. Types of theories on social networks

	Dependent variable (outcome)	
Independent variable (antecedent)	**Non-network variable**	**Network variable**
Non-network variable	Not a network theory	Theory of networks

Network variable	Network theory	Network theory of networks

Source: Adapted from (Borgatti and Halgin, 2011, p. 1177[156]).

Social network analysis and teachers' knowledge

There is a growing number of social network studies that investigate the relationship between teachers' networks and educational change (Daly, 2012[157]). Drawing on modern social network theory, Liou and Daly (2014[153]) identify three types of social capital – structural, relational and cognitive social capital – and describe how these manifest in professional learning communities.

Emerging findings suggest that social interventions can not only influence the structure of networks, but also mobilise resources that teachers access and introduce new types of interactions among teachers (Coburn, Mata and Choi, 2013[158]). The foci of these studies include investigating the relationship between teachers' social networks and various change processes. To illustrate the high relevance of social network analysis in understanding teachers' knowledge processes, the following sections highlight some of the main findings on network characteristics and their role in teachers' knowledge mobilisation, and the creation and diffusion of knowledge.

Network structure

The *distribution of ties* in a network can influence access to new ideas and information as well as sustainability of change. For example, "closed networks" that are characterised by a large number of strong internal ties may have less access to new ideas, and may be less prone to innovation (Granovetter, 1973[144]; Baker-Doyle and Yoon, 2011[159]). On the other hand, networks that demonstrate a lack of ties and generally low connectivity have fewer opportunities to exchange knowledge and might find it difficult to disseminate new knowledge and sustain change (Baker-Doyle and Yoon, 2011[159]). Centralised networks, in which one or a few actors have many ties, whereas the majority only few, can however be effective in disseminating codified knowledge such as formal research knowledge.

The main assumption behind knowledge mobilisation is that there is a lack of connection between research and practice, and hence between researchers and practitioners. Granovetter (1973[144]) argued that communities with strong internal links tend to lead to an overall fragmentation of the macro network, such as disconnected cliques. This phenomenon has also been described as "structural holes", referring to a lack of direct contact between entities (Burt, 1992[143]). Sub-groups in education form not only along the different stakeholder groups, but cliques can also exist within the community of practitioners. Too many cliques can reduce the ability to take risks or make big changes (Daly et al., 2010[160]). The same holds for too centralised networks (Daly et al., 2010[160]).

The network structure plays a crucial role in the generation and diffusion of innovation as well. Research has shown that while networks with many structural holes are conducive to generating new ideas, they are the least appropriate to integrate innovation (Long, Cunningham and Braithwaite, 2013[161]). A network with closely tied sub-groups linked by weak ties is the ideal structure for generating and

producing innovation, while evidence also suggests that increasing the number of structural holes eventually becomes counterproductive (Long, Cunningham and Braithwaite, 2013[161]). Diffusing new knowledge about teaching and learning can be described as "complex contagion", meaning that one simple interaction is not enough to transmit them (Centola and Macy, 2007[162]). Cohesive (high density) networks are more effective in spreading such complex and often tacit knowledge than sparse networks (with more structural holes) (Long, Cunningham and Braithwaite, 2013[161]).

Network nodes

The *position of actors* in a network – whether they are isolated, embedded or centralised – can influence not only their perceptions, but also the overall dynamics of knowledge in a network (Baker-Doyle and Yoon, 2011[159]). A study specifically looking at the influence of network characteristics on research use in schools showed that teachers who have more frequent and useful interactions with their colleagues on teaching and learning are also more positive about the research use climate in their school (Brown, Daly and Liou, 2016[163]).

The *individual attributes of members* are however equally important. For example, teachers' prior knowledge of research on a topic, their attitudes towards the use of research or data, and their reasons for participating in collaborative activities may all influence the overall effectiveness of knowledge mobilisation within a network (Lai and Schildkamp, 2013[164]). Knowing who in the network has expertise in various fields or topics can also be crucial in ensuring effective knowledge mobilisation (see also below) (Coburn, Choi and Mata, 2010[165]).

How the positions and attributes of members are matched matters greatly for effective knowledge mobilisation. When central actors are those who have the knowledge or access to external knowledge, and positive attitudes towards research evidence on teaching, the network has a greater capacity for knowledge mobilisation (Baker-Doyle and Yoon, 2011[159]). On the other hand, the network will not be able to benefit from highly knowledgeable individuals who are isolated. Such members are sometimes described as "silent experts" (Mueller-Prothmann and Finke, 2004[166]).

Studying the behaviour and *characteristics of brokers* who bridge structural holes is one key area of social network theory. Granovetter argued that weak ties play a crucial role in connecting different communities (Granovetter, 1973[144]). For knowledge mobilisation in education, this implies that the role of brokers who do not belong to either the community of researchers or that of teachers can be important in linking this structural hole.

Brokers in education could be teacher educators who provide professional development, coaches and mentors, and school inspectors for example. Social network studies have shown that while coaches and outside contacts can function effectively as knowledge brokers who bring outside information and materials into teachers' social networks, this role is sensitive to support (e.g. from the school district). However, after initial external brokering, teachers can also become brokers (Coburn et al., 2012[167]; Coburn, Mata and Choi, 2013[158]; Coburn, Choi and Mata, 2010[165]). It has also been widely emphasised

that brokers need to be equipped with special skills that enable them to diffuse their own knowledge (Akkerman and Bakker, 2011[168]). For example, Lomas (2007[169]), who studied 400 knowledge brokers in the health sector, identified the following skills:

- entrepreneurial (networking, problem solving, innovating)
- trusted and credible
- clear communicator
- understands the cultures of both the research and decision-making environments
- able to find and assess relevant research in a variety of formats
- facilitates, mediates and negotiates
- understands the principles of adult learning (Lomas, 2007, p. 130[169]).

In addition, brokers need support in order to function optimally, as their role of accessing and transferring specialised knowledge can easily be overwhelming (Long, Cunningham and Braithwaite, 2013[161]).

Network ties

Relationship between actors often develop based on homophily, i.e. between members with similar characteristics, or proximity, i.e. physical or geographical closeness. In a school for example, teachers teaching the same subject or same grade, those who have similar teaching and learning related beliefs, or those who share an office tend to form stronger connections. If such sub-groups are too closed, they have limited opportunities to external influences and knowledge (Baker-Doyle and Yoon, 2011[159]). For example, closed same subject or same grade teacher cliques can inhibit the circulation of knowledge that could be relevant across disciplines such as general pedagogical knowledge, or across age groups and grade-specific curriculum.

Centola and Macy (2007[162]) have also shown that while weak relational ties, such as more distant acquaintances and less frequent contacts, are important to access new ideas, such ties do not facilitate the spread of complex knowledge or behaviours. The authors demonstrated the importance of the width of bridges, i.e. the number of ties connecting two distant nodes. For effectively spreading and integrating new knowledge, a higher number of connecting ties between the various sub-groups (such as cliques of same subject teachers or the teacher and researcher communities) is more favourable (Centola and Macy, 2007[162]).

Aral and van Alstyne (2011[170]) examine the relationship between network diversity[3] and the "bandwidth" of ties (the volume of communication between nodes) (Figure 2.5). They conclude that in an environment in which actors hold homogeneous knowledge, have a large scope of knowledge (e.g. many topics) and the knowledge environment changes rapidly with frequently appearing new information, high bandwidth is more favourable for providing access to new information. In the context of education, this can be the situation when teachers work in an intense reform period (e.g. changing curriculum, changing requirements). In this case, closely tied teacher networks (e.g. same subject or same grade teachers within a school) have a higher potential to access and mobilise new knowledge. On the other hand, if actors have relatively heterogeneous knowledge, with a limited knowledge scope (e.g. fewer topics), but the overall knowledge base is fairly constant, network diversity has a greater impact on access to new information. This might hold for knowledge mobilisation and brokerage across the researcher and teacher communities.

Figure 2.5. The diversity-bandwidth trade-off

As structural diversity increases, tie bandwidth decreases.

Source: Adapted from (Aral and van Alstyne, 2011, p. 95[170]).

In terms of knowledge mobilisation, tie formation, i.e. the connection between individual characteristics and specific types of relationships, is central. In particular, an important question is who teachers turn to when they need advice, or when they seek out teaching and learning related knowledge. When such ties form based on homophily or proximity, it may not be the best available knowledge that circulates. The knowledge of the location of expertise within a network clearly contributes to a positive impact of knowledge sharing. Tie formation can change as a result of interventions that place an emphasis on developing individuals' knowledge of the location of expertise. A sustained effort is required, however, to ensure that knowledge or advice seeking ties develop based on relevant individual characteristics (Coburn et al., 2012[167]).

Network context

A number of contextual characteristics have been found important for the exchange and flow of resources in a network. First, *school leadership* plays an important role in enabling the use of research

[3] Diverse networks here refer to networks in which an actor generally has many non-redundant contacts, two actors are rarely connected to the exact same nodes and the network is rich in structural holes (Aral and van Alstyne, 2011[170]).

and data among teachers (Schildkamp, Smit and Blossing, 2017[171]). Formal leaders have the power to provide resources such as time or access to facilities. They can also encourage and support teachers, for example by acknowledging the importance of their work and efforts of mobilising knowledge (Schildkamp, Smit and Blossing, 2017[171]). As part of the leadership culture of a school, a clear vision, norms and goals related to the use of research and data is important to facilitate their use among teachers (Schildkamp, Smit and Blossing, 2017[171]).

Second*, school climate*, and in particular, *trust* matters. For example Brown, Daly and Liou (2016[163]) showed that teachers who report a positive school climate regarding learning, experimentation and valuing new ideas, also report more use of research and evidence. This means that a school focused on organisational learning will be more able to integrate research evidence in teaching practice. The same holds for trust: higher levels of perceived trust in the school are associated with higher levels of research use (idem.).

Third, *training and support* directed specifically at the use of research is important. Some studies showed that coaches can support the use of data by transmitting specific expertise, modelling behaviours and supporting teachers in the process (Schildkamp, Smit and Blossing, 2017[171]).

Finally, where the interactions take place is an interesting question with the increasing use of online *spaces for networking*. In general, social ties on the internet mirror real-world situations. For example, people occupy similar positions in real-world and online networks (Yeh and Luo, 2001[172]). A study looking at how parallel real-world and virtual interactions played a role in a research collaboration of teachers found that online collaboration both extended and complemented weak collaborations in the real world. Online interactions can overcome the constraints of time and space by expanding the breadth of interaction and dissemination (Lin et al., 2016[173]).

The above review of social network research demonstrates the relevance of this approach to studying the dynamics of teachers' knowledge. Research has consistently shown that the extent to which knowledge permeates a network such as teachers in a school or the professional teaching community as a whole, is shared and used across the members depends largely on the network characteristics (Baker-Doyle and Yoon, 2011[159]). A mapping of the existing network characteristics, such as who the central actors are, what the cliques are, how ties are formed, where ties lack, etc. can usefully inform such efforts. Vice versa, network characteristics can change as a result of explicit attention and effort (Coburn, Choi and Mata, 2010[165]; Hubers et al., 2017[174]).

Relevance and limitations of social network theory

Overall, social network theory offers a relevant and valuable approach to understanding how the social context of teachers influences their knowledge and learning. However, focusing purely on social relationships runs the risk of neglecting the impact of the material world that surrounds individuals and in which their social processes are embedded (Fenwick, Edwards and Sawchuck, 2012[175]). For example, in online social networks, the way members interact with technology can potentially influence the formation,

structure and evolution of their social networks (Schlager and Fusco, 2003[140]). Schlager and Fungo mention several examples:

- Administrative control structures in some online systems may encourage top-down, hierarchical communication, which inhibits members to form groups based on shared interests and needs.
- Gatekeeping policies and security mechanisms can exclude outsiders from participating e.g. by blocking access from outside the school or district server.
- Chat and discussion board technologies mediate communication between members and may influence the nature of knowledge sharing, as well as tie formation (Schlager and Fusco, 2003[140]).

Investigating the use and impact of technology is a main object of study in the work organisational literature. Orlikowski and Scott, are among the first not to treat technology as a separate entity, but as integral part of "emergent and dynamic socio-material configurations that constitute contemporary organisational practices" (Orlikowski and Scott, 2008, p. 434[176]). Technology is however not the only element in the material world that influences social processes and outcomes. The way someone engages with a book, a computer or any object for that matter can shape their individual properties (e.g. individual knowledge and practice) as well as their social interactions. Teachers, for example, interact with the environment in which they work: the disposition of their desks in the staff room, the presence or absence of various tools (whiteboard, computers), and so on, all influence their interactions. Therefore, focusing solely on the interactions among human actors is not sufficient to understand their knowledge processes. Socio-material approaches help account for this phenomenon.

2.3.4. Socio-material approaches

Historically, socio-material approaches developed in the field of management and organisational theories drawing heavily on social theories. Following the development of the study of society (sociology) as a science, a debate around whether it is predominantly the social structure or human agency that determines the individual's behaviour emerged among social theorists. The two positions – structure or agency – have been reconciled in most contemporary sociological theories. One of the most dominant theory that balances the two views is Anthony Giddens's *structuration theory*, which proposes an analysis of social systems that is based on both structure and agents without giving primacy to one or the other (Giddens, 1984[177]). In parallel, Pierre Bourdieu developed his *theory of practice* with the concepts field, habitus and capital at its heart (Bourdieu, 1977[178]). This theory posits that each field of the social world (e.g. markets, education) has its agents who interact according to the rules of the field, their "habitus" and capital. Habitus is a dynamic internal structure of an individual that is based on their experience and knowledge appropriated through the act of socialising. The individual agents' actions and interactions – determined by their habitus – will influence their position in the field. The field itself develops into a complex of social relations, the structure of which will, in turn influence the way the agents engage with their everyday practice within them.

Bourdieu's epistemological discussion, in which he takes an applied rationalist stand (Kale-Lostuvali, 2016[179]), is also relevant from the point of view of knowledge creation. He theorises the scientific world as a field, i.e. "a system of objective relations", in which the scientific truth is produced through a competitive process of particular agents. The main stake in this process is the social recognition of the agent's capacity to "speak and act legitimately in scientific matters"[4] (Bourdieu, 1975[180]). Therefore, in his view, the scientific fact as well as the reality it refers to are constructed, and the concept of field helps understand the conditions under which scientific propositions are constructed and validated (Kale-Lostuvali, 2016[179]).

While both Giddens' and Bourdieu's theories were influential in the field of organisational and management sciences, it is Bruno Latour's discussion around knowledge and reality that brings about the socio-material turn. Instead of engaging in the classical epistemological debate around truth and reality, Latour (Latour and Woolgar, 1986[181]) rejects the ontological divide between these (Kale-Lostuvali, 2016[179]). Rather than distinguishing between "science as a social endeavour and reality as a non-social entity", he sees the process of social construction as an assembly involving both human and non-human actors (Kale-Lostuvali, 2016[179]). Following these social theories, a new approach emerged that explores how human and non-human elements are assembled to act as a whole for a specific objective (Carroll, Richardson and Whelan, 2012[182]).

Actor-network theory

Actor-network theory (ANT) is one of the dominant "material-semiotic" approaches – i.e. it maps relations simultaneously between material (things) and semiotic (concepts) – that contributed to the development of socio-materiality. It was developed in the early 1980s by science and technology studies scholars and sociologists, Michel Callon, Bruno Latour, John Law and others. It can be described as a socio-material approach as it looks at how things and people 'act' in networks. ANT uses the term 'actant', that refers to both human agents and non-human elements that exist in networks defined by their relations without which their 'actions' are meaningless or inactive. The object of analysis in this theory is the appearance / emergence of new networks and the collapse of old ones, and learning is an aspect of this process (Fenwick and Nerland, 2014[183]; Fox, 2002[141]).

An example of actor-network given by Fox relates to traffic:

> *"Traffic lights signal 'stop' by turning red, but they do not act to stop the driver; rather the driver acts in accordance with rules and customs upon seeing the signal. It is the network of roads, cars, signals, highway code, and humans that acts, each of these components, human and non-human, acting upon the others." (Fox, 2002, p. 83[141])*

[4] Citation based on the English translation: Bourdieu, Pierre. 1975. The Specificity of the Scientific field and the Social Conditions of the Progress of Reason. Social Science Information 14 (6): 19–47. (page 19)

ANT has contributed to science and technology studies as a systematic approach to explore the context and emergence of scientific and technological achievements and service networks. It helps understanding how social action shapes technology and, vice versa, how technological innovations shape social action (Carroll, Richardson and Whelan, 2012[182]). Later this approach was further developed and applied in the domain of organisational studies, information sciences, health studies, geography, sociology, anthropology, feminist studies and economics. As a method, ANT is inherently qualitative, it takes an analytical and empirical approach to explore patterns of relations, and the ways in which these are assembled in particular locations and contexts (Mulcahy, 2012[184]).

In the socio-material perspective, knowledge and learning are explored as assemblages emerging from a constantly changing configuration or network of socio-material elements. Assemblages can be described as self-organising networks of actors and materialities ("socio-spatial territories"), in which "heterogeneous knowledge practices are enacted" (Blok, 2011, p. 64[185]). For example, as teachers engage in collective inquiry of a certain practice, their learning will be influenced by the environment in which they work. The "assemblage of knowledge and learning" will be determined by the ties formed amongst them, their activities, but also by the objects and arrangements in the staff room (is there a whiteboard, computers and a projector, how the desks are arranged, and so on) and how teachers "interact" with them. It will also depend on whether and how teachers "connect with" resources (such as teaching and learning toolkits, books, videos). Similarly, the way a teacher's knowledge is then enacted in the classroom is influenced by the configurations of the classroom: the ties and relationships with the students, the material environment of the classroom and the way the students and the teacher connect with them. Such processes are also denoted by emergence, indeterminacy, collective and discursive relationships (Mulcahy, 2012[184]).

ANT has also been applied to study education, in particular teachers' professional knowledge. A study by Mulcahy (2012[184]) conducted in Australian schools, for example, addressed the relationship between the development of professional standards for geography teachers and teachers' professional learning. A socio-material account on teacher learning was developed based on data collected through video-recordings, focus groups and interviews. Findings confirmed previous evidence that productive professional learning occurs in the intersection of the human and the nonhuman. As the author argued: "teacher professional learning can, with profit, be conceptualised as a performative knowledge practice constituted and enacted by people and tools in complex collectives or assemblages" (Mulcahy, 2012, p. 133[184]). The study identified a strong representational element of teacher learning, i.e. learning about teaching, rather than directly about teaching practice.

Cultural-historical activity theory

Cultural-historical activity theory (CHAT) is a theory widely used by researchers to understand the relationship between the human mind and activity, and as such, it has been used in socio-material accounts.

CHAT originates in psychology, and was developed by Lev Vygotsky (1978[119]) in the 1920s and early 1930s, and later by his student, Alexei Leontev (1978[186]; 1981[187]). Yrö Engeström, a work and organisational researcher, identified three generations of CHAT (Engeström, 2001[116]). Vygotsky's (first generation) activity theory posits that human behaviour cannot be understood independently of the socio-cultural context in which they are embedded, and the society cannot be understood without the agency of the individuals (Engeström, 2001[116]). Leontyev's (second generation) activity theory added the notion of collective activity, and shifted the focus from the individual to the interrelations between the individual and the community (Engeström, 2001[116]). Engeström himself developed the third generation activity theory, which tackles the issue of cultural diversity with new conceptual tools to understand dialogue, multiple perspectives and networks of activity systems (Engeström, 2001[116]).

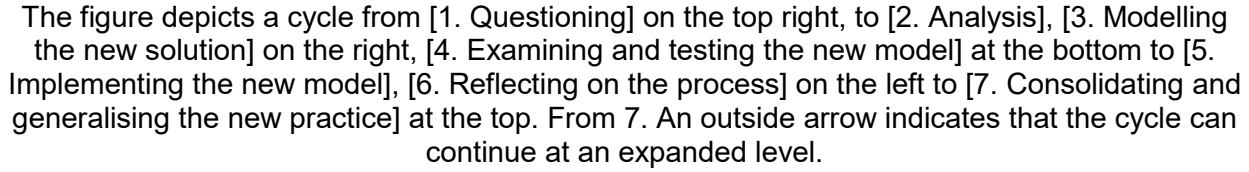
Engeström's activity theory builds on the following key principles:

1. The primary unit of analysis is a collective, artefact-mediated and object-oriented activity system, seen in its network relations to other activity systems.
2. Activity systems are multi-voiced, i.e. a community of participants with multiple points of view, interests, and different positions in the system, creating multiple layers of history in the artefacts, rules and conventions.
3. Activity systems develop and transform over time, and understanding their problems and potentials requires studying their history.
4. Contradictions, i.e. "historically accumulating structural tensions within and between activity systems" are drivers of change and development by generating disturbances, conflicts and innovative attempts. (E.g. the integration of a new element such as a new technology or object in an activity system often leads to a contradiction with some old element.)
5. Activity systems can go through expansive transformations yielding radically new possibilities. (E.g. when some individuals question and deviate from the system's established norms, which results in a collective change effort that reconceptualises the object of activity in a way that it yields radically new possibilities.) (Engeström, 2001[116])

His major concept, "expansive learning", builds heavily on the fifth principle, developing a model for knowledge creation that differs in some fundamental ways from Nonaka and Takeuchi's model (section 0). Engeström questions the seemingly unproblematic nature of knowledge creation in the SECI and some other organisational learning models. In particular, he rejects the assumption underlying these models, according to which the purpose of knowledge creation is management decisions external to local knowledge processes, and these latter are smooth and conflict-free. Engeström contends that there must be a conflictual questioning of existing standard practice in order to trigger a process of knowledge creation (Engeström, 2001[116]). The idea of expansive learning is based on the observation that what people (e.g. teachers) learn, is most often not something fixed and pre-defined. By this, Engeström also rejects an

acquisition- or participation-based conceptualisation of learning, because learning involves not only the construction of new objects and concepts, but also the transformation and creation of culture (Engeström and Sannino, 2010[188]). His expansive learning cycle (Figure 2.6) consists of seven stages, starting with individuals questioning their existing activity, analysing it, then developing a new solution, testing and implementing it, and finally reflecting on the process and consolidating practice (Engeström and Sannino, 2010[188]). The process of transformation and creation of new culture is characterised by horizontal movement and hybridisation, and it leads to the creation of theoretical knowledge and concepts (Engeström and Sannino, 2010[188]).

Figure 2.6. Sequence of learning actions in an expansive learning cycle



Source: (Engeström and Sannino, 2010, p. 8[188]).

Engeström and his colleagues have used a formative intervention method in their research on work-based learning, called the "change laboratory" or "boundary-crossing laboratory", to guide the reflection of members of a workplace community on their activities as teachers, health professionals, librarians, etc. (Engeström, 1994[189]; Engeström, Engeström and Kärkkäinen, 1995[190]; Engeström, Rantavuori and Kerosuo, 2013[191]). Boundary crossing means that practitioners seek out and give help to others from a different organisational, epistemological, professional community. Appropriate tools ("boundary objects") such as forums, knowledge repositories and visual models, as well as discursive methods and activities were shown to be important for successful knowledge dynamics through boundary crossing (Engeström and Sannino, 2010[188]).

2.3.5. Relevance of social theories and aspects of education research

Social and socio-material theories are certainly appropriate for investigating teachers' learning and the evolution of their knowledge as it is embedded in their social and material context. These theories account for the social interactions and their impact on knowledge and learning processes, as well as for interactions between various elements of the system including objects, technologies or even abstract concepts. While work on CoPs, PLCs, social networks and socio-material assemblages have significantly deepened the understanding around teachers' knowledge and learning, a number of issues related to teacher professionalism discussed in Chapter 1 need to be taken into account as well. It is important to complement sociological theories with educational research that can address the specificities of teaching and the educational context.

First, different types and sources of knowledge involved in teaching need to be taken into account. As discussed in the first section of this chapter, teachers can draw on theoretical-scientific knowledge, as well as practical-experiential knowledge. Lieberman (2000[192]) highlights the importance of these knowledge sources that are often heterogeneous in a network that brings together different communities. The ways in which practitioners integrate these different sources and types of knowledge in the process of knowledge creation, is a fundamental element of their knowledge dynamics. Educational research often draws on knowledge creation models developed in management sciences (such as that of Nonaka and Takeuchi) to study and explain these knowledge processes. In the field of practice-based research, Engeström's socio-material approaches (expansive learning model) are also relevant for investigating this.

Second, the different scales of knowledge processes must be acknowledged and incorporated in the investigation. Social and socio-material studies often focus on a bounded community or network. Knowledge creation is usually examined locally both in management and organisational, and in sociological studies. However, teachers' knowledge processes take place at and across different social levels. Global and local knowledge bases interact with each other as different actors in the education system engage in social processes. The travelling (or scaling) of local knowledge bases is one of the key questions of the teaching profession, and a lot is still not understood in this regard (Enthoven and de Bruijn, 2010[193]). Innovation and knowledge diffusion theories should thus be integrated in the sociological investigation of teachers' knowledge.

2.4. Conclusion

In this chapter, I provided an overview of the various theories and conceptualisations of knowledge and learning, and examined their relevance and limitations for the teaching profession. I would like to underline that the review is not fully comprehensive in that it could not present the vast amount of literature each of these theories have provided. Rather, the aim was to summarise the most influential approaches that have been applied for educational investigations along with some of their key questions, findings and critiques.

In addition, while this review discussed psychological, management and social theories separately, building on the unique epistemology of each of these disciplines, it is important to recognise that this is a somewhat artificial distinction. The review has demonstrated that the various disciplines often strongly draw on each other. For example, organisational learning theories discussed in the management approaches section heavily draw on situated learning theories and the CoP literature. Some of the social theories themselves, including socio-material approaches emerged from social psychology.

I have shown that social and socio-material approaches are highly relevant for investigating the key questions this thesis asks about the dynamics of teachers' knowledge in their social environment. Nevertheless, as pointed out above, the educational context has some specificities, which require a strategic integration of certain theories and methods of other disciplines. In the next chapter, I will focus on

these specificities and examine three paradigms of education research and policy, which emerged from reflections on teacher professionalism and which are fundamental aspects of teachers' knowledge and learning.

Chapter 3. Evidence, innovation and networks: Three influential paradigms for teachers' knowledge

The first two chapters discussed the context for teachers' knowledge (profession-professionalism) and reviewed the development of conceptualisations and models of knowledge and learning. In this chapter[5], I will describe three major and strongly interrelated paradigms that have had a substantial impact on teachers' social environment and practice over the past two decades: evidence, innovation and networks. I will provide a short overview of the research underlying the three paradigms, show how they manifest in policy, and discuss the main implications for practice. To describe the emergence of each paradigm, I will review literature on the development of concepts and the models capturing them. I will also highlight some key debates or findings emerging from education research. To illustrate the ways in which they have impacted education policies, I draw on OECD reports and national policy documents. Policy uptake is exemplified through a number of examples from various countries, including France in each case to contextualise the empirical part of this thesis. Lastly, to understand what evidence-, innovation- and network-related policies imply for teachers' social practice and environment, I examine the OECD's discourse related to the three paradigms. I draw on critical policy analysis to reveal inconsistencies between policy discourses and policy measures (programmes) (Diem et al., 2014[194]).

3.1. Paradigm 1: Evidence-based practice

A dominant issue that emerged from reflections on professions and the professionalisation of teaching is that of evidence-based practice. Following the relative consensus of the attributional approaches in the professionalism literature that teaching is a semi-profession because it lacks a systematic knowledge base, it is Hargreaves' seminal lecture in 1996 (1996[9]) that set the grounds for the research-based profession paradigm, which subsequently had a large influence on policy. In the following sections, I review the development of this paradigm in education research and its manifestation in policy.

[5] This chapter draws on my work published as a Working Paper: (Révai, 2020[51]).

3.1.1. Emergence of the evidence-based practice paradigm

The core idea from the profession-professionalism literature – the lack of a systematic and robust knowledge base that can consistently constitute the scientific basis of teaching practice – married well with performative policy agendas. The assumption that research has the potential to increase the quality of teaching practice and thus to enhance student learning, has become dominant in both education research and policy. In line with this, strengthening the link between research and practice has become to be seen as a fundamental lever in realising the promise of the evidence-based model (Levin, 2011[195]; OECD, 2000[78]; OECD, 2007[196]; Dumont, Istance and Benavides, 2010[197]).

The evidence-based model has implications for both the research agenda and researchers, and practitioners. First, education research should be producing evidence for practice, with a rigorous methodology and in a cumulative manner (Goldacre, 2013[10]; Hargreaves, 1996[9]). Second, teachers as professional practitioners should be accessing and integrating this accumulating evidence continuously through initial training and professional development. Subsequent discussions, investigations and policy initiatives have therefore been focusing on two key elements:

1. What is "good evidence" and how can we produce it?
2. How can we facilitate knowledge mobilisation, i.e. teachers taking up research?

The two questions are strongly interrelated, as knowledge mobilisation will depend on the type of evidence accepted, and the production of knowledge may also be intertwined with mobilisation.

What is evidence and how can we produce it?

The term evidence refers to "the available body of facts or information indicating whether a belief or proposition is true or valid" according to the Oxford English Dictionary[6]. The nature and source of evidence has however been largely debated (Nutley, Walter and Davies, 2007[198]; OECD, 2007[196]; Nutley et al., 2010[199]).

The main object of this debate is what should be considered as high quality evidence. A hierarchy of evidence based on its quality was established in the health sector by Glover and colleagues. According to the Glover hierarchy, systematic reviews and evidence syntheses represent the highest level, followed by randomised control trials (RCT), then cohort studies, case studies and eventually expert opinion is the lowest (Glover et al., 2006[200]). Considering RCTs as the golden standard has also been advocated in education (Goldacre, 2013[10]). In medical research, RCTs are used to establish evidence on what treatment works. Using the analogy between teaching and the medical profession, advocates of RCTs argue that the same kind of "what works" evidence can be established for education.

The "what works" movement in education led to the reformulation of research agendas, and the foundation of organisations, which were supposed to produce and disseminate this evidence. In the United

[6] https://en.oxforddictionaries.com/definition/evidence

States, the No Child Left Behind education policy act defined a set of narrow criteria for conducting educational research based on the above principles (Cochran-Smith and Lytle, 2006[201]). The What Works Clearinghouse founded in 2002 within the U.S. Department of Education is an actively functioning organisation to date (Institute of Education Sciences, 2019[202]). Perhaps the most well-known body of evidence produced specifically for teaching practice and schools is John Hattie's effectiveness meta-analysis the "Visible Learning" (Hattie, 2008[203]). Hattie reviews evidence on 138 different practices and identifies those that have large effects on learning. Since the first volume, several more have been published. Meta-analysis is considered as the most robust way of synthesising evidence on "what works". The Best Evidence Synthesis in New Zealand and the Teaching and Learning Toolkit in England are similar efforts (Education Endowment Foundation, n.d.[204]).

The instrumentalist approach of the "what works" movement has been widely criticised by educationalists, sociologists, and organisational and management science economists. One set of critiques pointed to the narrow interpretation of evidence and the problematic nature of applying the medical evidence hierarchy in education. Hiebert, Gallimore and Stigler propose to turn the question around completely, and instead of researchers producing evidence for practice in isolated academic communities, get practitioners systematically accumulate knowledge gained from their practice and make it available (Hiebert, Gallimore and Stigler, 2002[205]). Reorienting educational research towards applied, practice-based forms such as action research became a popular alternative to RCT-based evidence.

What applied or practice-based research actually means has however been debated among educationalists (Furlong and Oancea, 2005[206]). An influential conceptualisation is based on Stokes's notion of Pasteur's quadrant. Stokes (1997[207]) characterises research according to its use and purpose (Figure 3.1). Some proponents of applied educational research use Stokes' Pasteur's quadrant, "use-inspired basic research", as a way to define this type of research. However, Furlong and Oancea argue that defining applied research purely by its aim ignores important questions such as how far research is from application, or how it is managed in terms of autonomy and accountability of research partners (Furlong and Oancea, 2005[206]).

Figure 3.1. Quadrant model of scientific research proposed by Stokes

The figure shows a square divided into four subsquares with main label: [Research is inspired by:]. The horizontal axis represents [Considerations of Use?] with [No] on the left, [Yes] on the right.
The vertical axis represents [Quest for fundamental understanding?] with [No] at the bottom and [Yes] at the top.
Top left: [Pure basic research (Bohr)] – [Yes] for Quest and [No] for Use.
Top right: [Use-insipred basic research (Pasteur)] – [Yes] for Quest and [Yes] for Use.
Bottom right: [Pure applied research (Edison)] – [No] for Quest and [Yes] for Use.
Bottom left: empty square

Source: (Stokes, 1997[207]).

Another conceptualisation originates from the sociology of sciences, Gibbons and colleagues (1994[208]) define Mode 2 knowledge production as opposed to Mode 1. The latter is founded on discrete scientific disciplines, whereas the former refers to multidisciplinary knowledge production, in which a research team seeks to address a context-specific problem. Mode 2 is thus applied research, but as Furlong and Oancea (2005[206]) emphasise, it is not just the purpose, which is different, but also the way knowledge is produced across disciplinary and institutional boundaries. Research and practice are integrated activities that mutually influence and inform each other in this model (Furlong and Oancea, 2005[206]).

Numerous scholars of management sciences have also suggested more inclusive conceptualisations of evidence. Nutley, Powell and Davies (2013[209]) argue that the type and quality of evidence depends on the question, which is not necessarily an instrumentalist view of "what works". For example, practitioners and decision-makers could be interested in why, when and for whom something works, how much it costs, what the risks are. They may also wish to understand the nature of social problems, why they occur, and which groups and individuals are most at risk. The authors suggest that mapping what kind of evidence can answer what kind of question is more useful than defining a hierarchy of evidence types independent of the question. For example, there are a number of questions, such as "how does it work" and "does it matter", that qualitative research can answer, whereas RCT evidence cannot (Petticrew and Roberts, 2003[210]). Therefore, insights from systematic reflection of practices or case studies also constitute evidence that can inform practice (Epstein, 2009[211]). Such more inclusive conceptualisations have been endorsed by international organisations, such as the OECD (OECD, 2007[196]).

Critiques of the evidence-based paradigm

Many critics raised voices against the term "evidence-based", pointing to the difficulty of directly applying de-contextualised evidence in actual classroom situations. As a result, the term evidence-informed, rather than evidence-based, practice gained popularity. Sharples defines evidence informed practice as "integrating professional expertise with the best external evidence from research to improve the quality of practice" (Sharples, 2013, p. 7[212]).

However, this softening of the term did not satisfy most critics. The evidence-based practice paradigm and its implications and implementations opened up a strong debate around teacher professionalism, with a key focus on understanding what this means with regard to teachers' knowledge and teaching practice.

The most prominent critiques of evidence-informed practice criticise the "what works" perspective, and the view that "what works" evidence can be put to practice directly. Gert Biesta, Dutch educationalist, in his renowned papers "What works won't work" (Biesta, 2007[12]; 2010[213]), argues that the evidence-based (or –informed) paradigm is built on a narrow and technical view of the effectiveness of education, in which students' academic achievement is the only goal. He points to the complexity of

educational goals and values (which can include social and emotional development, and other factors) which are difficult, if not impossible to account for in the "what works" paradigm. Biesta also draws the attention to the complexity of evidence use, arguing that this is not a direct and linear process, but involves the teachers' professional judgement, which depends on a number of situational factors (interactions between the students, the class and the wider context) (Biesta, 2007[12]; 2010[213]; 2015[214]). Similarly, Hammersley (2005[13]), argues that professional decision-making is complex and cannot just be based on external established evidence, but also involves judgement and values. He also points to the fact that researchers and practitioners value different types of knowledge.

Cain (2015[215]) summarises some of the major concerns of critics of this paradigm in his review as follows:

1. *Research findings cannot be converted into recipes for practice.* Education is a more complex endeavour than research: research findings are by nature narrowly focused, they need to be linked to other findings and contexts, and integrated into a coherent educational theory in Dewey's (1929[216]) sense of the term. Research evidence based on experimentation (such as RCTs) can only show what has happened in the past, not what might happen in the future (Biesta, 2010[213]).
2. *Educational means and ends are inter-dependent.* Selecting the most effective means, such as a particular teaching method, depends on the purpose, which in turn can be complex and multiple (Biesta, 2007[12]; 2010[213]). "What works" type of research findings tend to have a narrow understanding of the purpose, in terms of academic achievement and learning gain.
3. *Educational practice is inherently value-based*. Practitioners must rely on their own experience and judgement, informed by their own values, to make decisions as teachers (Hammersley, 2005[13]). Viewing education as a purely technical matter of achieving an aim underrates the importance of values. Therefore, "what works" research is not an appropriate basis for educational practice, which is fundamentally moral, not simply technical (Biesta, 2007[12]).
4. *Research knowledge and teachers' knowledge differ by nature*. What researchers and what practitioners consider to be well-founded knowledge is very different (Hammersley, 2005[13]). Research knowledge is generalised, propositional, impersonal, abstract and theoretical; it is evaluated for its clarity, coherence and validity; it is narrowly focused and generated by rigorous and rational thinking. On the other hand, teaching is personal in nature, and teachers' pedagogical knowledge is context-specific, propositional and practical; its application is focused on complex, multidimensional and unpredictable situations (McIntyre, 2005[217]).

The various criticisms of the evidence-informed practice paradigm led to a wide support for actually discrediting the relevance of educational research to practice even within the educational research community itself (Winch, Oancea and Orchard, 2015[61]). Philosophical investigations have even been questioning the concept of educational theory. Carr goes as far as suggesting that this concept should be abandoned because there is no absolute context-independent truth that could be the foundation of

teaching practice, as both education research and teaching are historically-informed context-dependent practices (Carr, 2006[64]). Some, like Hammersley, consider educational research as a valid body of disciplinary knowledge, but refute its direct relevance for practice (Hammersley, 2008[218]).

Recent development in the evidence-informed paradigm and knowledge mobilisation

Since the first critiques, a number of scholars contributed to understanding what we mean by using evidence, or "evidence-informed practice" in more subtle ways. Nutley, Powell and Davies recognise that research and other sources of evidence are often not used directly, but they shape attitudes and ways of thinking in indirect and subtle ways (Nutley, Powell and Davies, 2013[209]). This is sometimes called the enlightenment effect of research.

Kvernbekk (2011[219]) points to a lack of profound conceptualisation of evidence in educational research, and provides an analysis of the concept using philosophical literature. Through this analysis, she demonstrates that the critics' interpretation of "evidence-based" is misguided. Evidence in the philosophy of sciences is anything – facts, data, propositions, narratives, etc. – that stands in relation to a hypothesis, and is certainly not just RCT. Kvernbekk thus argues that the main function of evidence is support (Kvernbekk, 2011[219]). By examining the process of teachers' decision-making in-depth and the role of evidence in that, the author points out that evidence is used indirectly, as "backing" to justify the warrant for a decision. In this sense, evidence does not by any means replace professional judgement, nor does it prevent a value-based decision (Kvernbekk, 2015[220]).

Winch, Oancea and Orchard (2015[61]) also reason for building a positive relationship between education research and practice. Similarly to Kvernbekk, the authors view research as an important contribution to teachers' "technical knowledge", which provides support for decision-making. Teachers' engagement with and in research enrich their reflection on practice, while the authors also highlight the inverse effect: teachers' reflection on their practice helps them interpret research and enhances research itself (Winch, Oancea and Orchard, 2015[61]). Importantly, Winch and colleagues position themselves in opposition with Carr, arguing for the legitimacy of educational theory, in particular "in enabling teachers to discriminate autonomously between good sense and commonsense" (2015, p. 213[61]).

In sum, we can distinguish three main branches among educationalists, or rather three types of attitudes towards evidence-based or evidence-informed practice. First, "hard-core proponents" of evidence-based practice, who believe in the primacy of RCTs, in the possibility of its direct application in teaching practice, and in the irrefutably positive impact of such kind of evidence on teaching and learning. Second, "total sceptics", who reject the relevance of evidence and research for practice, and question the legitimacy of educational theory and research for teachers. And finally, those in the middle (the "golden means"), who adopt a broader and usually more practice-oriented interpretation of education research, and advocate for "research-backed practice", i.e. believe that the way such research shapes teachers' attitudes and decision-making is useful and important for teaching practice. Apart from total sceptics,

education researchers have been interested to explore the processes through which research can support or inform teaching practice.

How can we facilitate knowledge mobilisation?

The ultimate goal in terms of teachers' knowledge in this paradigm is to establish effective mechanisms to disseminate evidence and align teaching practices to this at a large scale. The evidence-based practice model gave rise to a rich field of studies looking into the dynamics of knowledge. These have been described by many different terms: knowledge transfer, dissemination, exchange, knowledge to action, knowledge mobilisation and so on (Levin, 2008[221]). In the following, I will refer to it as knowledge mobilisation.

Ben Levin developed one of the first models. This model captures knowledge mobilisation through three interacting functions of knowledge: its production, use and mediation (Levin, 2013[222]; 2011[195]). Levin acknowledges that these functions are overlapping in terms of actors. For example, those who produce knowledge such as researchers, can also actively mediate their findings towards practice. Similarly, practitioners (teachers) can be involved in both the production and mediation of research. In line with this view, facilitating teachers' engagement in and with research has come to be seen as a major element of successful knowledge mobilisation (Levin, 2011[195]; Gibbons et al., 1994[208]; Cordingley, 2016[223]; Hargreaves, 1996[9]).

While there is disagreement on the relevance and definition of evidence and research, there is a strong consensus among those who believe in the value of research or evidence on the necessity of interpreting knowledge mobilisation more widely. In particular, knowledge mobilisation is not simply about transferring and translating a narrow set of "codes" from one community to the other. Rather, it involves more complex dynamics through which knowledge transforms.

Best and Holmes (2010[11]) identify three models of knowledge mobilisation:

- Linear model – making research available for users, focusing on "getting the right information to the right people in the right format at the right time" as it was previously defined in the health sector (Levin, 2008[221]).
- Relationship model – incorporating linear models but focusing on strengthening the relationship among stakeholders through partnerships and networks to facilitate the link between research and practice. Here knowledge can come from multiple sources (research, theory, policy, practice).
- Systems model – building on linear and relationship models, but recognising that agents are embedded in complex systems, and the whole system needs to be activated to establish connections among its various parts (Best and Holmes, 2010[11]).

In a linear model that focuses on disseminating research evidence to teachers, teachers are seen as passive recipients of knowledge. In both the linear and relationship models, a strong emphasis is placed on mediation, i.e. intermediary actors and processes that bridge the gap between the communities of

research producers and users. Again, a multiplicity of terms and definitions are used sometimes interchangeably, for people who have a specific role in bridging the knowledge gap between communities. These include:

- Translators: “individuals who can frame the interests of one community in terms of another community’s perspective” (Brown and Duguid, 1998, p. 103[224]).
- Brokers: individuals who participate in multiple communities and who facilitate the transfer of knowledge between these (Brown and Duguid, 1998[224]; Haas, 2014[225]).
- Gatekeepers: individuals within one community who collect, understand and interpret external information, and translate and diffuse this information to other members of the community (Haas, 2014[225]) often playing a quality assurance role (OECD, 2007[196]).
- Boundary spanners: individuals who represent the interface between areas (within, at the periphery/boundary of or outside a community/organisation) and make intergroup exchanges possible (Haas, 2014[225]).

The relationship model looks at the research-practice link in terms of the connection between actors. However, it is the systemic view of knowledge mobilisation that best captures its complexity by:

- taking into account the nonlinear, dynamic interactions between a large number of elements
- understanding context and acknowledging that due to the constantly changing nature of external conditions and systems, evidence on the past does not imply evidence about the future
- looking beyond individual cause-and-effect relationships, and focusing rather on emerging patterns
- realising that people in the system both shape and are influenced by the system
- valuing innovation and change, and integrating new knowledge into the system (Best and Holmes, 2010[11]).

Translating this to teachers’ knowledge, Cain (2015[215]) describes three elements of the process of transformation: conceptual development, reflection on cases drawn from personal experience and the diffusion of research knowledge into areas beyond the original research focus. The transformation process therefore involves a dialogue between different knowledge types (McIntyre, 2005[217]), a selection of and critical reflection on relevant findings based on teachers’ values, knowledge of context, as well as an interpretation of research and its applicability.

Understandings of knowledge mobilisation have increasingly moved away from linear interpretations towards interpreting it as a dynamic and iterative process involving social interactions, feedback loops and co-creation (Campbell et al., 2017[226]). In this model, researchers and research evidence are not the unique facilitators of systemic change. Rather, all actors in the system shape the knowledge creation-synthesis-application process through their interactions, collaboration and co-creation (Van De Ven and Johnson, 2006[227]; Van De Ven, 2007[228]). Nevertheless, linear associations often still

dominate the education policy discourse and characterise some of the existing practices (Fenwick and Farrell, 2017[229]). The next section presents examples for the implementation of the evidence-based practice paradigm in education policy.

3.1.2. Policy uptake

The evidence-based agenda has been taken up by national policies as well as international organisations, such as the OECD. The assumption that research could and should increase the quality of teaching practice fit well in the performative policy agendas, which have been focusing on increasing the quality and efficiency of education systems. The "evidence-informed practice agenda" has been the most fiercely taken on board in Anglo-Saxon countries (e.g. in the United States, United Kingdom [England in particular], Australia and New Zealand), which set out to reshape both the education research agenda and professional practice.

In some countries, central governments have been investing considerable efforts in the evidence-based agenda by introducing incentives for teachers to mobilise knowledge produced in research as well as actively participate in producing research (Cain, 2015[215]). Mediating research towards practice – "knowledge brokerage" – has become a major policy focus in countries that put the evidence-informed practice agenda at their forefront. In some countries, educational knowledge brokerage has been institutionalised, most often by governments, through establishing agencies dedicated to such efforts (OECD, 2007[196]).

The OECD publication "Evidence in Education" presents examples for national knowledge brokerage efforts in Canada, Denmark, the Netherlands, New Zealand, the United Kingdom (England), and the United States (OECD, 2007[196]). This work focuses on the use of evidence not only in teaching and school practice, but also in education policy itself. It uses the term "evidence-informed policy" defined as "the conscientious and explicit use of current best evidence in making decisions and choosing between policy options" (OECD, 2007, p. 16[196]). The most investment in strengthening evidence-informed practice was made in the United States and in England.

In the *United States*, the No Child Left Behind Act requires schools and teachers to develop their programmes and teaching methods based on what has been proven "effective" in research. The Act also established funding mechanisms, which re-oriented education research towards producing evidence for practice through experimental studies (mostly RCTs) (Fazekas and Burns, 2012[230]). This programme has been widely criticised for its unintended negative impact on educational achievement and equity (Fazekas and Burns, 2012[230]; Cochran-Smith and Lytle, 2006[201]).

As part of the evidence-based practice agenda, the U.S. Department for Education established the *What Works Clearinghouse* (WWC) knowledge brokerage agency. The WWC's mission – to "provide educators with the information they need to make evidence-based decisions" (Institute of Education Sciences, 2019[202]) – reflects a linear transmission view. The agency reviews research, determines which studies meet rigorous standards, and summarises the findings (Institute of Education Sciences, 2019[202]).

Products of such agencies are based on the idea of "translation", i.e. transforming researchers' knowledge products into products accessible for practitioners. For example, in addition to detailed technical reports, the WWC publishes user-friendly evidence snapshots and practice guides targeted at teachers, administrators and policy makers. This transmission approach assumes that teachers and other actors seek out and mobilise the evidence produced, and little attention is dedicated to establishing direct relationships.

In *England*, an emphasis on bringing together researchers and practitioners is manifest in the Teaching and Learning Research Programme (TLRP) running between 2000 and 2011 (OECD, 2007[196]). The TLRP's six strategic commitments set out various ways and strategies for mobilising knowledge:

- User engagement for relevance and quality.
- Knowledge generation by project teams.
- Knowledge synthesis through thematic activities.
- Knowledge transformation for impact.
- Capacity-building for professional development.
- Partnerships for sustainability (OECD, 2007[196]).

In addition to mobilising existing formal research knowledge, the TLRP also include generating knowledge and transforming it. In fact, an evaluation of the TLRP reveals that partnerships have been a key enabler of impact: projects in which research institutions collaborated with partner schools in co-conducting research or testing findings showed greater impact on teaching practice (Parsons and Burkey, 2011[231]). The TLRP is thus founded upon a relationship model of knowledge mobilisation.

The new generation of the United Kingdom's brokerage effort, the *Education Endowment Foundation / Sutton Trust* (EEF), broadened the scope even further by applying an "evidence ecosystem" model. In this model, the evaluation, synthesis, translation and use of research, as well as innovation are explicitly linked (Gough, Maidment and Sharples, 2018[232]). The activities include synthesising evidence, generating new evidence and supporting schools in using this evidence (EEF, 2019[233]).

While Anglo-Saxon countries are "hard core proponents" of evidence-based practice, many other countries also promote the use of research, although advocate for the softer "research-backed practice" paradigm. For example, the Dutch ministry of education established the *Netherlands Initiative for Education Research* (NRO) in 2012. The NRO coordinates and funds educational research, including research on teaching and learning, schools and the broader education system. It also facilitates connections between research and practice with the aim of contributing to innovation and improvements in education (NRO, 2021[234]).

In *France*, the relevance of research (and in particular cognitive sciences) for teaching practice has been increasingly more recognised and various initiatives promote this. In 2013-2014, a new teacher

education institute is established at all universities offering preparing future teachers[7], and a review recommends to make teacher education more research-oriented. The most recent Education Act that took force in 2019 put research on effective teaching methods more central to teacher education (although disciplinary training and republican values remain the core of teacher education curriculum)[8] (Normand et al., 2019[235]; French Government, 2019[236]; Muller, 2011[237]). To support the implementation of recent educational reforms, cognitive sciences have become a major element in teachers' professional development. Both teacher education institutes and the ministry of education organise conferences and seminars on this topic (Ministère de l'Éducation Nationale, n.d.[238]).

3.1.3. Implications for practice

These policy initiatives create a context in which schools and teachers are expected to regularly access, understand, analyse and interpret research evidence, but also increasingly more to participate in and conduct research themselves. This is well reflected in the OECD's discourse:

> *"In a knowledge society, teachers are also increasingly seen as knowledge professionals, working at the frontline of one of society's most important knowledge creation and transfer systems: education. […] Teachers are expected to process and evaluate new knowledge relevant to their core professional practice and to regularly update their profession's knowledge base. This challenge is situated in a rapidly changing educational system, which is expected to deliver on "21st century skills" in increasingly more diverse classrooms, and conditioned by expanding research-based scientific knowledge base on teaching and learning. This process of continuous renewal of teachers' professional knowledge is an important part, maybe the most important, of teachers' professionalisation. These new demands and opportunities might require teachers to update their teaching methods, employ innovative teaching practices and mobilise various sources of knowledge." [Van Damme in (Guerriero, 2017, p. 3[35])]*

Clearly, the evidence-based practice paradigm implies complex expectations for teachers, schools, and more broadly education systems (including teacher education). These expectations sometimes translate into strong and explicit pressures, other times are expressed more softly.

The Anglo-Saxon policy initiatives presented above constitute explicit hard pressures for the teaching profession. This strong push for teachers to acquire and use theoretical knowledge based on research evidence ("medical-type knowledge base"), is sometimes conflicting with other policies. For example, recent teacher education policies in England have moved towards a "teachers as technicians" (see Chapter 1) view. Teacher training is increasingly based on apprenticeship models by schools. Schools

[7] Les Écoles Supérieures du Professorat et de l'Éducation (ESPE)

[8] To mark this change, the name of teacher education institutes were changed: the ESPE became « Les Instituts Nationaux Supérieurs du Professorat et de l'Éducation (INSPE).

are not prepared for supporting new teachers in acquiring conceptual and theoretical knowledge (Beach and Bagley, 2013[68]).

In this respect, it is also useful to explore the OECD's work and discourses. The promotion of evidence-informed teaching practice has been present in OECD work for long. Most recently, it has represented a relatively hard pressure for countries and indirectly for teachers across the world. The "Innovative Teaching for Effective Learning" project, running between 2013 and 2020, is promoting a learning sciences-based approach for education. The OECD sees (or foresees) the emergence of a new "Science of Learning", an interdisciplinary science that incorporates all sciences that study human learning as their object, including not just pedagogy and educational sciences, but also cognitive psychology, social and behavioural sciences, neuroscience, computer science and engineering (Kuhl et al., 2019[39]). The most recent report "Developing Minds in the Digital Age: Towards a Science of Learning for 21st Century Education" formulates a strong criticism towards education, which also constitutes a clear pressure:

> *In order to realise this ambition, 21st-century education needs to be underpinned by the best available research evidence on human learning and how to improve it. Knowledge is one of the most important raw materials of education; yet education is not particularly good at updating its own scientific knowledge base. A lot of the knowledge at work in education practices and transmitted in teacher education and professional development activities is outdated and sometimes contradicts more recent research. Education seems to be vulnerable to myths and erroneous ideas, born out of romantic ideals, wishful thinking or love for children. Sometimes science tells us something different from what educators wish to hear. Constantly updating its own knowledge base is one of the most needed but also most difficult tasks in moving education forward. In many countries, the mechanisms and practices used to translate and transmit scientific evidence into education policy and practice are missing. [Schleicher in (Kuhl et al., 2019, p. 3[39])]*

The evidence-informed practice paradigm is also strongly present in the OECD's Teacher Knowledge Survey, which sets out to assess teachers' pedagogical knowledge (Sonmark et al., 2017[36]). An international assessment of knowledge builds on the assumption that a universal knowledge base, which all teachers should possess, exists or should exist. An objective assessment of knowledge, in which items are scored on a binary, "correct" or "wrong", basis, certainly suggests a hard approach to evidence-informed practice. However, the study has evolved over the years and the hard evidence approach is now complemented with a softer one that allows for taking into account teachers' professional judgement through situational judgement items. The description of the study also emphasises that the goal is not to assess individual teachers, but rather to draw system-level knowledge profiles (OECD, 2020[82]).

Policy initiatives, such as the Dutch NRO, reflect a softer approach. Earlier CERI work also promoted the use of research softer ways. "The Nature of Learning" volume edited by Dumont, Istance and Benavides brings together research on learning with the objective to "help build the bridges, 'using research to inspire practice'" (Dumont, Istance and Benavides, 2010, p. 14[197]). The volume provides a review of research on various approaches to teaching and learning such as formative assessment, co-operative and inquiry-based learning, the use of technology and outside classroom learning. Research

includes the results of experimental studies but is not limited to these. The publication is the OECD's own knowledge brokerage activity, as it intends to "provide a powerful knowledge base for the design of learning environments for the 21st century" (Dumont, Istance and Benavides, 2010, p. 14[197]). However, rather than promoting a direct application approach, the book draws much softer conclusions on designing learning environments, which leave ample room for implementation for teachers. This soft "research-inspired" approach is also present in CERI's innovation-oriented work strand (Innovative Learning Environments, Innovative Pedagogies for Powerful Learning discussed in section 3.2).

Overall, the OECD explicitly advocates for a "knowledge rich" teaching profession, where knowledge is interpreted in a relatively complex way. Some strands of work emphasise the theoretical-scientific side, i.e. knowledge emerging from a wide variety of academic disciplines – this is more of hard-core form of evidence-informed practice. Other strands of work place a stronger emphasis on the importance of professional judgement, the adaptation of theories to the context, and thus reflect a more nuanced, softer approach. The co-existence of the two approaches can be confusing for policy-makers and practitioners if the link between science and research, and practice is not explained. Yet, to date, no substantial work has been done by the OECD on how that link plays out: how can teachers access and translate that knowledge for practice, what new skills do they need to engage with research, what mechanisms support the reconciliation of practice-based and research knowledge.

In sum, the debate around the relevance and use of research for teachers has led to various "sub-paradigms", such as evidence-based, evidence-informed, research-backed or research-inspired practice. These have been taken up by a number of national policies and have been present in international discourses, which constitute seemingly contradictory pressures for teachers, schools and education systems. Softer approaches see research and evidence use as part of the construction of new knowledge incorporating professional-practical and formal research knowledge. This relates to innovation processes, and brings us to the second the paradigm.

3.2. Paradigm 2: Innovation

With the managerial and performative turn of public services (New Public Management), another issue is penetrating education policy: the "innovation imperative". Generating and scaling innovation have become dominant demands for educational services. As innovation is closely related to knowledge, and specifically to knowledge creation, this policy imperative is an important contextual element for this thesis. To better understand what has shaped the innovation imperative in education, this section traces the development of innovation research and highlights some key implications for education policy and practice.

3.2.1. Emergence of the innovation paradigm

Before going into the development of the concept of innovation, it is useful to clarify two related terms that are often used interchangeably with innovation: reform and change. Cerna (2014[239]) distinguishes the three terms based on definitions, key characteristics and types found in literature.

Reforms typically refer to structured and conscious processes of producing change driven from the top of a system or organisation. Changes, i.e. intended or unintended transformations or alterations, can be central elements of reform, although sometimes reforms result in little or no change at all. Contrary to innovation, reform and change do not necessarily imply the application of new or improved ideas or knowledge. Both innovation and reform can be incremental, radical or systemic, whereas change is usually characterised by its pace (continuous or episodic) and scope (convergent or radical) (Cerna, 2014[239]).

What is innovation?

Expansion of the concept and the focus

The interest in innovation originally emerged in the manufacturing industry sector, and for a long time was focusing on innovation in technologies and products as a way to increase the competitiveness of businesses. Innovation studies find their roots in Joseph Schumpeter's work who more than 100 years ago identified innovation as the main source of economic growth, and was the first to advocate for a scientific investigation of innovation (Fagerberg, Martin and Andersen, 2013[240]). For several decades, innovation studies were primarily the territory of economists, industrial sociologists and psychologists most often exploring technological innovation in firms in the framework of industry-financed projects. Multidisciplinary and more academic approaches to investigating innovation started with the establishment of science and R&D units at universities in the 60s (Fagerberg, Martin and Andersen, 2013[240]). With this, more coordinated efforts to measure innovation began to emerge. The Frascati Manual of the OECD, the first edition of which was developed by Christopher Freeman in 1963 (OECD, 1963[241]), the Charpie Report in the United States and later the several editions of the Oslo Manual (OECD/Eurostat, 2018[242]) aimed at providing frameworks for measuring and monitoring innovation. The evolving definition of innovation of the Oslo Manual is still widely used today:

> *"a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)" (OECD/Eurostat, 2018[242]).*

The focus of innovation studies has broadened over the decades, and in addition to manufacturing industries, increasing attention has been paid to the service sector from the second half of the 1980s. While initial research on service sector innovation was mostly focusing on supply development, from the 2000s, new, service sector-specific perspectives emerged. These include non-technological innovations, a focus on the client (user, customer), and organisational and management issues (Carlborg, Kindström and Kowalkowski, 2014[243]). The new focus on service innovations strengthened the attention on processes, rather than products.

For a long time, public services were of little interest in terms of innovation, mostly because they were not market services, and thus not pressured by competition and costumers, and the political influence and lack of resources were also considered as factors not conducive to innovation (Djellal, Gallouj and

Miles, 2013[114]). Djellal, Gallouj and Miles list a number of arguments for why public sector innovation deserves attention:

- Many governments are determined to use new technologies to improve processes and services for their citizens.
- Several public service sectors, including health, broadcasting, security and defense, have well documented innovation activities.
- Boundaries between public and private services have become blurred with increasing competition in some public domains due to marketisation and partial privatisation processes.
- Economic and societal changes (economic crisis, demographic changes, new societal demands) have led to increasing pressures for innovation (Djellal, Gallouj and Miles, 2013[114]).

Research on innovation in the public sector has grown hugely over the past few decades. In their extensive systematic review of innovation research in the health sector, Greenhalgh and colleagues (2004[57]) identify six categories based on the object of analysis, and provide a typology of 13 different research traditions ranging from rural sociology, marketing and communication studies through to evidence-based medicine, knowledge utilisation and complexity studies (Greenhalgh et al., 2004[57]).

Despite the increasing interest and broadening scopes, to date there is no common theoretical core underlying innovation literature (Lundvall, 2013[244]). Lundvall identifies three main streams in innovation research:

- an evolutionary strand that seeks to create a basis for understanding economic change through studying the drivers and barriers of innovation, and the agents generating innovation
- a techno-economic approach focusing on the conditions for profiting from innovation in industry and other sectors
- a socio-economic theory of innovation that aims at understanding innovation by studying the actors involved and how they interact in the process of innovation (Lundvall, 2013[244]).

In tracing the development of innovation research, Fagerberg, Martin and Andersen note various scales: Schumpeter's early work and the field of entrepreneurship studies focus on individual entrepreneurs; after World War II. the main focus was on studying innovation in large firms, and then increasingly more in firms and other types of organisations of various sizes. In the last few decades, the focus shifted to exploring *innovation systems*, i.e. the environment in which firms are embedded (Fagerberg, Martin and Andersen, 2013[240]). In the systems approach, the object of analysis is the interaction between the different actors (firms and other public and private sector actors), to understand how the knowledge, skills and resources necessary for innovation are distributed, accessed, shared and used (Fagerberg, Martin and Andersen, 2013[240]).

Innovation in education

Innovation in the education sector in a techno-economic approach is seen as a driver for social and economic welfare, and the main purpose of studying innovation is to understand the conditions in which it can be best achieved. This approach is reflected in the 2004 OECD volume "Innovation in the Knowledge Economy: Implications for Education and Learning", which develops a framework for analysing and assessing the innovation capacity, not specifically in education, but more generally in any sector of the economy. The analysis identifies four drivers of innovation: science, users and doers, modular structures and ICTs. The report then discusses the potential impact of the four sources of innovation on the transformation of the education sector. Innovation in education here is explored similarly to manufacturing industries, focusing largely on technologies and technological processes.

The "Measuring Innovation in Education" 2014 and 2019 OECD volumes are also examples of a primarily techno-economic approach. Innovation here is considered effective, or even necessary, to address economic and social challenges, such as demographic pressures, an increasing demand for government services, higher public expectations and decreasing satisfaction with regards to public services, and productivity growth in a context of fiscal constraints (OECD, 2014[245]). However, the four values of innovation in education listed in this volume also reflect strong democratic values such as equity:

- Improving learning outcomes and the quality of education provision. (For example, developing and adopting new school organisations, pedagogies and ICT use can help personalise learning.)
- Enhancing equity in terms of access to education, use of education and learning outcomes.
- Acting a stimulus for a more efficient provision of public services: help minimise costs and maximise value for money.
- Making sure that education remains relevant to societal needs, e.g. by improving results in literacy, numeracy and scientific literacy (OECD, 2014[245]).

The 2014 volume uses two approaches to measure innovation through quantitative data. First, innovation surveys that ask higher education graduates about their employment, and the intensity and type of innovation in their organisation. This data provides an assessment of innovation, comparing types and levels of innovation in education and in other sectors, as well as across sub-sectors of education. Second, teacher and student surveys, which provide data on innovation in education via change as a proxy measure. This second approach, also applied in the 2019 volume, looks at change in classroom and school practices as reported by teachers and students, such as teaching style, assessment practices, use of textbooks, class organisation, use of computers, teacher collaboration and more (OECD, 2014[245]; Vincent-Lancrin et al., 2019[246]). While this work still heavily relies on an economic conceptualisation of innovation (e.g. it uses the definition of the Oslo Manual), it also adapts measuring innovation to education by using specific measures.

Innovation in education has also been explored in a socio-economic perspective in the CERI project “Systemic Innovation in Education”. Systemic innovation was defined as “any kind of dynamic system-wide change that is intended to add value to the educational processes and outcomes” (OECD, 2009[247]). It compares the way education systems go about initiating innovation, the processes involved and the relationship between the main actors, the knowledge base the innovation processes draw on, and the procedures and criteria for assessing progress and outcomes. Building on a number of case studies in various countries, one work strand analyses innovation in vocational education and training (OECD, 2009[247]), another one looks at ICT-based educational innovations (OECD, 2009[248]). The focus on the interaction of actors and knowledge processes is a clear feature of the socio-economic strand of innovation studies described by Lundvall (2013[244]). The systems perspective is taken forward in CERI work on governance (Governing Complex Education Systems), although innovation is no longer the explicit object of study in that project.

Innovation, knowledge and learning in education research

While early research on innovation was focusing on investments in Research and Development (R&D) and the dissemination of scientific knowledge, in the last two decades innovation has been increasingly seen as a function of learning and knowledge creation (Ellström, 2010[249]). The relationship between innovation and learning is also one of the most important topic that Lundvall proposes for future research to focus on, and he considers socio-economic theory the most fit for this purpose (Lundvall, 2013[244]).

Organisational management literature represents a socio-economic perspective, in which knowledge and learning are central to innovation. Nonaka for example, defines innovation as “a process in which the organisation creates and defines problems and then actively develops new knowledge to solve them” (Nonaka, 1994, p. 14[102]). For Nonaka, organisational knowledge creation is a form of innovation itself. Such knowledge-based approaches explore organisational innovation as a function of the existing knowledge base, the organisation’s values and goals in terms of knowledge sharing and creation, its leadership and links with the external environment (boundary-spanning) (Greenhalgh et al., 2004[57]). While most empirical studies in this area still look at intra-organisational processes, the conceptualisation is close to a systems perspective.

In the systems perspective, the unit of analysis changes from the organisation to the broader environment and the relationship between the various agents, organisations and contextual elements. For example, Edquist defines an innovation system as “all important economic, social, political, organisational, institutional and other factors that influence the development, diffusion and use of innovations” (Edquist, 2006, p. 183[250]). While he recognises that this approach is not a formal theory and suffers from conceptual diffuseness, Edquist emphasises the various strengths of looking at innovation in a systems perspective:

- It places innovation and learning processes at the centre of focus.
- It adopts a holistic and interdisciplinary perspective.

- It employs historical and evolutionary perspectives, which makes the notion of optimality irrelevant.
- It emphasises interdependence and non-linearity.
- It can encompass both product and process innovations, as well as subcategories of these types of innovation.
- It emphasises the role of institutions (Edquist, 2006[250]).

In the education sector, the majority of innovation research focuses on top-down reforms and interventions, and only a smaller proportion on local school-level innovations in teaching and learning (Halász and Fazekas, 2016[251]). Moreover, most empirical studies in education explore innovations as they relate to curriculum change, reform implementation or other domains. Halász and Fazekas (2016[251]) identify nine main research areas, which have substantially contributed to understanding innovation in education. These are: Curriculum research; research related to educational change; school effectiveness and school improvement research; research on school management; school leadership and the school as an organisation; disciplinary research; research on educational technology; implementation research; research on teacher behaviour, teacher knowledge and learning; and research on teaching and learning in higher education (Halász and Fazekas, 2016[251]).

Many studies adopted the Oslo Manual's definition to characterise educational innovation, although, in line with the conceptual expansion described above, increasingly more recognise the limits of such a techno-economic conceptualisation in understanding the social nature of public service innovations. Teaching and learning related innovations generally focus on either the innovation itself (as an object or product) or the process of its development. A new or improved practice is considered innovation if it can be linked to improved outcomes, such as better student achievement, more effective development of student competences or increased equity (Kärkkäinen, 2012[252]; OECD, 2013[253]).

A major research area in educational innovation belongs to the practice-based (or work-based) innovation research, which explores innovations emerging from the daily practice of employees, in the case of education, teachers (Melkas and Harmaakorpi, 2012[254]). In this perspective, generating innovation is essentially a problem-solving process, which requires the creation of new knowledge and collaboration, and the focus shifts from a traditional, linear model of innovation to models focusing on non-linear processes (Melkas and Harmaakorpi, 2012[254]). In the education setting, this is typically about trying out new teaching methods and tools, described as teacher-led innovation or teacher-led workplace innovation (Fraser, 2005, Avadhanam and Chand, 2016).

Informal learning in the workplace through experimentation is central to the process of practice-based innovation (Ellström, 2010[249]). Learning theories that are able to explain how innovation occurs through learning are relevant for this approach. For example, Argyris and Schön's (1978[111]) notion of single and double-loop learning distinguish between learning as responding to changes in the environment within a given framework (single-loop) and learning by changing the framework (e.g.

questioning and modifying the core set of organisational norms, assumptions, practices). Engeström's expansive learning theory (see Chapter 2) also emerged from practice-based studies.

In most practice-based models, innovation is rooted in a practical problem or question, and is understood as a problem-solving process directed at improving teaching practice (Paniagua and Istance, 2018[14]; Melkas and Harmaakorpi, 2012[254]). Specific procedures and methods have been developed that engage teachers and schools in an innovation process. These include action research or practitioner research, collaborative enquiry and design-based research. Whether the process of innovation is operationalised through lesson study, action research, enquiry or other mechanisms, teachers integrate various knowledge sources in the process (Earl and Timperley, 2015[255]). They mobilise existing knowledge and facilitate the transfer processes between the tacit and explicit dimensions of knowledge. The innovation cycle (Earl and Timperley, 2015[255]; Engeström and Sannino, 2010[188]) typically includes designing new materials, methods or processes that are then trialled. In this phase, the mobilised knowledge is discussed and negotiated and new knowledge is created. Trialling ideally involves collecting data on the impact such as students' or teachers' perceptions and outcomes. The observations and data analysis again adds to the process of knowledge creation and can lead to a modification of the innovation product or process. The knowledge is then consolidated and can be further generalised. Making this locally created knowledge public and available to those outside the professional community in which it was produced, requires an effort of diffusing this knowledge.

How can we facilitate and spread innovation?

An important body of research in the socio-economic strand explores the diffusion of innovation. Everett Rogers established the theory of diffusion in his seminal book "Diffusion of Innovations" (Rogers, 1962[256]). Diffusion is "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 1962, p. 5[256]). Rogers identified four elements that determine the spread of an innovation: the innovation itself, communication channels, time and the social system. He described five types of actors in the process of adoption: innovators, early adopters, early majority, late majority and laggards (Rogers, 1962[256]). In its early interpretations, diffusion was mostly perceived as a linear process of information transmission from a source to a receiver. Rogers (1962[256]) describes diffusion as a convergence model, in which communication involves creating and sharing information between participants to reach mutual understanding.

The socio-economic research strand and diffusion theory broadened the concept of innovation, incorporating the perspective of adopters and making knowledge a central element. For example, Larson and Dearing define innovation as "anything that potential adopters perceive to be new, inclusive of new ideas and beliefs, explicit and tacit knowledge, processes and protocols, tools and technologies, even value belief systems" (Larson and Dearing, 2008[257]). In this sense, knowledge is also the outcome of innovation created as a result of the innovation process. With this perspective, innovation and knowledge became intimately linked, and studying knowledge processes and innovation were no longer separable.

In the domain of educational innovations, a lack of diffusion and the often isolated nature of successful educational innovations is often perceived as a major challenge (Looi and Woon Teh, 2015[258]). The concept of scaling incorporates two aspects of diffusion: a quantitative change, i.e. an increased number of schools using the innovation, and a qualitative change, which occurs in the diffusion process (Cohen and Loewenberg Ball, 2006[259]). This qualitative change is one of the difficulties in managing the process of diffusion (Looi and Woon Teh, 2015[258]).

Recent theories integrate the product and process aspects of innovation and interpret innovations as complex systems, paying particular attention to how "innovation patterns" emerge from the complex interactions of the different agents (Van de Ven, Angle and Poole, 2000[260]). These theories are also able to account for dimensions of space and time in innovation processes. For example, the way similar innovations can emerge at different places at the same time, can merge into new ones and change over time.

3.2.2. Policy uptake

As research on public sector innovation grew over the last few decades, so did policy interest increase. To the extent that it quickly became an "innovation imperative" in the policy context, which is reflected both in national policy discourses and in international organisation's work since the early 2000s. National innovation strategies in Australia, Finland, the Netherlands, Norway and the United Kingdom, all encourage and dedicate resources to more innovation in the public sector (OECD, 2014[245]). In the background report for the 2015 ISTP, encouraging innovation to create 21st century learning environments is one of the three main aspects of successful education systems (Schleicher, 2015[261]). In the 2016 report for the same event, the OECD views innovation as becoming integral to the teaching profession as a response to the complex challenges that societal changes imply (Schleicher, 2016[3]).

Many countries have a global innovation strategy of which education or investment in education and R&D is part. Some examples from the 2019 OECD Education Policy Outlook are:

- Austria created an overall fund of EUR 1 billion dedicated to education projects such as establishing a foundation for innovation and research in education.
- Germany introduced a "Pact for Research and Innovation of the federal government and the Länder" in 2005, which was renewed in 2014.
- Belgium introduced a "Decree on Educational and Administrative Innovations in Public Education" in 2010.
- Ireland has a more overarching strategy for innovation (Innovation 2020 Strategy) (OECD, 2019[262]).

Several countries also established dedicated bodies to facilitate innovation in schools. In France, intensifying pedagogical innovation has been an important mission of the ministry of education since the 90s, reflected in various bodies and councils created within the ministry over the years. A new Education

Act (Law for Orientation and Programme for the Future of School) introduced in 2005, proposed a framework for Academies (regional education authorities in France) to stimulate creativity and support innovative approaches (French Government, 2005[263]). A new Department for Research and Development, Innovation and Experimentation (DRDIE) was established within the Ministry of Education to build partnerships with research teams and to disseminate international research and experiences to actors in the education system. In addition, the DRDIE established and was running a network of Academic Advisers for Research and Development, Innovation and Experimentation (Conseillers académiques recherche-développement, innovation et expérimentation – CARDIE) within the regional authorities (Archives Nationales France, 2013[264]). The CARDIE's mission is to support educational innovation in the field, as well as monitor and coordinate innovations and experiments in schools. The CARDIE at the regional level and the DRDIE at the national level also act as catalysers for diffusion by offering meetings, seminars and innovation forums in order to promote the exchange of experience and practices.

Since their conception, the CARDIEs have evolved from a set of territorial advisors towards a strategic positioning (MEN-DGESCO-DRDIE, 2017[265]). In several Academies, the acronym changed from counsellors to centre or cell. While local (territorial) needs remained at the heart of their work, they have developed stronger governance structures to be able to provide organised support for schools. The ministry (Department for Research and Development, Innovation and Experimentation – DRDIE) was giving overall support to strengthen regional strategies by capacity building and developing platforms for communication and knowledge sharing (the virtual platform ViaEduc, later RESPIRE, the Expérithèque application). A system for monitoring and evaluating activities (Cardie Mirror) was also put in place. In parallel, bottom-up processes through sharing knowledge created at the local level were enhancing the national system (MEN-DGESCO-DRDIE, 2017[265]).

In England, innovation policies have long been framed in school improvement strategies. In the past ten years, this manifests in the British government's "self-improving school-led system" (SSIS) agenda. SSIS creates clusters of schools as structures, promotes local solutions and co-construction as two cultural elements, and puts in place system leaders as central actors for realising the agenda (Hargreaves, 2010[266]). The 2012 model for SSIS features "disciplined innovation" as one of the main strands of the "collaborative capital" dimension of SSIS. Partnerships are seen as key to facilitating evaluation and innovation across schools in this model (see more in section 3.2) (Hargreaves, 2012[267]).

While these are examples for global innovation policies, many of the educational innovation policies relate to specific areas, such as digitalisation or curriculum reform. For example, as part of the Austrian digital education strategy, an innovation package aims not only to provide broadband to schools, but also to support innovative projects in schools. In 2018, Austria introduced a "New Master Plan for Digitalisation in Education" in 2018, which extends to teaching and education content, professional development of teachers; and infrastructure and school administration (OECD, 2019[262]). In Portugal, stimulating innovation at the school level is part of several recent education reforms, such as the Profile of Students at the end of Compulsory Schooling (2017) and the National Programme for the Promotion of

School Success (PNPSE) (2016) (OECD, 2019[262]). Similarly, supporting innovative teaching methods and developing teachers' related competences are integral parts of Hungary's Strategy for Digitalising Education adopted in 2016 (Hungarian Government, 2016[268]).

Despite the frequent appearance of innovation in education policies, one key recommendation of the 2019 Education Policy Outlook is that policies should shift toward inspiring and enabling innovation (OECD, 2019[262]). This foresees an even stronger pressure on teachers and schools in this regard in the future.

3.2.3. Implications for practice

The innovation imperative creates pressures for teachers to continually question their daily routine, experiment with new ideas, and share these within their school as well as across schools. It also translates into expectations for schools to create the conditions for innovation. However, there are a number of internal tensions within education policies, which result in controversial expectations for educational actors.

Professional autonomy versus central control for innovation

The first tension is between autonomy and central control. A socio-economic and systems perspective of innovation implies that significant professional autonomy is required to engage in educational innovation. Because innovation in this sense involves experimentation, risks, and trial and error, teachers' and schools' social context needs to be trust-based.

A clear tendency to decentralise education systems can be observed in most countries over the past few decades (Burns and Köster, 2016[45]). Decentralisation has allowed local authorities and schools greater autonomy to respond to local challenges and needs. CERI's studies on education governance have shown that this has not just meant devolving power to regional and local levels, but has also reshaped relationships between the different levels. Hierarchical relationships have shifted towards increasing horizontality, mutual independence and self-regulation (Burns and Köster, 2016[45]). Decentralisation was in many countries accompanied by increasing accountability, holding local authorities and schools accountable for educational achievement through performance indicators. The OECD underlines that strong accountability systems need to be carefully designed to allow for innovation. Evaluation and assessment systems have to be balanced with room for risk-taking and potential failure involved in innovation (Burns and Köster, 2016[45]).

Critical policy analysis however suggests that the authority many governments have retained through softer forms of governance (or meta-governance) has resulted for schools and school leaders in an illusion of autonomy and self-governance. The reality of practice is increased pressures to achieve set targets and a loss of support (Greany and Higham, 2018[269]; Ball, 2017[270]). Taking the example of the SSIS agenda in England, an empirical investigation shows that achieving the balance between accountability and innovation is not straightforward (Greany and Higham, 2018[269]). The perception is that increased autonomy for schools have been counter-balanced with stronger accountability, which

eventually allowed the state not only to continue to steer the system, but also to intervene and force certain changes when it considered necessary (Greany and Higham, 2018[269]).

In Wales, the OECD's study on schools as learning organisations highlighted two areas of weakness: "developing a shared vision centred on the learning of all students" and "establishing a culture of enquiry, innovation and exploration". The study attributed these weaknesses at least partly to the fact that assessment and evaluation practices were driven by accountability demands. These demands are often not favourable for encouraging schools to engage in enquiry, innovation and exploration (OECD, 2018[135]).

The French innovation policy also reflects internal tensions in this respect. While the CARDIEs' principle mission is to support local innovation and experimentation, official documents also consider them as an interface between national policy and schools (Archives Nationales France, 2013[264]). In particular, they are seen as a means to promote the implementation of national and regional policies through their direct contact with schools and teachers. In the empirical work of this thesis, it will therefore be important to examine how this tension manifests in practice.

Innovation as exploration and problem-solving versus innovation as the use of "modern/effective teaching methods"

The second tension is between innovation as exploration and innovation as the use of "modern teaching methods". As demonstrated above, modern conceptualisations view innovation as a problem-solving process, in which teachers (with potentially other actors) identify a local challenge or need and address it by drawing on various knowledge sources and improving or designing a new environment. The idea of innovation as exploration is reflected in, for example, the French CARDIE's mission. However, techno-economic conceptualisations, which measure innovation through the use of a number of normatively defined "innovative" practices still prevail in some policy discourses. This tension manifests also in the OECD's discourse on innovation.

The bulk of OECD work on educational innovation has an understanding of innovation, which is restricted to a particular element of education, such as teaching, pedagogy or curriculum. In much of the work, innovation is not theorised, but is used as a buzzword, sometimes interchangeably with other trendy expressions, such as developing 21st century skills or creativity, or "innovative" is used as a general positive adjective. This is the case for example, in the ISTP reports, which bring together various OECD work to formulate a policy message without clarifying the conceptual basis of these. Expressions such as "innovation and modern learning environments", "reform and innovation", "innovative learning", "innovative partnerships" reflect the nature of these reports (OECD, 2013[271]; Schleicher, 2016[3])]. Behind these policy-oriented syntheses, projects have quite different understandings of innovation as it relates to teaching and learning. Two of the most influential projects are the Innovative Learning Environments series of work conducted in CERI and TALIS. The former represents a bottom-up, process-oriented, problem-solving paradigm, whereas the latter is a prescribed, normative interpretation of innovation.

CERI has a long history in looking at innovation in and across schools marked primarily by a series of projects: Schooling for Tomorrow, Innovative Learning Environments (ILE), Innovative Pedagogies for Powerful Learning (IPPL). The ILE project set out to collect examples for innovative learning environments from around the world, where anything that represented "an intentional departure from the traditional approach of […] general or vocational education in its own context" was considered innovative (OECD, 2013, p. 25[253]). The project thus takes a bottom-up approach, in which innovation is locally defined as a function of the context and judgement. The concept of learning environment, rooted in situated learning theories and practice-based studies (e.g. Lave and Wenger, Engeström reviewed in Chapter 2), is defined as "an eco-system of learning that includes the activity and outcomes of the learning", i.e. both the learning and its context (OECD, 2013, p. 22[253]). The report explicitly states that limiting "innovation to a small set of international universal practices [is…] contrary to the concept of 'learning environment' and to that of 'innovation'" (OECD, 2013, p. 26[253]). The justification given for using this approach is to be able to include any kind of innovation, even those that have not yet been documented. In line with most conceptualisations of innovation, the ILE one also has a normative value aspect. The searched innovations had to be "powerful" by placing learning at the centre and "effective" in realising a set of overarching learning principles that emerged from the Learning Research strand of project (The Nature of Learning report). The effectiveness requirement corresponds thus to research-based innovation.

The two following volumes, "Schooling Redesigned" (OECD, 2015[272]) and "Teachers as Designers of Learning Environments" (Paniagua and Istance, 2018[14]) take the practice-based approach forward. In addition to further describing (collecting, classifying and synthesising) idiosyncratic practices, these volumes also explore the scale of innovation and its diffusion, in particular through networks. A new definition of innovation in teaching appears: "a problem-solving process rooted in teachers' professionalism, a normal response to addressing the daily changes of constantly changing classrooms" (Paniagua and Istance, 2018, p. 13[14]). This definition establishes a conceptual link between innovation and professionalism. Referring to the professionalism literature, this work takes a stand in professionalism as a mix of science, craft and art in opposition to a technician view. Professionals in this sense engage in a design activity which consists of a constant problem-solving process drawing on scientific theories (Paniagua and Istance, 2018[14]). The concept of innovation extends to ways in which certain practices are applied, the actors involved in the process and dissemination approaches.

Promoting an exploration, problem-solving and process-centred view of innovation by education policies, translates into complex expectations for teachers and schools. It requires teachers to dedicate considerable time for reflection on their own practice, and engage in a design activity through cycles of exploration, planning, trial, evaluation and redesign. It also requires them to disseminate innovation through sharing their experience and knowledge, and often to work with teachers from other schools and professionals from other sectors (boundary-crossing). In addition, it requires schools to create the conditions for all this to happen: develop a positive and collegial climate, and shared leadership to allow for teacher-led innovation to flourish. A lack of appropriate resources for schools, in terms of time, human

and financial resources, and insufficient support and capacity building are likely to turn these expectations into social pressures.

Expectations and subsequent pressures can be radically different when innovation follows a more techno-economic approach. In this approach, innovation is often directed to a certain number of more or less prescribed practices.

In TALIS, the concept of innovation is radically different from – almost opposing to – the CERI work presented above. A 2012 TALIS report uses a definition of innovation adapted from Kirkland and Sutch: "…a new idea or a further development of an existing product, process or method that is applied in a specific context with the intention to create a value added" (Vieluf et al., 2012, p. 39[273]). While this definition reflects a relatively broad (although techno-economic) conceptualisation, the report does not follow that route. Instead, it opts for exploring "recent advances" in educational practice as a way to capture innovation in education. Two "practices" are chosen: socio-constructivist teaching and professional learning communities. While the report recognises that evidence on the value added (or effectiveness) of these practices is weak, controversial and context-dependent, the choice is justified by their popularity in national policies:

> *"TALIS does not lend itself to discovering radically new ideas in education, nor is it appropriate for studying the process of innovation. But, in education systems where educational policy advocates socio-constructivist approaches to teaching and professional learning communities as innovation, data from TALIS on profiles regarding these practices can contribute to an implementation check" (Vieluf et al., 2012, p. 41[273]).*

The 2018 TALIS framework (Ainley and Carstens, 2018[274]) presents a somewhat more elaborate background. It shortly reviews three perspectives: innovation in teaching practice, innovation diffusion and innovation in the organisational context. Similarly to the 2012 report, innovation in teaching practice is considered from a policy-trend point of view. It is restricted to practices that develop students' cross-curricular skills, such as creativity and innovation [interestingly, innovation here is mentioned as a skill!], problem solving, critical thinking and digital literacy. Much like in the 2012 report, a random choice is made to look at the integration of digital technologies into current teaching practices, because this topic is "often mentioned in this context". Unlike the 2012 report, there is no discussion on the evidence regarding what teaching practices can foster such skills. Instead, an affective-motivational factor is added to the framework, namely teachers' attitude towards technologies and technological innovativeness.

As part of the second perspective relating to innovation diffusion, the framework integrates a psychological and a sociological angle. Regarding the former, the discussion considers instruments measuring individual teacher characteristics including general innovativeness (e.g. risk-taking, resistance to change, opinion-leading) and related personality traits (e.g. openness and extraversion). As for the sociological angle, collective characteristics, such as the school organisation being an open system, are considered in light of existing instruments measuring these. It is not entirely clear how the third perspective, i.e. whether the school context is open to innovation differs from this sociological angle. School leadership,

school climate and some system characteristics are mentioned here, referring also to professional learning communities identified in the previous report. Based on the discussion, the 2018 framework chooses to capture two indicators: teaching practices (reflecting an individual perspective) and school climate for innovativeness (reflecting an organisational perspective) (Ainley and Carstens, 2018[274]).

While measures of "team innovativeness" and "organisational innovativeness" constructed in TALIS can translate into similar expectations as those of a problem-solving and process-oriented view of innovation, innovation measures constructed on the basis of teaching practices imply very different pressures for teachers and schools. This is well-reflected in the "Measuring Innovation in Education" reports, which measures innovation as change in teaching practices over time as reported by students (Vincent-Lancrin et al., 2019[246]). The report acknowledges that observed change does not necessarily imply that the new practices or the countries where more change has occurred are more innovative. In addition, the report also notes that innovation in this sense is not necessarily improvement. However, similarly to TALIS, it does refer to effectiveness studies (such as meta-analyses) that have proven that the majority of reported practices "work".

Numerous policy studies have demonstrated that OECD rankings are often interpreted by countries without their context (Normand et al., 2019[235]). In the case of Measuring Innovation in Education, this means that the innovation imperative might easily become a "change imperative", and the expectation for teachers is then to use a certain number of evidence-based practices. This conceptualisation therefore shapes teachers' and schools' practices in significantly different ways from the exploration and process-oriented CERI conceptualisation. In fact, the two could be interpreted as conflicting unless they are reconciled in meaningful ways.

The impact of innovation policies focusing on the imperative of change has been demonstrated in various studies. Lortie (1975[275]) noted that the overwhelming amount of schoolwork together with the indeterminacy surrounding teaching hinders teachers' engagement with long-term, deep and reflective innovative change. In the same vein, Hargreaves and Shirley (2009[276]) found that the majority of schools that took part in a national programme for fostering innovation focused on short-term initiatives. The authors conclude that innovation-centred policies resulted in a culture of change based on 'quick wins' rather than in deeply transforming teaching practices. In addition, the result-oriented culture of school improvement developed a form of addiction to such easily implementable strategies. Hargreaves and Shirley describe this phenomenon as 'addictive presentism' referring to teachers' active engagement in "emotionally effervescent exchanges of instant strategies that enhance effectiveness in what already exists rather than reflecting on and reforming what already exists" (Hargreaves and Shirley, 2009, p. 2526[276]). Overall, some forms of innovation policies can be counter-productive, leading to innovation per se, and thus constituting limits for change (Paniagua and Sánchez-Martí, 2018[277]).

In sum, the way innovation is understood largely influences how innovation related education policies shape teachers' practice, knowledge and learning. Understanding innovation as a system implies that innovation does not happen in isolation, rather, it is an interactive and collective process involving a

wide range of actors (OECD, 2009[247]). Relationships, and therefore networks, are central to understanding the generation and the diffusion of innovation. Collaboration among schools, authorities, professional organisations, and businesses allows access to different sources of knowledge, skills and resources, and also creates a space for creative thinking and experimentation (OECD, 2009[247]). This leads us to the third paradigm: networks.

3.3. Paradigm 3: Networks

In recent years, establishing networks has been considered as a collective solution to complex problems across organisational, geographic, professional or sectoral boundaries (Networks Leadership Summit IV, 2009, in: (Popp et al., 2014[278]). A general positive view on networks both as forms of governance and as facilitators of school improvement and innovation at scale has dominated the field of education (and more generally public) policy discourse (Grimaldi, 2009[279]; European Commission, 2017[21]).

3.3.1. Emergence of the network paradigm

The network paradigm is strongly related to the first two paradigms described above. In particular, it is the implication of a systemic understanding of knowledge mobilisation and innovation. Networks are often considered as important drivers of innovation diffusion, or the fundamental "meso-level in innovation scaling" (OECD, 2003[280]; 2013[253]). They are also believed to play a central role in knowledge mobilisation, and as such, can be the facilitators of evidence-informed practice in education. An increasing amount of research has contributed to questioning and deepening the general positive discourse that has surrounded networks in recent years.

What are networks?

While social network theory (presented in Chapter 2) considers networks as an analytical lens, in the network paradigm discussed here, networks are understood as forms of organisations. In this sense, networks can refer to inter-organisational partnerships between schools or professional learning networks of teachers. Studying networks as social forms of organisation finds its theoretical underpinnings in social capital and network theory and some studies use social network analysis as an empirical method. At the same time, they offer a critical understanding of networks as formally established organisations with quantitative and qualitative investigations. For example, analyses of networks explore their governance and effectiveness with the aim of identifying conditions under which they produce certain positive outcomes (such as innovation scaling, knowledge sharing).

There exists numerous definitions and typologies of networks based on the purpose and object of analysis [e.g. (Muijs et al., 2011[52]; Provan and Kenis, 2008[281]; Suarez Estrada, 2017[282])]. Networks of organisations – perhaps the most extensively studied form – are usually defined as three or more autonomous organisations that are working together to achieve a collective goal (Popp et al., 2014[278];

Provan and Kenis, 2008[281]). Hopkins defines networks as "purposeful social entities characterised by a commitment to quality, rigour, and a focus on outcomes. They are also an effective means of supporting innovation in times of change" (OECD, 2003, p. 154[280]). It is important to note that both these definitions have a normative perspective in that they comprise an expected outcome or collective goal.

Drawing on policy studies, psychology and sociology, Muijs and colleagues (Muijs et al., 2011[52]) offer a theoretical background to educational collaboration. They identify three localised theories and three societal theories of collaboration and networks. Localised theories are constructivist organisational theory, social capital theory and social network theory (see Chapter 2 for a detailed discussion), whereas societal theories comprise theories on new social movement, theories that view the basis of collaboration in aiming to avoid "organisational anomie" (using the Durkheimian notion of anomie), and functionalist theories of networking (e.g. Durkheim, Luhmann). Muijs and colleagues note that none of these theories is alone sufficient to explain the phenomenon of networking between organisations, rather, they each shed light on certain phenomena. The authors suggest that this theoretical framework is useful for both empirical research and practical work on education networks (Muijs et al., 2011[52]).

Types of networks in education

Examples in education include networks of individual teachers such as professional learning networks (Brown and Poortman, 2018[20]), online networks (Trust, 2016[283]; Kelly et al., 2015[284]), federations, multi-agency collaboration and networked learning communities (Muijs et al., 2011[52]). De Lima (2010[285]) offers a general and descriptive framework to characterise networks along four dimensions: composition (network of individuals, organisations or a mix of these), substance (goals and relationships), ownership (voluntary or mandated) and structure (size, density, connectedness and centralisation). Similarly to de Lima, Muijs and colleagues (Muijs et al., 2011[52]) also build on network theory concepts to establish a typology of education networks based on the 11 dimensions described in Table 3.1.

Table 3.1. Typology of education networks

Dimension	Description	Types
Goals and activities	Goals: school improvement and learning, or broader scope involving collaboration with other types of organisations; Activities: short-term, medium term or long term timescales	School improvement / Broadening opportunities / Sharing resources
Voluntarism or coercion	Collaboration is voluntary or coerced (at least to one partner) e.g. through government grant, or obligation by local authority	Voluntary / Intermediate / Coercive
Power relations	Relationships are based on equality or domination by one or more partners	Equal / Intermediate / Domination
Network density	Level of engagement of the members of partner organisations: e.g. only school heads engaged in collaboration, or the whole staff of each partner school is engaged	Low / Medium / High density
External involvement	Involvement of organisations other than schools and non-educational organisations	Low / Medium / High external involvement
Time frames	Permanent or very long term networks versus networks established for a specific timeframe (e.g. under a grant)	Short / Medium / Long term
Geographical spread	Local, cross-local, regional, national, international	Proximity / Medium / High

		distance
Density of schools	The number of schools involved and the number of connections between them (both can change over time)	Small / Intermediate / Large
Vertical or horizontal	The extent to which collaboration is within schools (vertical) or between schools (horizontal)	Vertical / Horizontal / Horizontal and vertical networking
Network diffuseness	Composed of a loose collection of actors and shifting memberships or fixed group of actors connected through formal mechanisms	Loosely connected to fixed or formally connected actors
Network formalisation	Relationships and collaboration based on trust and good faith or on formalised agreements and management structures	From informal, flexible, trust-based to defined by formal structures and agreements

Source: Adapted from (Muijs et al., 2011[52]).

Some typologies focus only on particular types of networks. For example, an OECD study of 27 educational innovation networks established the following typology based on the main purpose of such networks.

- *Pedagogical Approach Networks*

Network of schools woven together by a common approach that is made up of a complex set of elements including a philosophy of learning and pedagogy. The approach is often deliberately constructed to rectify certain shortcomings apparent in mainstream schooling. As these networks encourage building coherence around the approach, they work towards developing shareable knowledge. These emerge within a range of variations, while it remains easy to identify the underlying approach. Examples: Art of Learning (Scotland), Lumiar Institute International (Brazil).

- *Innovation Promotion Networks*

The emphasis in these networks is on sharing and discussing diverse innovations that are built around a common pedagogical core. The networks themselves are conceived as "spaces" in which teachers are connected by their desire and experience in innovating, for example within the same subject or in similar contexts. In these networks, there is no specific collective knowledge privileged and shared, rather various knowledge elements come together, are questioned, compared and further developed through such confrontations. Reflection on and evaluation of practices are key in network processes. Teacher forums or conferences are typical mechanisms to facilitate such networks. Examples: OPEDUCA Project (Netherlands/International), Red Escuelas Líderes (Chile).

- *Professional Learning Networks*

Similarly to Innovation Promotion Networks, the main mission is the dissemination and sharing of innovative practices among teachers and schools. However, these are informal networks that developed from a professional development initiative. The specific teacher training programme/initiative relates to a particular pedagogical approach, and the main source of knowledge is originally provided by the leading organisation – typically an external organisation, such as a teacher association, university unit or third sector organisation. The programme is the initial context, in which participating teachers start to develop relationships among each other and their respective schools. Over time, these relationships develop into an informal network, through which teachers can share their experiences and knowledge. Examples: Galileo (Canada), Computing at Schools (United Kingdom) (Paniagua and Istance, 2018[14]).

Impact of networks in education

Networks in education are often viewed as normative structures in national policy documents and by international organisations. For example, England has been promoting school networks through a number of policies for the past few decades (e.g. Networked Learning Communities, Teaching School Alliances) based on the belief that networks will further national educational goals. The European Commission (2017[21]) published "Guiding principles for policy development on the use of networks in school education systems" in 2017. The publication is based on the explicit assumption that networks are important for efficiency, effectiveness and innovation in education (European Commission, 2017[21]). The report defines networks based on the following normative characteristics: having established connections and relationships that maintain the network; "collective intelligence", i.e. members exchange knowledge, skills and resources for the mutual benefit of all, and alliances working towards a particular common or shared goal(s). Networks are thus distinguished from clusters and partnerships that do not necessarily maintain long-term relationship, share resources or have common goals (European Commission, 2017[21]).

In its work on educational innovation, the OECD sees networks' potential in promoting collaboration, linkage and partnerships by being situated at a strategic meso-level between the local (school) level and the national policy level (OECD, 2003[280]; Paniagua and Istance, 2018[14]). Networks are also considered as critical in knowledge transfer through organisational and professional learning (OECD, 2003[280]). Van Aalst in the same publication lists the following advantages of networks in this regard. Networks:

- open access to a variety of sources of information
- offer a broader range of learning opportunities than hierarchical organisations can generally provide
- promise a flexible but also stable base for co-ordinated and interactive learning
- provide mechanisms for creating and accessing tacit knowledge (OECD, 2003[280]).

Although OECD work recognises that networks can be fragile and vary in effectiveness, the normative assumptions are overall not questioned. However, strong evidence on the impact of networks on student learning, teachers and schools are still lacking. Some effort has been dedicated to review existing evidence.

In 2005, the CUREE (2005[286]) conducted a systematic review on the impact of networks, and based on 14 evaluation studies from Australia, the United Kingdom and United States, found that networks can be effective for improving teaching, learning and student attainment. Impact on student engagement, learning and attainment varied: a few studies reported high impact on a number of elements, while others only moderate or low impact. Similarly, networks' impact on teachers varied, although gains in teacher skills, knowledge and understanding were observed in the majority of the studies. These were usually

linked to changes in teachers' behaviour and practices, and positive change was also reported on their attitudes, motivation and confidence. Examples for change in teachers' knowledge include:

- becoming more informed about school policies
- finding novel ways of identifying and addressing students' needs, better understanding the conditions which support student learning
- deepening understanding of content and pedagogy, improving some specific teaching skills
- recognising the importance of professional learning and reflection on practice, learning from colleagues
- developing research skills (e.g. action research) and learning analytical tools to measure the impact of new activities
- developing leadership skills (CUREE, 2005[286]).

The review also identified impact on schools. The benefits included stronger connections with the local community and parents, the development of professional learning communities, improved skills in adapting new ideas, changes in school and classroom organisation, and management structures (CUREE, 2005[286]). However, the review could not reveal how exactly collaboration and networking was influencing school structures and governance processes (Muijs et al., 2011[52]).

Muijs and colleagues (2011[52]) summarise findings on the impact of networks in studies mostly conducted in England. These studies point to impact on school performance, increase in student achievement, improved pedagogical added-value, school climate, staff morale, more opportunities for professional development, increased sharing of leadership (Muijs et al., 2011[52]). While networks seem to have positive impact in a number of dimensions, most studies and reviews underline that the extent of impact can vary considerably. They also point to a number of conditions that are favourable or that hinder networks' effectiveness. This raises the question of what matters for networks to bring about positive change.

How can we facilitate networks' effective functioning?

Interestingly, more studies have been focusing on understanding the conditions under which networks are more effective than their actual impact (Muijs et al., 2011[52]). This is all the more surprising because it is problematic to interpret effectiveness without understanding the desired outcome, i.e. the intended impact. Provan and Kennis define network effectiveness as "the attainment of positive network-level outcomes that could not normally be achieved by individual organisational participants acting independently" (Provan and Kenis, 2008, p. 2[281]).

While there is extensive work that describe and characterise networks, few empirical studies look at their effectiveness in terms of improving teaching and learning. Emerging evidence does however converge towards a certain number of features that effective networks have. The following summary is

based on the systematic review conducted by CUREE (CUREE, 2005[286]), a review of inter-organisational partnerships (Best and Hall, 2006[287]), the review and conclusions of Muijs and colleagues based on a number of case studies on school networks in England (Muijs et al., 2011[52]) and a recent literature review specifically summarising network effectiveness in education by Rincón-Gallardo and Fullan (Rincón-Gallardo and Fullan, 2016[288]). The findings can be grouped by key network characteristics:

Network goals

1. *Having specific shared goals focusing on teaching and learning*

There is consensus that having clear goals is necessary for networks to be more effective. In fact, their effectiveness can only be appropriately evaluated against clearly set goals (CUREE, 2005[286]; Rincón-Gallardo and Fullan, 2016[288]). Studies also suggest that more specific, narrower goals are favourable than broad aims, and that they should target issues that individual schools cannot tackle in isolation (CUREE, 2005[286]). It also seems important that the goals are shared among network members, and that they have a sense of ownership of them. For education networks, these goals should be centred on student learning and teaching, and the network's vision and strategy should be clearly linked to these goals (Rincón-Gallardo and Fullan, 2016[288]; Muijs et al., 2011[52]).

2. *Placing professional learning at the centre*

A shared commitment to professional learning at all levels has been shown to be fundamental for network effectiveness (Muijs et al., 2011[52]). Professional development includes introducing new ideas, bringing in external expertise and building capacity, and through these it is the main vehicle for knowledge transfer in the network (CUREE, 2005[286]).

All studies emphasise the importance of the collaborative nature of professional learning for effectiveness. Collaborative learning allows for a continuous sharing of practice, can increase school capacity, and also strengthens the link between schools (or network partners more generally) (Muijs et al., 2011[52]). Among the various mechanisms that can facilitate collaborative learning, Rincón-Gallardo and Fullan highlight cycles of collaborative inquiry as an effective means of continuously improving teaching practice. These cycles correspond to cycles of innovation described above (in section 3.2): identifying appropriate problems or challenges for the network drawing also on available evidence, designing solutions (changes in practices), testing them, monitoring impact and building evidence of the changes, improving the design based on this evidence, and finally re-starting the process (Rincón-Gallardo and Fullan, 2016[288]).

Muijs and colleagues also emphasise the importance of co-constructing knowledge and new solutions by the network through collaborative learning. Designing own solutions in response to local problems, as opposed to introducing externally designed programmes, makes sure that new practices are properly contextualised. Collaborative learning through co-construction is also stronger than learning an externally imposed content (Muijs et al., 2011[52]).

Network ties

3. *Establishing and maintaining strong and quality relationships based on trust*

The quality of relationships and trust in particular, is a condition for effectiveness highlighted in every network study. Trust is necessary for members to be open about their difficulties, acknowledge sub-optimal performance and lack of knowledge, and be receptive for constructive criticism. Without trusting relationships people cannot engage in challenging conversations and collective learning is limited, if not impossible (Rincón-Gallardo and Fullan, 2016[288]). Brown and Poortman also emphasise the role of the *quantity and quality of relationships* in generating knowledge. They argue that simply working together will not lead to the desired outcomes. Rather, network members need to develop trusting, supportive relationships that allow for risk-taking and making ourselves vulnerable. Reflecting on, questioning and improving practice require the "de-privatisation" of practice (Brown and Poortman, 2018[20]).

Being able to establish strong, trust-based relationships starts with finding the right partners, according to Muijs and colleagues. Proximity is often a basis for partnering up, however, being close is not the best reason for collaboration. For example, in some systems, local schools are in competition with each other, which makes it difficult to establish trust, to share information, data and practice in a transparent manner (Muijs et al., 2011[52]). The next step is creating well-functioning channels for communication (Muijs et al., 2011[52]), which allow for frequent interaction among people and facilitate the engagement of all members (Rincón-Gallardo and Fullan, 2016[288]).

The review of Rincón-Gallardo and Fullan also suggests that high trust without internal accountability may not be enough. Internal accountability refers to a culture in which people in the network hold themselves responsible for their goals and tasks, and how they accomplish them. It helps the group to go beyond their comfort zone and be challenged (Rincón-Gallardo and Fullan, 2016[288]). Establishing strong trusting relationships and internal accountability however takes time, and this has to be acknowledged by leaders.

4. *Involving relevant stakeholders*

Achieving the ultimate goal of education networks – increasing educational excellence and equity – requires engaging students themselves as well as parents who are indispensable partners in their children's learning (CUREE, 2005[286]; Rincón-Gallardo and Fullan, 2016[288]; Muijs et al., 2011[52]). Effective networks tend also to involve the wider community through various actions and initiatives. Again, network leaders, facilitators and brokers play a key role in bringing together partners and stakeholders, and establishing a shared understanding of goals (Muijs et al., 2011[52]).

5. *Drawing on external knowledge and expertise*

Bringing in external expertise is underlined in all studies as an important element in realising network goals. Establishing and maintaining connections with the outside can give access to knowledge and expertise not available within the network (CUREE, 2005[286]; Rincón-Gallardo and Fullan, 2016[288]; Muijs et al., 2011[52]). It can also help disseminating knowledge produced within the network (CUREE,

2005[286]). This requires networks to have the capacity to identify relevant external expertise and exploit opportunities for such kind of support (in Muijs).

External knowledge can not only come from actors or experts outside the network. Network members can make a conscious effort of accessing and interpreting knowledge not formerly available in the network (e.g. evidence related to the specific teaching and learning goals of the network), and applying it for their purposes. The use of evidence can also improve collaborative processes, can help highlight areas of improvement and thus contributes to monitoring progress (Rincón-Gallardo and Fullan, 2016[288]).

Network governance and leadership

6. *Distributed leadership and facilitation*

Distributed leadership has generally been associated with increased network effectiveness. When network members are valued and their contributions to achieving network goals are recognised, they can constructively contribute to leading network activities through taking on various responsibilities (Díaz-Gibson et al., 2017[289]). Such distributed leadership implies greater capacity for leadership within partner organisations and across the network (Muijs et al., 2011[52]). This also appears to work inversely: collaboration enhances leadership capacity and distributed leadership by creating opportunities to lead (Muijs et al., 2011[52]). In effective networks, leadership roles emerge based on competence and expertise in solving a particular problem, rather than being determined by positions in the hierarchical structure (Rincón-Gallardo and Fullan, 2016[288]).

7. *Coordination and governance*

Inter-organisational networks require sustained, engaged leadership with a spirit of facilitation, empowerment and participation, rather than command, control and delegation (Best and Hall, 2006[287]). Nevertheless, networks also need effective coordination structures. Network co-ordination, involving formalised rules, roles and structures with agreed action strategies that enable participation, facilitate knowledge construction and the uptake of innovations (Best and Hall, 2006[287]).

Deliberate leadership is crucial when the network involves multiple communities such as schools, universities, local authorities and businesses, and both formal and informal leaders need to be competent in facilitating collaboration (Rincón-Gallardo and Fullan, 2016[288]). This means being able to identify and maintain a common goal, create alignment and coherence while bringing in diverse views. Involving external evaluators to give feedback on progress can contributes to network effectiveness, when leaders are reflective and willing to learn and adapt their practice (Rincón-Gallardo and Fullan, 2016[288]).

Network capacity

8. *Developing skills to collaborate, facilitate and broker*

Collaboration and effective networking require special skills. The ability to facilitate collaboration is key in initiating and sustaining networks, and ensuring intensive knowledge transfer (CUREE, 2005[286]). Brown and Poortman point to the importance of teachers' and leaders', but also other participating actors',

such as researchers' skills to facilitate professional learning networks (Brown and Poortman, 2018[20]). Sometimes navigating difficult conversations is easier for a third party, and involving an external facilitator can make collaboration more effective. Skilled facilitation means being competent in managing accumulated experiences, able to reflect on one's own learning and guide collaboration based on this (Rincón-Gallardo and Fullan, 2016[288]).

Networks involve different actors often coming from different cultural backgrounds (e.g. from schools with different school cultures) or even different epistemic communities (e.g. teachers and researchers). For effective collaboration, some network members need to be able to "translate" between these actors and communities. Brokering essentially involves connecting different groups and ensuring knowledge flow. Evidence is today clear that brokering requires special competences to initiate and maintain links, and access and transmit knowledge (Muijs et al., 2011[52]). Connection with other communities and actors (within or outside the network) is also important to break down "echo chambers", i.e. groups that keep circulating their shared knowledge and ideas (Rincón-Gallardo and Fullan, 2016[288]).

Network structures and resources

9. *Having adequate resources, both money and time*

Flexible access to funds that ensure smooth operation and sustainability is critical for network effectiveness. Financial resources are necessary for establishing online communication channels, funding face-to-face meetings, accessing and producing materials. Adequate physical resources are also important to promote collaboration, such as facilities to meet. However, effectiveness also depends on sufficient time dedicated for collaboration, i.e. time specifically built into members' schedules (Rincón-Gallardo and Fullan, 2016[288]). This is particularly important in the education setting, because the immediate benefits of networking are not always clear, and the increased workload of school staff, including leadership and teachers, can lead to resentment (Muijs et al., 2011[52]). For example, giving enough time to developing shared goals and understandings, and trusting relationships may not have tangible benefits, but are crucial to make the network work. Schools that are able to find flexible solutions such as rescheduling and use existing resources optimally are more effective in networks (Muijs et al., 2011[52]).

Network context

10. Taking into account the network context

In addition to network members' internal capacity, structures and practices, a number of external factors influence network effectiveness. Understanding and taking into consideration the context of the network is thus critical (Muijs et al., 2011[52]). Muijs and colleagues identify five main external factors in the case of school networks:

- "External help from credible consultants/advisers (from the local authority or elsewhere) who also have the disposition and confidence to learn alongside their school-based partners.
- A willingness and desire among local authority staff to support and engage with the collaborative process, exploring and developing new roles and relationships.
- The presence of incentives that encourage key stakeholders to explore the possibility that collaboration will be in their own interests.
- Suitable motivation for collaboration between partners.
- An accountability system than encourages, rather than discourages, collaboration (Muijs et al., 2011, p. 158[52])".

Policy studies have underlined that the accountability system can create competition and hinder collaboration (Greany and Higham, 2018[269]; Muijs et al., 2011[52]). Internal network hierarchies and power issues can also be detrimental (Greany and Higham, 2018[269]), unless expectations are carefully negotiated and ground rules for decision making are laid out (Best and Hall, 2006[287]).

Clearly, the ten conditions listed above are not independent: some are pre-conditions for others (e.g. strong, trust-based relationships for professional learning) others are mutually linked. Public management studies are useful to better understand the relationship between some of the factors.

In the field of public management a central focus of investigation is the governance of networks, and how that relates to its effectiveness. A major contribution of this field is related to understanding how network governance relates to the characteristics that are generally perceived or shown to be favourable for network effectiveness. Provan and Kennis (2008[281]) identify three types of governance: networks where governance is shared by partner organisations (shared governance), where the network is led by one of the partner organisations (lead organisation network), and where there is a separate body (organisation or entity) set up specifically to lead the network (network administrative organisation). The authors argue that the effectiveness of one or the other form of governance will depend on a certain number of characteristics in the network (see Table 3.2). While they recognise that mandated networks may not have the choice of governance, it is important that decisions about the form of governance are not made randomly. Provan and Kennis propose to examine four factors when selecting the most suitable form of governance.

Table 3.2. Key predictors of effectiveness of network governance forms

Governance Forms	Trust	Number of participants	Goal consensus	Need for network-level competences
Shared governance	High density	Few	High	Low
Lead organisation	Low density, highly centralised	Moderate number	Moderately low	Moderate
Network administrative organisation (NAO)	Moderate density, NAO monitored by members	Moderate to many	Moderately high	High

Source: (Provan and Kenis, 2008, p. 9[281]).

First, different governance forms require different distributions of trust for being effective. High density trust means that trust is widely distributed across members, and this is necessary for shared forms of governance. For lead organisation or NAO governed networks, lower density (i.e. some small groups – dyads or cliques – are based on trust, while others are not) can be sufficient. It is important that trust is centralised for lead organisation governance, because all members have to trust the lead organisation(s).

Second, while the size of the network per se is not a predictor for network effectiveness (CUREE, 2005[286]), it may matter for certain forms of governance. We have seen above that shared governance is generally desirable; this form does not necessarily work for a large number of organisations. Participants may either spend a lot of time to coordinate across many members, or may end up ignoring critical network issues, which makes shared governance inefficient. Evidence suggests that a shared form of governance is most likely to be effective for a network consisting of maximum six to eight organisations. Lead organisation or NAO types of governance are better suited to accommodate a large network because decision making is centralised, and the direct involvement of all organisations in every single decision is not necessary. As NAO-led networks have a unique administrative structure specifically developed for governing the network, this form is likely to be the most suitable for very large networks.

Third, the issue of goal consensus must be nuanced and aligned to the form of governance. It is important to distinguish between organisational and network-level goals. We noted above that a general consensus on network-level goals (in terms of both content and process) can facilitate network members' involvement and commitment to collaborate. However, this does not mean that all the goals of network members must be shared. This can even hinder collaboration for example in a competitive context. While networks may vary in terms of the level of goal consensus, some agreement is necessary for effective collaboration. For networks that share governance across members it is more important to agree on network-level goals so that members can work together, each contributing to the common network goals, while also working towards their own organisational goals. When the level of consensus is lower, lead organisation or NAO governed networks may be better forms of governance. For example, when members are only partially committed to network goals and find it difficult to agree on all main goals, lead organisations can still keep to the broad, network goals.

Fourth, we have cited evidence on the need for specific competences for networking. This however may differ depending of the nature of the task and the external demands. If the types tasks imply that

members are interdependent, there is a greater need for specific competences to facilitate action. Lead organisation, and especially NAO models, which are specifically set up for network governance, and therefore already possess such special competences, may then be more effective forms. In some networks, external demands coming from for example a funder or authority, or external tasks such as lobbying, recruiting new members or securing funding, are high. A lead organisation or a NAO can more easily respond to and manage such external pressures in general. Lead organisations can easily address internal network demands, but may not have the appropriate competences for some external demands. A NAO is the most suitable when the demand for such specific skills are very high (Provan and Kenis, 2008[281]).

3.3.2. Policy uptake

Policies encouraging collaboration and networks have become increasingly more popular. In Anglo-Saxon countries, they often focus on school improvement, building on the principle that schools can learn from one another (Muijs et al., 2011[52]). However, in many countries facilitating partnerships and collaboration between schools and other agencies or organisations have also been gaining traction in policy. The OECD has gathered examples for networks in education from almost its member countries on all continents (OECD, 2003[280]; Paniagua and Istance, 2018[14]). The European Commission brought together a number of examples for education networks from its member countries falling in one of six groups based on their main objectives:

- "international support to policy and practice development
- supporting national policy development and implementation
- developing national and regional structures of governance
- connecting schools for school development
- connecting teachers for professional development; and
- multi-stakeholder networks targeting specific groups of learners" (European Commission, 2017[21]).

To connect to the first and second paradigm, this section presents four selected networks that all aim specifically at scaling evidence and/or innovation in education. Three of these networks emerged from national policy efforts (two are from England, where the network paradigm has perhaps been the strongest, and one from Canada), and one from a supra-national policy effort: that of the European Union. The short descriptions also provide an analysis of the network structures and processes as they relate to teachers' knowledge.

Research School Networks – England (United Kingdom)

The *Education Endowment Foundation / Sutton Trust* (EEF) established as part of England's school improvement policy, has put in place a strategy to generate and synthesise evidence and support

schools in using this (see also section 3.1) (EEF, 2019[233]). This strategy involved establishing the "Research Schools Network" in 2016, a network of schools comprised of 39 schools in 2019 (EEF, 2019[233]). Member schools – appointed through a competitive application process – work with other schools in their region to help them use evidence to inform their teaching through:

- "encouraging schools to make use of evidence-based programmes and practices through regular communication and events
- providing training and professional development for senior leaders and teachers on how to improve classroom practice based on the best available evidence
- supporting schools to develop innovative ways of improving teaching and learning and provide them with the expertise to evaluate their impact" (EEF, 2019[233]).

In this network, knowledge brokers are teachers and school leaders themselves, whose activities are situated in a space between the brokerage agency (EEF) and schools. Due to the special mission of brokering, network members themselves need to excel in using research knowledge in teaching. However, knowledge dynamics in the network goes beyond knowledge mobilisation. It involves knowledge creation ("generating new evidence"), manifesting in innovation being facilitated in schools. Innovation is specifically related to improving teaching and learning, and the focus on evaluating impact suggests that these innovations can in turn feed back into the evidence that EEF synthetises. Indeed, the Innovation Evaluation Handbook makes this explicit:

> *The goal of the innovation evaluation fund is to increase the evidence base of what works in education by conducting evaluations of innovations in teaching and learning approaches, communicating the findings across the Research Schools Network and beyond, and encouraging applications for larger, rigorous evaluations of promising approaches (IEE, 2017, p. 1[290]).*

The EEF measures the efficacy of its own strategies in terms of the outcome stated in their mission – the attainment of disadvantaged pupils – using experimental trials (Gough, Maidment and Sharples, 2018[232]). Nevertheless, since the Research Schools Network is a relatively recent initiative, network related effects haven't yet been extensively explored.

Overall, brokerage agencies generally undertake little evaluation of the impact of their work on ultimate beneficiaries (Gough, Maidment and Sharples, 2018[232]; OECD, 2016[291]). Challenges include the limitation of research methods and the subjectivity of outcome measures that are based on self-reported impact (Gough, Maidment and Sharples, 2018[232]). Future research could be directed at identifying network characteristics and approaches that facilitate (or hinder) teachers' knowledge dynamics.

Knowledge Network for Applied Education Research (KNAER) – Canada

Fostering research collaboration through networking and partnerships, and mobilising well-validated bodies of knowledge to shape education policy and practice are among the key components

of the Ontario Research Strategy. As part of this strategy, the Ministry of Education launched the Knowledge Network for Applied Education Research (KNAER) in 2010 (Campbell et al., 2017[226]). Campbell and colleagues' (2017[226]) research analyses the knowledge mobilisation approaches applied in KNAER, and has particular relevance to this paper as it also describes the evolution of the network as a result of monitoring and evaluation processes. The following description of the KNAER is based on this research.

The KNAER was governed by a partnership consisting of the Ministry of Education of Ontario, the University of Toronto and Western University. To operationalise knowledge mobilisation in the region, a committee of this partnership published a call for proposals, as a result of which 44 projects (networks) were funded. The projects fell in one of the four categories of knowledge mobilisation (Table 3.3). Using Best and Holmes' typology (see section 3.1.1), the authors point out that although exploiting research and visiting world experts seem to be built on a linear conceptualisation of knowledge mobilisation, in practice, many projects put emphasis on relationship building and engagement. In fact, building and stimulating networks is a success factor common across all categories.

Table 3.3. Knowledge mobilisation in KNAER

Category	Strategies	Challenges	Successes
Exploiting research: Taking existing research and connecting it to practice/policy in useable and accessible ways	Connect to communities of practice; Analyse their needs; Produce K mobilisation products; Monitor results/impact; Disseminate	Researchers had to shift language use to adapt to practitioners	Substantial number of outputs; Project leads could extend their research; change of mindset regarding professional learning (shift from oneoff occasions to continued networking)
Building or extending networks: identify priority areas, existing capacity in those, build more through networks	Creating or extending networks, needs & gap assessment, producing products, sometimes learning opportunities for teachers, disseminating	Time: longer time needed to gain access to gatekeepers at school boards, build trust, scheduling difficulties due to heavy workload	Access and connection to others: learning communities allowed for sharing, deepening understandings
Strengthening research brokering: connect researchers with each other and with interested organisations to use existing resources and expand impact	Gap assessment through literature reviews or collecting information, collecting and mobilising relevant knowledge to inform practice (e.g. engaging teachers through mentoring, coaching)	Reach consensus regarding the knowledge to be shared, dealing with differing views about topics, scheduling difficulties	Building lasting networks with different stakeholders, effective use of intermediaries (e.g. teachers' federations) to connect research to practice
Visiting world experts: invite recognised experts in high-priority education areas to share their knowledge with stakeholder groups	Establish partnerships with recognised networks or created new networks, involve school board and university, mobilise visiting experts' knowledge through workshops, lectures, research days, seminars, discussions	Maximise the benefits of short term expert visits, not all interested schools could participate due to short timelines, work out how to sustain an expert visit	Engagement in more complex knowledge mobilisation than just organising events

Source: Based on (Campbell et al., 2017[226]).

The research also showed an evolution of the concept of knowledge mobilisation in KNAER over time. While the first phase was focusing on linear transmission of research knowledge towards practice, an evaluation of the interim reports revealed a lack of knowledge and skills across the projects in realising effective knowledge mobilisation. To address this, the KNAER team started to provide support and capacity building in this area to the projects, which then adopted a more complex, relationship focused approach.

Campbell and colleagues' conclude by emphasising the importance of a systemic approach to knowledge mobilisation that recognises the importance of quality products, collaborative relationships, developing capacity on knowledge mobilisation and addressing challenges system-wide.

Although the impact of the KNAER initiative on teaching practice was not examined in this research, a number of project examples are mentioned related to this. The examples suggest that the following factors made knowledge mobilisation in networks more impactful or successful:

- facilitating professional learning among teachers
- involving multiple perspectives and understandings, including those of teachers', in the process of knowledge mobilisation
- using action research to involve both researchers and teachers in collaborative work.

Regarding the last point, knowledge mobilisation through collaborative (action) research has been recognised for enabling network members to develop knowledge for practice (Cornelissen et al., 2011[292]).

Teaching School Alliances – England, United Kingdom

Teaching School Alliances are an English national network of schools founded as part of the "self-improving school-led system" (SSIS) agenda of the British government. The network was created following the model of teaching hospitals: schools identified as outstanding lead the initial training, professional development of teachers and head teachers in a local network of schools and facilitate school-to-school support (Department for Education, 2010[293]). The TSA model was conceived to facilitate mutual improvement across the system based on local collegial co-construction (Hargreaves, 2010[266]; Hargreaves, 2012[267]). Co-construction involves teachers and school leaders co-interrogating teaching through shared rounds of evaluation and innovation (Hargreaves, 2012[267]). Beyond local knowledge creation, leading schools also had the responsibility to support schools in innovation and knowledge transfer across the national networks (Harris and Jones, 2012[294]).

Collaborative enquiry was seen to play a key role in extending, expanding and creating new professional knowledge, and the National College for School Leadership[9] developed a resource to assist teaching schools in leading collaborative enquiry (Harris and Jones, 2012[294]). Enquiry in this document is seen as a process that supports the research and development (R&D) work of the teaching schools. Knowledge creation is described as an enquiry cycle that consists of implementation, innovation and impact. In the implementation phase, the TSA defines its enquiry focus based on an analysis of data and relevant research evidence; they map existing knowledge within the alliance, set out methods to collect more information; develop the collective knowledge base. In the innovation phase, they develop and choose instructional strategies that address the focus, they trial them, gather data on their effectiveness. In the impact phase, the data is analysed, the TSA evaluates the outcomes and adjusts strategies.

[9] Replaced in 2013 by the National College of Teaching and Leadership that existed until 2018.

Particular attention is also given to knowledge transfer. Testing the validity of new knowledge and applicability of new practice, and transferring these within and between, are key responsibilities of leading schools (Harris and Jones, 2012[294]).

Making use of research knowledge is explicitly present in the idea of TSAs. This is evident, for example, in the description of effective pedagogy:

> *Great pedagogy develops when outstanding teachers make active use of the research and knowledge-base for teaching. There is a robust research-base which helps to identify the ingredients of great pedagogic practice. Truly successful pedagogy depends on making connections between ideas from the research-base in systematic and sophisticated ways (Harris and Jones, 2012, p. 41[294]).*

Yet, how teachers in TSAs are supported in accessing and mobilising research knowledge is not straightforward. A number of alliances recognised the need to involve universities in their research and development work to obtain this support. In parallel, some universities also saw the potential in working with schools. As a result, several networks developed that included both TSAs and higher education institutions (Ainscow et al., 2016[295]; Maxwell et al., 2015[296]).

Maxwell and colleagues (2015[296])report on the R&D work of five TSAs. They describe three models of collaboration:

- Discrete R&D projects: located within a single school or academy trust, with significant within-school collaboration but limited cross-school collaborative work.
- Multi-strand partnerships for R&D: multiple schools with a common overarching project focus and specific foci for individual schools within this. Characterised by some common data collection and cross-school collaboration to share learning.
- Collaborative model for R&D: jointly developed focus and a common approach to investigate this. Characterised by high levels of cross-school collaboration, decision-making and evaluation of learning.

The report suggests that the collaborative model had the most impact on teachers, the quality of evidence generated and degree of wider knowledge mobilisation. It also acknowledges the potential effect of the strong engagement from a local higher education institution (HEI) in achieving this impact. In terms of knowledge dynamics, the authors note varying perceptions: some alliances stress having adapted existing knowledge from elsewhere, others having deepened their understandings, yet others creating new knowledge. Participants also felt that the work enhanced their thinking about evidence-based practice and research, and reported to have developed research skills.

While several studies reported positive impacts on knowledge dynamics, Greany and Higham (2018[269]) also identified tensions and inequalities in the system of TSAs. Some of these represent threats to the original goal of closing the gap between high- and low-performing schools. The study found that many TSAs developed in a way that only one or a few high-performing schools benefited most of the

opportunities the alliance provides, while lower performing schools were either excluded or had limited opportunities for development. This demonstrates that networks are not automatically inclusive and balanced, and a number of contextual factors matter for their success in facilitating knowledge dynamics equally across all members.

eTwinning – a European online teacher network

The eTwinning network is an online network of teachers across Europe, facilitated through a digital platform available in 28 languages. The platform was established in 2005 and is funded by the European Commission under the Erasmus+ programme (Vuorikari et al., 2015[297]). Its purpose is not specifically linked to innovation or evidence scaling, rather it is defined by a range of activities and actions provided for the community through the platform and the Erasmus+ programme. These include joint projects for schools at national and international level, collaborative spaces and professional development for teachers.

The main area of eTwinning, called eTwinning Live, is restricted to registered users, mainly teachers, and comprises of a range of communication and collaboration features such as:

- finding and interacting with other members of the community
- professional development activities: online courses (lasting six weeks), learning events (lasting two weeks) and online seminars (one hour webinars)
- collaborating and exchanging best practices in thematic groups
- finding partners for projects in the partner forums (Pateraki, 2018[298]).

eTwinning is an inclusive network, in which participation is completely voluntary and possible for any teacher from the eligible countries (Vuorikari et al., 2015[297]). The network involves more than 600 000 teachers working in almost 200 000 schools in one of the 36 European countries (eTwinning) or 8 neighbouring countries (eTwinning Plus). More than 80 000 projects have been run, involving more than 4 500 000 students across the continent (Pateraki, 2018[298]).

Discussing online networks related to the diffusion of innovation is increasingly more relevant today, when such platforms proliferate. Vuorikari and colleagues (2015[297]) discuss eTwinning as an ICT-enabled innovation for learning and highlight the role of teacher collaboration through networks in fostering the diffusion of innovative pedagogical practices. Opportunities to share pedagogical know-how and educational content, such as those provided by eTwinning, can foster educational change and play a role in scaling pedagogical innovation at the system level (Vuorikari et al., 2015[297]).

Digital platforms provide a fertile ground for various network analyses. Learning analytics of the eTwinning platform has shown that on average 27% of eTwinners engage in deeper forms of professional collaboration (such as participation in learning events, project collaboration or writing project diary), and this proportion is the highest for those who have been on the platform for longer than three years (Vuorikari

and Scimeca, 2013[299]). It has also demonstrated how the dynamics of horizontal (between school) and vertical (within school) networking can change as a result of specific attention. In 2009, almost two out of three eTwinners were the only ones from their school, whereas after a campaign year of "eTwinning school teams" in 2012-13, the number of schools with a single eTwinner decreased by 12 percentage points (Vuorikari et al., 2015[297]). In a survey of eTwinners conducted in 2011, 64% of respondents reported that they had involved colleagues from their school in eTwinning activities (European Commission, 2013[300]).

As part of the Teachers' Lifelong Learning Network, a group of researchers conducted social network analysis on eTwinning to explore the underlying mechanisms for the transfer of good practices and innovation from eTwinning projects (Berlanga et al., 2012[301]; Pham, Cao and Klamma, 2012[302]). They used user interaction data gathered from the platform over 6 years. Data shows that the eTwinning network has evolved into a scale-free network[10]. Such a degree distribution indicates that the network has a few hubs (very highly connected nodes). Hubs have been shown to play an important role in ensuring connectivity, information spread and behaviour cascading in networks (Barabási, 2009[303]). Hubs also have more power and control over the network than the other nodes. Pham and colleagues (2012[302]) also show that the network has a strong community structure, i.e. a high number of clusters with densely connected nodes inside the cluster. Strong communities are important for scaling change in pedagogical beliefs, norms of social interaction and pedagogical principles (Coburn, 2003[304]). A large-scale survey conducted by the European Commission in 2011 confirms this:

- 74% of responding eTwinners report to have improved their personal knowledge, competences and skills.
- 58% report to have developed their teaching skills through reflection and dialogue with other teachers.
- Around 70% of members who participated for longer than 6 years had gained 15% more benefit from their participation in the network than those with 2 years or less experience (European Commission, 2013[300]).

3.3.3. Implications for practice

Similarly to the two previous paradigms, the collaboration and network imperative also generate new responsibilities and create pressures for teachers and schools. As demonstrated in the section 3.3.1, there are complex conditions for networks to function effectively, including extensive capacity building to develop facilitation, brokering and leadership skills, building relationships, establishing shared goals, putting in place and maintaining structures and processes. Each of these eventually come down to schools and teachers.

[10] The proportion of nodes with *k* connections is inversely proportionate with a (positive) power of *k*.

Networks as a fuzzy policy buzzword versus a well-described form of organisation

Just as innovation, some OECD reports use network mainly as a buzzword with almost exclusively positive connotations. This is especially true for the ISTP publications, which strip concepts from their context and analysis, and present them as norms for educational excellence. For example, networks appear as a feature of innovative schools (Gomendio, 2017[305]) or as a form of school-embedded professional development (Schleicher, 2016[3]). Policy recommendations include that schools should create networks for the benefit of the learners and the community (Gomendio, 2017[305]). It is also worth noting that networks are sometimes confused with "networking", i.e. considered as a way of connecting to people. The term "school networks" is used in OECD country reviews (e.g. the School Resources Review series) to refer to all the schools of a country or system. This use disregards any standard understanding of networks as forms of organisations, and speaks about a network of schools that are not linked in any way other than being in the same country or falling under the same national (or regional) government. Aside from this surprising neutral use of the term, the policy buzzwords hide different OECD strands with unique conceptualisations and analyses. Just as the case with innovation, these lead to conflicting implications for practice.

One conceptualisation is again provided by TALIS, that sees "peer networks" as one pillar of teacher professionalism (see also Chapter 1) (OECD, 2016[306]). Interestingly, in its conceptual framework, the TALIS report on teacher professionalism links the concept of peer networks to high professional standards. The argument is that peers set and hold each other to high standards, and therefore professional networks function as a form of internal accountability. Network is not defined, but the way the term is described suggests that it refers to supporting and sharing knowledge with other teachers ("peer network"). It is certainly not considered as a form of organisation, nor does it refer to the broad understanding of social networks. The way the concept is captured with five indicators is even more confusing:

- *induction* measured by participation in a formal induction programme
- *mentoring* measured by participation in formal mentoring programme
- *peer feedback* measured by received peer feedback on teaching based on direct observation
- *professional development plan* measured by the reported development of such a plan
- *professional learning communities* measured by participation in network supporting teacher professional development (OECD, 2016[306]).

Induction, mentoring and feedback imply structured or ad-hoc work with colleagues, but none of these reflect the understanding of networks as forms of organisations with a collective goal. A professional development plan is a form of accountability involving work with a supervisor of mentor, and is thus hard to consider it as horizontal collaboration. The last indicator is the only one that refers to networks as forms of organisation or as teachers' professional (social networks).

The TALIS report presents profiles of teacher professionalism based on three dimensions (autonomy, peer networks, knowledge), and ranks countries according to their overall "professionalism index" calculated from these three elements. While different possible profiles are acknowledged, the ranking approach suggests that all three of these elements, including peer networks are considered as normative goals countries should be working towards. Based on the way the concept of peer network is captured, this implies that schools should provide formal structures for teacher development (mentoring and induction) and facilitate accountability mechanisms in terms of teacher development (professional development plan). At the same time, teachers should be encouraged to observe each others' lessons, give each other feedback and participate in networks. Schools and teachers may interpret these as contradictory pressures because they involve both formal and in some cases hierarchical mechanisms and informal, collegial cultures. The report provides no discussion or guidance on how these can be reconciled.

CERI work on innovation offers a very different discussion and analysis on networks. In this work strand, already discussed in the previous section, networks appear specifically in relation to how they can further innovation, facilitate scaling, but also being innovations themselves (OECD, 2003[280]; 2013[253]; Paniagua and Istance, 2018[14]). The 2003 publication provides the most extensive discussion on networks and is perhaps the most theorised. Chapter 2 authored by Judith Chapman defines networks as:

> *"intentional constructions, linked together in a web of common purposes, in which all the constituent elements are equal in the weight of their enmeshment and the responsibility that they bear for contributing towards the furtherance of their shared interests" (OECD, 2003, p. 42[280]).*

This (somewhat complicated) definition corresponds to standard definitions of networks as forms of organisations in that it emphasises shared interest and common goals. It adds that elements have equal weights, which is a narrower understanding that limits networks to horizontal structures. The report starts with theories (definitions, typologies, characteristics) of education network, then presents a number of specific examples from various countries, and finally summarises the discussions of a seminar that aimed to understand the nature, conditions and potential of education networks, discuss the role of policy to support such networks and identify policy guidelines (OECD, 2003[280]). Overall, it provides a positive account of networks by underlining their key role in innovation. The report concludes with a strong push for governments to embrace networks to support the implementation of reforms. It proposes that a future policy framework for networks should focus on how networks can:

- support the adaptive implementation of reform and inform second level reform
- become the agents of knowledge dissemination, creation, transfer and use
- become effective sites for teachers' professional development and means for schools to develop capacity for reform implementation
- integrate horizontal and vertical support and policy coherence through synergies between existing and new structures

- support scaling
- support schools in change and improvement without requiring that everyone does the same thing in the same way at the same time (OECD, 2003[280]).

In subsequent CERI work, the focus is on networks as a means to scale innovation. The analysis of the 40 case studies of "innovative learning environments" concludes that these extend beyond institutional boundaries, and schools involved achieve innovation by building partnerships and networks (OECD, 2013[253]). This decade of work on innovation developed an understanding that networks function as meso-level drivers of innovation. Building on this, the 2018 volume (Paniagua and Istance, 2018[14]) specifically gathers examples for networks that put pedagogical innovation at their centre. The report identifies three main network profiles (see section above) and offers some analysis on factors facilitating and hindering networks. By identifying factors that impede networks' potential in generating and scaling pedagogical innovation (the focus of this book), this strand of work questions the purely positive and normative account. A lack of financial resources, or a lack of long-term financial stability, lack of time and incentives, rigid accountability systems, market-based contexts and the superficial innovations these contexts incentivise (Paniagua and Istance, 2018[14]) all suggest that networks cannot and will not be a cure for all just by themselves, their policy context matters.

Networks and policy context

The broader policy context in which networks operate can set contradictory expectations. For example, national policies push schools to deliver national curriculum and at the same time dedicate time to developing local solutions. A competitive policy context can clash with the expectation to collaborate. In addition, networks require significant resources, and while policy initiatives may guarantee funds, they often ignore time. Four specific tensions are laid out next.

The first tension is between centralisation and hierarchies on the one hand, and locally developed solutions responding to local needs on the other. In its work on governing complex education systems, the OECD noted that the role of the state in steering education remains important even in the most decentralised systems (Burns and Köster, 2016[45]). Inversely, most centralised systems involve "hybrid" forms of governance, devolving certain decisions, while keeping others (Lassnigg, 2016[307]). Such structural complexities imply pressures for school leaders as they try to navigate contradictory expectations (Greany and Higham, 2018[269]).

One basic principle in making networks effective is that they identify their own goals in view of the local challenges. In a highly centralised system, where curriculum is largely prescribed and teaching is strongly regulated, local goals need to be formulated within the national framework, which might leave little room for developing genuinely local goals and solutions (Ozga, 2009[308]). In addition, systems characterised by a bureaucratic culture, such as France, require a high amount of administration (e.g. documentation and reporting based on narrowly conceptualised templates). Centralised systems are typically built on hierarchical relationships between the different levels. It is particularly difficult to establish

trust and collegial relationships in a network involving several levels of hierarchy (e.g. regional educational authority and schools, or inspectorate and schools). While hierarchy enables coordination through control and formal authority, it can weaken collaboration and lateral innovation (Adler, 2001[309]).

A second tension is between competition and collaboration. In a number of systems, schools' existence and funding depend on a stable student intake, which creates local competition between schools. For example, in the case of Teaching School Alliances in England (see section above), many schools were unwilling to collaborate and engage in a collective school improvement because they were in competition with each other (Greany and Higham, 2018[269]). Sometimes competition emerges as result of internal network hierarchies. In the English case, the idea that the networks are led by a leading school, which is identified based on national league table results, meant that power relations were unequal. This in turn could make it difficult to establish trusting and collegial relationships. Greany and Higham also highlight cases where a set of high-performing schools established a network to secure their own position ("exclusive alliances"), leading to widening inequalities with other schools (Greany and Higham, 2018[269]). In general, while marketised education can help manage supply and demand, it can undermine developing trust and hinder knowledge sharing and equity (Adler, 2001[309]). In addition, marketised contexts tend to favour quick solutions and "superficial modernisations" that negatively affect networks aiming to achieve longer term deep change (Paniagua and Istance, 2018[14]).

A third tension is between external accountability and local collaboration and innovation. As noted also in section 3.2, in more decentralised systems, the state retains its control through stronger accountability mechanisms. Accountability frameworks can also be highly prescriptive: specifying types of targets to be achieved, as well as modalities and procedures. Central targets may limit the framing of local problems and needs. In addition, networks aiming to develop solutions to their problems need space for experimentation and time to go through cycles of enquiry including trial and error. Strong accountability mechanisms may seriously impede such processes. Finally, collaboration requires trust and the de-privatisation of practice to enable others and self to learn from practice. In a prescriptive and high accountability context, teachers might be less willing to open their classroom doors for others. The OECD also draws the attention to this tension without resolving it:

> *"Accountability procedures, especially external test-based accountability should be mindful of not disrupting the collaboration and networking of teachers. Teacher collaboration is a crucial component for the adoption of innovative practices, and collaboration between and within schools can be effective to improve the quality of instruction and to adequately respond to the pressure brought by external teacher-based accountability." (Gomendio, 2017, p. 41[305])*

Finally, a fourth tension lies between the complexity of the expectations and the available resources. Having sufficient resources features as a separate condition for networks to function effectively, because all other conditions are dependent on them. Indeed, building trust, developing specific competences, bringing in external knowledge, professional learning and leadership, all require time and money. As noted earlier, policies designed to encourage networks may provide labelled funds, but the

long-term stability of these is often not guaranteed (Paniagua and Istance, 2018[14]). In addition, policies tend to underestimate the timeframe such complexity requires. Funds are often provided on a project-basis for two-three years, but establishing effective networks and sustaining them is a much longer process.

Engaging in networks also require a substantial amount of teachers' time. rso In an analysis of teachers' time, Boeskens and Nusche (2021[310]) also note that time constraints do not affect schools and teachers equally: they present a greater barrier for some than for others (Boeskens and Nusche, 2021[310]). For example, teachers in schools with staff or resource shortages may have increased teaching hours to compensate for shortages, which leaves less time for collaboration and professional learning in networks. Part-time workers also report to have less access to such activities in most professions (Boeskens and Nusche, 2021[310]). This suggests that already disadvantaged schools may suffer more from lack of time. France is actually one of the very few countries that recognised this problem, and that provides teachers in disadvantaged schools with additional time outside the classroom (Boeskens and Nusche, 2021[310]; Éduscol, 2018[311]). However, most national policies do not pay attention to such inequalities.

In sum, networks impose great demands on schools as organisations as well as teachers. Once again, international organisations' policy discourses can be confusing: some conceptualisations call for forms of accountability and hierarchical support structures, whereas others emphasise horizontality and strategic collaboration. In addition, the policy context strongly influences how networks can operate and create tensions with contradictory expectations.

3.4. Conclusion

In this chapter, I intended to illustrate the importance of three topics for the social environment of teachers today: evidence, innovation and networks. All three have been omnipresent in national policies, international discourses as well as in education research. Although the policy trajectories of each of these would deserve a more in-depth analysis (a theme for another thesis), this discussion helped shedding light on both the interlinkages of the three topics, as well as the various tensions they create for practice.

While evidence, innovation and networks were presented separately, it becomes apparent in the discussion that the three areas are strongly interlinked, in particular as they relate to teachers' knowledge and learning. First, the evolution of teachers' knowledge tie evidence and innovation together. Innovation, as understood in the practice-based educational research tradition, is a cyclical problem-solving process that involves drawing on existing knowledge sources. Innovations do not emerge from thin air, rather they are "inspired by" knowledge coming from research, sometimes unconsciously, or consciously build on existing evidence. On the other hand, evidence and research is actually often generated through innovation processes as teachers (and researchers) test and evaluate new pedagogical solutions, or understand teaching and learning process in their practice. Second, networks are often the context for both evidence and innovation. We have seen that networks provide mechanisms for generating and diffusing innovation,

as well as for constructing, mobilising and disseminating research knowledge. For investigating teachers' knowledge and learning, these links have to be well-understood and serve as a conceptual basis.

Another important conclusion is that all of these three topics have generated ambiguous and contradictory policy discourses. The resulting 'policy agenda', i.e. the set of intended reforms with an overarching desired trajectory, which may be inconsistent and contradictory, have implications for the teachers, schools and the school system (Greany and Higham, 2018[269]). The following key tensions emerge:

- A push for evidence-based practice and innovation at the same time. Although the intimate link between the two has been demonstrated in research, they are often not well-conceptualised and not reconciled in policies.
- A push for local innovation, collaboration and networking in a global context of high accountability, standardisation and competition.

In addition, teachers' working conditions are often not adapted to respond to the complex expectations these paradigms imply. Lack of financial resources and time, a lack of genuine professional autonomy, as well as lack of support and capacity in realising the intended and controversial policy goals related to evidence use, innovation, networks and collaboration are tensions many teachers and schools experience.

In sum, understanding the processes of teachers' knowledge and learning as embedded in the school as an organisation and the broader social context, requires taking into account all three paradigms, and clearly conceptualise the links between them. In the next chapter, I will therefore examine which aspects of each of the approaches presented here are central to the questions of this thesis, and develop a conceptual framework appropriate for the purposes of a sociological investigation of teachers' knowledge dynamics.

Chapter 4. Theoretical and conceptual framework and research questions

In the first three chapters, I introduced the theoretical foundations for investigating teachers' knowledge and learning, and highlighted the various tensions caused by the dominant discourses on teacher professionalism and teachers' knowledge. A number of conclusions and questions emerged that need to be taken into account for a sociological investigation. In this chapter, I will develop a conceptual framework that is appropriate for empirically studying teachers' knowledge. I then discuss the theoretical underpinnings of the framework, and how relevant areas of social and educational research can be incorporated to form a coherent theoretical basis. Finally, I formulate the main research questions for a sociological investigation of knowledge.

4.1. The context of teacher professionalism: evidence and innovation

An investigation of teachers' knowledge cannot disregard the context of the teaching profession and its implications for teacher professionalism. Teachers' practice is embedded in the broader societal context characterised by global transformations (e.g. technological development, demographic changes, climate change) as well as local and/or temporary phenomena (e.g. pandemic, economic crises). These processes affect teachers directly both personally and professionally, and also indirectly through their impact on education policies.

In Chapter 1 and Chapter 3, I discussed issues that emerged from reflections on teacher professionalism and that have substantially influenced policies as these were trying to address societal and economic pressures. The uptake of the evidence-informed practice, innovation and network paradigms have created complex expectations for teachers' knowledge and practice. I will now discuss their implications for conceptualising the transformation of teachers' knowledge in a sociological investigation. I will start with the role of evidence/research and innovation.

Chapter 3 already indicated that evidence use and innovation are not disconnected issues. At a superficial level, evidence-informed practice may seem to relate primarily to the mobilisation and brokerage of scientific (research) knowledge (as discussed in Chapter 3.1.1), whereas innovation is often discussed in terms of knowledge creation and diffusion in the community of practitioners (see Chapter 3.2.1). However, a deeper analysis of the issues point to the problematic nature of such a divide.

Knowledge mobilisation models originate in the intent to increase the use of research evidence in practice. The relationship model (as opposed to linear transmission) recognises the legitimacy of multiple knowledge sources in the process of "knowledge to action" (Best and Holmes, 2010[11]). The systems model ties evidence and innovation even more closely together. Best and Holmes make the explicit link with Van de Ven's three views of the theory-practice gap: bridging through means of knowledge transfer, through exchange and use of two different kinds of knowledge (research and practice-based) or through co-production of knowledge to respond to complex problems (Van De Ven and Johnson, 2006[227]; Van De Ven, 2007[228]). This last co-production view corresponds to the systems model of knowledge mobilisation (Best and Holmes, 2010[11]), and is precisely what makes the link with innovation. Best and Holmes consider that knowledge mobilisation works through the generation and diffusion of innovation. Knowledge in a systems perspective is produced, "implemented" and integrated in the system through a continuous learning process, through trial and error, involving feedback loops and the emergence of patterns, thus through innovation (Best and Holmes, 2010[11]). In the same vein, systems views of innovation stress the strong link between research and formal knowledge and innovation. For example, competence building is one of the three types of learning taking place in systems of innovation (Edquist, 2006[250]).

Concretely, in the context of teachers' practice, the systems perspective manifests in models such as Bereiter's knowledge building (Bereiter, 2002[312]) or Engeström's expansive learning models (Engeström and Sannino, 2010[188]). Paavola and colleagues (2004[71]) identified a number of key features that these models share. First, the starting point is the dynamics of knowledge creation and the pursuit of newness. Second, questioning and criticism of existing practice are the drivers of the dynamic processes of innovation, learning and knowledge creation. Third, the dynamics of knowledge is an inherently social process. Cognitive resources lay in social interactions, and knowledge building is an iterative process emerging from shared problem-solving among agents (Paavola, Lipponen and Hakkarainen, 2004[71]).

These cyclical and iterative innovation and knowledge creation models have been operationalised through specific methods. The most well-known forms are:

- *Action research* is a "systematic process of practitioner problem posing and problem solving" (Kuhne and Quigley, 1997, p. 23[313]). Its main goal is to better understand teaching and learning related problems and improve practice. The practitioner is both the researcher and the teacher. It is a trial-and-error approach consisting of four key stages: planning, acting, observing and reflecting (Kuhne and Quigley, 1997[313]).
- *Collaborative enquiry* is an adaptation of action research, in which teams of teachers explore and answer questions about their professional practice (Townsend and Adams, 2014[314]). It has been described as "a process of knowledge generation, occurring when researcher and practitioner knowledge meet in particular sites, aimed at producing new knowledge about ways in which broad values might better be realised in future practice" (Ainscow et al., 2016, p. 10[295]).

- *Design-based research* is a methodology in which an intervention is developed as a solution to a practical teaching and learning related problem. The intervention is then tested and adapted in iterative cycles of design, enactment, analysis and redesign. It has two intertwined goals: design learning environments and develop theories of learning with relevant implications to practitioners. It is realised through a collaboration between researchers and practitioners (Design-Based Research Collective, 2003[315]).

All innovation-oriented methods recognise the importance of formal knowledge in the process, although, they do not necessarily refer to evidence coming from educational research or theories. These methods nevertheless involve data collection and analysis, and research documentation. Collaborative enquiry often directly builds on teachers' formal knowledge, while design-based research aspires to contribute to its creation. According to Bereiter and Scardamalia, formal knowledge transforms into professional knowledge through problem-solving (Bereiter and Scardamalia, 1993[316]).

If teachers' formal knowledge is a key element of this process, we must ask where that knowledge comes from. In most countries, teachers are trained in formal initial education and through continuing professional development. Whitty and Furlong's (2017[59]) exploration of knowledge traditions in teacher education programmes demonstrate that most of these programmes (if not all) teach some forms of scientific theories (e.g. child psychology, learning sciences, educational philosophy) or applied education research. Even the least theory-based practical knowledge tradition often contains some forms of research or theories. Therefore, scientific, theoretical, research knowledge – being the basis for teachers' formal knowledge – is necessarily part of innovation and knowledge creation processes. Insights into these models demonstrate that education research – here understood in an inclusive sense, not limited to any kind of methodology or specific content domains – and innovation in education cannot be discussed separately. Different knowledge processes, such as accessing and using formal (e.g. research) knowledge, combining this with knowledge and information about the context, and meaning-making by trial and error are at play in an innovation process.

The relevance of research and evidence for professional practice has been largely debated and there are strong opponents who consider research findings as irrelevant (Biesta, 2007[12]; 2010[213]; Hammersley, 2005[13]) or who go as far as abandoning the concept of educational theory (Carr, 2006[64]). Nevertheless, the idea of evidence-informed or research-backed practice has penetrated education policies and has become a reality for teachers. I have also shown that if formal knowledge is part of innovation, then so is research. Therefore, in conceptualising teachers' professional knowledge and its dynamic transformation, formal, scientific knowledge and innovation / knowledge creation processes must be considered together.

4.2. Social context of teachers' professional knowledge and learning

The importance of the social context for teachers' professional practice, finds its root in two sources: social theories of learning and the transformation of education systems, which brought about the prominence of collaboration and networks as social organisations. I will briefly summarise the relevance of both for studying teachers' knowledge and its dynamic transformation.

4.2.1. Social theories of learning

In Chapter 2, I presented the development of social constructivism and situated learning theories. The former recognised that the social and cultural context play a fundamental role in the development of cognition (Putnam and Borko, 2000[90]). Social constructivism views knowledge as distributed over groups of individuals and their environment. Learning in this view is situated and focuses on knowledge sharing and co-construction (Putnam and Borko, 2000[90]; Paavola, Lipponen and Hakkarainen, 2004[71]). Social theories of knowledge and learning made it clear that the dynamic transformation of teachers' knowledge can only be interpreted in teachers' social context.

The first social level is that of the smaller teaching community whose social practice is situated in a shared context such as a school organisation. This is also labelled as community of practice (CoP) (Lave and Wenger, 1991[107]) or professional learning community (PLC) (Senge, 1990[110]). Teachers knowledge in these communities are shaped by their interactions, for example as they discuss students' progress, share their challenges, and exchange ideas and materials. Beyond ad-hoc interactions, teachers can also engage in more complex knowledge construction processes (see the previous section).

Organisational learning and knowledge management theories have provided models to understand knowledge processes in an organisation or community (Nonaka and Takeuchi, 1995[112]). The important contribution of these theories is that they explore factors such as leadership, organisational structures and cultures, and the ways in which these influence the transformation of knowledge. Practice-based, socio-material perspectives shift from "knowledge creation as management" to "knowledge creation as conflictual questioning" that involves not only the construction of new knowledge, but also the transformation and creation of culture (Engeström and Sannino, 2010[188]).

The second social level goes beyond the close community and the school organisation and involves the wider web of relationships. The wider network can transcend institutional and professional boundaries. Teachers from several schools can work together, or they can work with different actors, such as teacher educators, researchers, other (e.g. health or youth) professionals, and educational authorities. Teachers' knowledge is shaped in these social interactions. Boundary crossing involves different organisational, epistemological and professional communities that interact through "boundary objects" (e.g. forums, knowledge repositories and activities) (Engeström and Sannino, 2010[188]).

While social capital theory is primarily concerned with social relationships as resources that exert influence on certain outcomes (Lin, 2001[142]), social network theory also focuses on the dynamics of

knowledge processes, including knowledge mobilisation, creation and diffusion. By systematically exploring actors and ties (connections between actors), social network analysis (SNA) reveals the patterns and mechanisms of social relationships and helps understand their effects on people, organisations and knowledge processes (Wasserman and Faust, 1994[150]). Such an "interpersonal relationships" view in social network research looks at factors such as trust, expertise, engagement in collaborative activities, value of knowledge and reciprocity of knowledge exchange (Cornelissen et al., 2015[317]). Therefore, social network theory and its methodological tool, SNA, helps investigate the dynamics of teachers' professional knowledge in a broader web of interactions and social context.

4.2.2. Educational research on collaboration and networks

As we saw in Chapter 3, collaboration and networks as forms of organisations established between individuals or organisations have become widespread in the field of education. While the overall policy discourse around collaboration and networks is mostly positive and normative, research has shown that their impact on teachers and schools varies greatly (Muijs et al., 2011[52]; Rincón-Gallardo and Fullan, 2016[288]; Vangrieken et al., 2015[318]; CUREE, 2005[286]). The main contribution of this research strand to understanding teachers' knowledge is its focus on the conditions under which networks exert positive impact.

I summarised the various aspects that matter for network "effectiveness" based on research in Chapter 3. The key characteristics concern: network goals, the quality, distribution and nature of network ties, the leadership and governance of networks, capacity building within networks and network structures and resources. Research has also demonstrated that the context of the network strongly influences its mechanisms. Critical policy analysis revealed a number of tensions that can hinder positive outcomes, for example in terms of networks' capacity to facilitate innovation and change:

- Tension between centralisation, and local innovation: To develop practices responding to local challenges, networks need to identify their own goals in view of these challenges. However, in a highly centralised system, the national framework might leave little room for developing genuinely local goals and solutions (Ozga, 2009[308]).
- Tension between hierarchies and trust: Centralised systems with hierarchical relationships often impede developing trust and collegial relationships, which are key for innovation (Adler, 2001[309]).
- Tension between competition and collaboration: In performance-driven systems, schools are often in competition with each other. This can decrease schools' willingness to collaborate, share knowledge and engage in collective innovation (Greany and Higham, 2018[269]).
- Tension between external accountability and local collaboration: Highly prescriptive accountability frameworks may limit the framing of local problems and needs. In addition, these frameworks often have a short-term focus and their timeframes are in conflict with the time needed for developing local solutions through experimentation and cycles of trial and error. A high accountability context

is also in conflict with trust and the de-privatisation of practice that are key to learning and innovation.

- Tension between the complexity of expectations and available resources: Time and money are fundamental for realising long term, deep change. Policies tend to underestimate the timeframe such complexity requires, and fail to provide sufficiently flexible and sustainable funding sources.

Investigating teachers' professional knowledge and its transformation in the broader social and policy context of networks needs to take into account the nature of these social structures. Self-organising bottom-up networks do not function in the same was as centrally mandated network organisations. These latter can also differ in terms of their governance structures (Provan and Kenis, 2008[281]). Horizontal and hierarchical relationships may have different roles and impact on knowledge processes. Therefore, research on educational networks as forms of organisations will be important for my sociological analysis.

4.3. Theoretical and conceptual framework

The comparative review of theories and critical policy analyses conducted in the first three chapters form the basis of the theoretical framework for studying teachers' professional knowledge and its dynamic transformation. To address the main objectives of this thesis laid out in the introduction, the theoretical framework needs to satisfy three criteria. It has to:

- capture the complexity of professional knowledge as it relates to teaching practice
- consider the social context and processes in which teachers' knowledge and practice are embedded
- take into account the policy context of education systems in which schools and teachers operate.

My empirical study needs to build on theories that are suitable for a sociological investigation of knowledge and learning. In the next section, I highlight the theoretical basis for my research.

4.3.1. Professional knowledge

Taking into account the context of the teaching profession and its implications for teacher professionalism presented in the first section of this chapter, the theoretical framework is based on the notion of "professional knowledge" as it is conceptualised in the sociological literature on professionalism.

Ontologically, professional knowledge implies a clear distinction from everyday, common knowledge and requires codes (Brante, 2010[53]). Professional knowledge thus manifests not (only) in horizontal – context-specific, concrete and practice-related – discourses, but (also) in vertical discourse, which is coherent, explicit and context-independent (Bernstein, 1999[58]). I define teachers' "theoretical-scientific" (or "formal research" or "academic") knowledge drawing on these ontological and socio-linguistic perspectives. These terms will be used mostly interchangeably, as one key aspect of teachers' professional knowledge.

Educational theories have contributed to understanding the specificities of teachers' professional knowledge as they relate to teaching practice. Three aspects of knowledge were distinguished: situated understanding ("know-how" to act in practice incorporating moral and ethical judgement), technical knowledge (procedural knowledge to design and execute a process and to define criteria for success) and critical reflection (knowledge and ability to systematically review practice for future improvement) (Winch, Oancea and Orchard, 2015[61]). In addition, the characterisation of the different content domains include subject, pedagogical content and general pedagogical knowledge, among some other elements (Shulman, 1987[6]). While my investigation will not require a specification of content domains, it will define teachers' "practical knowledge" along Winch, Oancea and Orchard's aspects of knowledge.

Cognitive sciences distinguish symbolic, declarative knowledge that is explicit (can be articulated) and goal-oriented, procedural knowledge of practice that can be explicit and tacit (not articulated) (Corbett and Anderson, 1995[75]; Nickols, 2000[97]). In the dualistic approach, tacit and explicit are complementary dimensions of knowledge rather than distinct parts of a knowledge stock (Johnson, Lorenz and Lundvall, 2002[18]). Explicit and tacit dimensions of knowledge are also important to consider when conceptualising teachers' professional knowledge.

Based on the above, I will consider two main components of professional knowledge:

- "theoretical-scientific" knowledge is associated with declarative, explicit knowledge expressed in vertical discourses
- "practice-based" or "practical" knowledge comprises situated understandings, technical knowledge and critical reflection. It can be expressed in both vertical and horizontal discourses, and can relate to explicit and tacit dimensions.

Distinguishing between different aspects, forms and dimensions of knowledge is important because my investigation is concerned with the transformation of knowledge, which involves dynamics between these dimensions. For example, explicit scientific knowledge of the subject content and pedagogy is mixed with more implicit forms of practice-based knowledge that enable the teacher to make decisions based on certain situations (Blömeke, 2017[86]; Stürmer and Seidel, 2017[319]). Transformations of knowledge involve structural changes over time such as codification (from tacit to explicit) (Cowan and Foray, 1997[17]) and internalisation (from explicit to tacit) (Nonaka and Takeuchi, 1995[112]). In addition, dimensions of knowledge have consequences for knowledge transmission: tacit knowledge can only be transmitted through direct contact via mimicry and behaviour skill training (Bennet and Bennet, 2008[96]).

4.3.2. Knowledge dynamics

Knowledge is dynamic in nature as it is evolving through formal education, is constructed through reflection and practice, and shaped through social interactions. Traditionally, research has studied such dynamics from the perspective of teachers' learning. Paavola, Lipponen and Hakkarainen (2004[71]) discuss three metaphors for learning:

- Learning as acquisition: It is based on cognitive theories, in which knowledge is a property or capacity of the individual mind, and learning happens through the process of applying knowledge in new situations. Learning in this sense corresponds to the acquisition and construction of knowledge by the individual (see Chapter 2.1).
- Learning as participation: It is based on social constructivist and situated learning theories, in which knowledge is not an individual property, nor an outcome. Rather, knowledge can only be interpreted as part of the situations where it "takes place". The focus here is on activities ("knowing"), and learning is a process of participation in these shared cultural practices and activities (see Chapter 2.2.4 and 2.3.2).
- Learning as knowledge-creation: Giving equal emphasis to both cognitive, individual and socially situated processes, this model conceptualises "learning and knowledge advancement as collaborative processes for developing shared objects of activity" such as products, practices and artefacts (See Chapter 2.3.4) (Paavola, Lipponen and Hakkarainen, 2004[71]).

All three of Paavola and colleagues' metaphors demonstrate the inherent connection between learning and the transformation of knowledge. Indeed, knowledge dynamics and teacher learning could be seen as two sides of the same coin: any form of learning results in some change in knowledge, and any change in teachers' knowledge can be interpreted as a form of learning. However, just as the two sides of a coin show us different images, studying learning or knowledge dynamics can also reveal different information (Amin and Roberts, 2008[320]). In particular, when focusing only on learning, one can miss out on some important aspects. First, the concept of learning often places the teacher in the centre as the principle actor of the "action of learning", even though learning is not always a conscious and deliberate action. The term "informal learning" tries to capture this unconscious nature of learning. Originating from John Dewey's work on learning from experience, and first used by Malcolm Knowles (Knowles, 1950[321]), informal learning refers to forms of learning that do not have explicitly formulated learning outcomes and are not intentional at least on the learner's side. Despite the fact that this aspect of learning has been theorised, the word learning is still often associated with conscious and intentional processes or deliberate actions both in everyday language and in some areas of research (e.g. cognitive psychology). The term "knowledge dynamics" incorporates both the intentional and formal, and unintentional and informal dimensions in a more straightforward way.

Second, the dynamics between different types of knowledge, such as tacit (implicit) and explicit knowledge, declarative and procedural knowledge, or the theoretical-scientific and the practice-based knowledge of a teacher (Nutley, Walter and Davies, 2003[322]; Paavola, Lipponen and Hakkarainen, 2004[71]) cannot easily be described as learning. Yet, these processes are important for understanding teachers' knowledge. For example, when implicit knowledge is codified, it can be more easily shared, or when theoretical knowledge is combined with professional judgement and decision-making, it transforms into practice-based knowledge.

Third, while knowledge construction can be understood as learning relatively easily, this is less evident for knowledge diffusion and dissemination. These processes can be interpreted in a broader social context, e.g. explicit and codified knowledge can be disseminated in a community, in a geographical area (region, country) or in a network of actors, but this does not necessarily translate into learning. Learning cannot describe either all the dynamics between the personal knowledge of a teacher, the collectively constructed knowledge of a community of practice and the global knowledge base of the profession. Yet, it is important to understand how these interact: how individual teachers access knowledge sources within and outside their community, and how locally developed knowledge is integrated in a global knowledge base. For these reasons, I propose to theorise knowledge dynamics as a basis for understanding teachers' knowledge processes as they are embedded in various levels of the social environment.

The term knowledge dynamics has mostly been used in the field of economics, in particular studies of industrial innovation [e.g. (Cowan, Jonard and Özman, 2004[323]; Crevoisier and Jeannerat, 2009[324]; Guile and Fosstenløkken, 2018[325])]. These, usually simplistic, conceptualisations serve as the basis for instrumental economic analysis. For example, Cowan and colleagues build a theoretical model of agents whose individual knowledge is described numerically at any given point in time. Knowledge grows as a function of knowledge generation (individual innovation) and sharing (acquiring knowledge from another agent) (Cowan, Jonard and Özman, 2004[323]). Such models are built on simplistic assumptions, such as two individuals' knowledge is comparable (one is equal to or greater than the other), and when they interact the more knowledgeable person transmits their knowledge to the other. For a sociological investigation that considers all the complexities described above, such economic conceptualisations are not suitable.

Sociology and more recently educational sociology, describes the dynamics of knowledge in terms of the construction and diffusion of scientific knowledge, and the relationship of knowledge and professional practice. Knorr Cetina studied how some professional practices integrate not only scientific knowledge itself, but also practices typically characterising scientific communities (e.g. modes of systematic investigation) (Nerland and Jensen, 2012[326]). She suggest that these forms of epistemic practice imply that practitioners engage with knowledge in new ways and have new opportunities for contributing to the global knowledge construction (Nerland and Jensen, 2012[326]). Nerland and Jensen (2012[326]) use these sociological perspectives to explore three aspects of knowledge dynamics:

- "Objectual practice": practitioners' engagement in learning as they explore complex problems. This process requires mobilising different knowledge resources, develop new practices through explorative and confirming actions.
- Social implications of knowledge and object relations: the formation of expert communities around specific problems and how these enrich dominant conceptualisations of professional communities.
- *"*Wider machineries of knowledge construction*":* explore relations between knowledge practices in different communities, and across time and space; i.e. how local epistemic objects and practices relate to wider knowledge construction mechanisms (Nerland and Jensen, 2012, p. 103[326]).

To conceptualise knowledge dynamics in line with my conceptualisation of professional knowledge, I draw on socio-material approaches such as Nerland and Jensen's work and knowledge creation models in socio-material research (such as Engeström's expansive learning). I complement these with diffusion models equally based on social theories. I distinguish two main types of knowledge dynamics in the space-time.

Structural dynamics refers to the interactions between different sources and types of knowledge. These include the following:

- Dynamics between explicit and implicit forms of knowledge: the transformation of explicit into implicit knowledge, codification (implicit to explicit), and the particular ways in which explicit and tacit aspects manifest in the everyday practice of teachers.
- Dynamics between theoretical-scientific (research-based) and practice-based knowledge: the translation of formal academic (research) knowledge into practical knowledge, and the various ways in which these are blended in knowledge processes (such as knowledge mobilisation and creation).

Functional dynamics refers to "what happens to knowledge" in terms of the purpose (function) of its evolution. I distinguish the following dimensions of functional dynamics:

- Knowledge construction (or creation, these are used interchangeably): a collaborative process mediated by shared objects (Paavola, Lipponen and Hakkarainen, 2004[71]). This involves the emergence of new knowledge as teachers (potentially with other actors) engage in a process of enquiry (innovation), they mobilise existing knowledge sources, negotiate meaning and construct new practices to respond to particular problems. A cyclical, iterative enquiry can lead to the consolidation of new knowledge.
- Knowledge mobilisation: usually as part of the construction process, teachers access both internal and external knowledge sources, interpret and evaluate them, and translate them into their context. Internal sources are those available in teachers' immediate social context (e.g. community of practice), and external sources are those accessed from journals, online platforms, handbooks, CPD courses, or in the wider social network.
- Knowledge diffusion: the spread of new knowledge in a broader community or network. This includes knowledge dissemination: the conscious, intentional effort of spreading, and unintentional diffusion (Greenhalgh et al., 2004[57]). Diffusion can happen through knowledge brokerage or mediation by intermediate actors or by the communities (research or practitioner) themselves.
- Knowledge integration: the conscious consolidation and systematisation of new knowledge constructed locally in different communities or networks, and its incorporation in a publicly available knowledge base (Enthoven and de Bruijn, 2010[193]). Integration is an interplay between the micro and macro levels.

These aspects of knowledge dynamics are by no means distinct processes, nor do they follow each other in linear ways. Rather they are mutually interdependent, often happen at the same time, interact in non-linear ways, and form together a complex system of dynamics (Best and Holmes, 2010[11]). In line with knowledge creation and innovation models in the systems view (presented above), they co-exist as teachers engage in social processes. Knowledge dynamics are thus embedded in the broad social context of education. They are also influenced by policy discourses and agendas.

4.3.3. Social dynamics in networks

As I am interested in professional knowledge as it is embedded in the social interactions and practice of teachers, I will draw on social theories that situate the transformation of knowledge in the complex interactions among teachers (and with other actors).

Understanding knowledge dynamics in a system perspective has implications for understanding the role of social processes. Complex systems are characterised by multiple actors interacting at multiple levels (Mason, 2008[91]). Their fundamental characteristics is self-organisation, which involves a constant rearrangement of networks anticipating the future based on predictions and environmental feedback (Mason, 2008[91]). For teachers and schools this corresponds to creating horizontal relationships in a bottom-up, self-organising way with other teachers, schools and actors. Analysing these emerging (and constantly changing), horizontal and informal networks are key to understand the dynamics of knowledge within the smaller community (e.g. within a school), as well as beyond.

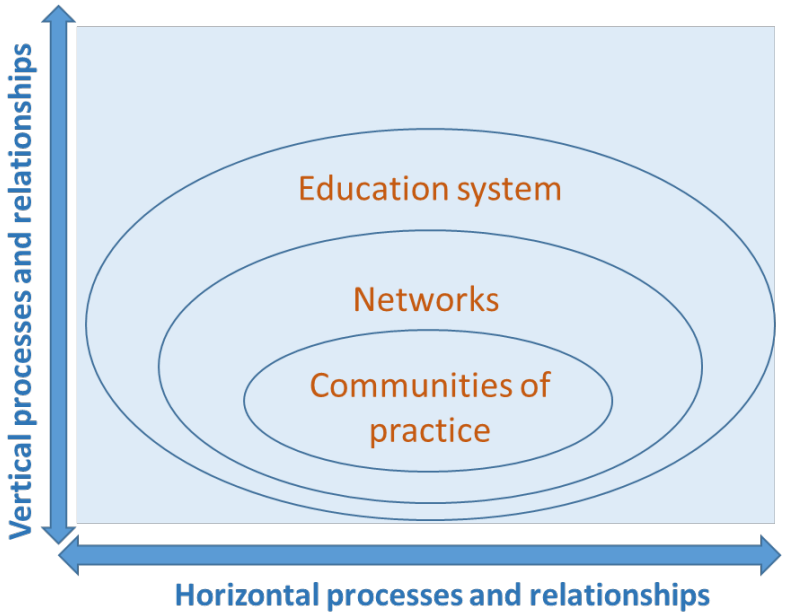
However, networks are not always self-organising in the education system. Formal networks are also created both based on bottom-up initiatives and as a result of central policies (Muijs et al., 2011[52]). As I have demonstrated above, such networks can involve the combination of horizontal and vertical relationships, which have consequences for the various dynamics of teachers' knowledge. Drawing on Muijs and colleagues' typology of education networks, I will consider three main dimensions of formal networks: their context, their characteristics in terms of actors and relationships and the specific social devices they use, particularly to facilitate knowledge processes (Table 4.1).

Table 4.1. Dimensions of formal networks

Dimensions	Components
Network context	• Policy context • Governance & leadership • Voluntarism or coercion • Timeframes • Geographical spread
Network characteristics	• Structure (density, sub-structures) • Nodes (attributes, roles) • Ties (quality, tie formation)
Network devices	• Activities • Tools and technologies

In order to explore the social dynamics through which teachers' knowledge transforms, I define three social levels (Figure 4.1). First, teachers' immediate social context, their community (or communities) of practice, which is most often, but not necessarily (!), situated within the school organisation. Second, the wider network, involving boundary crossing of different types – institutional, professional, epistemological. Third, the social context of the education system, including local, regional and national authorities and educational institutions and agencies (e.g. inspectorate, teacher education institutions). In addition, I take into account both horizontal and vertical relationships and processes.

Figure 4.1. Three levels of social dynamics



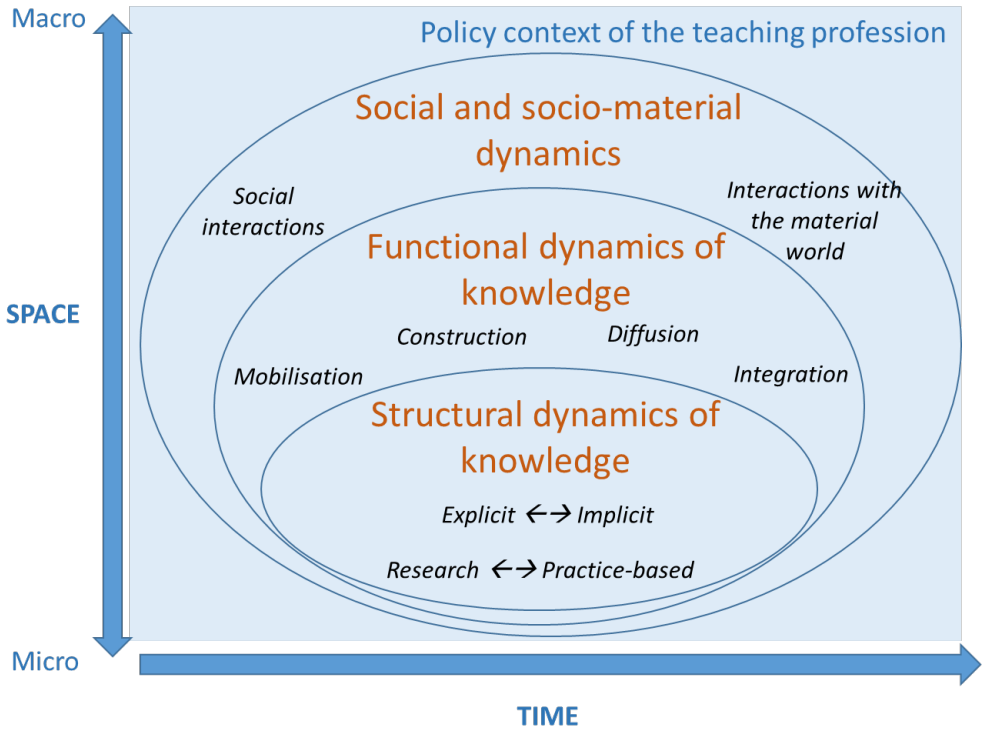
This understanding of social dynamics draws on social network theory and research on networks as forms of organisations. Network ties are not considered as purely structural "channels" through which knowledge flows, because knowledge also transforms in these interactions. The nature and quality of ties (relationships) and the processes that characterise interactions are important for understanding the dynamics of knowledge. In Borgatti and Halgin's (2011[156]) framework of theoretical approaches to studying networks (see Chapter 2), my research is situated in the intersection of the "network theory" and "theory of networks" domains. The former takes network variables (e.g. number of ties, types of relationships) as antecedents and explains non-network variables (knowledge dynamics) with them. The latter does the opposite and can thus explain the formation and nature of social ties based on non-network variables such as perceptions of policies or organisational factors.

4.3.4. Conceptual framework

Bringing together the conceptual elements developed above – professional knowledge, knowledge dynamics and social dynamics – I propose a conceptual framework (Figure 4.2) that considers the

dynamics of teachers' knowledge across two dimensions: time and space. The temporal dimension captures the constant emergence, transformation and evolution of knowledge. Space refers to the different social levels where knowledge processes take place: from the individual teacher, dyads, small groups and communities within a school (micro) through to broader communities and networks (meso) and finally the regional or national level of education systems (macro). Space also includes the material environment of teachers such as objects and technologies in the classroom, the school and the broader material world.

Figure 4.2. Conceptual framework for teachers' knowledge dynamics



This framework considers that structural dynamics occur through functional dynamics. For example, tacit knowledge becomes explicit in the process of knowledge construction, or research knowledge interacts with practice-based knowledge as teachers mobilise and construct knowledge. It is reasonable to assume that dynamics between types of knowledge cannot occur without some kind of knowledge processes described as functional dynamics.

Social dynamics tie together both structural and functional knowledge processes. Social dynamics consist of the complex interactions of actors: teachers in the first place, but also all those with whom they interact and who influence their professional knowledge. These can include students, parents, school leaders, inspectors, teacher educators, researchers, professionals from other sectors, policy makers, and so on, depending on their context and forms of collaboration. In addition, the way teachers connect with their environment such as textbooks and technology, or how they access information is also necessary to grasp the structural and functional dynamics of their knowledge. Socio-material dynamics include teachers'

and other actors' interactions with their material environment: tangible objects such as books, the whiteboard or a computer, and more abstract entities, such as technology or online resources.

Knowledge transforms and evolves as a result of social and socio-material dynamics. Therefore, analytically, the main question is understanding the relationships between social and socio-material dynamics, on the one hand, and structural and functional dynamics of knowledge on the other. The next section specifies the research questions based on this framework.

4.4. Research questions and hypotheses

Research most often targets a particular social level (e.g. a community of practice, or a school as an organisation, or a network of schools), and particular knowledge processes (e.g. its creation or diffusion, or codification). Thus, most studies miss the perspective of the system, i.e. the way in which all these knowledge processes at the various social levels interact. Although it would be extremely interesting to study knowledge dynamics truly as a system through the lens of various theories, it is also very difficult to realise, especially in the framework of a doctoral research conducted individually. This is mostly because the analytical methods are different, and a cross-theoretical investigation would require the construction of different instruments (social network questionnaire, standard quantitative questionnaire, qualitative interview or focus group protocols, observation and coding protocols), as well as the complicated triangulation of data of different nature.

For example, although the interplay between implicit (tacit) and explicit forms of knowledge (structural dynamics) is extremely interesting, its investigation requires demanding qualitative methods. Implicit knowledge can only be traced through observations (because it is implicit, teachers cannot report on it through an interview or a survey), or the analysis of materials produced by the teacher such as lesson plans and reports on students. This in itself could constitute the object of an entire research project. Similarly, studying the dynamics of knowledge in a socio-material approach, for example through actor-network theory, could be the object of another thesis.

Therefore, while the conceptual framework captures the complexity of teachers' knowledge system in their social and material environment, I will restrict the actual empirical investigation to some more narrowly defined research questions. I derive two overarching research questions from the conceptual model. The first aims to describe the various dynamics of knowledge, whereas the second relates to understanding the social dynamics that drive them.

4.4.1. Research question 1: How can we characterise the dynamics of teachers' knowledge?

Given the conceptual framework of knowledge dynamics presented above, the first overall research question asks about how teachers mobilise and construct knowledge; how is knowledge diffused

(including intentional dissemination and diffusion); and how is new knowledge integrated in a the wider public knowledge base?

Regarding knowledge mobilisation:

- What types of knowledge sources do teachers engage with and where do they access them?
- How do teachers engage with various knowledge sources?

Regarding knowledge construction:

- What kind of reflection and enquiry processes do teachers engage in?
- Who do they interact with in these processes?
- What is the content, object and purpose of knowledge construction?
- What structural dynamics occur during these knowledge processes? How do teachers translate research knowledge for practice?

Regarding knowledge diffusion:

- How do teachers consciously disseminate knowledge?
- What platforms are used for knowledge diffusion?

Regarding knowledge integration:

- How is new knowledge validated and consolidated?
- How is knowledge managed at the professional community / network level?
- What mechanisms exist for integrating locally constructed knowledge in integration?

Links between aspects of knowledge dynamics:

- How are the various aspects of dynamics – mobilisation, construction, diffusion and integration – related?

Hypothesis 1.1: Knowledge mobilisation, construction and diffusion are closely linked.

The first research question pertains to characterising teachers' knowledge dynamics. Practice-based innovation research suggests that different knowledge processes happen in parallel and complement each other. Underlying this hypothesis, there is the assumption that it is possible to capture the various aspects of knowledge dynamics and show the variety and levels of knowledge mobilisation, construction and diffusion in which teachers engage.

4.4.2. Research question 2: How do social dynamics influence teachers' knowledge dynamics?

Despite efforts invested in developing networks to facilitate innovation and educational change, empirical research only recently started to investigate the dynamics of teachers' knowledge within these. As a result, many questions remain open (Cain, 2015[215]; Cornelissen et al., 2015[317]; Muijs et al., 2011[52]; Brown and Poortman, 2018[20]). In particular, there is still a need to build an understanding on how exactly the various network characteristics and mechanisms influence teachers' knowledge dynamics. Exploring these relationships will also help understand what specific investment and effort is needed for networks to achieve desired changes in teaching practice and, through that enhance student learning.

All dimensions of networks (Table 4.1) can be linked to all dimensions of knowledge dynamics. For each network dimension, we can ask how its various aspects – context, characteristics and devices – relate to the way teachers mobilise and construct knowledge, the way knowledge is diffused within and beyond the network.

Regarding network context:

- How does the governance and leadership of networks relate to knowledge dynamics?
- How is the degree of ownership by members, the level of trust, and the extent to which objectives are shared associated with the dynamics of knowledge within the network?
- What timeframes are suitable for the various knowledge dynamics related goals?

Regarding network characteristics:

- What are the social configurations that facilitate the dynamics of teachers' knowledge?
- What network structures and what kinds of ties matter in brokering and diffusion?
- What individual characteristics (e.g. competences) do knowledge brokers and network facilitators need?

Regarding network devices:

- How do teachers' engagement in activities (e.g. collective enquiry) and with network tools (e.g. online platforms) influence their knowledge dynamics?
- What activities, tools and technologies help strengthen knowledge dynamics between the micro and macro levels (knowledge diffusion and integration)?

Hypothesis 2.1: Network and organisational culture are important factors in facilitating social processes.

The global context of the network, including its leadership, collegiality versus competition, horizontality versus hierarchies, are determining factors for the intensity and range of social processes actors engage in. For example, knowledge dynamics may be less intense in a competition-driven context

as in a collegial, competition-free one. School and network leadership may be particularly important for creating cultures that foster knowledge dynamics.

Hypothesis 2.2: Social structures and the nature of social ties in a network influence the dynamics of knowledge.

The specific characteristics of the network, its structure, the attributes of its members, and the nature of the ties between them can influence knowledge dynamics in various ways. Teachers can construct knowledge locally, and interactions among multiple actors at multiple levels can bridge communities, facilitate brokering and diffuse knowledge.

A certain awareness of the social structure and ties can lead to more intense knowledge construction and can facilitate the diffusion of knowledge. When actors that have both internal and external social ties (boundary spanners) actively engage in mediation activities, they can ensure higher levels of knowledge flow within an organisation by also bringing in external knowledge.

Hypothesis 2.3: Social processes and devices and actors' engagement with these influence the dynamics of knowledge.

First, more intensive social processes are hypothesised to positively influence teachers' levels of knowledge mobilisation. Engaging in collaboration with a wider network and in collective forms of professional learning can raise awareness of a wider range of resources, research and literature, that teachers can subsequently mobilise in their work. Stronger social links can also provide opportunities for actively participating in research.

Second, more intensive social processes also have a potential to positively influence teachers' levels of collective knowledge construction. Similarly, intensive collaboration with colleagues and other actors can facilitate reflection on practice and can trigger innovation, which are key elements of knowledge construction.

Third, network devices, i.e. the range of activities, tools and technologies used, can influence teachers' knowledge dynamics. For example, action research or collaborative enquiry are social technologies that can facilitate the blending of different knowledge types and sources.

Having presented the conceptual framework and research questions, I will now move on to the second part of the thesis, which reports on an empirical investigation within a set of networks in one region in France.

Part II. Empirical investigation: Teachers' knowledge dynamics in France

Chapter 5. Study design, methodology and data

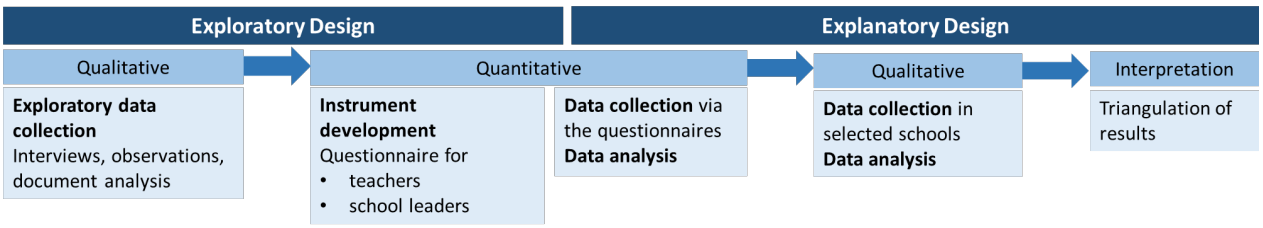
5.1. Study design

In the introduction to this thesis, I set out the objective to go beyond the school as an organisation and investigate teachers' knowledge, and the mechanisms underlying the dynamics of this knowledge in networks. In Chapter 4, I presented a conceptual framework and discussed the theoretical underpinnings to study its various elements. It became clear that the different research questions require different methods of investigation. Therefore, to gain a deep understanding into teachers' knowledge dynamics, a mixed method study is used, combining quantitative and qualitative elements.

A quantitative survey can map the practices of a large number of teachers and schools, and can give insight into the relationship between the various elements presented in the conceptual framework. A survey also allows for exploring profiles of teachers in terms of their knowledge dynamics. However, a survey is less adapted to gain a deep understanding into the factors that lie behind particular activities, such as those that determine whether a teacher or a group of teachers will decide applying a certain practice, what obstacles they face, and how their interactions with each other, and with their context influence their choices. Such factors can be investigated through qualitative methods.

A combination of an **exploratory** and an **explanatory design** as two mixed method designs was used. The review of literature showed that empirical investigations on networks and on certain aspects of knowledge dynamics exist (see Chapter 2 and Chapter 3), however crossing the two in a complex way is a recent and emerging area. In addition, it is important that the research instruments are adapted to the context in which they will be used. Developing appropriate instruments therefore requires an exploratory phase (Creswell and Plano Clark, 2011[327]), which involves identifying relevant existing instruments and conducting a qualitative exploratory research to understand the context and identify relevant areas and questions. An explanatory design followed the instrument development, in which quantitative data obtained through questionnaires was the major source for analysis, and qualitative data was used to explain initial quantitative results (Creswell and Plano Clark, 2011[327]). The quantitative and qualitative elements are not independent in this study. Once the quantitative data analysed, a few sites (schools, teachers) were chosen purposefully for conducting further interviews to explain quantitative data. The research design is represented in Figure 5.1.

Figure 5.1. Study design



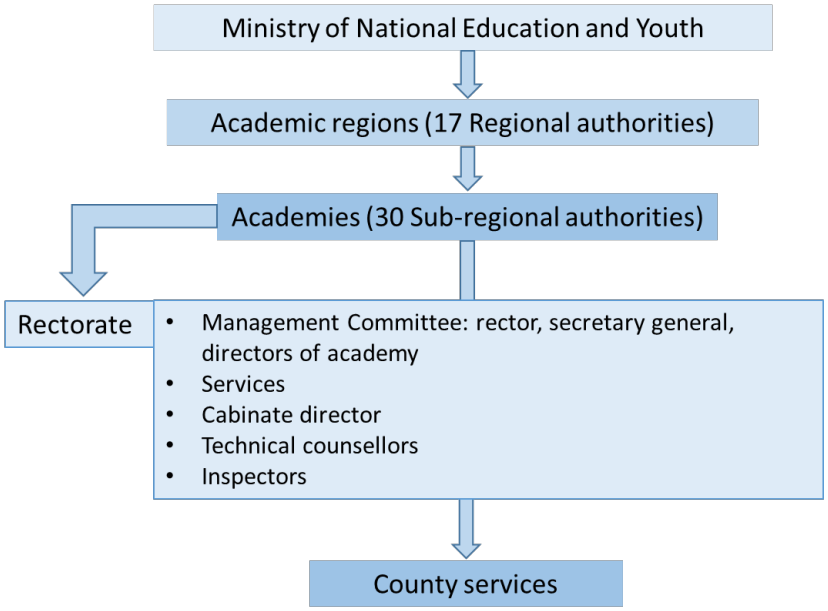
As the conceptual framework emphasises, teachers' knowledge dynamics are embedded in the broad context of education policy. While a comparative study of different education contexts would be very interesting in the long term, selecting one system to test the conceptual framework through an empirical investigation is a meaningful first step. Restricting the study to one context allows for investigating these new concepts in a relatively homogeneous field, thus reducing the chances that differences in knowledge dynamics occur essentially as a result of differences in context, rather than as a result of differences in the particular network characteristics we aim to study. Therefore, the empirical investigation targets teachers and schools in France.

5.2. Description of the context

To identify an appropriate field and target population, it is necessary to understand some basic features of the French education system.

France has a centralised education system. The state defines pedagogical guidelines and sets the national curriculum. It also ensures the recruitment, training and management of school principals and teachers (OECD, 2014[328]). The Ministry of National Education and Youth oversees the 17 regional education authorities (régions académique), 30 sub-regional authorities, so called "Academies" (Académie), and the 97 school boards within the counties (départements) (see Figure 5.2) (Ministère de l'Éducation Nationale et de la Jeunesse, 2017[329]).

Figure 5.2. Education management in France



Each regional authority is led by a rector appointed by decree of the president of the Republic in the Council of Ministers. The rector represents the Minister of National Education within the Academy and its constituent counties. He/She is responsible for the entire public service of education from kindergarten to university, and has competence also in the field of contractual private education (Ministère de l'Éducation Nationale et de la Jeunesse, 2017[329]). As such, the rector has the following responsibilities:

- ensuring that laws and regulations relating to education are applied
- defining a strategy to implement national education policy
- managing staff and institutions
- developing relations with other state services involved in the academy: political, economic, socio-professional actors and local authorities
- implementing the regional training programme conducted by the regional council
- reporting to the Minister on the functioning of public education in the academy (Ministère de l'Éducation Nationale et de la Jeunesse, 2017[329]).

The national educational priorities developed by the ministry are implemented in each regional authority in the form of an "academic project". This document sets out a strategy adapted to the local context by defining educational objectives in that region for a given period of time (usually 4-5 years). Following a ministerial strategy to facilitate educational innovation, since 2011 every Academy has established a Centre for Research, Development, Innovation and Experimentation[11] (CARDIE) to support

[11] Centre/Cellule Académique pour la Recherche et le Développement en Innovation et Expérimentation

educational innovation, and monitor and coordinate innovations and experiments in schools (MEN-DGESCO-DRDIE, 2017[265]; Archives Nationales France, 2013[264]). CARDIEs also play a key role in knowledge sharing by organising meetings, workshops and innovation forums. The strategy and activities of each CARDIE is defined at the regional level.

The regional competence in defining local strategies makes a region a suitable level of analysis for this empirical investigation, as it allows for studying a system in a relatively consistent policy context. The main criteria for selecting one particular region was the existence of a regional strategy that provides a relevant field for the research questions. The region of Bel-Mondo (Academy of Bel-Mondo) was chosen for the empirical study as the regional authority (Rectorate) has been putting in place an innovative network, called EDUNET, since 2013. This network was recommended for field work by several experts in educational innovation in France, because it provides opportunities for studying different aspects of knowledge dynamics due to its multiple objectives. Geographical proximity also played a role to facilitate qualitative data collection.

5.3. Quantitative component: Knowledge dynamics survey

This section describes the process of survey design as described by Groves and colleagues (2004[330]). This process involves the following key steps: choosing the mode of data collection, developing and testing the questionnaire, in parallel, choosing the sampling frame, designing and selecting the sample, followed by administering the questionnaire to the sample, coding and editing data, making post-survey adjustments and conducting the analysis (Groves et al., 2004[330]).

5.3.1. Target population and sampling frame

The quantitative component consists of two questionnaires: one targeted at teachers, one at school leaders in the Bel-Mondo region of France. The main focus of interest of this study is teachers' knowledge, and the most valid way of capturing teachers' activities is to gather directly their own perceptions. However, the research questions require an understanding of the broader social structures and processes that teachers may not be competent to report on. The EDUNET networks are constructed in a way that all school principals are involved in their governance (see Chapter 6 for a detailed description of the governance structure). As members of the governing committees, they have a more global view on the network. In addition, school principals are also able to report on their perceptions of the school culture, which is relevant for the social dynamics of teachers (collaboration, communities of practice).

The questionnaire for teachers targeted the full population of teachers of public institutions in the Academy of Bel-Mondo, including those in kindergarten, primary, lower and upper secondary schools of all types. Similarly, the questionnaire for school leaders targeted all school principals of the Academy of Bel-Mondo from kindergarten to upper secondary schools. The school leader sample also included the National Education Inspectors (IEN) for the primary school level. In France these inspectors are responsible for the management of a group of primary schools, and as such have school leading functions.

The full population was targeted rather than a selected sample in order to ensure a relatively large number of responses, rather than aiming for a high response rate. Teachers in France (and in many other countries) are overloaded with surveys and suffer from survey fatigue. A small doctoral survey clearly does not have the same support from national administration and teacher unions as large-scale national or international surveys such as the Teaching and Learning International Survey (TALIS). As a single researcher, I did not have means and infrastructure to rigorously follow up individual responses, to go to the field and use tailor-made incentives for schools and teachers, or offer compensations for responding. It was therefore unrealistic to expect and ensure a high response rate. As a result of this strategy, sampling error, i.e. taking only a sample of the full target population, cannot occur in the survey (Groves et al., 2004[330]).

5.3.2. Developing the instruments

An exploratory design is suitable for testing a new conceptual framework (Creswell and Plano Clark, 2011[327]). Based on this design, developing the questionnaires consisted of the following steps:

- defining the constructs to measure based on the conceptual framework and the research questions
- exploratory phase:
  - identifying existing instruments that are relevant for the research questions
  - conducting exploratory research to identify relevant areas and questions.
- developing the instruments (two questionnaires):
  - drafting first version of questionnaires
  - testing
  - finalising.

Identifying the dimensions to measure

The conceptual model and framework for analysis described in Chapter 4 provide clear directions as to the components and their dimensions relevant for the research questions. Table 5.1 summarises the dimensions selected to be measured in this research. In order to strike the right balance between developing a valid measure of the dimensions and a feasible questionnaire length, some pragmatic decisions were taken. From among the knowledge dynamics dimensions, knowledge integration was not included. This is the highest level dynamics in the sense that it reflects processes happening between the micro and macro levels. There is evidence suggesting that consolidating locally constructed knowledge and integrating it in the global knowledge base is the most problematic type of dynamics that rarely happens in practice (Enthoven and de Bruijn, 2010[193]). It is likely that teachers have little notion of the extent to which this is happening, and higher-level actors such as regional inspectors or teacher educators may be better placed to report on this. Therefore, this aspect was not included in the questionnaires.

Table 5.1. Dimensions to measure in the teacher and school leader instruments

Component	Dimensions	Teachers	School leaders
Knowledge dynamics	Knowledge mobilisation	X	
	Knowledge construction	X	
	Knowledge diffusion	X	
Network	Network context	X	X
	Network ties	X	X
	Network devices	X	X
Organisational and network conditions	Resources	X	X
	Culture	X	X

Regarding the network component, all main dimensions were included: context, characteristics and devices. Most elements of the network context such as the policy context, its governance and leadership, the nature of participation (voluntarism or coercion), timeframes and geographical spread can be described through desk research and qualitative data collected from key network actors. However, what can be included in the questionnaires is teachers' and school leaders' perceptions of some aspects such as the extent to which network goals are realised. In term of characteristics, the questionnaires focus on network ties (who teachers and school leaders are connected to), the strength of ties and tie formation (e.g. new partners). Finally, teachers' and school leaders' use and perception of the various network devices is also included.

A third component relates to some of the main organisational predictors of knowledge dynamics identified in the literature. Available resources (financial, material and time) and organisational culture that can influence teachers' knowledge are particularly relevant. These can be interpreted at the level of the school, but also at the level of the network. Network conditions could in fact be integrated within the network context dimension. As a start, I grouped these together with organisational (school) conditions because they contain the same constructs (resources and culture). The data can help validate where they truly belong.

Exploratory phase

Although key network variables are known from the literature and instruments exist for exploring certain facets of knowledge dynamics, there is no comprehensive instrument yet available to address the conceptual framework in its complexity and answer the specific research questions. The questionnaires were thus developed based on existing instruments, and the exploration of the field through qualitative methods. Exploratory interviews, document analyses and event observations were conducted to inform the construction of the quantitative instruments.

The exploratory phase consisted of desk research, data collected through semi-structured interviews and focus groups with key stakeholders in this network, and the observation of network events. Desk research involved the review and analysis of the official documents of the selected network: government circulars, regional project descriptions, network maps and the evaluation of the first phase of network implementation. Exploratory interviews were conducted in December 2018 with seven persons

including the two central (regional) coordinators of the network and interviewees recommended by these coordinators. A semi-structured interview design was chosen to ensure comparability and facilitate analysis, while also permitting flexibility. In an exploratory phase, this flexibility is particularly important to ensure that interviewees can add perspectives and aspects that are beyond the initial structure, and thus help explore all relevant dimensions (Corbin and Strauss, 2008[331]). Additionally, a focus group was conducted with the four county-level coordinators of the networks (one of whom was also an interviewee). All interview protocols and design of the focus group are included in Annex D.

Table 5.2. Exploratory interview data sample

	Position at the time of the interview	Role in network at the time of the interview	Gender	Data collection
P1	Inspector	Central (regional) coordinator of EDUNET	F	Interview
P2	Regional authority officer	Central (regional) coordinator of EDUNET	M	Interview
P3		County level network coordinator	F	Interview and Focus Group
P4	Lower secondary school principal	Member of steering committee	M	Interview
P5	Lower secondary school principal	Member of steering committee	M	Interview
P6	Elementary school principal		F	Interview
P7	Kindergarten principal		F	Interview
P8		County level network coordinator	F	Focus Group
P9		County level network coordinator	F	Focus Group
P10		County level network coordinator	M	Focus Group

The exploratory research revealed a great deal about the context of the EDUNET networks. It also helped understand the networks' structure, nodes and ties, as well the various devices relevant for teachers' knowledge dynamics. These are presented and discussed in Chapter 6. In addition, desk research identified three instruments that contain measures relevant to the identified constructs and that have been validated across different countries: the OECD Teacher Knowledge Survey (Sonmark et al., 2017[36]), a teacher collaboration instrument by Grasel et al. (Grasel et al., 2007[332]) and the "Teachers' Research Engagement" instrument by Borg and Liou (Borg and Liu, 2013[333]).

Table 5.3. Constructs within each dimension

Dimensions	Constructs (scales)	Short description	Number of items[1]
Background and demographic questions			
Background		Gender, years of experience, type of school, classes and subjects taught, role in school, etc.	T & SL: 8
Knowledge dynamics (teachers)			
Knowledge mobilisation	Engagement with educational resources	How do teachers engage with various educational resources that are not necessarily linked to research? How frequently do they access such materials, adapt and use them, and validate their quality?	3
	Engagement with research	How do teachers engage with educational research? How frequently do they read research literature, verify its quality, interpret and use it, access and use data sources?	4
	Engagement in research	To what extent do teachers engage actively in research activities? How frequently do they collect and analyse qualitative and quantitative data or conduct action research?	3
	Content	In what areas of teaching and learning do teachers mobilise research knowledge?	5
Knowledge construction	Reflection	How, with whom and on what do teachers reflect regarding their practice?	4
	Instruction	How and with whom do teachers co-construct or co-design instruction?	3
	Innovation	What is the scope of new ideas and projects and who do teachers develop these with?	5
Knowledge diffusion	Diffusion through learning	How do teachers connect to others to share their knowledge and mobilise others' knowledge? What are the platforms and how frequently do they use them?	5
	Mediation of research	How frequently do teachers mediate research to practice by writing syntheses, giving presentations or designing materials based on research?	3
	Dissemination	How frequently do teachers share their knowledge with their colleagues through various means?	7
Network (teachers and school leaders)			
Network context	Goals	How do teachers and school leaders perceive the networks (EDUNET) in terms of their goals?	T & SL: 4
Network ties	Existing ties	With whom and how frequently do teachers collaborate on pedagogical projects?	T: 4
	Tie formation	How has the network (EDUNET) facilitated the formation of new relationships? With whom? Between which organisations?	T: 5 SL: 12 (5+7)
Network devices	Network devices	How do teachers and school leaders perceive the success of network devices in terms of realising specific goals (promoting common professional culture, professional development and innovation)? In what specific devices do teachers participate actively[2]?	5
Organisational and network conditions			
Organisational conditions	Resources	How do teachers perceive the adequacy of resources at the school (materials, financial, time)?	T: 3
	Culture	How do teachers perceive the professional learning culture of the school (support from management, opportunities, recognition)?	T: 4
Network conditions	Resources	How do school leaders perceive the adequacy of resources at the school (human, financial, time)?	SL: 3
	Culture	How do school leaders perceive the network culture in terms of trust, shared objectives and governance?	SL: 5

Note 1: T: number of items in teachers' questionnaire; SL: number of items in school leaders' questionnaire.
Note 2: These items are part of the mediation of knowledge dimension in the teachers' questionnaire.

Based on the review of literature and the exploratory phase, I identified relevant constructs of each dimension to be measured (Table 5.3), and developed a draft questionnaire by adapting existing instruments and developing new items. Because existing instruments were available in English and because this is the language of the thesis, most items were developed in English and translated to French. Some background questions were borrowed from the TALIS survey of the OECD, and thus a validated French translation was available. A number of questions in the network component relating specifically to the EDUNET networks were developed by a co-researcher, Fabian Harel, who intended to conduct research for his master's thesis in the same region on a strongly related topic. As the target group was the same, we integrated our questionnaires in one survey to maximise response numbers and minimise effort required from school leaders and teachers. His research was published as a master's thesis in 2019 based on the first data collection wave (see section below) (Harel, 2019[334]).

The item development process took into consideration the main requirements of a valid and reliable questionnaire based on survey methodology:

- Respondents must understand the question consistently the way the researcher intended (i.e. in line with the target construct).
- Respondents must have and be able to retrieve information needed to answer the question.
- Respondents must be able to turn relevant information into the required answer format.
- Respondents must be able to and willing to provide the answer as required (filling in the form) (de Leeuw, Hox and Dillman, 2008[335]).

Regarding the vocabulary, while some technical words were inevitable, I tried to make sure that these are known to teachers or that the item gives sufficient examples to make the term clear. Some of the technical terms were derived from the exploratory research (e.g. local training initiatives and knowledge sharing workshops are specific devices of the EDUNET networks that the target population should be familiar with). All questions that relate to participating in a certain activity were limited to the last 12 months. A given time frame specifies the boundaries for respondents to think about, and helps the researcher to interpret the answers (de Leeuw, Hox and Dillman, 2008[335]). Items do not include implicit assumptions about the respondent's situation, and do not ask multiple questions at the same time. One exception to this latter is the knowledge construction construct, in which the items had two response scales, one referring to involvement with teachers from the same school and the other one to involvement with teachers and partners from other institutions. The two response scales made it possible to separate the two questions included in these items. As all questions relate to teachers' and school leaders' own practice or their perception of certain aspects, respondents have the relevant information available.

The vast majority of items are closed-ended questions with an ordered response scale (Groves et al., 2004[330]). Only when the option "other" is available, did I include open-ended questions ("please specify"). The following response scales were used:

Direct rating with frequency scales – Never, Rarely (1-4 times a year), Sometimes (5-9 times a year), Regularly (1-3 times a month), Almost always (Once a week or more) – that refer to respondents behaviour such as participating in certain activities during the past 12 months. Survey methodologists suggest that frequency scales should not include any specific assumption of regularity (de Leeuw, Hox and Dillman, 2008[335]). Using only labels (e.g. rarely, sometimes) allows for very different interpretations of what that label means, so these were specified with quantifiers. One important limitation of such a frequency scale is that it cannot capture the intensity of activities. For example, a teacher may only read research literature once a year but then for two entire weeks (e.g. during summer holidays). This limitation should be considered when interpreting the data and potentially captured through qualitative interviews.

Indirect rating with agree-disagree scale – Strongly disagree, Rather disagree, Rather agree, Strongly agree, (in some cases) I don't know – to assess respondents' perception of statements containing a quality judgement. Despite some arguments that warn against using agree-disagree scales such as acquiescence response bias, increased cognitive demand and lower quality data (de Leeuw, Hox and Dillman, 2008[335]), they are still popular in social science research for a number of practical considerations (Revilla, Saris and Krosnick, 2014[336]). It is easier both to prepare and design the questionnaire, and to administer it with an item-battery format rather than as a set of separate questions. As labelling categories rather than just numbering them has been found to yield more consistent rating, separate questions would require a separate scale with a distinct set of labels for each question. This may extend the time required to answer the questionnaire and would require additional cognitive demand from respondents. As a result, I opted for using an agree-disagree scale that can be implemented in an item-battery format.

The number of categories in response options needs to strike the balance between ensuring appropriate discrimination between respondents and ensuring that respondents can distinguish between categories reliably (Groves et al., 2004[330]). Some studies suggest that a five to seven-point scale is optimal (Groves et al., 2004[330]; de Leeuw, Hox and Dillman, 2008[335]). For frequencies, a 5-point scale includes sufficient discrimination while allowing for meaningful labelling. However, agree-disagree scales tend to behave differently. One study found that two-point agree-disagree scales have better qualities than 5-point scales (Alwin and Krosnick, 1991[337]), and another study comparing 5-point scales with longer scales found that the former yield better data quality (Revilla, Saris and Krosnick, 2014[336]). The disadvantage of 5-point scales is that they contain a middle category (e.g. "neither agree nor disagree"). I chose to implement a 4-point scale forcing respondents to either agree or disagree. This scale can be reduced to a binary scale in data analysis by aggregating strongly (dis)agree and (dis)agree responses, and it can also be reduced to a 3-point scale by aggregating the middle categories and interpreting them as hesitant or less clear answers. For one question (a set of seven items to measure organisational conditions) I used a five-point scale adding "I don't know", simply because six of these seven items were adopted from a validated questionnaire. Using the same response format will allow for comparing data obtained by researchers who developed this question.

Only one question referring to the volume of content teachers engaged with (knowledge mobilisation / content) used a direct rating with a four-point evaluation scale (Not at all, To some extent, A fair amount, A great deal).

A reliable questionnaire also means that respondents are willing to provide the true answer. Neither the teacher, nor the school leader questionnaire contain particularly sensitive questions that respondents may feel unwilling to answer because of real risks of disclosure. Nevertheless, it is important to reassure respondents that they are free to express their true opinion and the data will not be used against them. The introduction to the questionnaire included information about data processing, ownership and anonymity in line with the European General Data Protection Regulations. A more important threat to reliability is social desirability bias, i.e. respondents' natural desire to present a good image of themselves to others (de Leeuw, Hox and Dillman, 2008[335]). Social desirability bias is less important when answering computer-based questionnaires as opposed to responding to interviewers (de Leeuw, Hox and Dillman, 2008[335]). Nevertheless, this type of bias can be present for questions that ask teachers to report on their behaviour. For example, teachers will be less likely to respond that they never engage in an activity that is generally considered or that they perceive to be "desired practice" (e.g. engagement in research and collaboration). Carefully chosen response options can reduce such bias. This has been shown to be true with frequency scales in which respondents may perceive more or less frequent behaviour more or less socially acceptable. To counter-balance such bias, the questionnaire contained precise frequencies (e.g. never, 1-4 times a year, once a week or more etc.) rather than just quantifiers such as rarely, sometimes. Nevertheless, the distribution of responses to these questions should be analysed for potential bias.

The last and perhaps most challenging aspect of developing these questionnaires was ensuring optimal length to mitigate effects of individual questions on item nonresponse and early dropout (termination of questionnaire) (de Leeuw, Hox and Dillman, 2008[335]). Teachers and school leaders are known to suffer from survey fatigue due to the increasing amount of surveys administered to these groups. Throughout the development process, several items were dropped to reduce questionnaire length. The survey platform allowed for defining conditions for certain questions (for example, a question on the EDUNET networks only appeared if the respondent answered they were aware of these networks to a previous question), thus further reducing the length of the questionnaire for individual respondents. In addition, I decided to design a short questionnaire to school leaders who need to accomplish high amounts of administrative tasks (OECD, 2020[37]). Although it would have been relevant to collect data on school leaders' perception of teachers' knowledge dynamics, this component – being the most extensive – was not included in their questionnaire. Instead the school leader questionnaire focuses on the network dimension.

Testing the questionnaire

Survey methodology literature generally describes three stages of testing: the developmental stage, the question testing stage and the dress rehearsal stage (de Leeuw, Hox and Dillman, 2008[335]). The developmental stage corresponds to the exploratory phase described above. The question testing

stage involves testing the already developed survey questions individually or the full draft questionnaire, whereas the dress rehearsal stage has the objective of testing survey procedures in real conditions on a larger sample size (de Leeuw, Hox and Dillman, 2008[335]). This latter is not relevant for a doctoral research, however the question testing stage is necessary to ensure that all questions meet the requirements of good questionnaire and to ensure a good flow of the questionnaire as a whole (idem.).

The testing phase involved sharing the draft questionnaires with a number of people with diverse and relevant backgrounds. The draft questionnaires were shared with nine people who were given a number of specific review questions and tasks (Table 5.4).

Table 5.4. Questionnaire review: experts, review questions and feedback

	Background / role	In what form was the questionnaire shared?	Review questions / tasks	Type of feedback
P1	Thesis supervisor	Excel	Are the questions relevant and understandable? How to shorten the questionnaire (identify items that are superfluous, less relevant)? What is missing? Verify translation A number of item-specific questions related to terms, etc.	Overall feedback on content Item-specific feedback related to terms and translation Missing areas
P2	Survey expert	Excel	Are the questions relevant and understandable? Are the scales coherent in terms of content? What is missing? How to shorten the questionnaire? A number of item-specific questions related to terms, etc.	Item-specific feedback
P3	Coordinator of EDUNET	Excel	Does it meet your expectations (in terms of what would be useful to better understand the learning context / dynamic of professional knowledge in the EDUNET networks)? Will teachers be able to answer the questions? If not, why/what not? What is missing?	General feedback and help (e.g. provision of information about schools)
P4	Coordinator of EDUNET	Excel		
P5	School leader, co-researcher[1]	Excel & Survey	Are the background questions relevant and understandable for the target group? What response format would you prefer for the EDUNET network-related questions?	Item-specific feedback on background questions Feedback on response format
P6	Teacher	Survey	Are the questions clear and easy to understand? Was it easy to answer them? Is any of the information requested sensitive? Would you have liked to add something that you weren't able to say (e.g. there was no appropriate category)? Were there any technical problems with the survey platform?	General feedback Item-specific feedback Feedback on response time (recorded by the survey platform and commented)
P7	Teacher	Survey		No response received
P8	Teacher	Survey		General feedback on questionnaire length and clarity
P9	Educator	Excel & Survey	Verify translation Test the survey platform and identify technical problems	Item-specific feedback on translation Feedback on survey platform

Note 1: Some of the EDUNET network-related questions were developed by a co-researcher conducting his master's thesis research in the same region on a strongly related topic.

The questionnaires were revised in several stages integrating the feedback received. Revision included rephrasing items, dropping and adding items and occasionally changing response format. The testing of the survey platform also led to the optimisation of the survey structure. The final questionnaires are included in Annex A.

5.3.3. Data collection

Data collection took place through online questionnaires (one for teachers and one for school principals) designed with the Limesurvey software provided free of charge by the University of Strasbourg. The rector of the Academy of Bel-Mondo agreed and gave his support to conduct the survey. The two central co-ordinators of the EDUNET networks at the Academy provided support for data collection. In particular, the main co-ordinator sent out the request to fill in the questionnaires and their links on behalf of the Academy. She also sent out reminders as I requested. The questionnaires were sent directly to school principals of lower and upper secondary schools, and the inspectors responsible for kindergartens and primary schools. The advantage of this method is that in the centralised French education system, the Academy is an important authority and school leaders are required to take their instructions seriously. The Academy has a valid email address to all school leaders and these cannot filter out official messages. The full school leader population received the link to the school leader questionnaire and were asked to forward the link to the teacher questionnaire to all teachers teaching in their school(s). No coverage error occurred for school leaders, because the sampling frame included the entire population (Groves et al., 2004[330]). Unfortunately, it is difficult to estimate coverage error for teachers. Some school principals may not have forwarded the link to the questionnaire to some teachers or the entire teaching staff.

To reduce coverage and nonresponse error in the teaching population, and nonresponse in the school leader population, several measures were taken. First, the data collection window was agreed with the Academy to suit teachers' schedules and avoid busy periods. Second, reminders were sent to school leaders including the link to their questionnaire, as well as the instructions to forward the link to teachers. Originally, the data collection window was planned to be 3-4 weeks in May 2019 with one or two reminders after 1 and 3 weeks. However, unfortunately the first vague of responses would not have been sufficient to conduct robust analysis, a relaunch was thus necessary. A second wave of data collection took place in November – suggested by the Academy as a suitable period for teachers. Unfortunately a reminder could not be sent out early December due to the massive inter-professional strike happening in France in which teachers were heavily involved. Again, in agreement and with the support of the Academy, the central coordinator asked the four county-level coordinators of EDUNET to relaunch the data collection one final time in January 2020, with a last reminder asked to be sent on the 20th January. In addition to the several reminders, county-level coordinators of EDUNET were asked to promote the questionnaire in their counties. The survey was finally closed on 31st January 2020. The three waves are depicted in Figure 5.3, which shows the number of responses per month.

Figure 5.3. Number of responses per month and per data collection wave – Teachers

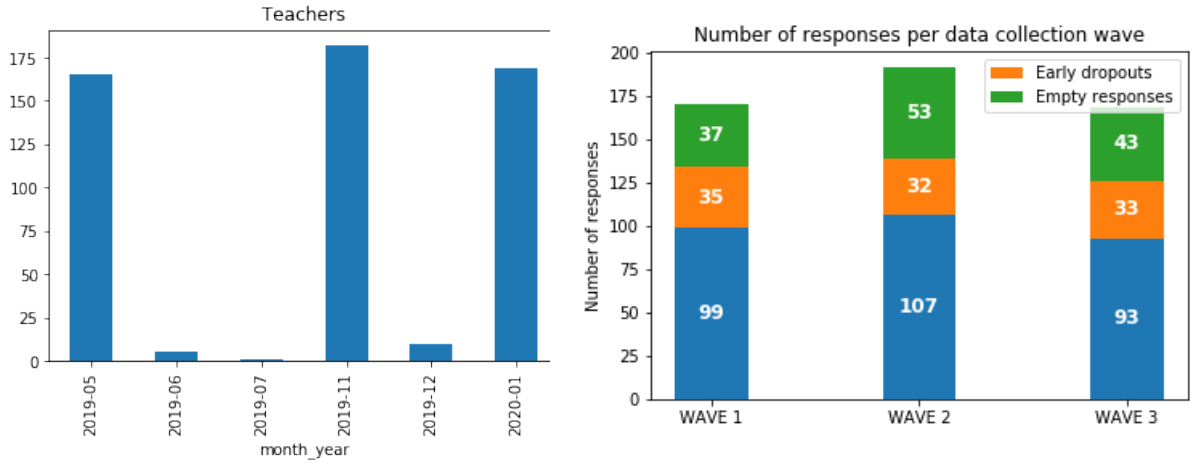
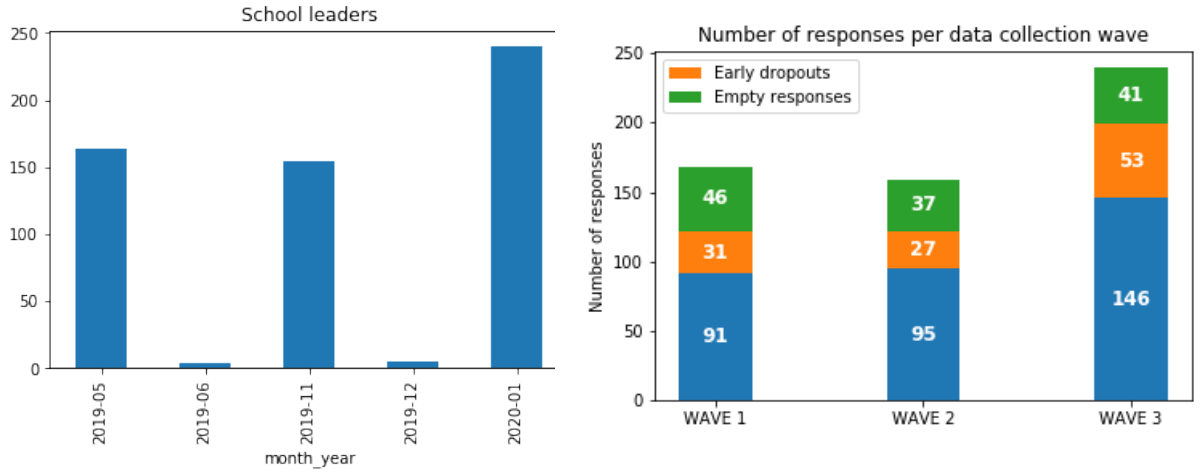


Figure 5.4. Number of responses per month and per data collection wave – School leaders

Figure 1.7.a.

Figure 1.7.b.



Notes: Data collection waves:
Wave 1 = [2019-05-06; 2019-07-03]
Wave 2 = [2019-11-11; 2019-12-12]
Wave 3 = [2020-01-06; 2020-01-31]. There were no responses in between these periods.
Dates are based on the datestamp, which is the last manipulation of the survey. If the survey was submitted this is the same as submission date.
The meaning of early dropouts and empty responses is explained in the next section.

In order to determine whether data in the three waves can be analysed as one database, I ran an ANOVA test for all content variables (these are all frequency and rating scales, therefore categorical variables, and a few binary variables) across the three waves. The null hypothesis under this test posits that the means are not significantly different across the groups. ANOVA resulted in a significant p value (<.01) for only 1 variable in the teacher dataset (KD55) and 1 variable in the school leader dataset (EC3.1). In these cases, the null hypothesis is rejected, implying that the means are significantly different across groups. These two variables are worth paying attention to in the analysis, and if necessary provide a

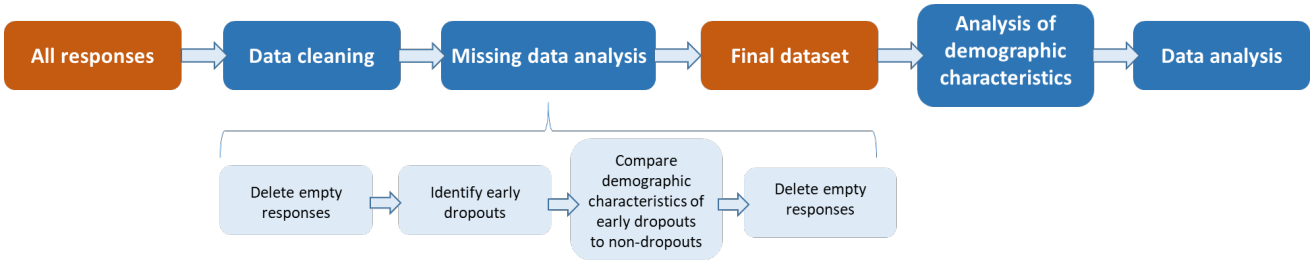
description per wave as well. Overall, both the teacher and the school leader datasets can be considered as one single dataset each.

5.3.4. Data processing

The main steps of data processing are depicted in Figure 5.5. I used Python 3 (version 3.7.6) (Van Rossum and Drake, 2009[338]) for data cleaning, database manipulations and some of the analyses. In particular, the following packages were used frequently: pandas (version 1.0.1), numpy (version 1.18.1), scipy (version 1.4.1), matpotlib (version 3.1.3).

Data cleaning started with recoding the variables so that they have a suitable form for analysis (e.g. float, integer, etc.). A new variable was created for the school's identification code, combining the codes that, in the raw database were stored as five separate variables depending on the type of school.

Figure 5.5. Data processing



As in all surveys, there was a significant amount of nonresponse. In both the teacher and the school leader surveys these can be split into four distinctive categories. First, those who did not respond at all. Unfortunately, it is not possible to track what such nonresponse is due to (coverage error, had no time or were not willing to respond). Second, some responses were submitted completely empty, i.e. the person opened and then closed the questionnaire without answering any of the items. These were still recorded in the Limesurvey platform. Third, there were a number of early dropouts who only filled in the background and demographic variables, but none of the content questions. Fourth, as in every survey, there are some item nonresponses, i.e. responses with missing values for some items. I adopted different strategies to account for the different types of nonresponses. Empty responses were removed from the database as they contain absolutely no information based on which any imputation would be meaningful.

Similarly, I decided to delete early dropouts too. This is because the main expected predictors in my research are not background variables. The research questions aim to explore relationships between network-related and knowledge dynamics variables, and between scales (dimensions) within these components. While, some background variables, such as years of experience or school type, can have predictive value, the main hypotheses are not related to these. Therefore, imputation would not be meaningful based only on background variables. Strategies for handling remaining missing data (item nonresponse) will be specified throughout the analysis.

Finally, a number of demographic outliers were also identified and deleted from the database. In the teacher dataset there was one single response by a teacher teaching in an adaptive teaching institution; two responses were by pedagogical counsellors in secondary education and one response from a deputy school principal. As these four responses might not reflect the overall teaching population due to their very specific school environment or role, they were deleted for the purposes of the analysis. The data analysis process is depicted in Figure 5.5 and the final sample is described in Table 5.5.

Table 5.5. Response frequency and rate

	Total number of responses recorded in Limesurvey	Number of empty responses (missing values for all variables)	Number of early dropouts (who did not respond to any content question, only demographic variables)	Number of responses analysed (Total – Empty – Early dropouts)	Full population targeted*	Response rate XXX / Full population
Teachers - Total	532	133	100	295**	18870	1.6%
School leaders - Total	567	124	111	332	1905	17%

Note: * Based on regional statistics 2018, teachers of pre-primary, primary and secondary level.
** 4 demographic outliers were also removed.
Source: Population data is based on regional statistics in 2018: (Académie de Bel-Mondo, 2019[339]).

Although the response rate compared to the full population is very low, the number of responses are sufficient to conduct descriptive statistics, correlational and factor analysis as well as regressions in a structural equation modelling framework. Multi-level analysis will not be conducted.

5.3.5. Sample analysis

As part of data validation we compare some key demographic variables to that of the full population to see how representative the sample is of the population both in terms of respondents and schools.

County representation

First, we look at representativeness of schools at the county level in the school leader dataset. There are less schools represented than the number of responses because from a number of schools, several school leaders answered (see details in section 1.4.2). The total number of responses is lower than the school leader sample as not all respondents reported the school code. Table 5.6 shows that the sample is not representative of the counties: County 2 and County 4 are overrepresented, whereas County 1 and County 3 are underrepresented compared to the total proportion of schools in these counties in the Academy. Similarly, in the teacher dataset (Table 5.7), County 2 and County 4 are overrepresented, and County 3 is underrepresented.

Table 5.6. Geographical representativeness of schools in the school leader dataset

Department	Number of schools represented by responses	Number of responses in sample	Proportion of schools per county in sample	Total number of schools in the Academy	Total proportion of schools per county in the Academy	Rate of Schools represented
County 1-16	27	36	10.3%	383	22.6%	7%
County 2-17	131	159	50%	579	34%	22.6%
County 3-79	22	23	8.4%	350	20.6%	6.3%
County 4-86	82	92	31.3%	388	22.9%	21%
Total	**262**	**310***		**1701**		

Note: * The discrepancy between this number and the total number of responses (332) is due to the fact that not all respondents indicated their school code. The county for these respondents was not identifiable.
Source: Population data is based on regional statistics in 2018: (Académie de Bel-Mondo, 2019[339]).

Table 5.7. Geographical representativeness of teachers in the teacher dataset

County	Number of teachers in sample	Proportion of teachers per county in sample	Total number of teachers in the Academy	Proportion of teachers per county in the Academy
County 1-16	56	19.3%	3652	19.4%
County 2-17	116	40%	6565	34.8%
County 3-79	29	10%	3776	20%
County 4-86	89	30.7%	4877	25.8%
Total	**290***		**18870**	

Note: * The discrepancy between this number and the total number of responses (295) is due to the fact that 5 respondents indicated an invalid school code. The county for these respondents was not identifiable.
Source: Population data is based on regional statistics in 2018: (Académie de Bel-Mondo, 2019[339]).

School level representation

Overall, school leaders are well represented in the dataset, however the secondary level is proportionally more highly represented than the primary level (Table 5.8). While the response rate for teachers is globally low, we can see that the primary and secondary levels are almost proportionally represented to the Academy's population, with the secondary level slightly more highly represented (Table 5.9).

Table 5.8. Representativeness of school levels in the school leader dataset

	Number of responses in sample	Share of school levels in sample*	Total number of school leaders in the Academy	Share of school levels in the Academy*	Response rate per school level
Kindergarten	56				
Primary school	131				
Inspector - Primary level	21		57		37%
Total primary level[1]	**208**	**62.7%**	**1527**	**80.7%**	**14%**
Lower secondary school	89	71.8%	247	65.3%	36%
Upper secondary school	32	25.8%	128	33.9%	25%
Adaptive teaching school	3	2.4%	3	0.8%	100%
Total secondary level [2]	**124**	**37.35%**	**378**	**19.8%**	**33%**
Total	**332**		**1905**		**17.4%**

Note: Grey cells indicate that there was no data available.
1. Primary level in France includes kindergartens and primary schools.
2. Secondary level in France includes lower and upper secondary schools, adaptive teaching institutions
* Number of school leaders in lower- and upper secondary schools, and adaptive teaching schools are compared to all secondary level school leaders.

Source: Population data is based on regional statistics in 2018: (Académie de Bel-Mondo, 2019[339]).

Table 5.9. Representativeness of school levels in the teacher dataset

	Number of responses in sample	Share of school levels in sample	Total number of school leaders in the Academy	Share of school levels in the Academy	Response rate per school level
Kindergarten	35				
Primary school	80				
Total primary level[1]	**115**	**39%**	**8353**	**44.3%**	**1.4%**
Lower secondary school	126				
Upper secondary school	54				
Adaptive teaching school	0				
Total secondary level [2]	**180**	**61%**	**10517**	**55.7%**	**1.7%**
Total	**295**		**18870**		**1.6%**

Note: 1. Primary level in France includes kindergartens and primary schools.
2. Secondary level in France includes lower and upper secondary schools, adaptive teaching institutions

Source: Population data is based on regional statistics in 2018: (Académie de Bel-Mondo, 2019[339]).

Gender representation

Table 5.10 shows that in terms of gender, the teacher sample can be regarded as representative of the teacher population in France. In the school leader sample, women are slightly underrepresented at the secondary level. The overall representation is not fully comparable to national data because this latter does not include primary school principals who also have teaching responsibilities.

Table 5.10. Gender distribution in samples versus full population

	Number of female in sample	Number of male in sample	Number of "Doesn't wish to communicate" in sample	Share of female in sample	Share of female in the Academy
Teachers primary[1]	98	16	1	85.2%	83%
Teachers secondary[2]	107	71	2	59.4%	58.8%
Teachers	**205**	**87**	**3**	**69.5%**	**70.8%**
School leaders primary (including inspectors)	167	43	1	79%	No data available
School leaders secondary	48	72	1	40%	45.5%
School leaders	**215**	**115**	**2**	**65%**	**53.5%***

Note: 1. Primary level in France includes kindergartens and primary schools.
2. Secondary level in France includes lower and upper secondary schools, adaptive teaching institutions
Source: Population data is based on regional statistics in 2018: (Académie de Bel-Mondo, 2019[339]).
Share of female overall was only available in national statistics for the 2018-2019 academic year (Ministère de l'Education Nationale de la Jeunesse et des Sports, 2020[340]). For the primary level only school principals without teaching responsibility are included. Therefore population data is not fully comparable to the sample.

Years of experience representation

Figure 5.6 and Figure 5.7 show that the distribution of primary and secondary level teachers by years of experience does not entirely correspond to that of the population. In particular, it seems that new teachers with less than 5 years of experience are somewhat underrepresented in the sample. The mean years of experience is higher in all cases than in the overall population. This must also be taken into account in the analysis.

Figure 5.6. Distribution of teacher sample based on years of experience

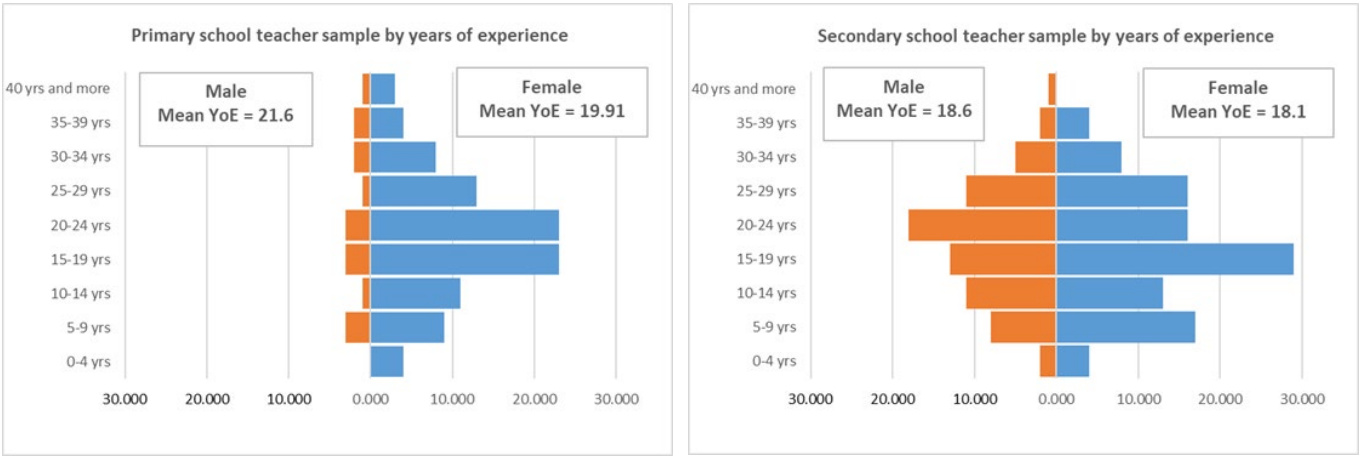


Figure 5.7. Distribution of the teacher population by years of experience in France

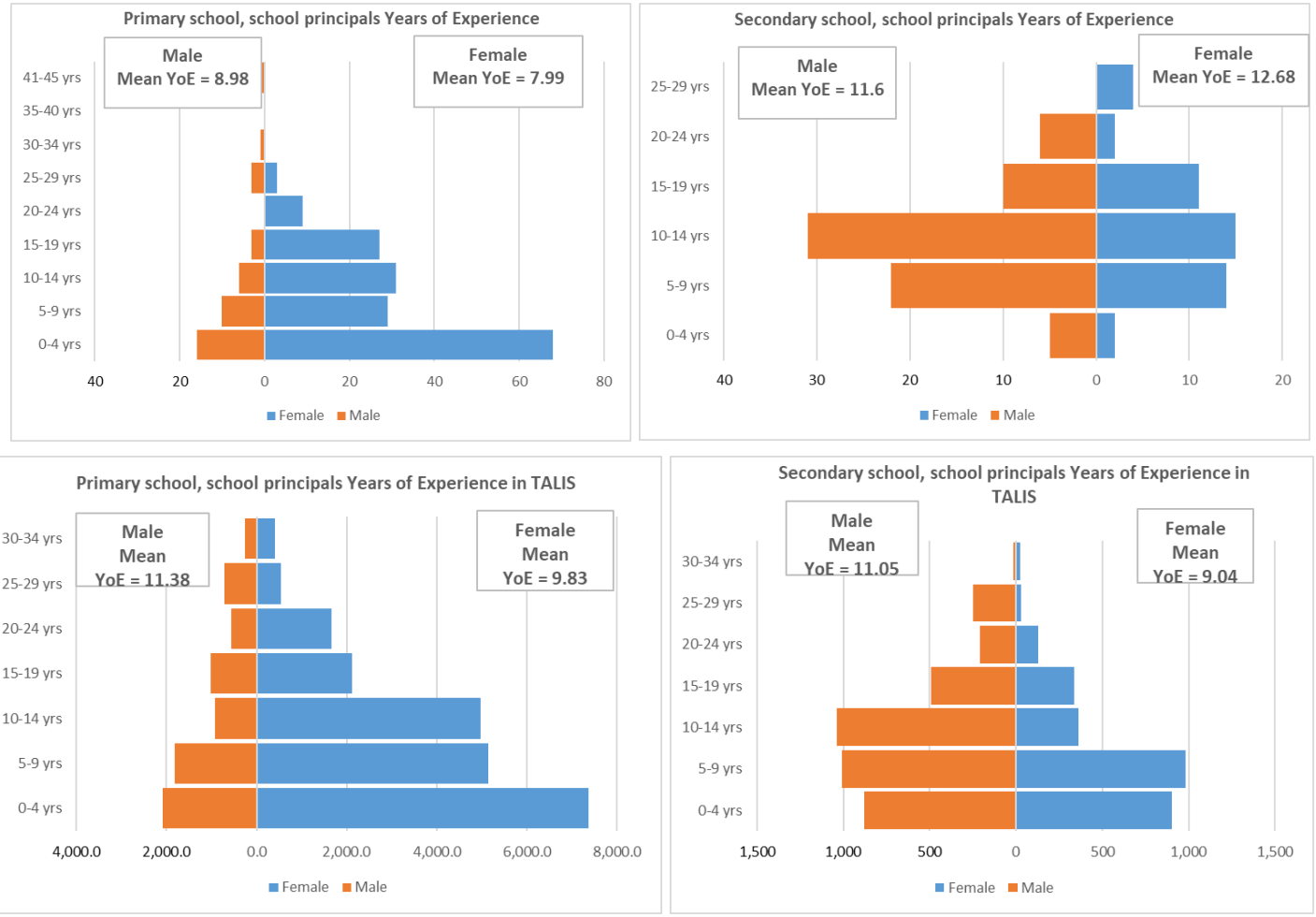
The left figure is a pyramid based on years of experience of primary school teachers. On the right it represents male teacher's YoE, with mean: 17.7 years. On the left, it represents female teachers' YoE, with mean: 15.8 years.

The right figure is a pyramid based on years of experience of secondary school teachers. On the right it represents male teacher's YoE, with mean: 16.7 years. On the left, it represents female teachers' YoE, with mean: 16.3 years.

Note: On the left: Primary level teachers by years of experience / On the right: Secondary level teachers by years of experience
Male in orange, Female in blue
Source: (Ministère de l'Education Nationale de la Jeunesse et des Sports, 2020, p. 3[341]).

Unfortunately, no national data is available on the years of experience of school leaders in France. The OECD TALIS survey is based on a representative sample, and can therefore be used as a basis of comparison (Figure 5.8). Primary school principals' mean years of experience is lower in the sample than in the representative sample of TALIS, and female principals with 5-15 years of experience are slightly underrepresented. However, the distribution is overall quite similar. At the secondary level, both male and female new principals with 0-5 years of experience are underrepresented.

Figure 5.8. Distribution of school leader sample based on years of experience



Note: Secondary level in TALIS includes only lower-secondary schools, while in the sample of this research also upper-secondary schools.
Source: Calculation based on OECD, TALIS 2018 Database.

5.4. Analysis methods

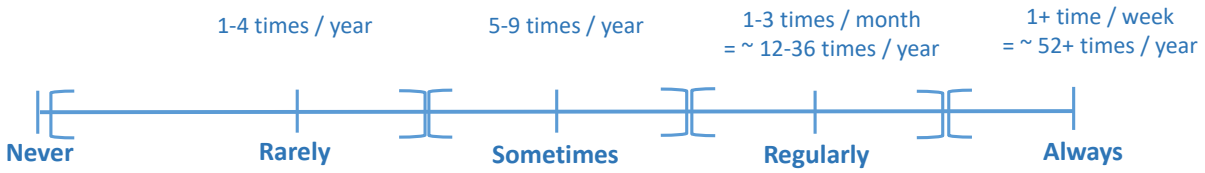
5.4.1. Descriptive statistics

As the questionnaire contains different types of measures, relevant descriptive statistics need to be selected for all. Both rating ("agree-disagree") scales and frequency ("how frequently") scales are ordinal variables. As such, they can best be described using frequency tables that include the counts and relative frequencies in the different categories, as well as the number of missing values. The mode and the median can be used as central tendency measures for all ordinal variables.

Whether likert scales can be regarded as interval variable or not has been largely debated. An interval variable is defined by an underlying metric, and the distance among the values are known. In the case of an ordinal variable, the distance between the values is not clearly defined, and is thus not necessarily the same. Some researchers suggest that classical arithmetic operations should not be

performed on categorical data, and for example, the mean and standard deviation are only meaningful on interval variables, and only non-parametric statistics should be used [e.g. (Jamieson, 2004[342])]. However, others argue for considering Likert scales as continuous interval variables and suggest that it makes sense to compute mean values [e.g. (Wu and Leung, 2017[343]; Norman, 2010[344])]. Recent simulation studies tend to converge towards considering likert scales as continuous when the number of points is high enough (7-11). However social research still often considers 4 and 5 point likert scales as interval variables and uses a range of parametric statistics.

Figure 5.9. Frequency scale as interval



The frequency scales used in my study have a relatively well defined underlying metric (how many times a year), although the distance between the values is not exactly the same, and there are only 5 value points (Figure 5.9). Because of the existing metric, for this type of scale it makes sense to report on the mean and standard deviation. For agree-disagree scales, due to the lack of metric and the small number of value points, these will not be reported.

Analysing relationships between variables often requires that the data is normally distributed, i.e. unimodal and symmetric. Again, for ordinal variables, normality cannot be interpreted in a straigthforward manner, and non-parametric (i.e. distribution-free) statistics are more relevant (Sheskin, 1997[345]). Similarly to the above, for frequency scale variables I will describe the distribution of values, using measures of skewness and kurtosis. Skewness shows how symmetric the data is: positively skewed data deviates from the symmetry “to the right” (i.e. has a higher frequency of higher values), while negatively skewed data deviates “to the left” (more lower values). Kurtosis indicates how pointed the distribution curve is (although we cannot speak of curve for ordinal variables): a positive value indicates that the distribution is sharper, a negative value shows a flat distribution (Sheskin, 1997[345]).

For basic relationship (dependence) analysis between categorical variables, contingency tables will be used with the appropriate statistical tests to determine if a distribution of observed frequencies differs from the theoretical expected frequencies:

- Pearson’s Chi square (test of independence): A measure of association dependent on the sample size.
- Cramer’s Phi: A measure of association designed for 2 × 2 contingency tables (i.e. between two binary variables) independent of the sample size. Phi is a chi-square based measure, but eliminates the sample size (Phi = sqrt(Chi-square / n)). It ranges between 0 (no relationship) and 1 (perfect relationship).

- Cramer's V: A measure of association for larger than 2 × 2 tables (i.e. at least one of the variables have more than two categories) independent of sample size. V ranges between 0 (no relationship) and 1 (perfect relationship).

The rule of thumb used to determine the significance level is much debated in the literature. A general rule of thumb of a p-value < .05 will be reported (indicated by *), while p < .01 (indicated by **) and p < .001 (***) will be considered as strongly significant throughout the analysis.

5.4.2. Factor analysis

To examine whether the constructs established to characterise the various dimensions of knowledge dynamics are well captured through the questionnaire, item analysis with descriptive statistics, scale analysis and a test of the structural validity of scales with factor analysis will be conducted. Exploratory factor analysis (EFA) is generally used for new instruments and when there are no purposefully developed underlying constructs. On the other hand, confirmatory factor analysis (CFA) is used when the complete factor model is pre-specified, either to confirm a formerly validated structure or a solid conceptual model (Gerbing and Hamilton, 1996[346]).

In this doctoral research, although some items have been borrowed from already existing validated questionnaires, the way they are combined is new, and a considerable number of new items has been added. For this reason, exploratory factor analysis is meaningful to compare the theoretical structure with the structure emerging from the empirical data. Confirmatory factor analysis can also be used to validate the model and improve fit if necessary. To benefit from the respective advantages of both methods, Gerbing and Hamilton suggested a two-step mixed exploratory-confirmatory method (Gerbing and Hamilton, 1996[346]). Other researchers argue that this method generates bias and overfit, and CFA cannot be conducted on the same data, only on a different dataset as a way of cross-validation [e.g. (Fokkema and Greiff, 2017[347])]. Some social research, inlcuding in the domain of education, does follow the two-step method [e.g. (Thoonen et al., 2011[348])]. While only using CFA would be possible in this thesis, it is meaningful to examine the suitability of the data for factor analysis with an instrument that is primarily new. Therefore, I will follow the recommendation of Gerbing and Hamilton, and use EFA as a preliminary step. (EFA results are not reported, however can be provided based on demand.) CFA is used as a second step to examine the model and improve fit if necessary.

As all items are likert-scale type (measured on 5- and 4-point scales), those analysis options were selected that best suit ordinal data. Research has shown that the Pearson correlation coefficient underestimates the relationship between two variables that present skewed distribution of observed responses and, for such data, tetrachoric or polychoric correlations yield better estimates (Gadermann, Guhn and Zumbo, 2012[349]). The factor analysis is thus based on polychoric correlations that assume that the variables are ordered measurements of an underlying continuum, and are not continuous and do not need to be normally distributed (Şimşek and Noyan, 2012[350]). This solution suits best likert-type data typically used in social sciences (Muthén, 1993[351]). Jöreskog and Sörbom developed an estimator

specifically suited for non-normal data and smaller sample sizes: the diagonally weighted least squares (DWLS) estimator (Gana and Broc, 2019[352]). I will fit the models using lavaan version 0.6-6 (Rosseel, 2012[353]) in R version 4.0.2 (R Core Team, 2020[354]). In lavaan the WLSMV estimator is a robust version of the DWSL method that gives corrected estimates, improving the solution outcomes, such as the standard errors, χ^2 and fit indices (Gana and Broc, 2019[352]). I will use standardised latent factors, allowing free estimation of all factor loadings.

The model chi-square is the fit statistic of the estimation method used to estimate the parameters. However, this statistic is highly sensitive to the sample size, and the null hypothesis – i.e. that the specified model fits the data – was rejected too often for larger sample sizes (Gana and Broc, 2019[352]). Therefore a number of other indices were developed to evaluate the model. These can be clustered in three major categories of statistics (Gana and Broc, 2019[352]). First, absolute fit indices compare the observed variance-covariance matrix with that based on the theoretical model. Second, parsimonious fit indices show the originality taking into account the parsimony of the theoretical model. Finally, incremental fit indices compare the specified model to models that are nested within it (i.e. that are special cases of the given model). In social research it is recommended to report at least one fit index in each of these three groups. In line with this, I will report on the following goodness-of-fit statistics:

- Comparative Fit Index (CFI): incremental fit index
- Standardised Root Mean Squared Residual (SRMR): absolute fit index
- Root Mean Squared Error of Approximation (RMSEA): parsimonious fit index – reported with 90% confidence intervals (Hu and Bentler, 1999[355]; Byrne, 2005[356]).

The most often used cut-off values indicating a relatively good fit between the hypothesised model and the observed data are those determined by Hu and Bentler: .95 for CFI (as well as other similar indices such as the Tucker-Lewis Index) close to .08 for SRMR and close to .06 for RMSEA (Hu and Bentler, 1999[355]). It is however important to emphasise that these cut-off values were determined for the maximum likelihood (ML) estimator used for continuous variables (Xia and Yang, 2019[357]). Xia and Yang showed that the fit indices produce better values for the DWLS estimator than for ML, and thus the conventional cut-off values may not detect misfit of model for categorical ordered data. Unfortunately, to date, there is no valid method (indices and cut-off values) to ascertain fit for categorical ordered data. The authors suggest that fit indices are used as one indicator showing that the model improvement is successful rather than the only justification. This should be complemented with other explanations and considerations of alternative options before a model is accepted as the final one (Xia and Yang, 2019[357]). Lacking recommended cut-off values for the DWLS estimator, I will use the Hu and Bentler rules of thumb with the caution raised by Xia and Yang.

Finally, another set of indices, called modification indices, identify the parameters that would improve model fit when added to the model. Changing the model based on modification indices is controversial because it may betray the original theoretical assumptions and indeed compromise the

confirmatory approach (Gana and Broc, 2019[352]). However, it can be meaningful to use modification indices to improve the model, particularly in an exploratory study such as my research on certain conditions. First, a suggested parameter should only be added to the model if it is in line with what can be conceptually assumed based on theories. Second, a step-wise approach is recommended, in which one parameter is added to the model at a time. The modified model is re-estimated, and if it still does not show good fit, an additional parameter based on the newly estimated first modification indices can then be added – again, if in line with the theoretical assumption. In order not to fall in the trap of overfitting a model, I will use maximum two steps.

5.4.3. Scale reliability

Once a model has been confirmed through CFA, the reliability of each scale needs to be examined in terms of internal consistency. Internal consistency refers to the consistency between the items of a construct, i.e. the extent to which respondents tend to respond to those items in a similar way. The standard measure of internal consistency is Cronbalch Alpha, however that is based on Pearson correlations, which – as mentioned above – may not be well-suited for skewed data and ordinal variables. Instead, ordinal alpha based on polychoric correlations is recommended to be used for this case (Gadermann, Guhn and Zumbo, 2012[349]). While there is no clear cut-off value to determine good reliability, most psychometric studies consider alpha values greater than .7 as acceptable and greater than .8 as good (Kline, 1999[358]). However, researchers also draw the attention to the potentially problematic nature of too high alpha values (e.g. greater than .95), as such values may suggest that the items measure almost the same aspect of the construct (Hair et al., 2019[359]).

In this thesis, I will use the psych package of R to compute ordinal alpha values and report on the following:

- Summary statistics: raw alpha value (Ordinal alpha), std.alpha (similar to raw alpha), Guttman's lambda 6 (calculated from the squared multiple correlation or 'smc'), average inter-item correlation, mean of the scale, standard deviation of the scale.
- Alpha drop values for each item: same values as in the summary statistics if the item is dropped from the scale. These values indicate whether reliability improves when dropping an item.
- Item statistics: raw score (correlation between the item and the total score from the scale), item-total correlation without that item itself (item-rest correlation), item-total correlation corrected for item overlap and scale reliability (Revelle, 2021[360]).

5.4.4. Structural equation modelling

To examine relationships between different constructs, I will use structural equation modelling (SEM), which allows for quantifying the dependence of certain variables or constructs on others by combining confirmatory factor analysis and linear regressions (Schreiber et al., 2006[361]). The first

application of SEM in sociology dates back to the 1960s and has become increasingly popular in the past decades (Tarka, 2018[362]). Gana and Broc (2019[352]) point out that SEM is a comprehensive and flexible approach to multivariate analysis. It is comprehensive because it is able to combine factor analysis and multiple regression analysis. It is flexible because it can determine the direct and indirect effects of variables and estimate the parameters of complex models (Gana and Broc, 2019[352]). Indeed, a great advantage of SEM is that it allows for integrating both latent constructs and single items in one model either as predictors (exogenous variables) or as outcomes (endogenous variables), these are called hybrid models (Gana and Broc, 2019[352]).

The SEM approach is suitable for an exploratory research, because it is able to identify multiple relationships between complex constructs. Although SEM is able to integrate factor analysis, the exploratory nature of my research justifies a two-step approach, in which I first run confirmatory factor analysis as described above, and once the latent constructs are established, I use them to analyse relationships through SEM. I will use the same package, lavaan 0.6-6 package of R (Rosseel, 2012[353]), and the same methods (DWLS estimator for ordered categorical data) as for the CFA described above. I report only significant regressions (*: p< .05; **: p< .01, ***: p< .001) with the standardised coefficients, which allow for making inferences about the relative strength of relationships (Lefcheck, 2019[363]). However, as advised in SEM literature, the unstandardised coefficients are also included in Annex B and C along with all statistical parameters.

It is important to mention the limitation of the above methods in view of the sample size. Research has suggested several rules of thumbs with regards to the sample size required to perform factor analysis and structural equation modelling. For simple models a minimum of 100, 150 or 200 responses were suggested by different researchers (Gana and Broc, 2019[352]), which suggests that both datasets used in this thesis are satisfactory. Another rule of thumb defines minimum sample size in view of the complexity of the model: minimum five times more respondents than the number of free parameters for the maximum likelihood and the generalised least square estimators, and ten times more for distribution-free estimation methods (Gana and Broc, 2019[352]). A too small sample size can cause non-positive definite covariance matrices causing the estimation to fail. For this reason, it will not be possible to run one single highly complex model in this research. Both for factor analysis and for structural equation modelling, it is more appropriate to run several models separately. The sample size is an additional justification for using the two-step (first CFA then SEM) approach, as the SEM models may contain latent constructs from different dimensions, which could not be evaluated within the same CFA model.

5.5. Social network analysis

Social network analysis can not only capture the social relationships between individuals or organisations, but also allows for their in-depth analysis. A review of research in social network analysis (Borgatti and Foster, 2003[154]) characterises network analytical approaches along the following dimensions:

- Direction of causality: whether it is about the causes or the consequences of network structures.
- Levels of analysis: whether it investigates the dyadic level, actor or network level – (micro and macro level network research are theoretically and methodologically similar).
- Explanatory goals/styles: whether it is directed at modelling variation in performance and other value-laden outcomes, or homogeneity in actor attitudes or practices.
- Explanatory mechanisms: whether it is structuralist (e.g. looks at the configuration of ties) or connectionist (e.g. focuses on resources that flow through social ties).

Social network analysis has developed into a powerful quantitative method to study social processes (Hanneman and Riddle, 2005[364]).

5.5.1. Social network data collection

In constructing the social network questionnaire for school leaders, I originally aimed to implement a full network approach and collect data on ties between schools from all school principals in the region from kindergarten to upper-secondary level. To do this, the Academy provided a database of all schools in the Bel-Mondo region, and a unique code was assigned to each school. Asking every principal to report on all their ties with other schools is however very demanding, particularly if a school has a larger number of connections. Therefore, to map the relationship of a school with other schools, a fixed-choice design was implemented, in which the school leaders were asked to select maximum five other schools (from a list of all schools) with which they have collaborated on pedagogical projects in the past 2 years. This approach is accepted in network research, to make data collection feasible while still obtaining powerful data to describe the social structure of the network (Hanneman and Riddle, 2005[364]). The errors occurring due to missing data in a fixed choice design depend on the degree distribution of nodes and the missing pattern, but if the degree distribution is not too skewed, errors remain relatively small up to certain degree cutoff values (Kossinets, 2006[365]).

The unique school codes can be matched to the regional database obtained from the Academy of Bel-Mondo, which then allows to identify for each school which EDUNET network and administrative district it belongs to.

5.5.2. Social network sample analysis

Unlike other types of social survey research, whole network analysis requires a very high response rate in order to obtain reliable results on the network structure (Borgatti, Carley and Krackhardt, 2008[366]). A widely used rule of thumb is 75% response rate to ensure that main centrality measures remain valid (Borgatti, Carley and Krackhardt, 2008[366]). As discussed above, the response rate in the school leader dataset is very low, and therefore whole network analysis is not possible.

Although the questionnaire was not constructed for ego network analysis, ego networks can be subtracted from the dataset. There are two types of ego-centric networks: with alter connections, i.e.

including responses from the alters of ego, or ego only, with no alter connections (Hanneman and Riddle, 2005[364]). The former allows for understanding a number of important elements of the social structure, such as density, structural holes and brokerage (Hanneman and Riddle, 2005[364]). The latter is not quite network data in the sense that it does not represent an array of ties and does not give information about the macro-structure of the whole network (Hanneman and Riddle, 2005[364]). However it can still provide valuable information on the differences between actors' positions in the network and how these influence their behaviour (Hanneman and Riddle, 2005[364]).

Because the data was not originally conceived for ego network analysis, we need to evaluate the extent to which it is suitable for such analysis. This involves considering the suitability of the data collection method and that of the obtained data. First, ego network data is generally collected through name generation (Crossley et al., 2015[367]). As explained above, this study used a fixed-choice design, which means that egos did not have the chance to report on all their potential alters. However, respondents were asked about the full size of their ego network, i.e. how many schools they have collaborated with on pedagogical projects in the past two years. The data reveals that 80% of respondents have collaborated with maximum 5 other schools, implying that for the vast majority of respondents, the social network data generated through the fixed-choice design can cover their full ego network. Table 5.11 shows the number of alters actually reported in this group. All responses are at least partially consistent in that the number of reported alters is never greater than the full size of ego network reported. Although not all the responses are fully consistent, the vast majority (overall, 94.3%) reported the exact same number of alters as the full size of their ego network.

Table 5.11. Full size of ego network and reported number of alters

Full size of ego network (NW0)	Frequency	Reported number of alters = 0	Reported number of alters = 1	Reported number of alters = 2	Reported number of alters = 3	Reported number of alters = 4	Reported number of alters = 5	% of exact reporting
0	56	56	0	0	0	0	0	100%
1	68	1	67	0	0	0	0	98.53%
2	56	2	5	49	0	0	0	87.50%
3	35	0	0	0	35	0	0	100%
4	15	1	1	0	1	12	0	80%
5	17	0	2	0	0	1	14	82.35%

The target respondents of the questionnaire were school principals. As each school has one principal in France, in theory each response should correspond to one school, and there should be maximum one response representing a school. However, as a result of the three waves of data collection, this one-on-one matching can be violated. School principals could have changed between the waves and the new principal could have responded to the questionnaire indicating a school for which a response already existed. For ego network measures this is problematic, because several networks can exist for the same ego. Altogether there were 42 schools with multiple responses: for 36 schools two responses and for 6 schools three responses were submitted. Unfortunately the design of the questionnaire does not allow

for identifying whether multiple responses reflect a change over time, i.e. a new school principal was appointed, or school leaders with different roles, if for example, the deputy principal and the principal both responded to the questionnaire. For the analysis of perceptions of the network, it is valid to keep multiple responses in the database. However, for analysing ego network measures, only one of the multiple responses should be taken into account, so that for each ego a unique ego network can be associated. Therefore, for ego network analysis a method of deletion had to be applied. This method had to be consistent across all these cases and pre-defined to ensure that each decision taken does not depend on the particular observation. The following deletion method was used:

- First, responses that did not report on any alters were deleted. This ensured to keep data on reported ego networks, where one of the responses did and the other(s) did not report alters.
- From the remaining duplications, the most recent data was kept based on the datestamp of submission. The reason for making this decision is to reflect the latest state of the ego network.

5.5.3. Social network analysis methods

The various ego network measures are summarised in (Table 5.12) and described shortly below based on Crossley and colleagues' "Social network analysis for Ego-nets" book (Crossley et al., 2015[367]).

Table 5.12. Ego network measures

Measure	Description	Ego-alter ties	Alter-alter ties	Attributes
Tie central tendency	Total number or mean of ties	X		
Tie dispersion	Distribution or variation of ties	X		
Alter central tendency	Proportion in each attribute category or mean	X		X
Alter dispersion	Distribution of alters across attribute categories or variation	X		X
Ego-alter similarity	Similarity of ego attributes to alter attributes	X		X
Structural shape	Measures determined by the pattern of alter-alter ties	X	X	

Source: (Crossley et al., 2015[367]).

Tie central tendency measures are the most straightforward measures: the degree of ego is the number of relationships ego has. Social network data often contain a numeric measure of the ties, for example, the frequency of interaction. This measure reflects the strength of the tie with the standard descriptive statistics, such as median, mode and mean. Ties are often fall into a number of different categories in social research, such as friendships, colleagues and family members.

Tie dispersion describes how ties are spread. When a value is attached to the tie (strength of tie), this can be measured by the standard deviation or variance of this value. When no value is attached to ties, dispersion can show the extent to which ties are equally distributed in different categories. For this Blau's index H, or its standardised version, Agresti's IQV are used. For r relationship types and P_i proportion of ties in category i :

$$H = 1 - \sum_{i=1}^{r} P_i^2$$

H has a value of 0 if all ties are in one group, and 1-1/r if they are equally distributed in the groups. The IQV index is H divided by 1-1/r, and thus ranges from 0 to 1.

Alter central tendency is a measure of alter attributes, such as their gender and ethnicity, or in the case of school ego networks, it can be the level of school (primary, secondary). A simple measure is the proportion of alters in each of the categories. Alter dispersion looks at how alters are spread in these categories. The measures are the same as for tie dispersion: for continuous variables (e.g. age) the standard deviation can be used, for categorical variables Blau's H or Agresti's IQV.

Ego-alter similarity is a measure of homophily, i.e. how similar alters are to ego in terms of their attributes. Homophily for categorical data can be measured with the EI index developed by Krackhart and Stern (Krackhardt and Stern, 1988[368]). When E is the number of external ties (leading to an alter with a different attribute) and I is the number of internal ties (leading to an alter with the same attribute), then the EI index is:

$$EI = \frac{E - I}{E + I}$$

The EI index ranges from -1 (perfect homophily) to 1 (perfect heterophily). A note of caution when using the EI index is that it does not account for the pool from which alters are drawn. For example, if there are very few nodes in one of the categories (A) and many in the other (B), someone from category A socialising with all the other A group members and many more B group members will have an EI index suggesting heterophilie, when in fact, it could not be more homophile based on the pool. A more valid measure can be used when the distribution of nodes in the different categories is known.

All of the above network measures will be used to describe schools' social networks. Structural measures cannot be calculated as the data contains no information on alter-alter relationships. Measures are calculated in python using the pandas package to manage dataframes.

5.6. Qualitative component: Explaining results

Following the explanatory design, the purpose of the qualitative component is to help explain some of the quantitative results. I chose a multiple case study approach (Creswell and Plano Clark, 2011[327]) for this purpose, because it allows for exploring the research questions – characterising teachers' knowledge dynamics and their relationships with social processes – within a school. The school – as a bounded system – provides the organisational context for teachers' social and knowledge processes (in line with the conceptual framework). However, it also allows for exploring social and knowledge processes beyond the school, through school leaders' and teachers' "ego" perspective on their wider networks. A multiple (or

collective) approach involves conducting the research in several sites, in this case, several schools, in order to gauge convergences and divergences across the sites.

5.6.1. Sampling for qualitative research

Methodological literature describes two explanatory models: the follow-up explanation model and the participant selection model (Creswell and Plano Clark, 2011[327]). In the former, the quantitative results that require further investigation need to be identified. As the selection of the specific indicators is rarely possible prior to data analysis, it is rather the broad criteria for selecting these indicators that can be predefined. In the latter, a purposeful sampling of participants is based on quantitative results based on certain predefined characteristics (Creswell and Plano Clark, 2011[327]). In my research a mixture of the two approaches is justified.

First, investigating the relationships between social and knowledge dynamics in a particular setting needs rich data on these aspects, which justifies a purposeful sampling for the qualitative data collection. Organisational aspects, such as the school climate, leadership and teacher collaboration are important determinants of the various dynamics of knowledge. Therefore it is more suitable to select of a few schools rather than select individual teachers regardless of their schools. Specifically, schools that have high levels of collaboration between teachers and/or demonstrated high levels of knowledge dynamics are likely to produce rich data for the research questions. Such purposeful sampling of schools can be based on the quantitative data. In particular, the aggregate levels of knowledge mobilisation, construction and diffusion could in theory have been used to identify appropriate schools.

Unfortunately, the sample sizes did not allow for this sampling approach. In the quantitative questionnaire, individual schools were represented by only one or two teachers in the vast majority of cases. Therefore, these results did now allow for conducting an aggregate school-level analysis to identify schools with higher levels of knowledge dynamics. Instead, the central coordinators were asked to recommend such schools. From among nine recommended schools, two were selected for case study based on the analysis of available information and documents. The criteria involved evidence for strong collaboration among teachers, efforts to reinforce evidence-informed teaching practices, and involvement in experimentations and innovation.

Second, the analysis of the quantitative data could yield results that need further explanation, which justifies using a follow-up explanation model in parallel. The main hypotheses are formulated in terms of relationships between various components. If the hypotheses are not confirmed it will be important to better understand the reasons and reveal the factors that were not taken into account in the questionnaire. If the hypotheses are confirmed, a deeper understanding of causal relationships can be established through qualitative data. Moreover, a small part of the research questions could not be comprehensively addressed in the questionnaire. The first of these relates to the structural dynamics of teachers' knowledge, i.e. dynamics between tacit and explicit knowledge. Tacit knowledge by definition cannot be integrated in a questionnaire, but it can be inferred from interviews and other types of qualitative

data. The second relates to integrating locally constructed knowledge in the global knowledge base. Teachers may not have a deep understanding of this question, therefore this element should be explored with school leaders, and local and regional policy actors.

5.6.2. Qualitative data collection

A case study research requires data collection ideally involving multiple information sources such as documents, observations and interviews (Creswell and Plano Clark, 2011[327]). The timing of my data collection unfortunately limited the possibilities. Due to the covid-19 pandemic it was not possible to visit the schools in person, as France was in lockdown (November-December 2020). Therefore, it was not possible to carry out observations. I used documents available on the schools' websites and provided by the school principals, and in one of the schools, video materials on social media (youtube). In addition, I conducted a number of semi-structured interviews, following the same interview protocol. Interviews with teachers were sometimes conducted individually, sometimes in small groups (Corbin and Strauss, 2008[331]).

5.6.3. Qualitative analysis methods

Following Creswell's data analysis spiral, analysis consisted of the main steps described in methodological literature (Creswell and Plano Clark, 2011[327]):

Data managing involved creating interview files with the help of the Nvivo transcript software. Although machine transcription has improved in recent years thanks to development in artificial intelligence, unfortunately, transcription still requires quite substantial human revision. Notably, speakers needed to be labelled manually in the Nvivo transcript files. **Reading, memoing and coding**: I read the interview transcripts in their entirety several times through an iterative process, making a large number of margin notes. I adopted a mixed strategy including both deductive and inductive coding (Saldana, 2009[369]). Deductive coding was based on my conceptual framework (dimensions of knowledge dynamics) and the constructs and items of the quantitative instrument. This element is critical for my explanatory study design, because it allows for uncovering the ways in which the various knowledge processes play out. However, using only deductive coding limits the analysis to the pre-defined concepts (Creswell and Plano Clark, 2011[327]), and may conceal elements that were not included in the conceptual framework and the instrument. Therefore, I also used inductive coding, in which codes were identified based on the data. The coding was done on the printed interview files, using colour coding and marginal notes.

Describing in the case study approach involves a description of the context, which was done both based on the interviews, based on data available in public documents on the schools' websites and documentation received from the school principals. **Classifying** emerging patters involved the aggregation of the codes into larger categories and themes, and finally arranging these under two main headings: "drivers" and "barriers" of knowledge dynamics. Classification involved the direct **interpretation** of the data to develop naturalistic generalisations (Creswell and Plano Clark, 2011[327]). I chose not to quantify

qualitative data, i.e. not to count the codes for three main reasons. First, and most importantly, my mixed-method design already contains a quantitative component, which provides much more robust quantitative data than qualitative research could. Second, the quantification of codes suggests that the different themes have equal weighting, and carries the risk of ignoring contradictory perceptions (Creswell and Plano Clark, 2011[327]). Third, if such quantification is done, its reliability should be ensured, for example through developing rubrics and coding by several raters, and computing inter-rater reliability (Miles and Huberman, 1994[370]). This was not possible in the framework of a solitary doctoral research. Data analysis is presented as a narrative in Chapter 9.

5.7. Ethics, confidentiality and data protection

All ethical procedures were followed based on the university's guidelines[12] and research standards for quantitative (de Leeuw, Hox and Dillman, 2008[335]; Groves et al., 2004[330]) and qualitative research (Creswell and Plano Clark, 2011[327]).

The questionnaires was transferred to school leaders and teachers by email with a brief description of the research. The questionnaires themselves included a preamble with information on data protection issues, and participation was voluntary. Both questionnaires asked participants to indicate their school using a unique code (a table was provided with the questionnaire in which participants could identify the code of their school). The school codes were decoupled from school names in the analyses.

The region where the data collection took place and the network initiative (EDUNET), which provides the context for this study are anonymised (fictive names) and the sources used for desk research are blurred. The qualitative interviews all started with a short description of the focus of the research and seeked consent from interviewees to audio-record the conversation for data analysis purposes. In the case studies neither schools, nor teachers are identifiable: all names have been anonymised (using fictive names and codes). Data protection measures were also implemented. Qualitative data collection in some cases involved the use of videoconferencing platforms due to particular circumstances of the covid-19 pandemic in 2020-2021. The platform used were chosen in agreement and in certain cases on request of the participants (google meet, Zoom). Data was first stored on local device then transferred to the university's server. Interviews were transcribed using Nvivo transcript, which confirms with the European Union's General Data Protection Rules (GDPR).

[12] https://www.unistra.fr/ethique-recherche

Chapter 6. School networks: Regional governance and local dynamics

As a first step in the empirical investigation of teachers' knowledge dynamics in networks, I will describe the context of the study. The conceptual framework presented in Chapter 4 identifies three levels of the social context in which teachers' knowledge is embedded: communities of practice, network and education system. In this chapter, I present these two higher levels, while Chapter 9 will focus on the community of practice level through two case studies. The higher levels in this research include the Academy of Bel-Mondo, the region selected for this study, and the formal network put in place in this region: EDUNET.

As presented in Chapter 3, governing knowledge through networks has been promoted in a number of countries based on the belief that networks are able to create a balance between local autonomy and centralised governance, and as such can improve student achievement (European Commission, 2017[21]; Grimaldi, 2009[279]). This systemic approach softens the boundaries of schools as organisations and gives more importance to the transversal coordination of actions (see Chapter 3). It also imposes new roles and responsibilities for leaders and teachers. In addition, networks constitute a change of scale with important consequences for territorial educational governance (Looi and Woon Teh, 2015[258]; Grimaldi, 2009[279]). In France, a few networks have only recently been established as strategic tools to boost innovation while giving new identities and responsibilities to educational actors in a territory. The intention is that school networks mobilise people around common objectives linked to national or regional policy objectives. It is meant to be complementary to hierarchical management by allowing coordination of actions in a flexible and transversal manner.

I examine the construction of local knowledge by teachers and the dissemination of professional knowledge in the EDUNET network. To give the broader context to the case study, I first present some elements on the French educational context with particular attention to regional governance. Then, I describe the functioning of the network and the tensions between regional governance and local dynamics to understand how the intended knowledge processes relate to actual dynamics. The chapter concludes by highlighting the uncertain effects of building professional learning communities induced by bureaucratic regulation.

Theoretically, I draw on concepts of social network theory and on research on networks as forms of organisations. Data collected in the exploratory phase of this study includes seven semi-structured interviews, one focus group discussion and the observation of two network events. In addition, desk

research involved the analysis of several official documents. I present the analysis in the form of a case study, following the conceptual framework's three main dimensions of formal networks: network context, devices and characteristics.

6.1. Broader policy context: regional governance of school networks

The Academy of Bel-Mondo is one of the most rural regions in France, with 20.5% of students in public education attending a school in a rural municipality, and with a large proportion of isolated, small schools (half of primary schools only have 1-3 classes) (Académie de Bel-Mondo, 2017[371]). Its regional strategy has four key ambitions:

- **build** sustainable learning
- **guide** each student in the construction of their school career
- **open** the school, develop links with its partners, reinforce trust
- **train** all staff to foster professional development from their entry in the profession (Académie de Bel-Mondo, 2017[371]).

Each of these are further broken down into objectives that are illustrated with operational goals and examples of levers. In line with the national policy, this strategy has a strong discourse around student pathways (orientation and career guidance), which is a key policy strategy to enhancing equity and student achievement in France (Ministère de l'Education Nationale de la Jeunesse et des Sports, 2015[372]). Helping students transition between the different educational levels, guiding them to find a suitable and at the same time ambitious career goal is not only formulated as a separate key ambition (number 2), but is also present in several of the objectives within the other ambitions. For example, fostering collaboration among pre-school and primary school teachers, and strengthening the link between the different school levels (lower and upper secondary) are also part of building sustainable learning (Académie de Bel-Mondo, 2017[371]). Again, this corresponds to national policies emphasising pedagogical continuity as a key lever for increasing student achievement (Ministère de l'Education Nationale de la Jeunesse et des Sports, 2015[372]).

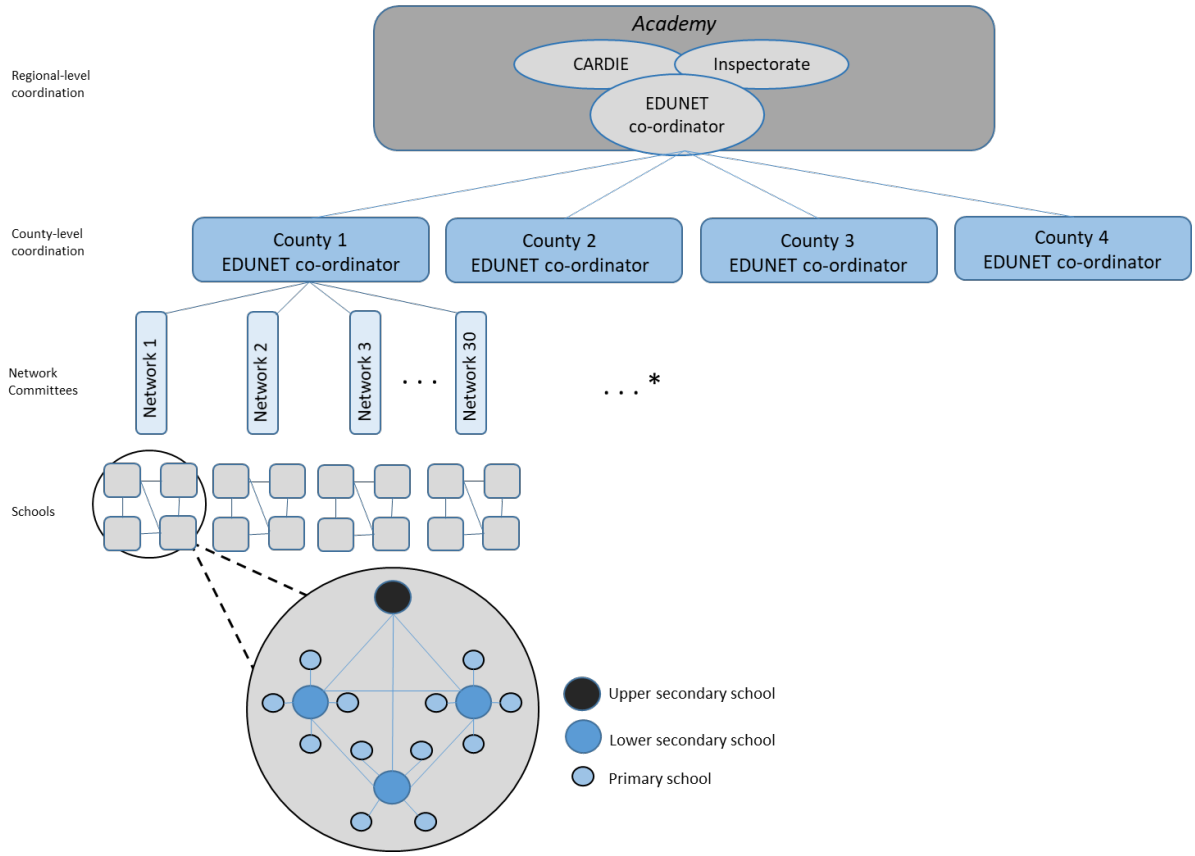
The Academy of Bel-Mondo conceptualised the EDUNET[13] networks in 2013 following a territorial diagnosis and an inventory of pedagogical practices and student results (Académie de Bel-Mondo, 2014[373]). As reported by an interviewee, this diagnosis pointed to a lack of cooperation between inspectors and school principals. In an effort to strengthen local collaboration among actors, the Academy decided to re-organise territorial units. The EDUNET networks became the new operational units for implementing the academy's strategy. They were a set of local clusters of schools of different levels established based on student pathway data. Formerly, schools cooperated based on administrative clustering, i.e. primary

[13] EDUNET is a fictive name for the network.

schools with the lower secondary school of their administrative sector, lower secondary schools with the (general and vocational) upper secondary school of their sector. However, this clustering did not always reflect student pathways, in particular around the artificially determined county borders. The new networks thus offered a possibility for collaboration between schools that were connected by a high share of students going from one school (e.g. primary) to the other (e.g. lower secondary).

6.2. Network context

The EDUNET initiative is coordinated at three levels (see Figure 6.1). It is centrally coordinated at the Academy, since 2016 by two main project leaders, one of whom is also the leader of the regional CARDIE and an inspector. Each county within the Academy has a county-level coordinator, who ensures coherence across the networks. The networks themselves are led by a steering committee consisting of the secondary level inspector, the primary level inspector, the school principals and their deputies of primary, lower and upper secondary schools, and in some cases additional members such as a pedagogical counsellor.



Source: The magnified representation of the network of schools is adapted from (Harel, 2019, p. 13[334]).

Facilitating the dynamics of teachers' knowledge is an important underlying objective of EDUNET. Knowledge construction is termed primarily as innovation, which is seen as a problem-solving process questioning the existing practices to respond to local problems (Académie de Bel-Mondo, 2017[374]). In the official document, the focus is on valuing and promoting innovation, while scaling is not explicitly highlighted. One of the central coordinators however emphasised scaling as one of the most important objectives:

> *Work also on innovation. That is, when we have a network it is also easy to say that 'look, there is a school that's kind of a leader on certain things, how do we disseminate that?*

Knowledge mobilisation in EDUNET is centred on disseminating evidence, in particular certain areas of research knowledge. The preface of its specification says:

> *The evolution of pedagogy in the light of current research in neuroscience, child psychology, interdisciplinarity, digital integration or students with special needs are all foundational topics of collective reflection in the field (Académie de Bel-Mondo, 2017, p. 1[374]).*

Integrating emerging evidence from the field of learning sciences has been particularly popular in France in recent years (see Chapter 3), which is also manifest in EDUNET. Three of the interviewees and the focus group mentioned neurosciences in the context of EDUNET and cognitive sciences were also prominent in the Innovation Day (event of the Academy observed in March 2019). EDUNET is therefore an ideal field to analyse how regional policy is implemented and how the intended knowledge processes play out locally.

6.2.1. Objectives and timeframes

Analysing the various knowledge dynamics in the EDUNET networks requires an understanding of the network objectives. In their first iteration (2014-2016), the EDUNET networks were focusing on student pathways and had the objective to "promote networking among primary, lower and upper secondary schools in a specific geographical area […] to consider the student's journey as a whole, seek coherence and complementarity of learning and avoid rupture especially at key points of transition" (Académie de Bel-Mondo, 2014, p. 2[373]). This objective was to be achieved through the following five work axes:

- encouraging cross-cycle and cross-level links to streamline student pathways
- developing collaboration between primary, lower and upper secondary school teachers
- providing educational orientation following a pathway logic (to students and professional development to teachers)
- fighting against interruptions of education by mobilising the entire education community and its partners

- setting up thematic, pedagogical and educational pathways throughout the school system (Académie de Bel-Mondo, 2014, p. 2[373]).

In 2015, a new rector took over the leadership of the Academy and commissioned the evaluation of the EDUNET project. Following a generally positive evaluation, the Academy renewed the mandate for the networks reformulating some of its objectives. This time, it was made explicit that the EDUNET networks are a device to facilitate the implementation of national educational policies. In particular, in their second iteration (2017-2021), the networks aim to:

> *…facilitate, in all territories, the engagement of actors by bringing together professional development and pedagogical practices. Each network and inter-network offers an agile tool, a space at the service of educational policies in which the strategy of the academy is situated (Académie de Bel-Mondo, 2017, p. 3[374]).*

The objectives are also explicitly aligned to the four key ambitions of the regional strategy. The networks are thus seen as:

- A "territorial incubator", promoting innovations consistent with educational policies.
- A support system for professional development and reflection on practice.
- A synergy among actors, to allow for sharing problems encountered and solutions identified across different disciplines.
- A special professional development space, a proximity-based implementation (Académie de Bel-Mondo, 2017, p. 3[374])

Clearly, the focus has shifted in this second iteration towards teachers: innovation, experience sharing and professional development have become the key words, although student pathways still remain one of the central elements of the document describing the project (Académie de Bel-Mondo, 2017[374]). As a result of one of the recommendations formulated in the evaluation of the first iteration, monitoring progress and evaluating the initiative was included in the second phase. The planned evaluation focuses on the evolution of teaching practice, measured through self-assessment of teachers along three dimensions: student achievement, school climate and professional practice (Académie de Bel-Mondo, 2017[374]).

In addition to the local networks of schools, the second iteration also set out to facilitate collaboration among the networks ("inter-networks"). In this sense, the EDUNET initiative has become a "supra-network" or "meta-network", i.e. a network of networks, in which each network is a distinct actor (de Lima, 2010[285]).

6.2.2. Governance: Centralised versus decentralised processes

Central coordination, responsible for steering the EDUNET initiative at the Academy, consisted of two main coordinators at the time of data collection, who work with the county level coordinators. This

monitoring team facilitates networking with the various actors who can contribute with advice, expertise or local resources to achieving the objectives set by the networks and internetworks (Académie de Bel-Mondo, 2017[374]). The team is in charge of both monitoring the implementation of the academic project, of which EDUNET is one of the levers, and monitoring the initiative itself. It provides networks and internetworks with indicators and self-assessment tools (Académie de Bel-Mondo, 2017[374]).

Locally, every network is led by a steering committee. These local committees have the following roles defined by the official document (Académie de Bel-Mondo, 2017[374]):

- Conduct network diagnosis:
    - Produce a background document that sets out the strengths and weaknesses identified within the network and the territory, focusing on the acquisition of basic skills.
    - Establish a roadmap – consistent with national educational policies and the academic project – that sets up actions for concertation and sharing practices for the professionals in the territory.
- Steer the network:
    - Identify the needs with regard to the diagnosis and the objectives of the network, prioritise the actions to be carried out by promoting the construction of a cross-level culture in the context of professional development, drive the dynamics of liaison between lower and upper secondary schools.
    - Identify key partners (e.g. at the local authorities: officers responsible for culture, school dropout, justice; coordinators of extracurricular activities, representatives of learning, agriculture, health and social sector, special education, actors of the economic and professional world, etc.).
    - Coordinate, animate and evaluate network activities.

Interviews mostly confirm that the official roles are put in practice. The steering committees were reported to meet a few times yearly. Interviewees emphasised that the fundamental function of this coordinating device is to identify common local challenges, coordinate the requests for locally initiated PDs and arrange knowledge sharing workshops. As the committees have members from each school level (primary, lower and upper secondary) and include the inspectors, they are also suitable forums to create cross-level links.

Steering committees also serve as a mechanism to collect network level information, allowing for the central coordination to have more visibility on local activities. The committees are required to send the summary record of each meeting to the county-level coordinator, who transmits it to the county administration. The bureau of the internetworks in turn, submits a yearly report of the activities to the county. While no data is available on the actual practice of such reporting, one of the central coordinator stressed that mechanisms of collecting information on local needs and practices through the EDUNET networks is one of the networks' key benefits. She sees the lack of visibility of what happens at the local

level as one of the main problems of administration in France. As she said, in this sense, EDUNET can become an extremely interesting lever for territorial cohesion. Steering committees thus play a key governance role in the dynamics of teachers' knowledge.

It is important to note that the distribution of roles within steering committees in some cases went deliberately against traditional hierarchies of the education sector. Some committees are led by the primary school principal, who therefore becomes the superior of the primary level school inspector – a member of the committee – in this setting. This is unusual as one of the inspector's role is overseeing the primary schools, and as such supervising the principals. As one interviewee explained, breaking traditional hierarchy was important to make real partners of the various actors.

Central coordinators organise two or three meetings a year for network coordinators (i.e. leaders of the network steering committees and county level coordinators). My data includes the observation notes of two of these meetings taking place in the 2018/19 academic year. The meeting held in December 2018 illustrates the parallel presence of top down objectives (presentation on national reforms and the regional strategy) and space for generating local ideas (in the objectives of the day, workshops). Several network devices are explicitly and consciously used to help disseminate research evidence and scale innovation. One of the workshops of the network coordinators' meeting was specifically dedicated to how EDUNET can be used to scale the use of educational research. This element is also present in the locally initiated PDs.

6.2.3. Multiple and sometimes contradictory objectives

The data demonstrates the complexity of the initiative and its implementation. A first factor, as shown above, is that objectives change over time. This can be a natural process, but can also be a sign of instability. For example, goals can shift naturally with a growing understanding or evolution of the context and of the specific needs of students, teachers and schools. It can also be the consequence of reflection or an evaluation of the network, as was the case in EDUNET. However, the interviews suggest that some actors perceive the change as instability. When speaking of the regular changes of rectors resulting in constant changes in the network objectives, one of the interviewees said: "Regarding the EDUNET networks, the main objective for me currently is rather survival". The perception of changes depends on various factors such as where the change comes from, i.e. whether it is top-down originating for example from new national or regional objectives, or it is bottom-up coming from network members. It also depends on actors' involvement and ownership over the process of change (Rincón-Gallardo and Fullan, 2016[288]; Muijs et al., 2011[52]).

A second element of this complexity is that multiple objectives exist in parallel. In EDUNET this is manifest both in the official documents and in actors' perceptions. While the various objectives are overlapping, almost every actor and document emphasises a different subset of them. Interestingly, the two central coordinators (project leaders) of the EDUNET initiative formulated almost entirely complementary objectives. While one of them, being the project leader from the start (first iteration) has a

strong focus on student pathways, the other, joining the project as a co-leader from the second iteration, emphasises knowledge sharing, reflection on practice and innovation. Similarly, some network members and coordinators interviewed stress almost exclusively student pathways, others report a larger variety of goals, including teacher, as well as school or territorial development.

Research on network effectiveness has unanimously stressed the importance of having shared goals in a network [e.g. (Provan and Kenis, 2008[281]; Rincón-Gallardo and Fullan, 2016[288]; Muijs et al., 2011[52])]. However, this does not mean that goals of the different members need to be exactly the same, rather, they should be compatible. Some even argue that, paradoxically, too much similarity can lead to difficulties, for example when a competitive context makes cooperation difficult (Provan and Kenis, 2008, p. 11[281]). In EDUNET, the perception of objectives seems to have an impact on engagement. Teachers and principals who reported facilitating student pathways as the key objective also perceive their role as relevant or irrelevant to the network in these terms. For example, a kindergarten principal said:

> *So I attended two meetings of the EDUNET network. At the beginning when it was set up I was already principal of my school and it is in this function that I was invited. So for me it was to create continuity, among other things, in the schooling of children and create more meaning, from kindergarten to high school. And then I was the only kindergarten teacher and after that I did not even get any other invitations. So I'm not, I did not keep going. Then I think that obviously those are privileged, like my colleague who is principal of an primary school, she who has fifth graders that go to the sixth grade[14]. She's going, I think she's going.*

A third indicator of complexity is the nested nature of objectives that, in the case of EDUNET, results from a centralised education system. The official document of the first iteration refers to the networks' articulation with "priority education networks" (schools with high proportion of disadvantaged students) – a national reform initiative (Académie de Bel-Mondo, 2014[373]). Embeddedness is however most prominently observed in the second iteration of EDUNET, in which its central objectives are explicitly embedded in the academic project's key ambitions and goals, which in turn reflect the nationally set educational goals. In the official documents embeddedness manifests in mutual cross-referencing: not only does the EDUNET document introduce its objectives as derivatives of the academic project, but the academic project also makes reference to EDUNET as part of its goals. This is partly the result of the evaluation process of the first iteration. In fact, the interviews suggest that some actors conflate the two and see realising the academic project as EDUNET's main objective.

Within the central objectives of the initiative, a fundamental element is that it should be based on local needs. Therefore, in both iterations, the official document clarifies that the steering committee of each network needs to define its pedagogical orientations, objectives and an action plan based on the issues identified locally (Académie de Bel-Mondo, 2014, p. 4[373]; Académie de Bel-Mondo, 2017[374]).

[14] In France, primary school lasts 5, lower secondary school 4 and upper secondary school 3 years. Consequently, children change schools after the fifth and the ninth grade.[15] Écoles Supérieures du Professorat et de l'Éducation (ESPE) until 2019, « Les Instituts Nationaux Supérieurs du Professorat et de l'Éducation (INSPE) since 2019.

Interestingly, none of the four principals interviewed reported any specific objectives that were locally defined, although two of them referred to local experience sharing as a key potential of the network. One of them also stressed the importance of identifying local issues:

> *…if the local leader is a good leader, if he looks for, if he identifies in his colleagues and gives the floor to the one who has a project, a problem and we try to solve it together, we will move forward together yes, that's how it will work.*

In EDUNET, the different indicators of complexity are not independent. The existence of parallel objectives and the change of objectives over time are related in the sense that those more deeply involved in the first phase keep more strongly to the original student pathway goal. Moreover the different objectives seem to be linked. Those who report facilitating student pathways as a key objective tend to stress collaboration between different school levels, while those who see teachers and teaching practice as the key focus usually emphasise collaboration more generally between any types of schools.

In sum, this case study confirms that network objectives are in reality a complex assemblage of individual and central goals and ideas about how to realise them. It is important to understand this assemblage to analyse knowledge dynamics, as it is the actors who drive such dynamics based on their perceived goals. The next section looks at the various dynamics in view of the explicit and perceived objectives.

6.3. Knowledge dynamics in EDUNET from a regional perspective

The centrality of knowledge dynamics in the second phase of the EDUNET initiative is clearly demonstrated in its objectives, and the exploratory interviews also reveal a strong focus on professional knowledge within the networks. Facilitating sharing and exchange, reflection on teaching practice, putting in place local professional development and mobilising evidence in teaching practice are all key elements of the current phase of the EDUNET initiative. Before going into mechanisms of knowledge dynamics, it is important to have a better understanding of what knowledge means in EDUNET.

6.3.1. Knowledge

Knowledge is conceptualised relatively narrowly in the official documents. While there is no explicit conceptualisation of teachers' knowledge, it is possible to infer an understanding of knowledge from the documents of both phases. In the first phase of EDUNET, in line with the key objectives, the descriptions of work axes stress elements of teachers' knowledge directly related to student pathways such as knowledge of education pathways and supporting students in their orientation. More broadly, the document also mentions pedagogical tools and practices that favour student achievement and student valorisation such as personalised pathways, individual development plans, etc. In the second phase, the official document suggests a broader idea of knowledge through its statement on what professional practice is. It includes elements such as leading teaching, class climate, supporting students. It also stresses innovation, reflection on practice and meaning making, as well as working with partners. In addition, the document

gives a list of research areas that matter for reflection and professional development: neuroscience, child psychology, interdisciplinarity, digital integration, working with students with special needs.

Actors' understanding of teachers' knowledge was explored through three questions in the exploratory interviews: what the most important topics regarding teaching and learning are; what competences teachers need; and what research on teaching and learning means for them. Based on the small number of interviews, actors seem to conceptualise teachers' knowledge somewhat more broadly than the documents. Most of the over ten different knowledge elements mentioned are related to general pedagogical knowledge, i.e. knowledge about teaching and learning that is cross-disciplinary (Sonmark et al., 2017[36]; Shulman, 1987[6]), some to content knowledge, while only indirect references were found to knowledge about how to teach a subject (pedagogical content knowledge). It is interesting to note the relative abundance of pieces that are not part of Shulman's taxonomy. These include experimenting with new methods, broader competences such as creativity and communication, as well as knowledge related to the external world and working with partners.

While educational topics and necessary competences reflected a very similar set of underlying knowledge, interviewees' concept of education research could not really be integrated in this. Only two out of the five interviewees gave examples for educational research areas, which were either very broad (research on 21st century competences, philosophy), or very specific (Singapore method, heart coherence method). Other than that, actors referred to sources of research (where they access it), its functions (in what way it serves them) or how they engage with it.

Overall, exploratory data suggests that there is no clear common understanding of knowledge among the actors. Documents' implicit understanding of teachers' knowledge or competences partly overlap with actors' views, but both have distinct elements as well. The strongest elements related to students seem to be: supporting student learning; student pathways and orientation; student heterogeneity. Related to teaching, what stands out as the most important are: reflecting on, observing, questioning and evaluating teaching practice; and experimenting with new methods. Lastly, broad competences (e.g. critical thinking, creativity, collaboration, communication) and working with parents are also strongly present.

6.3.2. Network devices: instruments and actions for knowledge dynamics

In this section, I explore how the four objectives of the current phase of EDUNET – promoting innovation, professional development, generating reflection on practice, and facilitating sharing – drive knowledge dynamics in the networks. In particular, a number of social devices that the network put in place to operationalise these objectives are presented and discussed.

Locally initiated professional development ("formation d'initiative locale")

Making a professional development plan is mandated to the Academies in France with the objective of providing support in line with national priorities but adapted to local specificities (Ministère de l'Éducation Nationale et de la Jeunesse, 2012[375]). Continuous professional development represents a

heterogeneous and fragmented landscape according to a recent report conducted by the French Inspectorates of the secondary level (Tardy et al., 2018[376]). The free market of CPD providers extends to 54,000 active providers (Tardy et al., 2018[376]). In practice, participation in PD is often realised through devices proposed by the Academies, which follow national guidelines and rarely respond to the expectations of teachers or build on their experiences (idem.). Primary school teachers also report that the national training plan that sets the national priorities leaves little space for integrating actual needs.

To address this issue, the Academy of Bel-Mondo surveyed teaching staff about their learning needs and proposed a PD plan on the basis of the expectations and in line with the local context (Tardy et al., 2018[376]). Part of the strategic approach to PD is the concept of locally initiated professional development. Teachers from a school can collectively identify their challenges and ask for professional development related to that. In addition, the EDUNET networks are used as a lever to coordinate strategic professional development. Network committees can meet to identify common local challenges and corresponding PD needs. Requests are collected by county-level network coordinators and then are aggregated by the Academy.

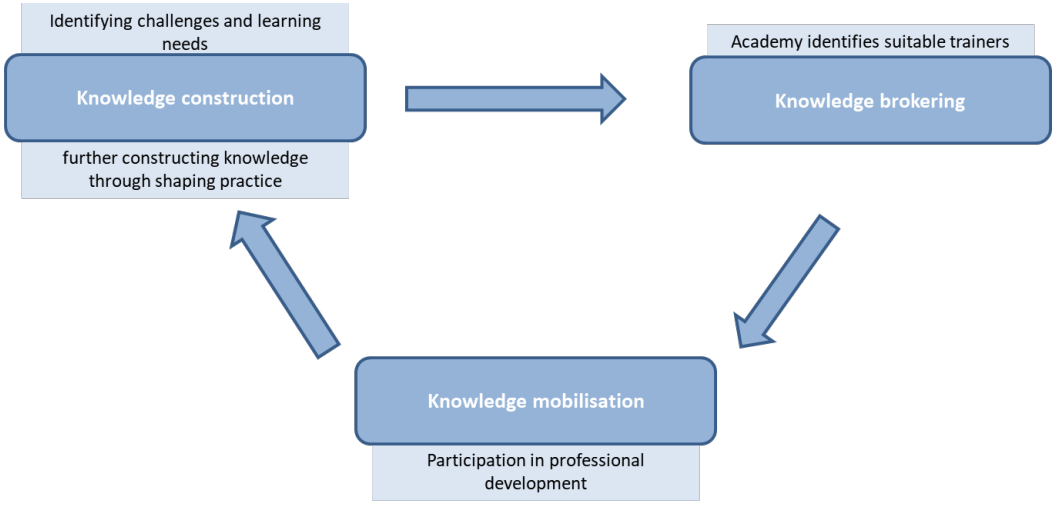
From the perspective of knowledge dynamics, locally initiated PD functions as a knowledge mobilisation device that helps connecting the actors in the field to the evidence base they need to address their challenges. The first step, i.e. identifying the challenges is a key phase of local knowledge construction. In Timperley and colleagues' (2007[377]) model for example, identifying students' learning needs first, and then teachers' learning needs accordingly, are the first two steps of the knowledge building cycle. It requires that teachers get together and reflect on their context, their difficulties and practices. Formulating specific PD needs also requires a certain awareness of available academic or formal knowledge that has the potential to address the needs, so the process necessitates some level of knowledge mobilisation. Collecting and aggregating schools' needs at the network level can constitute the basis for professional collaboration and exchange across schools.

Collective PD targeting a team of teachers from a school rather than isolated individuals has been shown to be more effective in changing teaching practice (Cordingley et al., 2005[378]; Timperley et al., 2007[377]). It provides a particular opportunity for combined knowledge construction, mobilisation and diffusion. In the setting of formal PD, knowledge mobilisation usually happens through external brokers – PD trainers – identified by the Academy. Trainers can be invited researchers of the field or teacher educators of the national teacher education institute[15]. New knowledge can then be disseminated in the schools by participating teachers. This second level was identified as a difficulty during a network coordinators' meeting, as it is not clear to what extent this type of brokering happens in reality. The main EDUNET coordinator pointed out that collective participation is one way to tackle this problem. That is, collective knowledge mobilisation can be an alternative to brokering by teachers, especially if such

[15] Écoles Supérieures du Professorat et de l'Éducation (ESPE) until 2019, « Les Instituts Nationaux Supérieurs du Professorat et de l'Éducation (INSPE) since 2019.

mechanisms are disfunctioning. The intended knowledge dynamics cycle (Figure 6.2) then continues with further knowledge construction.

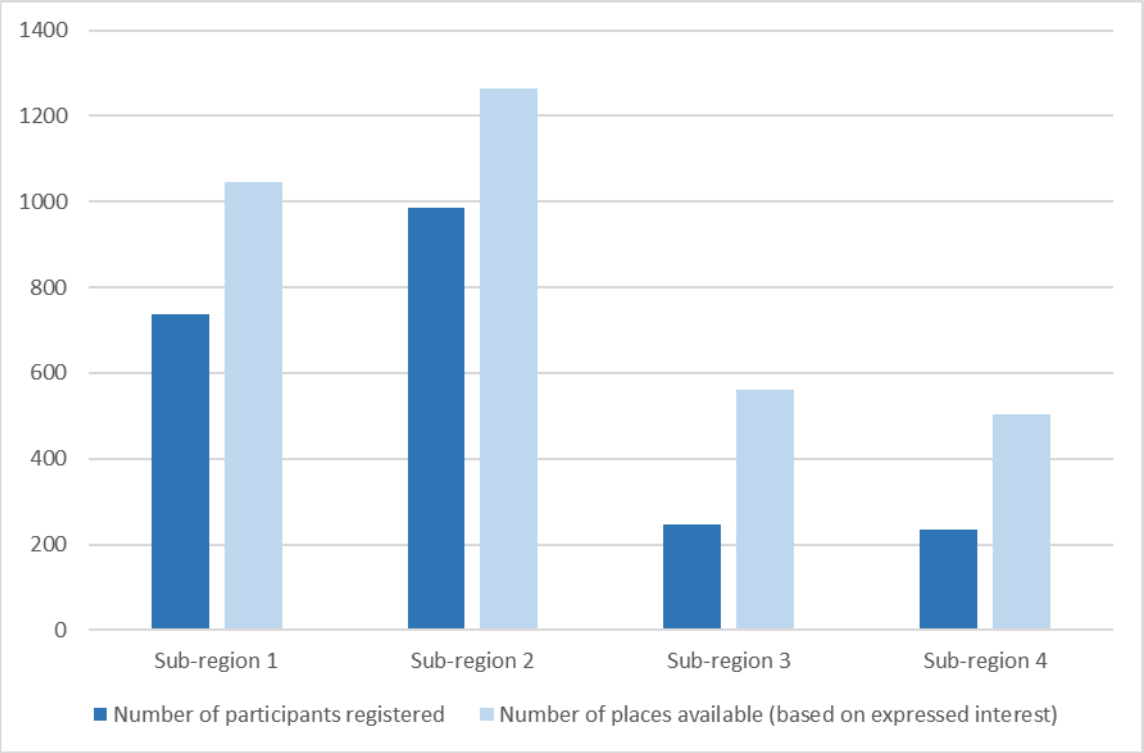
Figure 6.2. Knowledge dynamics through locally initiated professional development



Fulfilling the knowledge dynamics potential of this device is not without challenges. First, the Academy needs to navigate the space between national priorities, bureaucracy and local needs. As one of the EDUNET coordinators explained, the administrative process necessitates that the Academy sets out a PD plan a long time in advance. As needs cannot always be explored in time, they propose “open shells” which then can be filled with content based on the needs. For example, they propose professional development in learning sciences and emotions, which they then fill with a particular content requested by teachers. The actual PD courses are then organised at the appropriate scale. If it is only one EDUNET network that showed interest, they offer a course locally, if the same need was expressed by a larger number of networks in a county, then sometimes several courses are held at that level.

Second, actual participation rates are eventually lower than previously expressed interest (Figure 6.3). The Academy reported that each year they have to close a number of PD courses eventually. The same phenomenon was also noted by Tardy and colleagues (2018[376]), who reported that some teachers regret not being trained, while at the same time they do not register or do not show up at PD sessions. This can have various reasons. Primary school teachers for example face the particular challenge of substitution. As they are responsible for their class almost the full day, it is difficult for them to collectively participate in PD at the same time. The same holds for teachers in small rural schools.

Figure 6.3. Professional development needs: provisional needs versus actual registration



Source: Data presented during an event observed in the Academy of Bel-Mondo in the framework of the exploratory study (2018).

Despite the difficulties, the interview data suggests that locally initiated PD is seen as one of the key levers for network activation. However, gaps remain to reconcile good intentions with the realities in the field, particularly in terms of shared meaning-making and collaborative engagement (McArdle and Coutts, 2010[379]).

Knowledge sharing workshops ("atelier de mutualisation")

Another form of facilitating knowledge dynamics in the EDUNET networks is the so-called knowledge sharing workshop. As the main coordinator explained, these workshops are specific modalities that allow for teachers to form a research and development group around a particular professional practice, and discuss this among themselves without the institution being present. While this can refer to within school workshops, the main idea is to facilitate exchange across schools. Workshops can be initiated by the teachers themselves: teachers who wish to engage in collective work on a particular topic can signal their interest to the county-level coordinator. The coordinator then connects teachers and also transmits needs towards the Academy to obtain financial support for example to cover travel costs. Topics or particular practices can also be identified by the network coordinators, who discuss these with school heads (network committee), who in turn initiate workshops within and across their schools.

Examples collected through the interviews include workshops related to supporting students with special education needs and designing classroom layout to facilitate student learning. While no data is yet

available on the number and impact of such exchange, some tangible outcomes have been reported. For example, some schools started to experiment with innovative ways of arranging classrooms as a result of their exchange, e.g. with high tables at which students can also stand, arranging a reading corner with poufs. Exploratory data also suggests strong interest in this form knowledge sharing at different levels and by different actors. This manifests in reflections on what topics and practices could be exchanged in the future (e.g. developing students' oral communication skills across different disciplines and school levels, supporting students in shaping their learning pathways through cooperation between school levels, exchange practices on teaching reading and literacy skills between primary and secondary school teachers). Interest is also reflected in a discourse around its potential. For example, a school principal highlighted that sharing workshops could be beneficial for facilitating observation and reflection on practice.

Knowledge sharing workshops can seem at first sight as relatively simple forms of knowledge transmission, in which teachers share their own, predominantly practical knowledge with each other. While short term exchanges – e.g. only one or two workshops – do not necessarily allow for constructing a deeper collective knowledge base around a topic, they can still involve various knowledge dynamics. Using Nonaka and Takeuchi's knowledge creation model (Nonaka, 1994[102]; Nonaka and Takeuchi, 1995[112]), participating in workshops can involve a process of 'externalisation', i.e. transforming tacit knowledge to explicit. For example, when teachers explain how they transform and use the classroom space to facilitate learning, in addition to describing a new layout (e.g. a reading corner), they also need to explain in what kind of learning situations they use this space, with which students, and how this can help everyone to learn – some of which could have been tacit knowledge before. As one of the interviewees put it, in these modalities teachers become teacher trainers themselves. Sharing can also involve 'combination', i.e. contrasting and combining existing pieces of explicit knowledge and, ideally, is followed by 'internalisation', through which newly acquired and co-constructed explicit knowledge becomes partly tacit through practice and experience (Nonaka, 1994[102]; Nonaka and Takeuchi, 1995[112]). In sum, even relatively simple exchanges can involve complex knowledge dynamics.

In the case of regular workshops around a theme, sharing workshops can create communities of practice and involve the construction of new knowledge. The idea of "research and development" groups that come together to explore a common challenge – as it was put by an interviewee – corresponds to Brown and Duguid's (1991[109]) notion of knowledge generation discussed in Chapter 2. Workshops in this sense function as informal groups that develop a common understanding of improving professional practice in response to a local problem. Participants bring in their own knowledge and expertise not with the simple goal of sharing them, but to contribute to developing a solution to a question or problem. Teachers' individual knowledge here become building blocks to construct new collective knowledge.

Sharing workshops can also extend beyond teachers from different schools collaborating, to broader partnerships involving for example research labs. As one of the main EDUNET coordinators explained, traditionally it has been research labs that reached out to schools to collect data for their purposes. The resulting collaboration has mostly been one-sided and not based on schools' or teachers'

needs and interests. The intention of the EDUNET networks is to reverse this process and incentivise schools to reach out to research labs. Similarly to locally initiated PD courses, the aim would be to seek out researchers' formal knowledge related to a specific problem. However, rather than focusing on mobilising formal knowledge only, the emphasis is on co-creation. Such collaboration would involve "boundary crossing", in which both teachers and researchers work in unfamiliar grounds, and mutually shape each other's concepts (Engeström, Engeström and Kärkkäinen, 1995[190]). The idea of co-creation is also reflected by the concept of "learning labs" used in the interview with the main coordinator, who described the potential of the EDUNET networks as "learning labs" that reflect and work collectively on pedagogical practices.

Again, a number of challenges have been reported in the interviews. First, a lack of sharing and networking culture among teachers and schools was mentioned as a key obstacle. As a coordinator stressed, the timeframe for creating a culture of sharing is little compatible with the timeframe of institutional demands, which often crave for quick solutions. Second, several interviewees also reported a general lack of culture of class observation among teachers in France. As one interviewee formulated:

> *… teachers do not routinely […] observe, look at or discuss how they work. It's a bit a taboo for a teacher to attend a lesson in another class. And so if we managed to encourage these exchanges and to establish true sharing, it can have a really positive effect on reflection, on the practices and to make progress.*

The actual level of knowledge dynamics generated by the above described social devices depends on a number of implementation factors such as the typical lifespan of workshops, the way in which actors use this social device in practice and how schools benefit from them. The questionnaire data presented in Chapter 7 provides information on teachers' participation in these devices as well as how these forms of social engagement is linked to dynamics of knowledge.

6.4. Network characteristics: uncertain effects on knowledge processes

Having described the context of the network and the various devices put in place to facilitate knowledge dynamics, this section looks at how the various network characteristics may impact knowledge dynamics.

First, the members of the networks, as well as the way in which the links develop between them, carry tensions with regard to the objectives of EDUNET. Regarding its *nodes*, EDUNET networks strictly speaking consist of schools of different levels. While the intended knowledge dynamics clearly includes supporting teachers in mobilising and using research evidence, knowledge brokers or researchers are not formally part of the networks. Key coordinators did stress that the EDUNET networks are about developing a local ecosystem involving various stakeholders, and various knowledge brokers, such as research institutions and training providers, also have an important role in the networks. As these actors are not formally recognised as members of the network, they cannot systematically support teachers and school leaders in defining their knowledge needs and link these to the scientific knowledge base.

In addition, since EDUNET networks are mandated by the regional authority, tie formation is defined by the mandate. This is specifically aligned to the original objective of the first project phase: student pathways. However, with the change of objectives described earlier, network structures have not been redesigned to strengthen ties aligned to the new objective of facilitating horizontal collaboration among schools. The data suggests that some horizontal ties exist among schools, however, these are not recognised (formalised) as part of the EDUNET network. EDUNET networks are not conceived as distributed and flexible forms of organisations, but rather as pre-defined sets of members with specific roles and responsibilities. The formal and fixed structure of the networks defined by the mandate may prevent taking into account the existing “live” ties among individuals and schools.

Second, while the difference in the attributes of network members is valued, members lack some explicit knowledge, which prevents a richer dynamic. In EDUNET, the different school levels have different knowledge elements, which is consciously valorised through the various network devices. For example, in the coordinators’ meeting, primary and secondary school heads made their special knowledge base explicit (e.g. primary teachers knowing how to teach basic reading skills) and discussed how such knowledge can be shared to help the other school level (e.g. secondary teachers who still have some students struggling with such basic skills). At the same time, this seemed to be limited to specific areas of content knowledge. A more intense dynamic, for example between practical and formal research knowledge, is not possible without members having more diversified knowledge.

Third, the way the different network devices function is sometimes conflicting with the objective of fostering local dynamics. In the case of locally initiated professional development, identifying teachers’ local needs clashes with a bureaucracy, which inhibits problem-based innovation. Due to the bureaucratic process required to deliver this form of professional development, the regional authority needs to pre-define its frames, which implies that the content is at least to an extent prescribed. The Academy also explicitly pushes on knowledge transmission in particular fields such as neurosciences (this is the central theme appearing regularly at professional development as well as events, where invited speakers give lectures on particular aspects of neuroscience). A real support for defining local knowledge needs does not exist. As a result, while the objective of some network devices is to induce a need-based pull approach to professional learning, a push approach describes reality better. Concerning knowledge sharing workshops, lack of time and resources were also perceived as barriers to realising the goal of this device in terms of knowledge dynamics.

Fourth, the ambition of scaling local innovation through the EDUNET networks seems to encounter systemic obstacles. No clear mechanisms have been designed and implemented to bring locally constructed knowledge to the surface and share it at the regional level. Regional efforts focus on collecting and rewarding local innovations, however the way they are presented in online platforms (e.g. innovatheque) or regional events remains superficial. Such presentations are mainly promotional in nature, are limited to minimal description of practice and do not allow for a deep understanding of new knowledge. Understandably, the way in which such knowledge could be integrated in a more global knowledge base

is even less discussed, as the step of consolidating new practices in knowledge is missing. As a result, emerging local practices often stay local, in line with international research (Enthoven and de Bruijn, 2010[193]).

Fifth, the actors themselves show a great disparity in the professional knowledge mobilised, depending on whether they come from primary or secondary education, from a given level of education, or from a particular school discipline. The absence of moments of explicit reflection on existing knowledge, prevents teachers from considering teaching and learning situations in a relevant way, and from really discussing practices by explaining them. Indeed, teachers themselves rarely see their innovations as new knowledge, rather they view them as projects that lead to new practices. For the majority of teachers of the two case study schools it would probably be difficult, if not impossible, to formulate their work in terms of knowledge (see Chapter 9). Knowledge remains largely tacit if teachers do not acquire the necessary competences for codifying it. The EDUNET networks do not yet seem to offer specific support for such reflection and codification processes to happen.

Finally, the governance of networks constitute a challenge. There seems to be a strong tension between the Academy's effort to decentralise and the highly centralised nature of education governance in France. The frequent changes in regional leadership require the coordinators of EDUNET to re-justify the legitimacy of the networks every time there is a new rector. Leadership changes involve regular modifications of regional objectives, which implies a constant re-definition of the scope of the networks. This manifests in an uncertainty around networks, which slows down the implementation of a real dynamics in teachers' knowledge. The lack of stable and sustainable coordination also inhibits the mobilisation of local teams. Literature on school and local/regional-level educational leadership confirms that frequent churn in leadership has a high social cost and affects teachers (Finnigan and Daly, 2017[380]).

Decentralised autonomy given to networks seems limited and lacks appropriate support mechanisms and resources to facilitate the dynamics of knowledge mobilisation, construction and diffusion within and among schools. These barriers prevent the identification of local needs and their transmission towards the regional authority. In addition, creating horizontal collaboration sometimes deliberately breaks traditional local hierarchies. This is the case when a network coordinator role is assigned to a primary school head in a committee whose members include their hierarchical superiors (inspectors). As one interviewee reported, such forced horizontality led to a shift of perception in some cases, while it remained conflictual in others. In fact, horizontality is not a goal in itself, it needs to be evaluated in view of its impact on professional cultures. What is at stake is the collective mobilisation and construction of knowledge in order to solve local challenges and problems in an authentic way. It would also be necessary to facilitate the diffusion of knowledge, which requires making them explicit and go beyond a superficial description of pedagogical practices. School leaders play a key role in this process as they participate in working groups, in creating a professional learning culture for their teacher teams and in coordinating the local network (Leithwood, 2019[381]). They develop partnerships between schools along common objectives such as the

implementation of the curriculum, the development of basic skills, sharing of innovations, collaborative work around student career support and pathways, and support for disadvantaged students.

6.5. Conclusion

In this chapter, I examined the context and the functioning of the supra-network under study and identified factors that can be determining for such a social device to drive the dynamics of teachers' knowledge. Data put in evidence the tensions between centralised **governance of networks** and the inherently decentralised nature of the creation and sharing of professional knowledge and the emergence of innovative teaching practices. Given this tension, the case study raises questions about the extent to which the different **network devices** facilitate knowledge mobilisation, construction, diffusion and integration.

Does locally initiated professional development provide opportunities for teachers to mobilise knowledge that addresses local needs? Exploratory data suggests that bureaucratic injunctions can impede needs-based knowledge mobilisation within communities of practice, as also suggested by research on professional learning communities (Stoll and Seashore Louis, 2007[136]). In addition, there may be a tension between the push from central governance for knowledge transmission in particular fields and their "pull discourse" emphasising the importance of building on teachers' and schools' real needs.

Of course, teachers and schools sometimes access available knowledge, interpret, translate and transform it to meet their needs. But this knowledge seems to be largely external to their local practices. The extent of the adaptation process – the possibility of mixing different types of knowledge, their reinterpretation, transcription and transformation in a reflective and iterative process (Mausethagen, Prøitz and Skedsmo, 2018[382]; Brown and Poortman, 2018[20]) – is questionable. Knowledge sharing workshops are intended to facilitate these forms of dynamics locally within and across schools. However, lack of allocated time and resources are perceived barriers to this.

A closer examination of specific networks shows that the knowledge dynamics underlying networks is more complex than the administrative formalisation of **relationships**. Social ties involve hierarchical relationships that can hamper horizontal social processes, and can limit the possibilities for knowledge co-construction and diffusion. Tensions between horizontality and hierarchies matter for the extent to which the various network devices allow for sharing and diffusion of knowledge. In addition, mechanisms to bring locally constructed knowledge to the surface are not clear.

In sum, the case study demonstrated that the conceptual framework of social and knowledge dynamics can be used for a structured sociological investigation of teachers' knowledge in a networked context. It showed that although knowledge creation and sharing may be a real interest of teachers and local actors to respond to their challenges and needs, multiple social parameters are important for facilitating such dynamics of knowledge in networks. In the next chapters, I will study these parameters to

understand the relationships between various network characteristics and knowledge dynamics in-depth through quantitative and qualitative data.

Chapter 7. Measuring teachers' knowledge dynamics

This chapter investigates the two main research questions. First, "How can we characterise the dynamics of teachers' knowledge?". More specifically, I aim to get insight into the types of knowledge teachers engage with and the ways in which they mobilise, construct and diffuse knowledge. The first aspect taps into structural dynamics, in particular that between formal research knowledge and practice-based knowledge. The second aspect refers to functional dynamics, i.e. the various functions of knowledge and its evolution.

A new conceptualisation of teachers' knowledge dynamics – as described in the conceptual framework in Chapter 4 – needs to be validated through empirical data. In this chapter, I set out a way to measure knowledge dynamics and describe the quantitative instrument developed for this purpose. I apply multiple approaches to validate this instrument. First, I examine whether the constructs established to characterise the various dynamics are well captured through the questionnaire. Item analysis with descriptive statistics of teachers' knowledge dynamics in the EDUNET networks will be compared with prior research wherever possible, and compared with qualitative data collected in two case study schools. In this chapter, only minimal references are made to qualitative findings. I will present qualitative data in Chapter 9 and bring together quantitative and qualitative results in a more extensive discussion in Chapter 10. Second, I conduct scale analysis and a test of the structural validity of scales with factor analysis. The last sub-section in each knowledge dynamics dimension reports on the validation of the measures.

After a description of the data and the validation of the scales, the chapter looks into the second research question: "How do social dynamics influence teachers' knowledge dynamics?". I will explore relationships between the constructs through structural equation modelling. This chapter is primarily focused on presenting the results, an in-depth discussion will be provided in Chapter 10.

7.1. How do teachers' mobilise knowledge?

Research on teachers' knowledge mobilisation finds its roots primarily in educational philosophy, policy studies and educational sociology focusing on the teaching profession and professionalism. In recent years, a lot of the scientific discussion has been motivated by a policy context, in which teachers' engagement with research evidence has been promoted increasingly more strongly (see Chapter 3) (Fenwick and Farrell, 2017[229]). Research has raised attention to the complex ways in which occasionally

conflicting evidence circulates (Fenwick, Nerland and Jensen, 2012[383]), as well as to tensions between external formal knowledge sources, and the practical knowledge teachers need in making professional judgement in their daily practice. Teachers' situated understanding, technical knowledge and critical reflection have been identified as key aspects of professional knowledge relating to teaching practice, but often relying on theoretical research-based elements (Winch, Oancea and Orchard, 2015[61]). Research has also problematised and investigated the way teachers use data – another increasingly predominant element in policies shaping teachers' social practice. When characterising how teachers mobilise knowledge, I draw on this rich educational research. In particular, I investigate the types of knowledge sources teachers access, the ways in which they interpret and evaluate them, and translate them into their context. Knowledge mobilisation can not only occur through engaging with various sources, but also through actively engaging in research processes. This is the second main aspect of knowledge mobilisation examined.

7.1.1. What types of knowledge do teachers engage with?

Teachers draw on a range of knowledge sources in their daily practice, which have expanded dramatically with the World Wide Web and with the increasing pace of knowledge production (Pedder, James and MacBeath, 2005[384]; Fenwick, Nerland and Jensen, 2012[383]). The various sources have often been categorised based on the distinction between two dominant types of knowledge: theoretical and practice-based knowledge, both of which can be explicit (codified) or implicit (Eraut, 2004[385]). The usefulness of this categorisation has been debated, partly because it does not appropriately reflect the complexity of teachers' knowledge, in particular how these forms of knowledge are intertwined in the manifestations of professional practice (Winch, Oancea and Orchard, 2015[61]). Indeed, a teaching toolkit on the internet can be based on formal research (e.g. designed based on intervention studies), or can originate from teaching practice (e.g. a lesson plan proposed by a teacher) without an explicit reference to formal research. It is difficult to disentangle practical versus research-based sources. Nevertheless, such a distinction between sources remains pertinent in the policy context that increasingly requires teachers to use data and research (Mausethagen, Prøitz and Skedsmo, 2017[386]). Among the explicit knowledge sources (i.e. those that are stored in symbolic representations as opposed to implicit sources such as colleagues' knowledge), the following are often distinguished:

- Formal academic knowledge sources: theories and research findings manifest in research papers, reports, research summaries, etc.
- Practical knowledge sources: based on personal and professional experiences manifest in for example, teaching toolkits and blogs.
- Data sources: any systematically collected and structured information (Schildkamp and Lai, 2013[387]). For example, administrative data (e.g. student absences, demographic data), classroom test scores and national standardised test scores. (Pareja Roblin et al., 2014[388]; Pedder, James and MacBeath, 2005[384]; Mausethagen, Prøitz and Skedsmo, 2017[386]).

Mausethagen and colleagues (2017[386]) underline a key difference between mobilising practical knowledge sources and formal sources, namely that these latter – be it research or data – require "translation". Teachers cannot directly implement these sources, rather they need to interpret them and examine their suitability for their own context before integrating them in their practice (Mausethagen, Prøitz and Skedsmo, 2017[386]). Another important aspect of the information explosion in general, and the expansion of available resources for teachers in particular, is the need to verify their quality. Quality concerns have not only been raised with regard to practical resources, but also with regard to research (Winch, Oancea and Orchard, 2015[61]). Assessing quality involves judgement on whether the source is "trustworthy, valid, reliable, grounded […], dependable or believable" (Winch, Oancea and Orchard, 2015, p. 203[61]).

Based on the above considerations, the questionnaire for teachers attempted to distinguish between practical and formal knowledge sources, also asking about whether teachers verify the quality of these sources (Table 7.1). As indicated above, it is not straightforward to distinguish between these sources. For example, Pedder, James and MacBeath distinguished between reading research reports as opposed to using the web as a source. This may be problematic because most research sources are today accessible on the web, meaning that the latter category includes the former as a subset. To avoid this, the questionnaire I developed names more specific types of sources, such as blogs, websites, magazines or pedagogical resources, and distinguish them from research papers. I recognise that such a distinction may not be clear-cut either. Therefore, it will be important to verify whether educational resources more generally defined (as in items KD3-5) can be structurally distinguished from research defined more narrowly (items KD7-9).

The last column of Table 7.1 shows the various aspects of knowledge mobilisation as described above. Descriptive statistics for all 10 observed variables – scored on a scale from 1 (never) to 5 (almost always) – are provided in Annex B and Figure 7.1.

Table 7.1. Knowledge mobilisation constructs

Item code	Item	Response options / Tentative scales
Stem	During your professional learning in the past 12 months, were you engaged in the following? Where research/literature refer to topics related to teaching and learning.	1 Never 2 Rarely (1-4 times a year) 3 Sometimes (5-9 times a year) 4 Regularly (1-3 times a month) 5 Almost always (Once a week or more)
KD3	Reading educational blogs, websites/magazines?	Engagement with resources
KD4	Adapting and using pedagogical resources other than the regular textbook (e.g. lesson plans, toolkits, activities) in your practice?	Engagement with resources
KD5	Verify the quality of resources - blogs, articles, toolkits - for teachers (e.g. in terms of validity and reliability)?	Engagement with resources
KD7	Reading research papers on discipline-specific or general educational topics?	Engagement with research
KD8	Verify the quality of research findings (in terms of validity and reliability)?	Engagement with research
KD9	Analysing and interpreting research findings in terms of implementation in practice?	Engagement with research
KD10	Accessing and interpreting student data (e.g. results, absences, social data)?	Engagement (actively) in research
KD11	Collecting and analysing qualitative data (e.g. focus groups, interviews, video observations)?	Engagement (actively) in research
KD12	Collecting and analysing quantitative data (e.g. surveys, statistical analyses)?	Engagement (actively) in research
KD13	Conducting action research (e.g. experimenting with specific pedagogical interventions and measuring their impact)?	Engagement (actively) in research

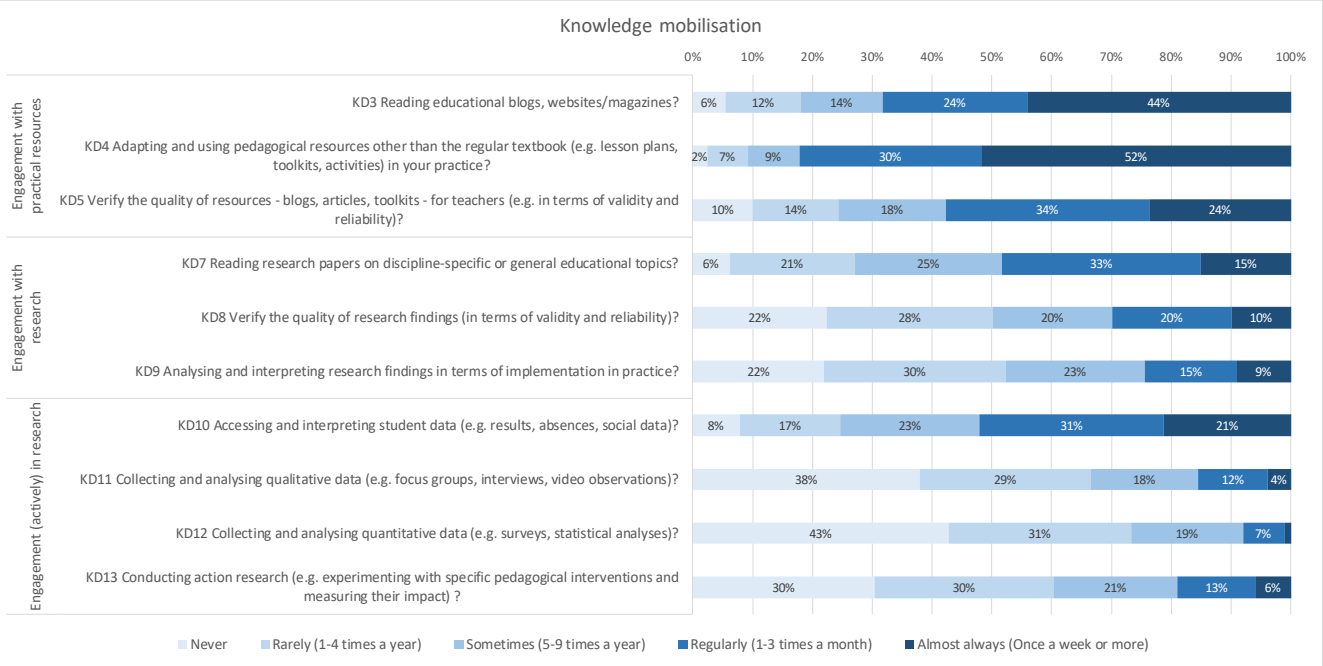
Data suggests that teachers engage more often with practical knowledge sources than with formal research knowledge overall. However, almost half of the teachers report reading research papers regularly or almost always. This is a very high proportion compared to results in similar surveys. For example, in a pilot study conducted in the United Kingdom, only 20% of teachers reported consulting research-based documents a lot (Nelson et al., 2017[389]). In an OECD pilot study covering five countries, more than half of teachers reported reading research papers in four out of five countries (Sonmark et al., 2017[36]), this survey however did not ask teachers about the frequency of accessing research. In the context of growing expectations towards teachers to use research both internationally and in France (see Chapter 3), reporting such high levels of mobilisation of research knowledge may also be at least partly attributed to social desirability bias. The qualitative interviews suggest that teachers mainly access theoretical knowledge in training sessions, on dedicated websites for professionals and social media such as twitter and facebook (see Chapter 9).

Accessing and reading research papers is only the first step in research use. In order that research feeds into teaching practice, teachers also need to interpret findings and examine their applicability in practice. However, more than half of the teachers reported that they never or only rarely do that. Among those who often read research, this proportion is considerably less, only around 23%. Logically, there is a high and significant positive correlation between reading research, verifying its quality (.66, $p<0.01$), as well as between reading and interpreting research for implementation (.66, $p<0.01$).

Teachers seem to trust the quality of formal knowledge sources much more than that of practical knowledge sources. Some 58% of teachers verify the quality of educational resources often (regularly or almost always), whereas one in every four teachers never or rarely does so. Concerning research, only

less than one third of teachers verify the quality often, and half of them never or rarely do. This could be slightly worrying if individual teachers engage with different sources. However, knowledge mobilisation can be part of teachers' collective work, in which case, it is possible that quality gatekeeping is the responsibility of a particular teacher (or a small group of teachers) who do this for the collective good.

Figure 7.1. Teachers' knowledge mobilisation – Percentage of teachers reporting to engage in knowledge mobilisation activities



7.1.2. Teachers' active engagement in research

To further explore the way teachers mobilise knowledge, the questionnaire also asked about the ways in which they engage actively in research (Table 7.1). Research on teaching and learning can involve a wide range of methods and is not limited to experiments or intervention studies (Nutley, Powell and Davies, 2013[209]). A source of motivation for engaging in research for teachers is to seek support for their decision-making (Kvernbekk, 2011[219]). Collecting, analysing and using data can for example, assist decision-making. Accessing data could in theory be considered simply as a form of engaging with a specific type of resource, and accordingly, some narrow definitions do not consider data use as a form of active engagement in research (Nelson et al., 2017[389]). In reality, however, data use is most often part of a more complex process, which involves analysing, interpreting data, as well as implementing results in practice (Kippers et al., 2018[390]). This activity can thus also be seen as a form of active engagement in research. One specific form of research that has been promoted also by education policy is action research (see Chapter 3). Some studies consider only "accessing and using externally-produced academic or professional research" as research engagement, and do not list action research among these (Nelson et al., 2017, p. 12[389]). Others acknowledge that action research almost always involves engaging with

external sources, and recognise it as a form of research producing context-specific evidence (Colucci-Gray et al., 2011[391]; Manfra, 2019[392]; Cochran-Smith and Lytle, 2009[393]). Because action research involves systematic enquiry about teaching practice (Cochran-Smith and Lytle, 2009[393]), in this research I consider it as a form of active engagement in research.

Data shows that teachers engage much less often actively in research than they access and engage with research sources. Only 16% of teachers report collecting and analysing qualitative data often (regularly or almost always), 8% report doing the same with quantitative data, while 18% conduct action research often. Around one third of teachers never engage in these activities (38%, 43%, 30% respectively), which also means that around two third at least sometimes do. This proportion is actually high compared to other datasets. For example, in the OECD's pilot study less than half of the teachers reported that they engage in these research activities in four out of five countries for each of the three activities (Sonmark et al., 2017[36]). Using student data is the most common form of engagement in research: more than half of the teachers report accessing and interpreting student data often, and only 8% of them never does so. This is in line with previous research: for example, in a pilot study in the United Kingdom, using student performance data was the most frequently reported source of influence on teaching approaches (Nelson et al., 2017[389]).

Overall, teachers report varying levels of engagement in different forms of knowledge mobilisation, but activities within the categories established conceptually seem to converge. I will now examine if the assumed structure of engagement with research and active engagement in research can be validated.

7.1.3. Factor analysis of knowledge mobilisation constructs

Factor analytical methods allow for verifying the underlying structure of data. In particular, it is important to validate the knowledge mobilisation constructs presented in the previous section, i.e. to investigate whether they indeed measure the latent constructs indicated in Table 7.1. A three-factor structure would correspond to the conceptual definition, where engaging with educational resources more generally (KD3-5) is distinguished from engaging with research (KD6-8), whereas a two-factor model would not distinguish these. Adequacy tests[16] show that the data is appropriate for conducting exploratory factor analysis (henceforth EFA). Parallel analysis (Schmitt, 2011[394]) suggests a three or two factor structure.

I tested both models with confirmatory factor analysis. Both the three- and the two-factor model fit the data significantly better than a model with only a single latent factor for knowledge mobilisation, ($\chi 2$ difference = 111.187 and 200.16 respectively, with $p<.001$ in both cases). As conceptually both models are plausible, in order to decide which one to use, I compared model fit. Fit indices clearly showed a better fit of the three-factor structure, which suggests that practical knowledge sources can indeed be structurally distinguished from sources of formal research knowledge (Table 7.2).

[16] Bartlett's test of sphericity – Chi square's p-value = 0; Kaiser-Meyer-Olkin [KMO] Test = 0.864.

Table 7.2. Comparison of three- and two-factor models through CFA

	3-factor model	2-factor model
χ2	33.0445	65.874
Degrees of freedom	32	34
CFI (scaled)	.991	.978
RMSEA (scaled)	.058	.088
90% CI for RMSEA (scaled)	(.036; .079)	(.069; .107)
SRMR	.039	.058

The indicators all show significant positive factor loadings, with standardised coefficients ranging from .597 to .889. There are significant positive correlations among all the latent factors, indicating that teachers who showed high levels of engagement with resources / research, also showed high levels of active engagement in research (see Annex B).

Ordinal alpha values were computed to verify scale reliability (Table 7.3). The lowest alpha value is that of the engagement with educational resources scale. While for three items, it can be accepted in social research (see Chapter 5), this scale should be improved in the future. In the engagement in research scale, not surprisingly, it is "Accessing and interpreting student data" (KD10) that stands out (alpha drop = .864). This is in line with the conceptual assumption that this item belongs less clearly to engaging in research.

Table 7.3. Internal consistency of knowledge mobilisation scales

Scale	Number of items	Ordinal Alpha
Engagement with resources	3	.748
Engagement with research	3	.875
Engagement in research	4	.836

Overall, the statistical results and conceptual considerations suggest that the three-factor model is both meaningful to work with and satisfies basic statistical requirements. Therefore, I will use this model in the following analysis. Nevertheless, future research could improve the instrument, most notably by strengthening all three scales and further validating them through larger samples and other educational contexts.

7.2. How do teachers co-construct knowledge?

Social, organisational and educational research have developed the concepts of knowledge construction, knowledge creation and knowledge building in an effort to understand the processes and practices of learning and innovation in different contexts. These terms are sometimes used interchangeably, but sometimes denote particularly defined notions. Knowledge construction is often associated with constructivist theories that see learning as an active process of meaning making and construction rather than as the passive acquisition of already existing external knowledge (see Chapter 2). Social theories brought the importance of the social context to this notion, emphasising the collective nature

of knowledge construction. Paavola, Lipponen and Hakkareinen (2004[71]) opt for using the term "knowledge creation" to distinguish more modern theories from traditional social constructivism. The authors contrast three influential models: Nonaka and Takeuchi's knowledge creation model (Nonaka and Takeuchi, 1995[112]), Engeström's expansive learning (Engeström, 2001[116]) and Bereiter's knowledge building model (Scardamalia and Bereiter, 1994[395]). While they note that the emphasis is on different elements in each of these models, Paavola and colleagues also identify a number of similarities:

- the centrality of the dynamics of knowledge creation and the pursuit of newness
- bringing mediating elements such as objects, activities and dialectics to the process of knowledge creation to oppose mentalism and cartesian dichotomies
- seeing knowledge creation as a social process: social interaction as a fundamental cognitive resource
- importance of the role of the individual in knowledge creation
- emphasising types of knowledge beyond propositional and declarative knowledge such as tacit knowledge or knowledge embedded in practice
- stressing the role of conceptual artefacts and making knowledge explicit in innovative processes
- interactions develop around and through shared objects such as concrete products, conceptual artefacts, practices and activity (Paavola, Lipponen and Hakkarainen, 2004[71]).

Teachers construct knowledge individually as they reflect on their own practice, interpret and implement research and other resources in their practice. However, the social nature of knowledge construction, put in evidence by social and organisational research, has gained in importance in the past decades. Teachers construct collective knowledge socially, through collaborating with their colleagues and other actors (Wenger, 1998[122]; Lave and Wenger, 1991[107]). Working with others also constitutes a major set of new roles and responsibilities that the current policy context imposes on teachers as demonstrated in Chapter 3. Collaboration goes beyond teachers' immediate community of practice, and involves crossing the boundaries of their school, as well as their profession: teachers today often work with teachers from other schools as well as with other actors including researchers, teacher educators and professionals from other sectors (Fenwick, Nerland and Jensen, 2012[383]). Knowledge construction in professional practice thus needs to be investigated beyond the individual teachers to include their social as well as material context (Fenwick, Nerland and Jensen, 2012[383]).

The aspects identified as common to knowledge creation in innovative communities by Paavola and colleagues also integrate the elements of each main theoretical approaches laid out in Chapter 2 (cognitive, organisational, social and socio-material) that are relevant for capturing the complexity of teachers' knowledge construction. Therefore, knowledge construction in my research adopts Paavola and colleagues' common aspects, and is understood as a collaborative process mediated by shared objects (van Aalst, 2009[396]; Paavola, Lipponen and Hakkarainen, 2004[71]). This corresponds to a broadly

interpreted socio-material perspective, which includes teachers' social interactions and extends the social perspective to the material world to incorporate their interactions with objects, tools, resources and conceptual artefacts (Fenwick, Nerland and Jensen, 2012[383]).

With regard to teachers' social network, earlier studies often focus on knowledge construction in more restricted communities of practices or professional learning communities such as teachers within a school, while less research has been conducted on wider networks. Yet, new forms of knowledge often emerge when traditional boundaries are crossed (Dillon, 2008[397]; Engeström, Engeström and Kärkkäinen, 1995[190]; Akkerman and Bakker, 2011[168]). Comparing the extent to which teachers engage in joint activities in smaller versus larger networks is therefore necessary to understand knowledge construction. Consequently, the questionnaire distinguished two social circles: colleagues (i.e. teachers from the same school) and teachers or partners from other schools. The items were the same for both groups capturing a) the ways in which teachers collectively reflect on instruction, b) co-design, co-develop and co-deliver instruction, and c) engage in innovation by developing new ideas and projects related to teaching and learning Table 7.4.

Table 7.4. Knowledge construction constructs

Item code	Item	Response options / Tentative scales
Item stem	How frequently did you participate in the following activities in the past 12 months? [Double-scale item with two columns] .1 items: With my colleagues: .2 items: With teachers/partners of other schools:	1 Never 2 Rarely (1-4 times a year) 3 Sometimes (5-9 times a year) 4 Regularly (1-3 times a month) 5 Almost always (Once a week or more)
KD27.1	We reflect on the learning development of individual students jointly with...	Reflection on instruction
KD28.1	We reflect on teaching and learning challenges related to the school context jointly with…	Reflection on instruction
KD29.1	We observe each others' classes to provide feedback.	Reflection on instruction
KD30.1	We jointly produce teaching materials.	Instruction
KD31.1	We prepare lessons together.	Instruction
KD32.1	We teach jointly as a team in the same class.	Instruction
KD33.1	We develop new ideas on how to teach a particular subject.	Instruction / Innovation ?
KD34.1	We develop interdisciplinary projects to help students develop competences.	Innovation
KD35.1	We develop initiatives that concern students and teachers across grade levels.	Innovation
KD36.1	We develop cross-school projects.	Innovation
KD37.1	We develop projects across school types.	Innovation
KD27.2	We reflect on the learning development of individual students jointly with...	Reflection on instruction
KD28.2	We reflect on teaching and learning challenges related to the school context jointly with…	Reflection on instruction
KD29.2	We observe each others' classes to provide feedback.	Reflection on instruction
KD30.2	We jointly produce teaching materials.	Instruction
KD31.2	We prepare lessons together.	Instruction
KD32.2	We teach jointly as a team in the same class.	Instruction
KD33.2	We develop new ideas on how to teach a particular subject.	Instruction / Innovation ?
KD34.2	We develop interdisciplinary projects to help students develop competences.	Innovation
KD35.2	We develop initiatives that concern students and teachers across grade levels.	Innovation
KD36.2	We develop cross-school projects.	Innovation
KD37.2	We develop projects across school types.	Innovation

Descriptive statistics for all 22 observed variables – scored on a scale from 1 (least frequent) to 5 (most frequent) – are provided in Annex B. It is important to note the considerable proportion of missing data (~20%) in the variables referring to knowledge construction with teachers and partners from other schools. The reason for this may be technical: the questionnaire had a double scale for each item, the first one referring to teacher colleagues, and the second to teacher/partner from other schools. It is possible that this format was not clear enough and respondents thought they had answered the question by clicking an option in the first column. However, it may also indicate that some of these items were not so relevant for the wider network and respondents simply skipped that response instead of answering "Never".

7.2.1. Reflecting on practice

Although present already in Dewey's work, reflection on practice as a form of constructing professional knowledge has become central since Schön's influential book "The reflective practitioner" (Schön, 1984[66]). Of particular relevance is Schön's concept "reflection-on-action", which refers to interpreting and analysing teaching practice after the "action" of teaching, and which is considered a fundamental form of learning and knowledge construction (Eraut, 1995[398]). Social interactions and collaboration can support reflection because teachers engage in shared meaning making (Garet et al., 2001[399]; Tse, 2007[400]). Reflecting on teaching and learning, observing each other in the classroom, discussing specific practices are fundamental elements of teacher learning and as such of knowledge construction (Vangrieken et al., 2015[318]). Three of these elements are explored in my survey: peer observation and reflection on teaching and learning at two different scales: related to individual students and related to the school context.

The vast majority of teachers report that they engage in reflection often (regularly or almost always) both on the development of individual students and on broader teaching and learning related challenges (72% and 61% respectively) (see Figure 7.2). However, a considerably smaller proportion of them observe each other in the classroom: almost three in four teachers never engage in peer observation. This privatisation of teaching practice was also reported in the exploratory interview and in the case study interviews, and explained by fear of judgement. One school leader formulated it as follows:

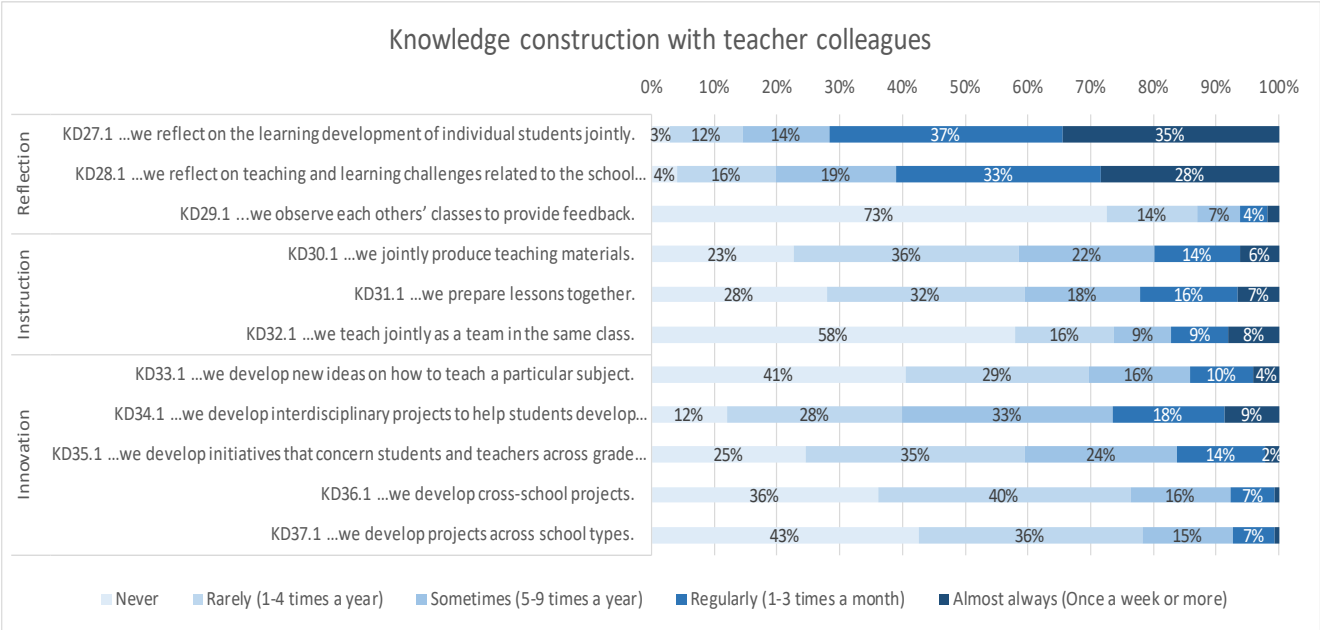
> *Because teachers are always quite closed, and they are always afraid of judgement. Because we have an institution ... so we are breaking it down, but we have the impression that when we present our work to someone then we will be judged.*

These results are very much in line with large-scale international surveys such as TALIS. Almost 80% of teachers in France reported never observing other teachers' classes, which is the third highest proportion compared to other countries, although similar to Spain and Portugal for example (OECD, 2014[401]). The same dataset also showed that engaging in discussions about the learning development of specific students is more common in most countries: in France, almost all teachers reported having such discussions (OECD, 2014[401]). This difference is in line with international research on teacher learning,

which has demonstrated that teachers are cautious to engage in real critical reflection so as to avoid conflicts (Ohlsson, 2013[402]). The privatisation of teaching practice has also been put in evidence by numerous scholars (McLaughlin, 2011[403]; Little Warren, 1990[404]).

Teachers engage significantly less in reflection with their wider networks (see Figure 7.3): around 40% never reflect on individual students with external partners, and around one third never does so on teaching and learning challenges related to their school context. This could be because teachers may consider that external partners have less relevant reflections to share with regards to student and school-specific issues. However, it is interesting to note that slightly more than one in ten teachers report reflecting on such aspects with external partners at least a few times a year. The qualitative interviews revealed that the EDUNET networks indeed function as a liaison between school types. Several lower-secondary teachers reported working with primary school colleagues to facilitate student pathways. This type of collaboration involves mutual class visits and joint reflection on core competences for example. Interestingly, some reported these forms of collaboration only with their wider network, i.e. teachers from a different school type, but not within their own schools.

Figure 7.2. Knowledge construction with teacher colleagues



7.2.2. Designing instruction

Shared objects that mediate knowledge construction have been emphasised in the various models of innovative communities. They incorporate conceptual artefacts, actual products as well as activities embedded in practice (Paavola, Lipponen and Hakkarainen, 2004[71]). In the case of teachers, these objects are related to their everyday social practice that involves planning lessons, delivering instruction, and correcting students' work. A socio-material aspect of collective knowledge construction looks at the

way teachers engage in collaboration related to these objects and activities. My questionnaire captures the most common of these:

- producing teaching materials: actual products as shared objects, in line with Nonaka and Takeuchi's knowledge creation model
- preparing lessons together and teaching jointly: engaging in an activity that mediates knowledge construction, in line with Engeström's activity theory.

In educational research, Grasel and colleagues constructed a questionnaire to investigate forms of teacher collaboration to examine how teacher training can foster teacher collaboration (Grasel et al., 2007[332]). Their study validated three scales, of which the co-construction scale contained six items with high factor loadings (see Annex B). I adapted four of the six items for my research (KD30-KD33 in Table 7.4).

Only less than a quarter of teachers report engaging in any of these forms of co-constructing instruction often (almost always or regularly). The majority of teachers, more than 70%, report that they produce teaching materials jointly or prepare lessons together at least a few times a year. However, teaching jointly is a less typical form of co-construction among teacher colleagues: 58% of teachers never do that. This is in line with the results of large-scale international studies: in TALIS 2013, 62.7% of French lower-secondary teachers reported never teaching jointly (OECD, 2014[401]).

Perhaps more interestingly, over 40% of teachers claim that they never develop new ideas on how to teach a particular subject jointly with their colleagues. This is surprising because teachers tend to have a strong disciplinary focus in France, where teacher training traditionally focuses on pedagogical content knowledge in Shulman's terms, or didactics (Allal, 2011[405]).

Teachers co-construct knowledge through instructional design significantly less with their wider networks: over 60% of them report that they never engage in these activities with teachers or partners from other organisations. This data suggests that the activity of instructional design is both socially and spatially bounded. The social-material environment in which knowledge construction takes place consists of teachers, the classroom with the students of a particular class or more broadly with the set of classes they teach, and the instruction-related objects (lesson plans, materials) and activities (instructional design). This space is occasionally extended to involve teacher colleagues, but remains mostly bounded by the school.

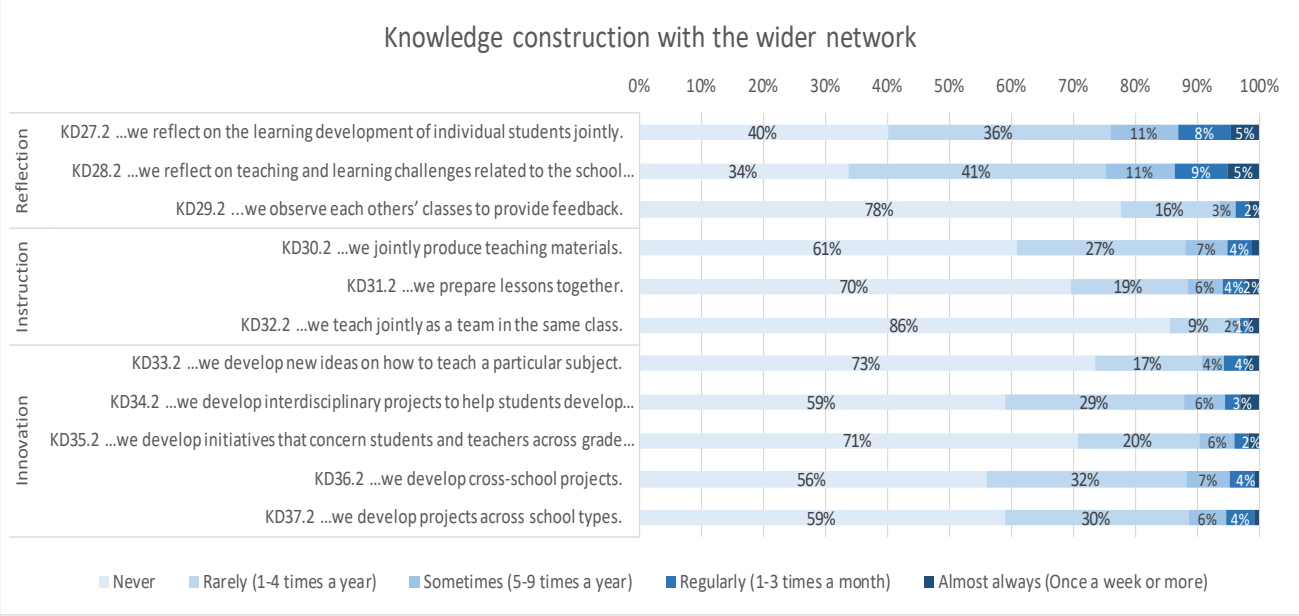
7.2.3. Innovation

Another key aspect of knowledge construction is the generation of something new (Paavola, Lipponen and Hakkarainen, 2004[71]). Innovation often emerges when actors' collective reflection involves crossing certain boundaries. Akkerman and Bakker describe a boundary as a "sociocultural difference leading to discontinuity in action or interaction" (Akkerman and Bakker, 2011[168]). Crossing these boundaries play a major role in innovation by bringing out differences between practices (Akkerman and

Bakker, 2011[168]). To capture the innovation aspect of knowledge construction in terms of boundary crossing, the boundaries typically present in teachers' practice need to be identified.

The primary focus of teaching practice relates to teaching methods, and in particular to those specific to a subject. Innovation in teaching methods with regard to a specific subject is thus the first level. As noted above, in secondary education, disciplines constitute a major boundary in France both in terms of social interaction (teachers tend to collaborate more with their colleagues in the same discipline) and in terms of knowledge construction, which often remains subject-specific. Crossing disciplinary boundaries is therefore the second type of innovation. School grades define another typical boundary for knowledge construction. In primary education, many teachers in France specialise in one particular school grade and teach that grade only throughout most of their career. As one major platform for exchange among teachers relates to the class they teach, new ideas, projects or knowledge often relate to specific grades in secondary education as well. The third type of innovation captured in the questionnaire thus relates to cross-grade knowledge construction. The school organisation is the most tangible physical and social boundary in terms of innovation, and cross-school innovation is therefore the fourth level addressed in the questionnaire. Finally, school levels (pre-primary, primary, lower and upper secondary) also delimit spaces, which are often not easy to permeate. In France, future primary and secondary teachers' initial training is separate (Normand, 2012[406]; 2020[407]). The main focus for pre-primary and primary teacher candidates is on pedagogy, while for secondary teacher candidates it is on subject content. This also means that teachers of different levels often seek different types of professional development opportunities (Normand, 2012[406]; 2020[407]), so the space where actors from different school types can develop new ideas and reflect collectively needs to be consciously created.

Figure 7.3. Knowledge construction with the wider network



Data confirms that the boundaries defined above are gradually more difficult to permeate. Only 12% of teachers never develop interdisciplinary projects, the proportion of teachers never developing cross-grade initiatives is double (25%), some 36% never work on cross-school projects, and almost half of the teachers (43%) never develop projects across school types with their colleagues. Nevertheless, these data also imply that the majority of teachers engage in the different types of boundary-crossing innovation at least from time to time. More than one teacher in four report that they often (regularly or almost always) work on interdisciplinary projects and around 16% of teachers often engage in collective work across grades.

Data also confirms that school organisations do not only constitute a physical but also a social boundary in terms of innovation. The majority of teachers report that they never engage in boundary-crossing innovation with colleagues from outside their schools. Those who often develop new ideas and projects with external partners are rare, the percentage of this teacher population remains under 6% for all types of innovation defined in the questionnaire. However, we cannot claim that such collaboration is non-existent, around 20-30% of teachers engage in such activities occasionally. The qualitative interviews reveal that the collective work of teachers from different school types usually relates to student pathways in the framework of the EDUNET networks. In this case, it is the teachers teaching "boundary grades", i.e. the first or last grades of a particular school type, who are involved. Questionnaire data only partially confirms this: teachers teaching grade 6 (the lowest grade) in lower-secondary schools report engaging slightly more in cross-school type collaboration than their colleagues not teaching boundary grades. Similarly, teachers of the last grade in kindergartens tend to engage in this type of knowledge construction slightly more than their colleagues. Such link cannot be observed between lower- and upper-secondary schools in the data.

Overall, data shows that reflection on individual students, and on teaching and learning more generally is the most frequent form of knowledge construction. Teachers' social ties are stronger with their immediate colleagues when it comes to professional collaboration. Nevertheless, a smaller proportion of teachers also work with their wider social network. To better understand the drivers and barriers of social knowledge construction, I will first examine the underlying constructs of this dimension.

7.2.4. Factor analysis of knowledge construction constructs

This dimension is clearly more complex and several models are plausible based on conceptual considerations. One option is that the two main constructs are based on the social group in which teachers construct knowledge: with colleagues and with the wider network (Model 1). Another option is that there are subscales in both social groups. The subscales can correspond to the tentative constructs defined in Table 7.4, which makes six factors altogether (Model 2). It is also plausible that reflection on instruction and instruction cannot be distinguished because teachers perceive these activities as very much connected, leading to four factors, two in each social group (Model 3) (Table 7.5). In addition, for Model 2 and 3, we can suppose an underlying factor corresponding to the social group. I tested all models through CFA to compare fit.

Table 7.5. Theoretical knowledge construction models

Item code	Model 1: 2 factors	Model 2: 6 factors	Model 3: 4 factors
KD27.1	KC with colleagues	Reflection on instruction with colleagues	Instruction with colleagues
KD28.1			
KD29.1			
KD30.1		Instruction with colleagues	
KD31.1			
KD32.1			
KD33.1			
KD34.1		Innovation with colleagues	Innovation with colleagues
KD35.1			
KD36.1			
KD37.1			
KD27.2	KC with wider network	Reflection on instruction with the wider network	Instruction with the wider network
KD28.2			
KD29.2			
KD30.2		Instruction with the wider network	
KD31.2			
KD32.2			
KD33.2			
KD34.2		Innovation with the wider network	Innovation with the wider network
KD35.2			
KD36.2			
KD37.2			

Unfortunately, none of the models showed fit (Table 7.6), nor did they improve considerably after a few steps of modification based on the modification indices. This part of the instrument thus does not seem to measure any clear latent constructs. Only statistics of individual items will be used for further analysis.

Table 7.6. Comparison of conceptually plausible models of knowledge construction through CFA

	Model 1: 2 factors	Model 2: 6 factors	Model 3: 4 factors
$\chi 2$	928.97	837.70	912.51
Degrees of freedom	208	208	208
CFI (scaled)	.838	.859	.842
RMSEA (scaled)	.132	.124	.131
CI for RMSEA (scaled)	(.124; .141)	(.115; .132)	(.122; .140)
SRMR	.146	.150	.151

In future research, this component could be improved in various ways. First, it is possible that teachers construct knowledge in their immediate community (colleagues) in very different ways than with their wider network. In this case, a different set of knowledge construction forms should be distinguished for the two social circles. The data seems to underpin this assumption: clearly the proportion of teachers reporting to engage in the activities captured in this questionnaire with their wider network is very small. Qualitative interviews suggest that this does not necessarily mean that teachers do not engage in

knowledge construction beyond the boundaries of their smaller community of practice. Two main forms of such boundary-crossing work emerged from the interviews: primary and lower-secondary school teachers collaborating related to student pathways, and certain subject teachers collaborating across schools of the same school level. However, these types of collaborations are restricted to teachers with certain characteristics, for example teaching the first or last grades of a school level (primary, lower or upper-secondary).

Model misfit could partly be due to the high rate of missing values in the items related to knowledge construction with the wider network. It is worth testing the dimension relating to the immediate social circle, i.e. construction with teacher colleagues separately. EFA for this dimension suggests the three-factor solution – reflection, instructional design and innovation – which is in line with the theoretical assumption. The only difference is that KD29.1 (observing each other and giving feedback) clearly loads on the instructional design rather than the reflection factor. This unfortunately means that only two items remain to measure the Reflection construct. CFA of this three-factor model yields a better fit, although still not perfect (Table 7.7). The first modification index suggests adding the residual covariance of items KD36.1 and KD37.1. This makes sense theoretically, as these two items measure closely related aspects: developing cross-school projects and cross-school type projects. After modifying the model, the fit becomes acceptable. Factor loadings are all above .5, with only two items (KD29.1 and KD37.1) that have loadings lower than .6. The ordinal alpha values show a good internal consistency of the scales (Table 7.8).

Table 7.7. Knowledge construction with teacher colleagues through CFA

	Model 1: 3 factors	Model 2: 3 factors modified
χ2	92.311	52.657
Degrees of freedom	41	40
CFI (scaled)	.964	.984
RMSEA (scaled)	.098	.067
CI for RMSEA (scaled)	(.081; .116)	(.048; .087)
SRMR	.061	.046

Table 7.8. Internal consistency of knowledge construction with teacher colleagues scales

Scale	Number of items	Ordinal Alpha
Reflection	2!	.888
Instructional design	5	.859
Innovation	4	.841

7.3. How is knowledge diffused?

Understanding how knowledge spreads has become an important focus in social sciences, in particular in economics and sociology, in the past few decades. The sociological theory of diffusion investigates how social structures and processes diffuse innovation. As noted in Chapter 3, Rogers

(1962[256]) in his seminal work identified four elements of innovation diffusion: the innovation itself, communication channels, time and the social system. The social system element of diffusion includes both the broad impersonal social structure with its mass information channels such as media and the more informal social networks set up of interpersonal relationships (Greenhalgh et al., 2004[57]). This latter is the dominant social tissue for innovation diffusion (Greenhalgh et al., 2004[57]). Social network theory has been one of the major methodological frameworks to investigate knowledge diffusion in social networks, i.e. the ties and social interactions among actors. The bulk of sociological and economics research has been specifically focusing on innovation diffusion [e.g. (Rogers, 1962[256]; Larson and Dearing, 2008[257]; Greenhalgh et al., 2004[57])]. However, given the intimate relationship between innovation and knowledge discussed in Chapter 3, both the theoretical frameworks and the findings of these studies are relevant for understanding the diffusion of knowledge more broadly.

A systematic review of diffusion in service organisations by Greenhalgh and colleagues distinguishes between diffusion, which is unplanned, informal spread, and dissemination, which is an active, planned and often formal process of spread (Greenhalgh et al., 2004[57]). The review identifies a number of fundamental components for diffusion and dissemination, which can be grouped in the following broad social network concepts:

- Network structure: for example, formal/informal, horizontal/vertical network structure
- Network ties: E.g. those based on homophily (similarity in socio-economic, professional and cultural backgrounds) are important for spreading innovation
- Network nodes: Opinion leaders (persons having a particularly strong influence on others' beliefs and actions), champions (key individuals supporting a certain innovation) and boundary spanners (those who mobilise their social ties both inside and outside the organisation to link the organisation to the outside world) constitute a key type of node in a network
- Network devices: Formal dissemination programmes used consciously to spread the innovation (Greenhalgh et al., 2004[57]).

The understandings and findings of these sociological studies are applicable for the social group of teachers. Teachers' knowledge is diffused through their social interactions that take place in a number of forms and platforms. A major precondition for knowledge diffusion is the absorptive capacity for new knowledge, which includes the ability to identify, interpret, translate, recodify and share new knowledge (Greenhalgh et al., 2004[57]; Farrell, Coburn and Chong, 2019[408]). For teachers, this can manifest in mediation activities such as synthesising and presenting knowledge from both internal and external sources to the community. Professional development is a major platform for knowledge diffusion in the case of teachers, which can have spillover effects on the whole teacher community within a school, not only those who directly participate in training (Sun et al., 2013[409]). Communication platforms include face-to-face interactions such as meetings, workshops, training, informal discussions, as well as digital communication technologies. As Greenhalgh and colleagues' review demonstrates, boundary-crossing is

not only important for the construction of knowledge, but also for its diffusion (Greenhalgh et al., 2004[57]). Teachers' links to external partners is thus fundamental for playing a boundary-spanning role. These aspects are captured in 20 items in the questionnaire. Descriptive statistics for all observed variables – scored on a scale from 1 (never) to 5 (almost always) – are provided in Annex B.

Table 7.9. Knowledge diffusion constructs

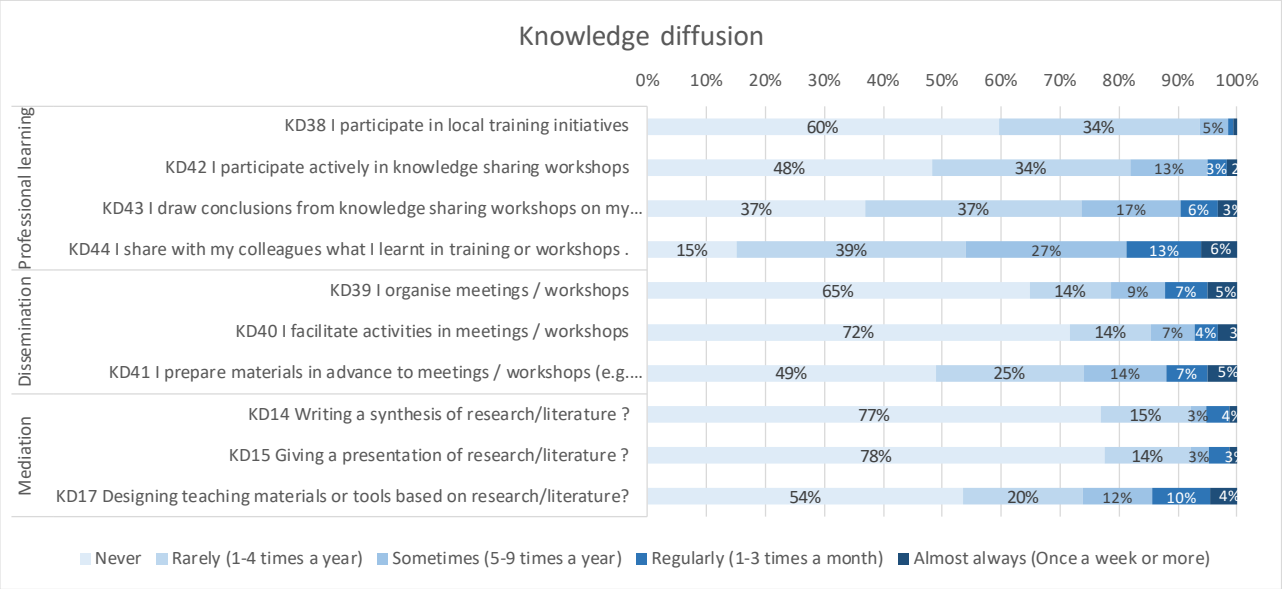
Item code	Item	Response options / Tentative scales
Stem	How frequently did you do the following in the past 12 months?	1 Never 2 Rarely (1-4 times a year) 3 Sometimes (5-9 times a year) 4 Regularly (1-3 times a month) 5 Almost always (Once a week or more)
KD38	I participate in local training initiatives.	Professional learning
KD39	I organise meetings / workshops.	Dissemination
KD40	I facilitate activities in meetings / workshops.	Dissemination
KD41	I prepare materials in advance to meetings / workshops (e.g. presentation, classroom video or observation, project plan).	Dissemination
KD42	I participate actively in knowledge sharing workshops.	Professional learning
KD43	I draw conclusions from knowledge sharing workshops on my teaching practice (e.g. lessons learnt for methods, list of ideas to experiment with).	Professional learning
KD44	I share with my colleagues what I learnt in training or workshops.	Professional learning
Stem	During your professional learning in the past 12 months, were you engaged in the following? Where research/literature refer to topics related to teaching and learning.	
KD14	Writing a synthesis of research/literature?	Mediation of research
KD15	Giving a presentation of research/literature?	Mediation of research
KD17	Designing teaching materials or tools based on research/literature?	Mediation of research
Stem	How frequently have you collaborated with the following actors on pedagogical projects during the last 12 months?	1 Never 2 Rarely (1-4 times a year) 3 Sometimes (5-9 times a year) 4 Regularly (1-3 times a month) 5 Almost always (Once a week or more)
KD52	Departmental inspectors	Partners
KD53	Teacher educators	Partners
KD54	Educational researchers	Partners
KD55	Professional from a related sector (e.g. social or youth worker, educator of students with special education needs, mental health professional)	Partners
Stem	How frequently did you share your teaching resources or knowledge about teaching and learning in the past 12 months in the following ways?	1 Never 2 Rarely (1-4 times a year) 3 Sometimes (5-9 times a year) 4 Regularly (1-3 times a month) 5 Almost always (Once a week or more)
KD44x	(a) by email/message	Communication channels
KD45	(b) on a server/intranet	Communication channels
KD46	(c) on an online platform for teachers (e.g. ViaEduc, Padlet)	Communication channels
KD47	(d) in social media groups for teachers (e.g. facebook, linkedin groups)	Communication channels
KD48	(e) in meetings	Communication channels
KD50	(f) in workshops or conferences	Communication channels

7.3.1. Professional learning, dissemination and mediation

The analysis of teachers' social network has demonstrated that participating in professional development programmes does not only disseminate knowledge to the participants, but it also results in a spillover effect (Sun et al., 2013[409]). This indirect knowledge diffusion can be as important as direct disseminations (Sun et al., 2013[409]). The knowledge diffusion dimension of the questionnaire thus asked teachers about the ways in which they engage in some of the dominant forms of professional learning such as workshops and training sessions. Some of these are specific to the context of EDUNET networks: local training initiatives and sharing workshops are knowledge diffusion platforms specifically designed and promoted in the Academy of Bel-Mondo (see Chapter 6). The questionnaire captures two dimensions: the ways in which teachers participate in forms of professional learning, and the ways in which they actively facilitate such platforms. This latter corresponds to a more conscious effort of dissemination (Table 7.9). In terms of professional learning, drawing conclusions from workshops (KD43) stands out slightly, as it captures the effect of the activity, i.e. the use of new knowledge, which falls almost into the dimension of knowledge mobilisation. Sharing new knowledge with colleagues (KD44) represents the spillover effect of professional learning. This item could also be classified as a form of dissemination, although it does not relate to setting up dissemination activities directly like the other items in that scale.

Participating in formal professional development such as training or specific workshops does not constitute teachers' daily practice. In line with that, the majority of teachers reported not having participated in local training initiatives (60%), and almost half of them never having attended knowledge sharing workshops (48%) in the 12 months prior to the survey. An important share of teachers however take part in these forms of professional learning at least from time to time: 40% in training and 52% in workshops. Social research highlights the capacity prerequisite of knowledge diffusion, i.e. that the individual teacher interprets new knowledge and translates it for their practice (Greenhalgh et al., 2004[57]). Data suggests an important capacity gap in this regard: more than one in three teachers (~37%) never draw conclusions from professional learning on their teaching practice. However, this data needs to be interpreted with caution as the question refers to engaging in a particular activity in the past 12 months, and if a teacher did not happen to take part in professional learning during this period, logically they may not have reported this kind of reflection. The same note of caution holds for interpreting the data on teachers sharing their new knowledge with their colleagues. Yet, despite the bias of question frame, significantly more teachers (85%) report sharing knowledge they learnt with colleagues at least from time to time. This finding is in line with prior research showing the important spillover effect of professional learning (Sun et al., 2013[409]).

Figure 7.4. Knowledge diffusion



The vast majority of teachers report never taking the deliberate effort of organising or facilitating dissemination forums (65% and 72% respectively). However, once such a forum (meeting, workshop) is organised by someone else, more than half of them engage in preparing materials for it at least from time to time. This confirms the important role of those who are active facilitators of knowledge diffusion (Greenhalgh et al., 2004[57]). According to this data, only a small proportion of teachers act as such network facilitators. The qualitative interviews in both schools suggest that this is primarily the school leader's role. Teachers on the other hand, usually engage in informal discussions related to a specific project with colleagues they are closely working with. Teacher-initiated informal meetings seem to relate more to knowledge construction rather than to wider knowledge sharing.

Mediation of new knowledge is closely related to the capacity issue discussed above. In order to disseminate new knowledge, teachers first need to interpret, reframe and recodify what they learnt (Greenhalgh et al., 2004[57]). Synthesising and presenting research and literature are mediation activities which require this type of interpretation and reframing. Slightly less than one in four teachers reported having mediated external knowledge sources (research or literature) this way at least from time to time. Although this is a minority, it still represents an important proportion of teachers who act as mediators. Interestingly, the qualitative data collected in the two case study schools does not clearly confirm such relatively high mediation activity by teachers. Interviewed teachers did not indicate either that they themselves mediate literature in such ways or that their colleagues do. In contrast, both school leaders reported reading and mediating literature. The third form of mediation, designing teaching materials or tools based on research / literature, requires not just interpretation but also translation of theoretical knowledge into practice. Almost half of the teachers report engaging in such kind of mediation at least from time to time. This higher level of engagement could be explained by the fact that designing teaching

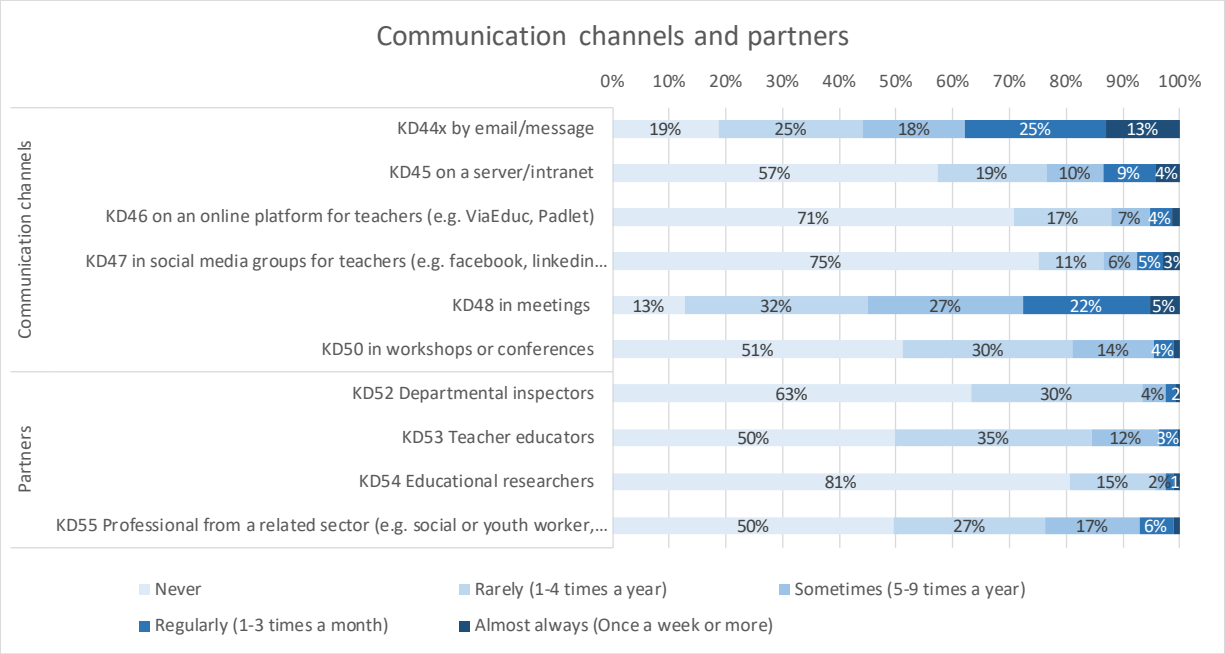
materials is part of teachers' actual daily responsibilities and this form of mediation could thus be seen as immediately useful for them.

7.3.2. Communication channels and partners

Social capital theory posits that people access knowledge and resources through their social interactions. Social network research has demonstrated the importance of boundary-crossing ties in gaining new knowledge, for example, connections to actors outside one's professional community. Research on innovation diffusion in particular, drew the attention to the importance of those actors who can mobilise their social ties both internally, within the school and with external partners (Greenhalgh et al., 2004[57]).

External (non-teacher) actors who have systemic links to teachers in France are teacher educators, particularly those providing continuous professional development, and inspectors. These two groups have a direct role in shaping teachers knowledge. In addition, teachers have more and more opportunities to work with education researchers. The impact of social ties between teachers and researchers is not straightforward however. As one interviewee explained in the exploratory phase of this study, typically, it is still researchers who seek out schools and teachers, and their research does not stem in the daily challenges of teachers, but rather focuses on their own research interest and agenda. Nevertheless, it is one of the ambitions of the Academy of Bel-Mondo's EDUNET network to make this relationship more practice-driven. In addition to these groups, cross-sectoral collaboration has also been increasingly more encouraged in education policy [e.g. (European Commission, 2018[410])], and emerging findings suggest that working with professionals from related sectors can facilitate teachers' knowledge building (Kennedy and Stewart, 2011[411]; Wohlstetter et al., 2004[412]). Other partners such as parents, actors from the community (e.g. sports clubs, libraries, leisure centres) and businesses (e.g. in the ed-tech industry), can also potentially shape teachers' knowledge. However, collaboration with these actors focus less directly on knowledge building, and is therefore not the primary concern for my study.

Figure 7.5. Teachers' communication channels and partners



Around half of the teachers reported never have worked with teacher educators and professionals from other sectors in the 12 months prior to the survey. The proportion is larger for the other two groups: more than 60% never collaborated with inspectors and 80% never did so with researchers. Again, these findings suggest that boundary-spanning, in this case across professions, is a role played by a minority of teachers. As a result, these teachers are key for bringing external knowledge in their community of practice within the school. However, this does not seem to be the case. There are no strong correlations between frequently connecting with external partners and the various forms of diffusion. Moderate correlations are observed in a few cases (see Annex B). Teachers who work with educational researchers tend to also engage more frequently in synthesising and presenting research, as well as in designing materials based on research (polychoric correlation coefficients: .52, .51 and .41 respectively[17]). Moreover, teachers who report working with teacher educators also tend to more often participate in workshops and draw conclusions from them subsequently (.49, .43 respectively). The overall weak correlations indicate that the social ties of well-connected teachers are not sufficiently used for knowledge diffusion. The qualitative interviews in the two case study schools reinforce this: those teachers who reported working with external partners do not necessarily have special roles in knowledge sharing, and the knowledge they gain from these connections may remain with them.

The second set of questions (KD44x-KD50) explores the use of various channels to share knowledge. These items do not assume a latent construct, rather they aim to identify the most and least used channels through descriptive statistics. The more classical communication means are clearly far the

[17] The magnitude of polychoric correlations should be assessed similarly to that of Pearson correlations. Their significance can be assessed by the estimated standard error of the polychoric correlation or via a chi-squared test.

most frequently used by teachers. Over 80% of teachers report sharing resources and knowledge in emails, and more than one third do so often. Similarly, close to 90% of teachers share resources and knowledge in meetings, and 28% of them do this often. Other communication channels are used by smaller proportions of teachers: more than two third of teachers report never using online platforms and social media for this purpose. It is important to keep in mind that the questionnaire was administered before the covid19 pandemic, which hugely increased the use of electronic communication means among teachers all over the world. Schools in France were closed from 16 March 2020 and only reopened at the end of the school year in June. Sudden school closures and confinement measures implied that teachers and schools had to organise themselves from one day to the next to provide distance learning. The qualitative interviews suggest that although exchanging in emails still remained prevalent, this situation resulted in increased use of online platforms. In particular, teachers started to use “Pronote”, the French national online platform provided for schools, more often for communication among themselves as well as with students.

7.3.3. Factor analysis of knowledge diffusion constructs

Four of the five knowledge diffusion aspects are likely to measure an underlying construct. Communication channel items aim to map the use of the various channels, however they do not constitute a conceptual construct, in that it is not expected that teachers who are likely to use one channel are also likely to use others. In line with the conceptual model defined in Table 7.9, I tested a four-factor structure of knowledge diffusion: professional learning (KD38, KD42-44), dissemination (KD39-41), mediation (KD14, 15, 17) and partners (KD52-55) with confirmatory factor analysis. The four-factor model fit the data significantly better than a model with only a single latent factor for knowledge diffusion ($\chi 2$ difference = 209.859 with $p<.001$), and the model fit was also satisfactory (Table 7.10).

However, lavaan raised a double warning in trying to fit the model. First, that the variance-covariance matrix of the estimated parameters (vcov) may not be positive definite. This is a common problem when using Polychoric correlations, and the smallest eigenvalue was still positive (though close to zero). Second, that some estimated variances are negative. Indeed the variance of KD15 was estimated negative. As the proportion of missing values is very low, this may be an indication that the model is too complex. To reduce the complexity it seems reasonable to try a model with one scale less. Two scales have a different stem: *Mediation* and *Partners*. Removing the *Partners* scale did not fix the problem, the same warnings were raised. Removing the mediation scale however led to an acceptable fit (Table 7.10).

Table 7.10. Knowledge diffusion model through CFA

	4-factor model	3-factor model
χ2	82.23	55.000
Degrees of freedom	71	41
CFI (scaled)	.985	0.987
RMSEA (scaled)	.060	0.069
90% CI for RMSEA (scaled)	(.045; .075)	(.051; .088)
SRMR	.057	.055

As expected, the indicators all showed significant positive factor loadings, with standardised coefficients ranging from .488 to .966, KD38 and KD55 being the only items with a loading less than .6. A significant positive correlation was found between each pair of the four factors, suggesting that teachers who engage frequently in either of the defined forms of diffusion also report high levels of engagement in the other forms (see Annex B).

Regarding scale reliability, Ordinal alpha values show good internal consistency for all the scales (Table 7.11). The professional learning scale improves to .874 when KD38 is dropped. This again suggests that participation in local training initiatives may measure something slightly different. Further qualitative research should be carried out to understand why. One possibility is that this particular form of EDUNET-specific knowledge sharing platform identified in the exploratory stage may eventually not be widely known among teachers in the region. This was partially confirmed by the qualitative data: most, but not all interviewed teachers were familiar with this concept, and none referred to it without being prompted. Concerning dissemination and mediation, the high alpha values suggest that the questions measure very similar aspects of knowledge dissemination and mediation respectively. Indeed, some studies suggest that alpha values higher than .9 should be treated with caution, but are acceptable up to .95[18] (Hair et al., 2019[359]). In future research, a revision of these two scales could be directed at diversifying the measurement to cover a potentially wider range of activities.

Table 7.11. Internal consistency of knowledge diffusion scales

Scale	Number of items	Ordinal Alpha
Professional learning	4	.825
Dissemination	3	.929
Mediation	3	.922
Partners	4	.779

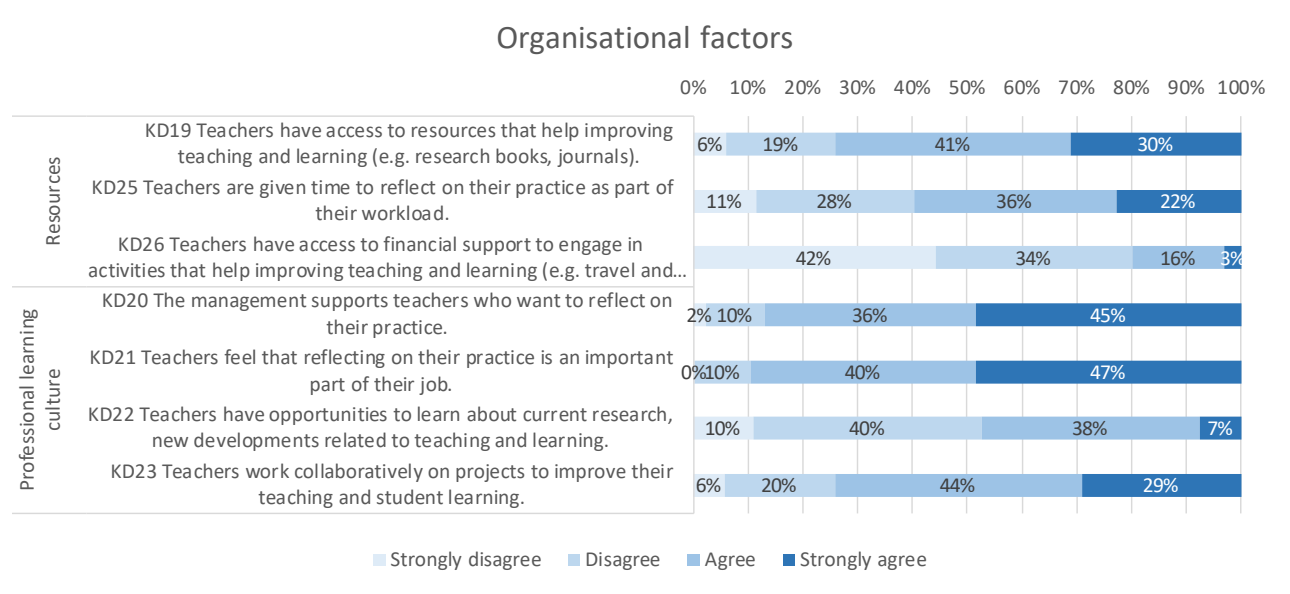
To conclude, although the hypothesised four-factor model for knowledge diffusion could not be used, the three-factor solution seems reasonable for the current study, however needs strengthening and further validation through larger samples allowing also cross-cultural validation in the future.

[18] Although these studies refer to Cronbach Alpha values, and not polychoric correlations and the respective ordinal alpha values, for which methodological research is still needed.

7.4. Organisational factors

Literature on organisational learning and professional communities examine the links between structural and cultural factors of schools and teacher learning (Thoonen et al., 2012[413]). Findings from these studies suggest that school organisational conditions, such as leadership practices, teacher collaboration, positive and trustful school climate, shared responsibility and values are conducive to teacher learning (Thoonen et al., 2012[413]; Leithwood, Steinbach and Ryan, 1997[414]; Sleegers and Leithwood, 2010[415]). As I also noted in Chapter 3, dedicated time, financial and physical resources are critical for teachers to engage in collaborative activities (Vangrieken et al., 2015[318]), and lack of time appears to be a main barrier across many countries (OECD, 2019[416]). In line with prior research, I measure organisational factors along two main dimensions: school resources, and a culture of professional learning (Stoll et al., 2006[137]). Apart from the item on financial resources (KD26), all other items were adapted from Borg and Liu's questionnaire (Borg and Liu, 2013[333]).

Figure 7.6. Organisational culture and resources



Overall, Figure 7.6 shows that teachers' perception of available resources varies and is the most negative with regard to financial resources. Interestingly, more than half (58%) of teachers consider that they have time to reflect on their practice, although only 22% strongly agrees. With regard to the professional learning culture, almost half of the teachers strongly agree that leadership practices are conducive to professional learning (reflection on practice is valued and supported). The majority also perceives their community to be collaborative and improvement focused. However, only 7% strongly agree that they have opportunities to learn about research. This can be a major concern, as without enough learning opportunities, the quality of that collaboration is questionable.

I tested a two-factor structure for organisational factors as described above. Unfortunately, this model did not show good fit [RMSEA .103 with CI (.075, .133)], not even after modifying it based on modification indices (RMSEA .088 and CI upper value still above .1). As these questions were adapted from prior research, this was the only 4 point scale in the instrument, and the only one having an "I don't know" response option. In future research, response options should rather be on (at least) a 5 point scale avoiding "I don't know" options. Due to misfit, these factors cannot be used in subsequent SEM, only on an item basis.

7.5. Network context

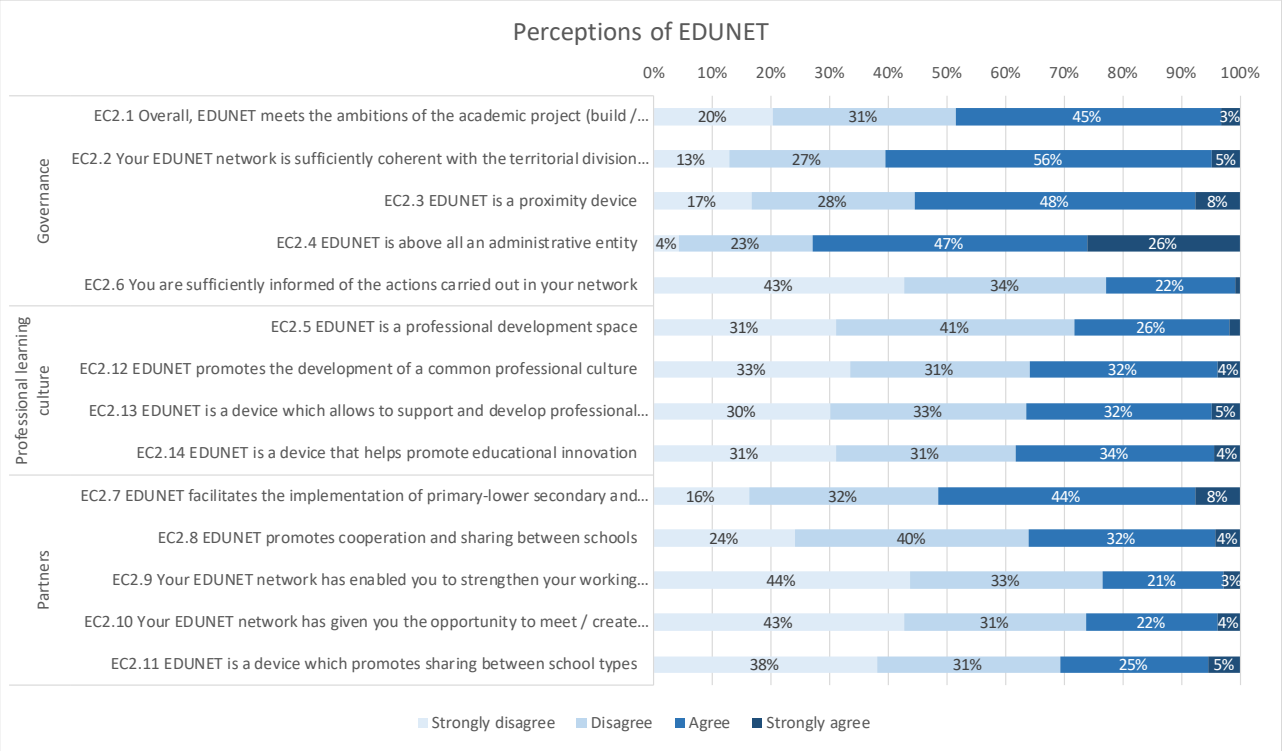
In line with the conceptual and empirical framework of this study, the instrument looked at the characteristics of the formal network, EDUNET, as perceived by teachers and school leaders. The set of questions were developed by Fabien Harel (Harel, 2019[334]). The questions were constructed based on the regional context and the intended objectives of the EDUNET networks described in Chapter 6. A set of items capture the high-level objectives of EDUNET: realise regional goals, create local networks that are coherent with territory and facilitate professional learning rather than simply create an administrative entity. These are labelled "governance" in Table 7.12. Another set of items, labelled "partners", teases out the objectives that relate to facilitating partnerships among schools and between schools and other organisations. Finally, a third set, labelled "professional learning culture", relate to different aspects of mutual exchange and learning among teachers that the EDUNET initiative intends to foster.

Table 7.12. Perception of the EDUNET networks

Item code	Item	Response options / Tentative scales
Item stem	To what extent do you agree with the following statements?	1: Strongly disagree 2: Rather disagree 3: Rather agree 4: Strongly agree
EC2A.1	Globally, EDUNET addresses the ambitions of the regional project (build, support, open, train)	Governance
EC2A.2	Your EDUNET network is sufficiently coherent with the territorial division (primary and secondary school disctricts, collectivities).	Governance
EC2A.3	EDUNET is a device of proximity.	Governance
EC2A.4	EDUNET is above all an administrative entity.	Governance
EC2A.6	You are sufficiently informed about the actions taking place in your network.	Governance
EC2A.7	EDUNET facilitates the implementation of linking primary and lower secondary, and lower and upper secondary schools.	Partners
EC2A.8	EDUNET promotes cooperation and exchange between schools.	Partners
EC2A.9	Your EDUNET network has enabled you to strengthen your working relationships with your colleagues or usual partners.	Partners
EC2A.10	Your EDUNET network has given you the opportunity to meet / create working relationships with new colleagues or partners.	Partners
EC2A.11	EDUNET is a device that promotes exchange between different school types.	Partners
EC2A..5	EDUNET is a professional development space.	Professional learning culture (Governance?)
EC2A.12	EDUNET promotes the development of a common professional culture.	Professional learning culture
EC2A.13	EDUNET is a device that helps support and develop professional practices.	Professional learning culture
EC2A.14	EDUNET is a device that promotes educational innovation.	Professional learning culture

The most striking piece of data is that the majority (73%) of teachers consider EDUNET as primarily an administrative entity, whereas only slightly more than one fourth of them view the network as a professional development space Figure 7.7. Overall, teachers' perceptions are not very positive: more than disagree or strongly disagree with most statements about the ways in which EDUNET facilitates professional learning and the relationships with partners. The only statement about which they are more positive is the network strengthens relationships across different school levels. This is consistent with the main objective of EDUNET's first iteration focusing on student pathways (see Chapter 6).

Figure 7.7. Perception of the EDUNET network



7.5.1. Factor analysis of EDUNET network perception constructs

While the set of items measuring perceptions of the EDUNET network are grounded in the specific context rather then being based on network theories, we can still assume that the various sets of items measure a construct. The adequacy tests of exploratory factor analysis[19] are satisfying, suggesting five factors. However, exploratory factor analysis for both five and four factors raised lavaan raised warning messages, suggesting an ultra-Heywood case, i.e. that a variable (or some variables) do not have unique variance. Four three factors, no warning was raised. EC2.4 and EC2.6 did not load on either of the factors, and were excluded from further analysis.

Conceptually, a few items could belong to several constructs:

- EC2.5 “EDUNET is a professional development space” – While this can be conceived as a measure of perceived objective of EDUNET (“Governance”), it could also belong to “Professional Learning Culture” based on its content. EFA suggested a weak, but clear loading on this latter scale.

[19] Bartlett's test of sphericity – Chi square’s p-value = 0; Kaiser-Meyer-Olkin [KMO] Test = .916; Parallel analysis suggests five factors.

- EC2.8 “EDUNET promotes cooperation and exchange between schools” refers to partnerships between schools (“Partners”), but cooperation and exchange could also be seen as a measure of “Professional Learning Culture”.
- EC2.11 “EDUNET is a device that promotes exchange between different school types” similarly to the above, can be seen as a measure of partnerships or learning culture.

I tested a three-factor model that corresponds to the factors represented in Table 7.12, excluding EC2.4 and EC2.6, with the expectation that some residual co-variances might need to be added. Indeed, while the factor loadings of items were high, the RMSEA index indicated misfit, and the first modification index suggested adding EC2.9~~EC2.10. Since both items refer to strengthening working relationships with colleagues, partners, it conceptually makes sense to add their residual covariance. In the second step the fit indices improved, however RMSEA was still greater than .10. The first modification index in this second step suggested a covariance of EC2.7~~EC2.8. Again, these two statements are very close in terms of content both referring to cross-school exchange. Therefore, a third model was tested including the two co-variances, and finally this model showed acceptable fit (Table 7.13).

Table 7.13. Fit statistics of models of EDUNET networks

	3-factor model	3-factor model with residual covariance	3-factor model with two residual covariances
χ2	155.22	89.161	47.98
Degrees of freedom	51	50	49
CFI (scaled)	.978	.984	.994
RMSEA (scaled)	.141	.107	.075
90% CI for RMSEA (scaled)	(.124; .159)	(.089; .126)	(.054; .096)
SRMR	.053	.043	.035

The indicators show significant positive factor loadings, with standardised coefficients ranging from .744 to .973. There is a significant and strong positive correlation between all three factors. It is important to highlight that the correlation coefficient between *Partners* and *Professional Learning Culture* is particularly high (.928), indicating that these two factors measure similar constructs. *Governance* and *Partners,* and *Governance* and *Learning* are also highly correlated (.855 and .829 respectively). Ordinal alpha values (Table 7.14) are high for all three scales. For *Partners* and *Learning*, they are “too high”, suggesting that the items measure almost the same aspect of the construct.

Table 7.14. Internal consistency of local collaboration and networking scales

Scale	Number of items	Ordinal Alpha
Governance	3	.872
Partners	5	.933
Professional Learning Culture	4	.936

The above data suggest that the component exploring teachers' perception of the EDUNET device are not perfectly conceived to measure separate underlying constructs. As the items relate to a specific context, it may not be worth to reconceptualise the questionnaire in future research. For this research, the model can only be used with caution as the highly correlated factors may cause multicollinearity. Therefore, only one of these factors will be used in each of the subsequent structural equation models.

In the three sections above, I described how teachers mobilise and construct knowledge, and how this knowledge is diffused based on descriptive statistics of the questionnaire data complemented with information from qualitative data in certain instances. While descriptive analysis can give a view of teachers' social practices, it is not sufficient for understanding the drivers and barriers of these practices. Exploring relationships between different aspects of knowledge dynamics helps understand the logic behind the actions, and gives insight into the impact of social structures and processes on the social practice of this professional group. The second step will thus involve statistical analyses of relationships.

7.6. Characterising teachers' knowledge dynamics in networks

This section investigates the research question "How do social dynamics influence teachers' knowledge dynamics?" by revealing the inherent relationships between the various constructs. Social research in education has focused on both the antecedents and consequences of teacher collaboration, and includes studies on communities of practices (CoP), professional learning communities (PLC), professional learning networks (PLN) as described in Chapter 2 and Chapter 3. A systematic review highlighted a number of positive outcomes of teacher collaboration in terms of various aspects of knowledge dynamics (Vangrieken et al., 2015[318]). In particular, collaboration, teamwork, PLCs have been shown to facilitate teacher learning, improve awareness of research-based practices and school-wide knowledge, facilitate the quality of interactions between teachers, increase the sharing of resources and ideas, and foster innovation (Vangrieken et al., 2015[318]). This systematic review confirms that research on teacher collaboration is highly heterogeneous, which makes it difficult to disentangle the various elements of teachers' social practice and study their specific impact on outcomes such as teachers' knowledge, practice, school-level innovation (Moolenaar, 2012[417]). Two strands of research streamlined the scientific discourse on collaboration: the study of networks as forms of organisation by situating and examining collaboration in a formal context (CUREE, 2005[286]; Muijs et al., 2011[52]; Rincón-Gallardo and Fullan, 2016[288]), and a social network perspective by investigating the patterns of social relationships among teachers (Moolenaar, 2012[417]). Key results of these two (overlapping) research strands were

highlighted in Chapter 2 and Chapter 3. As a reminder, let us shortly recapitulate the main findings in terms of various dynamics of teachers' knowledge.

Research has looked more specifically at the knowledge mobilisation outcomes of teacher networks. Social ties between teachers and researchers or teacher educators allow for blending external and internal knowledge sources and thus contribute to change in teachers' practice (Huberman, 1990[418]; Lieberman, 2000[192]). These social ties also bridge "structural holes" in the macro network, i.e. connects cliques formed by different epistemological communities (Granovetter, 1973[144]; Burt, 1992[143]). More recently, a number of social network studies put in evidence the ways in which teachers' social networks influence their research engagement. School-university partnerships and research-focused professional learning opportunities facilitate informal social interactions among teachers and increase teachers' research engagement (Cornelissen, McLellan and Schofield, 2017[419]). A related study of the main author, Frank Cornelissen, showed that in a school-university network, three main factors influence the development, sharing and use of knowledge. These are: the attributes of network members (e.g. their individual knowledge, cognition, activities, emotions), the relationships between network members (e.g. trust, engagement, power) and the context of the events within the network (e.g. purpose, inquiry, leadership) (Cornelissen et al., 2011[292]).

Research on formal school networks also underlined the value of **external expertise** in teachers' knowledge dynamics (CUREE, 2005[286]; Rincón-Gallardo and Fullan, 2016[288]; Muijs et al., 2011[52]). For example, external links can foster the diffusion of knowledge produced within a community, particularly if these ties are consciously used for dissemination (CUREE, 2005[286]). One way of bringing in external expertise is through professional development. **Collaborative professional development** facilitates a continuous sharing of ideas and practice (CUREE, 2005[286]). In general, commitment to and participation in collective professional learning has been shown to be a fundamental element of knowledge mobilisation and co-construction (Muijs et al., 2011[52]; CUREE, 2005[286]).

Both the **quantity and the quality of relationships** matter for knowledge mobilisation and construction (Brown and Poortman, 2018[20]). Well-functioning channels for communication allow for frequent interaction among people and facilitate the engagement in all knowledge processes (Rincón-Gallardo and Fullan, 2016[288]; Muijs et al., 2011[52]). At the same time, trust and mutual support among network members are necessary for sharing challenges and taking risks, and are thus fundamental for experimentation and innovation (Brown and Poortman, 2018[20]; Rincón-Gallardo and Fullan, 2016[288]).

Organisational factors, such as leadership, school climate, resources, professional learning culture have been widely reported to play a role in teachers' knowledge dynamics. For example, a study showed that if the school culture promotes learning and experimentation, teachers use research more frequently (Brown, Daly and Liou, 2016[163]). A specific aspect of knowledge mobilisation is using data to inform teaching practice. Again, social network research has shown that in addition to individual characteristics, such as prior knowledge and positive attitudes, leadership, trust and school climate, professional development and support matter for increased data use (Lai and Schildkamp, 2013[164]).

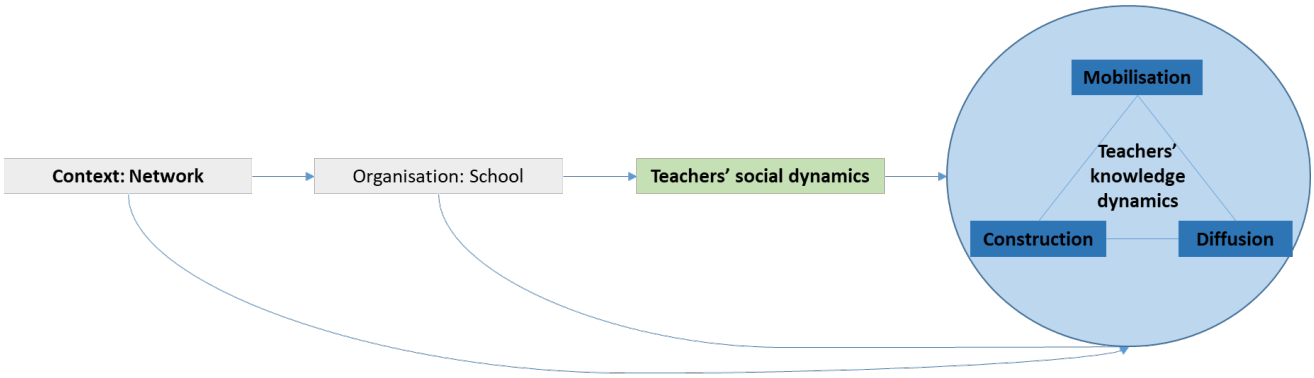
The role of **school leadership** in particular, is fundamental in fostering various dynamics of knowledge among teachers [e.g. (Spillane, Healey and Kim, 2010[420]; Penuel, Frank and Krause, 2010[421]; Liou and Daly, 2018[422]; Cornelissen, McLellan and Schofield, 2017[419])]. Cornelissen and colleagues (2017[419]) showed that school leaders support teachers in engaging with research both through formal and informal channels. They establish formal structures such as professional learning opportunities and formal partnerships, while they also invest in informally encouraging teaching staff to engage in research (Cornelissen, McLellan and Schofield, 2017[419]). However, it is not only formally designated leaders, such as the school principal, who play a role, but also informal leaders who emerge in a context of distributed leadership. Distributed leadership is both an antecedent and a consequence of networks. It implies greater leadership capacity leading to more effective networking. Inversely, stronger social ties and collaboration can create contexts in which leadership roles emerge (Muijs et al., 2011[52]).

Much of the research to date looked at the impact of social dynamics on either teaching practice (e.g. change in instruction as a result of reform implementation), or a very specific aspect of knowledge dynamics, such as research-engagement, data use or knowledge sharing. The new conceptualisation of knowledge dynamics presented in this research allows for a more holistic study of these relationships. In this section, I will test the hypotheses related to the second research question:

- Hypothesis 2.1: Network and organisational culture are important factors in facilitating social processes.
- Hypothesis 2.2: Social structures and the nature of social ties in a network influence the dynamics of knowledge.
- Hypothesis 2.3: Social processes and devices and actors' engagement with these influence the dynamics of knowledge.

These factors will be examined for the three dimensions of knowledge dynamics laid out in the first part of this chapter: knowledge mobilisation, construction and diffusion. Based on the review of research, the following embedded overall model can be hypothesised Figure 7.8. The dynamics of teachers' knowledge is influenced directly by the social processes in which they engage. The organisational context of the school affects the nature and intensity of these social processes. Organisational factors in turn can be impacted by the broader context in which schools are embedded. In my research, the contextual object of the study is the regional EDUNET networks. Each of these broader factors (organisational and network) can also directly influence teachers' knowledge mobilisation.

Figure 7.8. Embedded relationships between social contexts, processes and knowledge dynamics



Note: As the collected data did not support the existence of organisational factors (no fit was found for the hypothesised latent constructs), this element will not figure in the analysis.

In the following sections, I will analyse these relationships for each dimension of knowledge dynamics using structural equation modelling (SEM). In the following sections, I present the results of the SEM model, and discuss them in view of the professional and policy context of the target population to draw a conclusion with regard to the specific hypothesis.

7.6.1. Social context, processes and knowledge mobilisation

First, let us look at the impact of social processes on teachers' knowledge mobilisation. As explained above, knowledge mobilisation is captured through three constructs: engaging with practical educational resources (EngwPs), engaging with formal research-based resources (EngwR) and engaging actively in research (EnginR). All items are formulated as individual activities, and in theory, they can be performed without collective social interactions. The review of research presented above indicates however that social processes facilitate all forms of knowledge mobilisation. I expect that engaging actively in research will be the most sensitive to social processes because conducting research is most often a collective activity.

To capture the intensity of teachers' social involvement, I will use two scales from the knowledge diffusion dimension:

- collaboration with external partners (*Partners*) – as an indicator for social structure and the nature of social ties
- participation in professional learning (*Learn*) – as an indicator for social devices and processes.

The first one captures both the diversity of teachers' social networks by mapping their interactions with a variety of external partners, and the strength of these social ties by the frequency of interactions. The second captures their participation in collective forms of learning, such as local training initiatives, knowledge sharing workshops, and the related activities, such as sharing new knowledge with colleagues. Both of these were identified as factors that matter for teachers' knowledge in the literature.

Teachers' external links (Partners) as well as their participation in professional learning are both likely to be influenced by the broader context. The context, which is the object of my study, is the regional EDUNET networks. As a reminder, the three network factors – governance, partners and professional learning culture – are very highly correlated with one another, therefore, it is desirable to choose one of them as a predictor in the model. From among these factors, the professional learning culture is theoretically the most likely to impact teachers' knowledge mobilisation. Therefore, this will be used as an indicator for the network culture. I hypothesise that it may have both a direct effect and an indirect impact through the social processes identified above.

Figure 7.9 depicts the model, where only significant standardised regression and correlation coefficients are indicated. The model shows a good fit (Table 7.15) and several significant regression coefficient.

Table 7.15. Fit statistics for knowledge dynamics SEM models

SEM models	Knowledge mobilisation	Knowledge construction w teacher colleagues (factors)	Knowledge construction w wider network	Knowledge diffusion
χ2	156.52	276.392	211.854	219.0189
Degrees of freedom	194	178	102	98
CFI (scaled)	.997	0.995	.993	.994
RMSEA (scaled)	.033	.049	.073	.071
90% CI for RMSEA (scaled)	(.018; .045)	(.037; .060)	(.059; .087)	(.058; .083)
SRMR	.054	.063	.054	.056

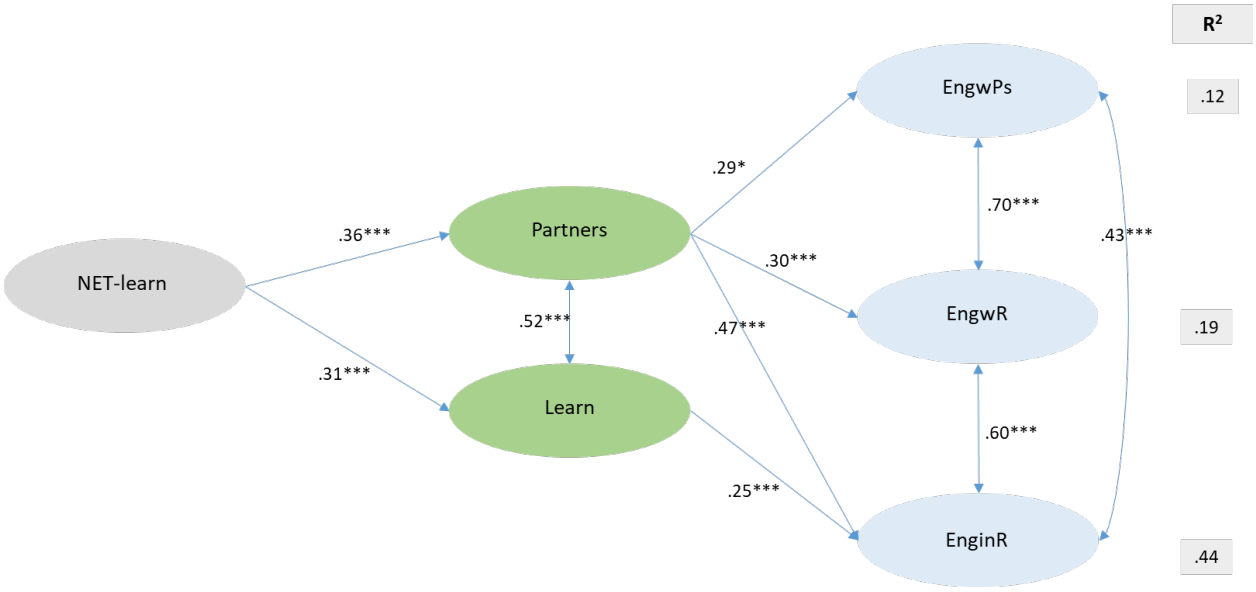
We can see that the perceived professional learning culture in the EDUNET network (NET-learn) has no significant direct effect on any element of knowledge mobilisation. The network culture exerts its impact indirectly, through facilitating teachers' engagement with external partners as well as their participation in professional learning. This link confirms hypothesis 2.1 for knowledge mobilisation.

In this particular dataset, we observe a relationship between teachers' engagement with external partners and knowledge mobilisation: such social ties appear to be related to engagement with practical sources, with research, and the most strongly with engaging actively in research. Collaboration with educational researchers and teacher educators represent key facets of the *Partners* construct, which may explain the impact of this construct on engaging with and in research. This link confirms hypothesis 2.2 for knowledge mobilisation.

On the other hand, participation in professional learning is not significantly associated with engagement with either practical or formal research sources. The only element of knowledge mobilisation it is (weakly) connected with is active engagement in research. Therefore, hypothesis 2.3 is only partially confirmed for knowledge mobilisation.

Overall, the perceived learning culture of the EDUNET networks explains 24% in the variance of engagement with practical knowledge, 26% with formal research knowledge and 29% of active engagement in research.

Figure 7.9. Social factors in knowledge mobilisation – SEM model



Note: *: p< .05, **: p<. 01, ***: p< .001

Overall, it is only active engagement in research, of which a relatively large part (close to 50%) can be explained by the social dynamics captured in this model. Variations in engagement with practical and formal research sources are mostly due to other factors. This result suggests that conducting research is the most social form of knowledge mobilisation, although social engagement alone (collaboration with partners and collective learning in this case) still does not explain all the variation. Previous research suggests that various organisational factors are likely to be responsible for the intensity of knowledge mobilisation. In addition, teachers' attitudes towards research use are also important and have been shown to be impacted by organisational factors (Brown, Daly and Liou, 2016[163]).

The data also shows that collaborating with external partners and participating in collective professional learning are highly correlated. This may be due to the fact that teacher educators and researchers are often trainers in professional development. The various aspects of knowledge mobilisations are also strongly connected as we already saw in the confirmatory factor analysis. Teachers' active participation in research is particularly strongly associated with higher levels of engagement with research sources. Whereas engaging with different types of knowledge – practical and theoretical sources – are also strongly associated. This suggests that although the three types of knowledge mobilisation can be distinguished, teachers with higher levels of engagement in one form of knowledge mobilisation, are also often engaged in some other form(s).

7.6.2. Social processes and knowledge construction

Second, we will look at the relationships between the network context, social processes and teachers' knowledge construction. It makes sense to theoretically distinguish between construction within the teaching community of a school, and that in the wider network (with other schools). Unfortunately, no factor structure could be extracted for knowledge construction with the wider network. Therefore only a few single items were selected to represent facets of knowledge construction in the model. Selection was based on item characteristics (presenting reasonable variation, skewness and kurtosis) and theoretical assumptions. For knowledge construction among teachers within a school, three factors are used as outcome variables.

For knowledge construction with the wider network (teachers and partners from other schools) four items were selected: the same to represent reflection (KD28.2) and innovation (KD34.2), and two more that specifically relate to cross-school collaboration, and as such represent key objectives of the EDUNET networks:

- reflecting on teaching and learning challenges related to the school context jointly [with teachers and partners from other schools] (KD28.2)
- developing interdisciplinary projects to help students develop competences [with teachers and partners from other schools] (KD34.2).
- developing cross-school projects [with teachers and partners from other schools] (KD36.2)
- developing projects across school types [with teachers and partners from other schools] (KD37.2).

Similarly to knowledge mobilisation, the hypothesis is that the network context will have a direct effect, and an indirect impact on knowledge construction. This latter is mediated by social processes, for which we use the same indicators: teachers' collaboration with external partners and participation in collective learning. In the case of knowledge construction with the immediate social network, I hypothesise that participating in professional learning will have a stronger impact than working with external partners. Regarding knowledge construction with the wider network, theoretical considerations suggest that collaboration with external partners may have a more important impact. At the same time, in this case, we can also expect a direct effect of the network, given that facilitating cross-school collaboration is an explicit objective of the EDUNET networks. It is also more straightforward to include the network dimension "NET-Partner", which refers to the perception of the teachers that the EDUNET networks facilitate building new partnerships with other schools and relationships with external actors. Although statistically this aspect is very similar to the perceived professional learning culture in the EDUNET network (NET-learn), theoretically it makes sense to distinguish between them.

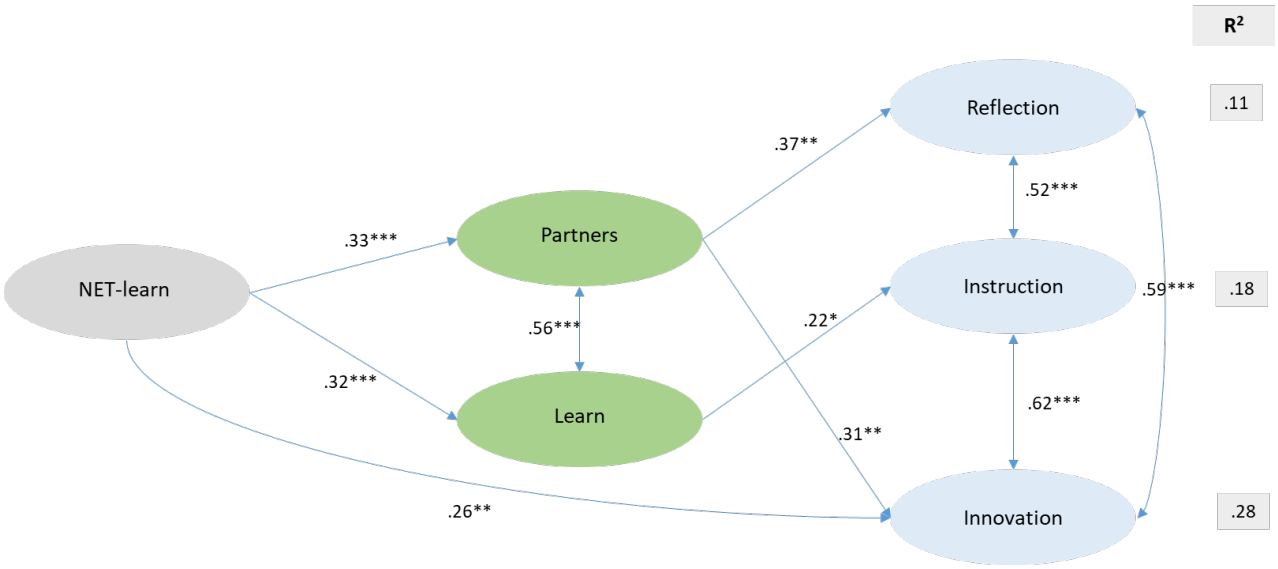
Figure 7.10.a shows that all three components of knowledge construction with teacher colleagues are associated to social dynamics to an extent. Collaborating with external partners is moderately and significantly associated with both reflection and innovation. In addition, higher levels of participation in

collective professional learning indicate higher levels of instruction-related knowledge construction, although this association is very weak and its significance value is also lower. The network learning culture has a small direct relationship with innovation-related knowledge construction. The R square values show that none of these social processes explains a large part of the variation in teachers' knowledge construction.

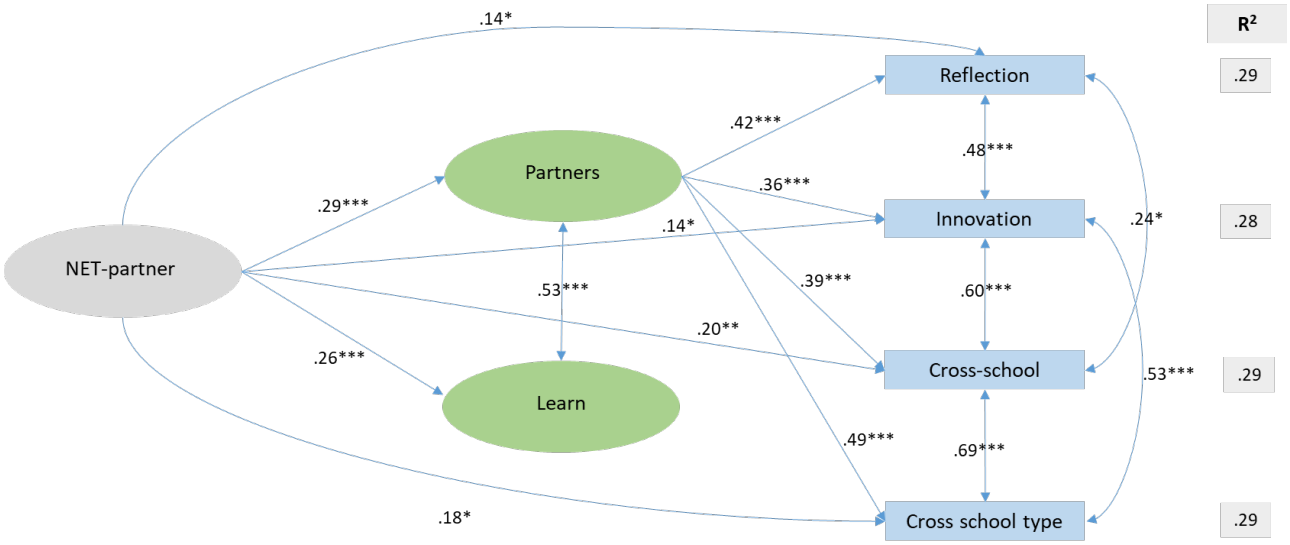
However, social dynamics appear to be much more important for knowledge construction with the wider network (Figure 7.10.b). In particular, teachers' relationships with external partners are related to all forms of such knowledge construction suggested by the moderate regression coefficients. The perception of the EDUNET networks as vehicles for developing social relationships also has a significant direct relationship with knowledge construction with teachers and partners from other schools, although the link is weak. Interestingly, teachers' participation in professional learning is not related to any forms of knowledge construction.

Figure 7.10. Social factors in knowledge construction

1.10.a With teacher colleagues



1.10.b With the wider network



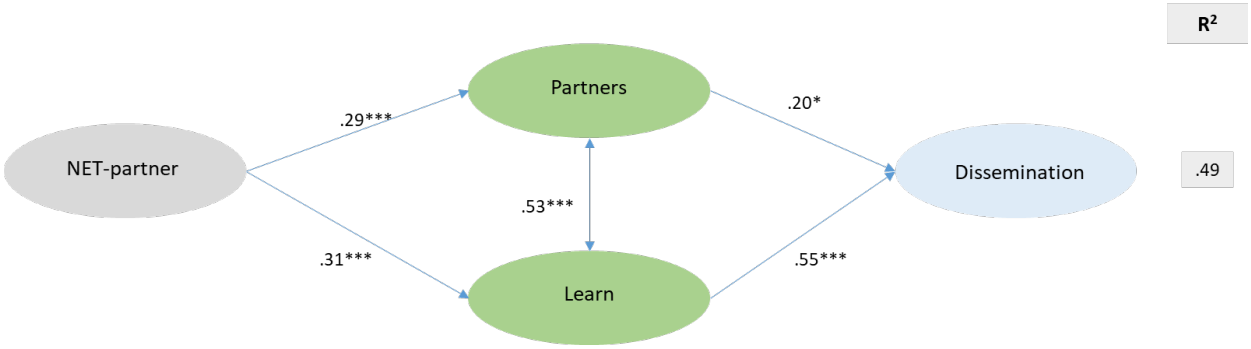
Note: *: p< .05, **: p<. 01, ***: p< .001

Knowledge construction items inherently carried social dynamics, as they captured collective reflection, instructional design and innovation with colleagues or the wider network. What the SEM regressions show, is that additional social dynamics, for example ties with external partners, participation in collective forms of learning and a network context conducive to social dynamics, do not seem to matter for knowledge construction in the immediate teaching community. On the other hand, teachers who perceive the EDUNET networks as beneficial for establishing new relationships also appear to engage more with their wider network. The qualitative interviews revealed important variations in teachers' perception of the usefulness of their EDUNET network (see Chapter 9 for more details).

7.6.3. Do boundary-spanners span boundaries?

Last, we look at relationships between social dynamics and knowledge diffusion. As a reminder, the *Partners* and *Learn* constructs used to capture aspects of social dynamics are in fact part of the knowledge diffusion dynamics, as they both represent the "social tissue" of diffusion. The other construct in this dimension is *Dissemination*, i.e. the conscious effort of facilitating forums where knowledge can be shared and co-constructed. As a reminder, mediation, i.e. the translation and transfer of research knowledge into practice could not be included in knowledge diffusion. This SEM model will therefore explore the relationship between social dynamics and deliberate knowledge dissemination. I hypothesise that those teachers who have more intense social involvement (through social ties with external partners and participation in collective learning) will also be more likely to put effort into spreading the knowledge they gain through their social dynamics. Similarly to the previous two models, I equally look at the direct and indirect impact of the perceived network context, more specifically the perception that EDUNET facilitates creating new partnerships and relationships.

Figure 7.11. Social factors in knowledge diffusion



Note: *: p< .05, **: p<. 01, ***: p< .001

As shown in Figure 7.11, both aspects of social dynamics are related to dissemination. Participation in collective learning is particularly strongly associated to this conscious form of knowledge diffusion. It is worth noting the relatively lower significance of relationships with external partners for dissemination. This suggests that teachers who have the potential to span the boundaries of the teaching profession do not systematically engage in conscious dissemination. One way to strengthen knowledge diffusion could therefore target benefiting from these social ties to a greater extent (Cornelissen, McLellan and Schofield, 2017[419]). The network context only exerts its effect indirectly. The moderate R square value suggests that dissemination is explained to a reasonable extent by social dynamics, although other factors are also responsible for its variance.

7.7. Conclusion

Overall, the results of structural equation models suggest that hypotheses 2.2 and 2.3, i.e. that social dynamics are linked to knowledge dynamics, are partially supported. Having social ties with external partners is more strongly associated with higher levels of knowledge mobilisation, construction and diffusion, than participating and benefiting from collective professional learning. The associations are not particularly strong in most cases, indicating that other social or individual factors play a key role in knowledge dynamics. External partners seem to be important for engaging actively in research and for constructing knowledge with the wider network, i.e. with teachers and partners from other schools. Collective professional learning is not very strongly linked to most forms of knowledge dynamics, except for knowledge dissemination.

For hypothesis 2.1, i.e. that network and organisational culture are important factors in facilitating social processes, only the effect of the network culture could be tested with the data. We saw that the majority of teachers do not perceive EDUNET as a device conducive to professional learning. In most cases, the perception of the professional learning culture of the EDUNET network only has a small indirect effect on teachers' knowledge dynamics. Teachers who do perceive EDUNET as a device promoting professional learning and innovation, also tend to be more connected with external partners and participate

more in collective professional learning, although the associations are not strong. This suggests that the EDUNET network is not yet a major social learning platform for teachers. The only case when the perception of the network had a direct link with knowledge dynamics was for developing innovation with the wider network. This would be expected based on the objective of the EDUNET networks, however, it must be noted that the direct effect even on this element is very small.

As emphasised in the literature, organisational factors play an important role in both teachers' social dynamics and in the levels of knowledge dynamics. One reason for the relatively weak associations might be the importance of these factors in the equation. The next chapter helps understand a fundamental aspect of the school organisations: school leadership. The explanatory study design allows for a deeper investigation of the reasons for the relatively weak links between social and knowledge dynamics. Qualitative interviews aim to reveal the extent and the ways in which teachers mobilise, construct and diffuse knowledge through their social interactions. They also explore the potential other factors that determine their engagement in knowledge processes.

Chapter 8. Leadership, school networks and knowledge dynamics

This chapter explores the second research question, “How do social dynamics influence teachers’ knowledge dynamics?” from the perspective of school leaders. In particular, it examines social structures and the nature of social ties in a network, and how these relate to school leaders’ perceptions of the networks’ potential for teachers’ knowledge. To do that I analyse data collected through the school leadership questionnaire. The chapter also explores relationships between the social interactions between schools and teachers’ knowledge dynamics by linking the teacher and school leader datasets.

As described in the conceptual framework in Chapter 4, the school provides the social context for teachers’ everyday work, and thus has a direct impact on their social practices. Reviewing the literature on the relationship between structural and cultural aspects of the school organisation and teacher learning, Sleegers and Leithwood (2010[415]) identify two dominant views of change. The “inside view” focuses on the school’s internal capacity to create an environment conducive for teacher learning. The “outside view” relates to factors that are external to the school, such as local, regional or national reform initiatives and interventions (Sleegers and Leithwood, 2010[415]). The present thesis is situated in the intersection of these two views in that it seeks to explore the relationships between the social dynamics of teachers within a school and their knowledge dynamics (internal view), as well as the impact of the EDUNET networks, an externally constructed social configuration, on teachers’ knowledge (external view). However, these two views do not account for a wider understanding of social phenomena. The outside view is described by Sleegers and Leithwood (2010[415]) primarily as the influence generated by top-down policy interventions. However, we cannot ignore social processes that are not directly connected to such interventions. Schools cannot be considered as isolated structures, they connect, exchange, collaborate and also compete and purposefully break links regardless or sometimes despite top-down policies. We have seen that horizontal boundary crossing can be a main driver of knowledge dynamics, and the lack of it can be a barrier. Extending the boundaries of the school organisation and looking at the broader social network of both teachers and schools, not just in the context of regional or national policy, is thus necessary to understand change in teachers’ knowledge and practices.

Understanding the impact of social processes on teachers’ knowledge more comprehensively therefore requires an extension of Sleegers and Leithwood’s framework. Based on the above discussion and in line with the conceptual framework (Figure 4.1 and Figure 4.2), I propose to distinguish a vertical and a horizontal outside view. The former is what Sleegers and Leithwood describe as the outside view

and it focuses on the impact of top-down reforms and interventions on schools – in the case of my research, on teachers' knowledge. The latter focuses on understanding horizontal social processes that emerge beyond the walls of a school. It is also important to note that these three perspectives are not independent. The vertical outside view may influence both the horizontal outside view and the inside view. The unique construction of my research allows for studying not only all three perspectives but also the interrelations between them. In the following, I describe how these three views are explored.

The "inside view" considers organisational factors, such as leadership, school climate and culture, and examines how these influence teacher learning (Thoonen et al., 2012[413]). In the school organisation, the immediate social context of teachers, school leaders play a key role in influencing teachers' learning (Sleegers and Leithwood, 2010[415]). Educational research on school leadership originates from the school and learning quality research tradition in the United States (Hallinger and Huber, 2012[423]). As the school effectiveness research movement has spread internationally, so has the conceptual and empirical understanding on school leadership grown and extended to diverse national contexts (Hallinger and Huber, 2012[423]). Studies have demonstrated that leadership can act as catalyst for student learning, and it exerts this impact primarily indirectly, through influence on teachers and staff (Leithwood et al., 2006[424]). Significant effort has been made to uncover the characteristics of effective leadership practices, which led to a number of normative leadership models such as instructional, transformational, distributed and more recently, system leadership (Bush and Glover, 2014[425]). While many of these models have been critiqued for ignoring the location of expertise, status, authority, hierarchy and power relations (Lumby, 2013[426]; Timperley, 2005[427]), the importance of leadership for teacher learning is today undisputable. Research has shown in particular, that leadership practice is important for creating a culture of professional learning as well as for ensuring the conditions for learning (Spillane et al., 2011[428]; Liou and Daly, 2014[153]). In this study, these organisational indicators of leadership practice are examined through teachers' perception of resources and culture for professional learning through the teacher questionnaire (see Chapter 7) and through the qualitative data collected and analysed in two case studies (Chapter 9).

The "vertical outside view" is concerned with assessing the impact of school reforms or the (top-down) implementation of certain practices, their scaling and sustainability, as well as exploring the conditions under which these efforts are successful (Thoonen et al., 2012[413]). Findings suggest that the following factors facilitate the successful implementation of reforms and interventions:

- co-construction by teachers, school leaders and other local actors to shape the programme to the local context
- alignment with the demands of everyday school life and students' needs
- strong formal leadership, teacher buy-in, sufficient resources including time, and support from the local / regional authority
- existing school capacity for improvement and change, rich professional learning culture (Thoonen et al., 2012[413]).

In this study, the “vertical outside view” is represented by exploring the impact of the EDUNET networks on teachers’ knowledge dynamics. As school leaders play a key role in mediating external factors towards their school organisation and staff, understanding their perception of the policy environment is fundamental. This is particularly important in the French educational context, which is characterised by strongly hierarchical relationships, in which one of the main responsibilities of school leaders is implementing national (and regional) policies. The school leader questionnaire explores principals’ perception of the EDUNET networks: its goals, coherence with local structures and devices.

The “horizontal outside view” explores the networks of schools independently of the policy context, and their impact on teachers’ knowledge dynamics. Social dynamics in the context of education systems can be captured at the personal level in interactions between individuals and at the institutional level in interactions between organisations. As discussed in Chapter 3, research has shown that school networks can increase opportunities for teachers’ professional development and can have a positive impact on teachers, including gains in skills and knowledge, and change in teaching practice (CUREE, 2005[286]; Muijs et al., 2011[52]). However, this impact varies across studies and contexts (CUREE, 2005[286]; Muijs et al., 2011[52]), and some investigations suggest that the policy context can negatively influence the effects, for example when it is characterised by strong accountability and high competition between schools (Greany and Higham, 2018[269]). In addition, there can be large differences between how schools collaborate: boundary crossing is more substantial when it occurs between different school levels and school types, or between schools in different geographical and policy contexts. Such differences can also imply variations in the impact of school networks on teachers’ knowledge and learning. This study asks school leaders about the nature of school networks and collaboration through a set of social network questions. It also captures school leaders’ perception of local collaboration and networking based on literature on network effectiveness.

Finally, the research methodology is designed to allow for understanding the interrelations between the different views. Structural equation modelling can reveal how the different factors relate to each other, incorporating mediating factors. In the following sections, I will first describe the social dynamics between schools, school leaders’ perception of both horizontal and vertical social processes, and explore how these relate to each other, and ultimately to teachers’ knowledge dynamics. The first two sections will focus on descriptions only, and relationships between the various elements will be explored in the third and fourth sections.

8.1. Schools’ social networks

Studying school networks is situated in the intersection of sociological and educational research. The theoretical framework (Chapter 4) draws on social network theory, which helps unpack the impact of social networks on various outcomes, including attitudes, personal and collective attributes, and practices. As discussed in Chapter 2, network theory contributes to this particular field of sociology with a distinct methodology conceived to study particular characteristics of networks and how they relate to social and

individual gains. My theoretical framework also incorporates the concepts, theories and empirical results of the rich field of research on school leadership and organisational learning, as well as those of education policy research that investigates the wider context of schools.

School networks have become recognised as key mechanisms to support teaching and learning (CUREE, 2005[286]; Muijs et al., 2011[52]). Social network studies have shown that network characteristics – its structure, nodes and ties – matter for how knowledge is mobilised, constructed and diffused among teachers and schools (Daly, 2012[157]). Chapter 2 summarised some of the main findings. First, the characteristics of network structure, i.e. the density of ties and their distribution can influence access to new knowledge, and capacity for generating and diffusing innovation. In particular, the extent to which a network is centralised, split into subgroups and characterised by structural holes matter for the various dynamics of knowledge (Burt, 1992[143]; Daly et al., 2010[160]; Long, Cunningham and Braithwaite, 2013[161]). Second, the way actors' positions and attributes are matched also determines knowledge dynamics. For example, the knowledge, expertise, attitudes and skills of both central actors, i.e. those with a high number of ties, and brokers, i.e. those who connect subgroups, can influence the mobilisation, construction and diffusion of knowledge (Baker-Doyle and Yoon, 2011[159]; Akkerman and Bakker, 2011[168]; Coburn, Mata and Choi, 2013[158]; Coburn, Choi and Mata, 2010[165]). Finally, the nature and strength of ties between members can hinder or foster certain mechanisms. Weaker relational ties are important to access new ideas, while stronger ties are necessary to transmit complex knowledge (Centola and Macy, 2007[162]; Granovetter, 1973[144]). The process and conditions of tie formation also matter: whether knowledge-intensive relationships (for example involving pedagogical advice) are based on homophily and proximity or on more relevant attributes such as expertise, can have a high impact on outcomes (Coburn et al., 2012[167]).

The broader policy context of school networks in my research is determined by the national and regional policies, in particular by the EDUNET initiative. As described in Chapter 6, regional objectives are complex, sometimes even contradictory, and can imply different types of collaboration between schools. First, the regional strategy emphasises the rural nature of the Academy of Bel-Mondo (Académie de Bel-Mondo, 2017[371]). School network literature suggests that in a rural context, schools can benefit from collaboration to address challenges associated with their small size and isolated nature (Muijs et al., 2011[52]). These can include sharing resources (personnel, physical), experiences and coordinating certain activities. Second, the EDUNET networks' original objective was to foster students' learning pathways. In terms of school collaboration, this goal translates into facilitating collaborations between different school levels (primary – lower-secondary, lower- and upper-secondary). EDUNET networks have been set up specifically in line with typical pathways. In this sense, school networks should reflect geographical proximity rather than administrative districts. The objectives of the second iteration of EDUNET focus more on facilitating innovation and professional learning, which is associated more with horizontal collaboration between similar schools. Based on this broader context, we are interested to know whether and to what extent existing school networks reflect regional objectives. Therefore, the exploration of school networks was guided by the following questions:

- Do schools collaborate with other schools on pedagogical topics and if so, how large is their collaboration network?
- What is the focus of collaboration, and how wide is its scope?
- To what school levels does collaboration extend? Is it primarily between the same level, rather between different levels or mixed? Does the focus of collaboration depend on the level of schools?
- To what geographical zones does collaboration extend? Are school networks primarily located in the same county or do they cross administrative boundaries? Is collaboration between schools embedded in the EDUNET networks?

As the research explores the impact of social processes on teachers' knowledge, the social network questionnaire focused on different types of pedagogical collaboration between schools. To map the relationship of a school with other schools, a fixed-choice design was implemented, in which the school leaders were asked to select maximum five other schools (from a list of all schools) with which they have collaborated on pedagogical projects in the past 2 years. To reflect both the national centralised and bureaucratic context, the regional rural context and the regional objectives, and capture the main elements of teachers' knowledge construction, it asked about nine aspects of collaboration, with the possibility of adding other focuses as an open question (Table 8.1). Due to a technical survey error, two of these could only be selected for the first school the respondent indicated. This anomaly is taken into account throughout the analysis.

Table 8.1. School networks questions

Item number	Subscale / Construct	Item	Response options
NW0	Social network	How many schools have you collaborated with on pedagogical projects in the past 2 years?	integer
NW1-5	Social network	Select the schools you collaborated with on pedagoigcal projects during the past 2 years.	Unique school code
	Collaboration focus	For each school, please select the themes on which the collaboration focused.	checkbox
NWBx.1	Coordination	student pathways	Yes / No
NWBx.2	Coordination	co-teaching, personnel sharing	
NWBx.3	Knowledge construction	research project	
NWBx.4	Knowledge construction	collective training / professional development	
NWBx.5	Knowledge construction	experimentation project	
NWBx.6	Knowledge construction	collective pedagogical reflection	
NWBx.7	Coordination	administrative coordination	
NWBx.8*	Knowledge construction	project on subject-related practice	
NWBx.9*	Knowledge construction	interdisciplinary project	
NWBx.oth	Focus	Other, please specify	

Note: * Due to a technical error, these two foci were only given as an option for the first school the respondent selected.

As shown in Chapter 5, the response rate in the school leader dataset did not allow for a whole network analysis and the network data can only be used to analyse ego networks with no alter connections

(Hanneman and Riddle, 2005[364]). While this data cannot describe the macro-structure of the whole network, it can still provide some insights into the differences between actors' social positions and how certain network characteristics influence actors' perceptions or behaviour (Hanneman and Riddle, 2005[364]). In the following section, I present the ego network measures used (Table 8.2) and give an overall description of the school ego networks. Ego is the school represented by the school leader who responded to the survey, and alters are all the schools that the respondent indicated to have collaborated with. The ego network measures were introduced in detail in Chapter 5.

Table 8.2. Ego network measures

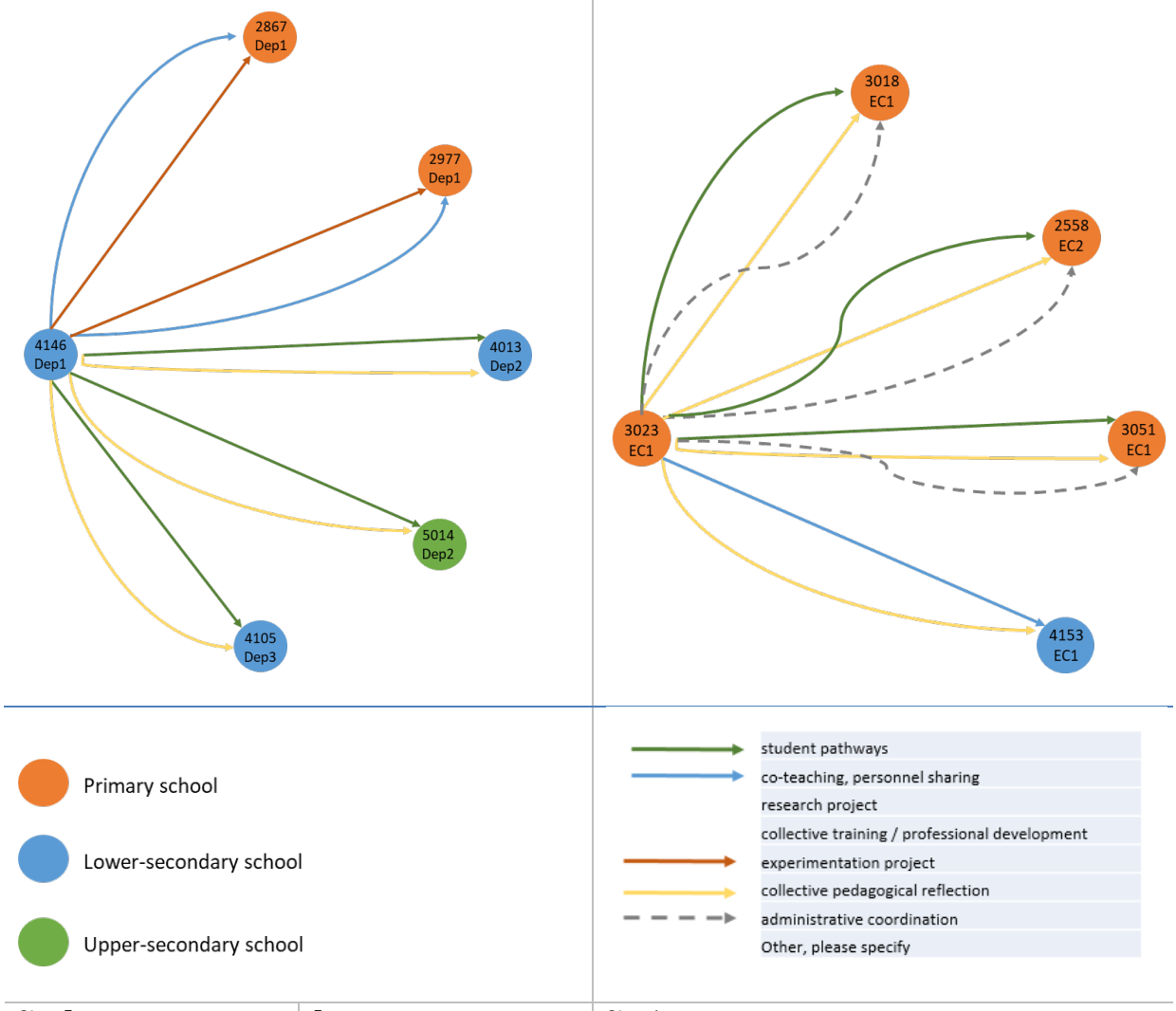
Type of network measure	Measures	Description	Value range
Node (ego and alter) attributes	School level	School level: from kindergarten to upper-secondary	5 school levels
	Geographical location	County in which the school is located	4 counties
	EDUNET membership	EDUNET network of which the school is a member	EDUNET code
Tie central tendency	Size	Number of alters reported	Min: 0 Max: 5
	Tie strengths (raw number)	Number of collaboration focuses indicated (including "other")	Min: 0 Max: 8 for NW2-NW5 Max: 10 for NW1
	Tie strengths (standardised)	Proportion of collaboration focuses to total number of possible focuses multiplied by 10	Min: 0 Max: 10
Tie dispersion	Dispersion of tie strength	Standard deviation of tie strength (calculated for tie strength proportion)	Min: 0 Max:
	Multiplexity	Number of different types of collaboration	(1) Min: 1* Max: 5
Alter central tendency	School level (type)	Proportion of alters in each school level	Min: 0* Max: 1
	Geographical	Proportion of alters in each county	Min: 0* Max: 1
	EDUNET membership	Number of EDUNET networks among the alters	
Alter dispersion	School level dispersion	Agresti's IQV for school levels	Min:0 Max: 1
	Geographical dispersion	Agresti's IQV for counties	Min:0 Max: 1
Ego-Alter similarity (homophily)	External school level	Number of ties leading to different school level alters	Min: 0 Max: 5
	School level similarity	EI index for school levels	Min: -1 Max: 1
	External geographical	Number of ties leading to different school level alters	Min: 0 Max: 5
	Geographical similarity	EI index for school levels	Min: -1 Max: 1
	External EDUNET	Number of ties leading to different school level alters	Min: 0 Max: 5
	EDUNET similarity	EI index for school levels	Min: -1 Max: 1

Note: * Missing values were coded as 0. For values among alters, a 0 corresponds to the case when no alter was indicated. A 0 in the ego network indicates that the respondent did not indicate its own school's code, nor its alters'. The maximum values are theoretical maximums, i.e. the total number of possible school levels / counties / EDUNET networks among alters and in the ego network.

As a way to illustrate all measures, two examples for ego networks from the data are depicted in Figure 8.1. In the first example (left), we can see that ego is a lower-secondary school that reported collaboration with five alters (the maximum number possible due to the fixed choice design). The school (ego) shares personnel / co-teaches and works on an experimentation project with two primary schools in the same county. It collaborates on student pathways and engages in collective pedagogical reflection with two other lower-secondary schools and one upper-secondary school, which are all in a different county. The second example shows a primary school collaborating with three other primary schools on student pathways, engage in pedagogical reflection and administrative coordination with them. Two of these

primary schools are in the same EDUNET network, one in a different one. Ego also engages in pedagogical reflection with a lower secondary school of the same EDUNET network, with which it shares personnel or has co-teaching projects.

Figure 8.1. Example school ego networks



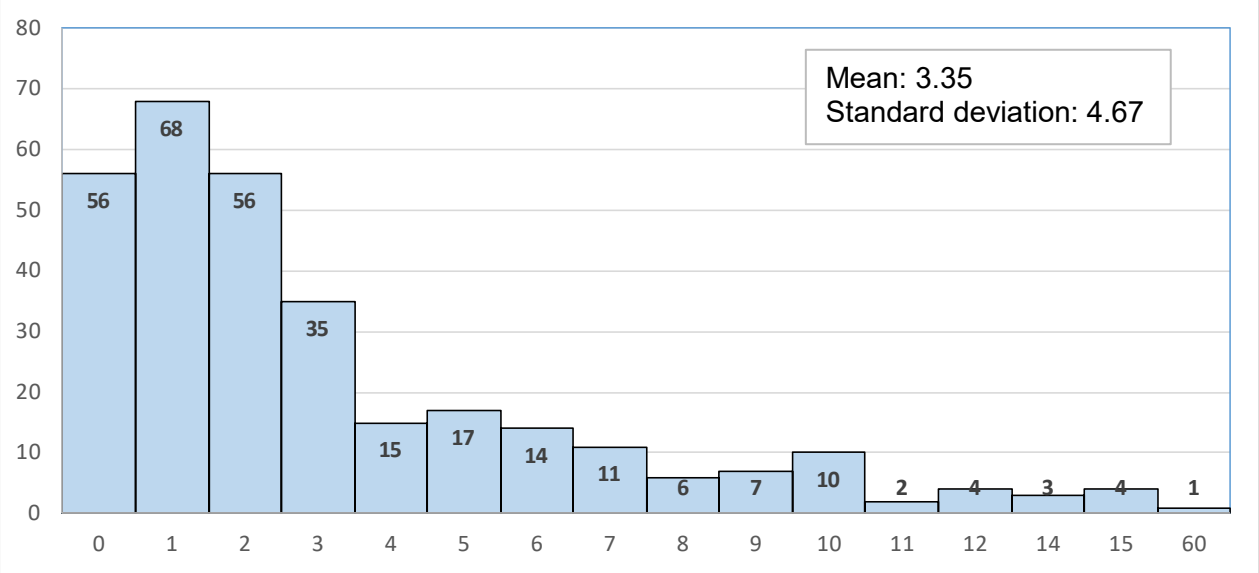
Size: 5	5	Size: 4
Multiplexity of ties: Strength of ties: Tie dispersion:	2, 2, 2, 2, 2 2, 2.5, 2.5, 2.5, 2.5 0.2	Multiplexity of ties: 3, 3, 3, 2 Strength of ties: 3, 3.75, 3.75, 2.5, 0 Tie dispersion: 1.71
Alter central tendency – School levels: No. 3 / Prop [Kind.gr, Primary, Lower-sec, Upper-sec, Adapt.]: 0, 0.4, 0.4, 0.2, 0 Alter central tendency – Geographical location: No. 3 / Prop. [Dep1, Dep2, Dep3, Dep4]: 0.4, 0, 0.2, 0.4 Alter central tendency – EDUNET membership: No. 3		Alter central tendency – School levels: No. 2 / Prop [Kind.gr, Prim., Lower-sec, Upper-sec, Adapt.]: 0, 0.75, 0.25, 0, 0 Alter central tendency – Geographical location: No. 2 / Prop. [Dep1, Dep2, Dep3, Dep4]: 0, 0.25, 0, 0.75 Alter central tendency – EDUNET membership: No. 2
Alter dispersion (IQV) – School levels: 0.8 Alter dispersion (IQV) – Geographical location: 0.853		Alter dispersion (IQV) – School levels: 0.469 Alter dispersion (IQV) – Geographical location: 0.5
Ego-Alter similarity (EI) – School levels:0.2 Ego-Alter similarity (EI) – Geographical location: 0.2 Ego-Alter similarity (EI) – EDUNET membership: 0.2		Ego-Alter similarity (EI) – School levels: -0.5 Ego-Alter similarity (EI) – Geographical location: -0.5 Ego-Alter similarity (EI) – EDUNET membership: -0.5

8.1.1. Ego: Size and types of collaboration

In analysing the networks, we first focus on ego and look at the number and nature of relationships it has. The size of the ego network, i.e. the number of schools with which school leaders indicated

collaboration in the two years preceding data collection, varies between 0 and 15, with one outlier value of 60 (removed from descriptive statistics) (Figure 8.2). Over half of respondents indicated that they collaborate with 1, 2 or 3 other schools, while 18% do not engage in collaboration at all. As 80% of respondents reported a size of equal to or smaller than five, the reported ego network, which was limited to maximum five alters due to the research design, could in theory correspond to the full ego network size for the majority. As seen in Chapter 5, around 75% of respondents did indeed report on all their alters.

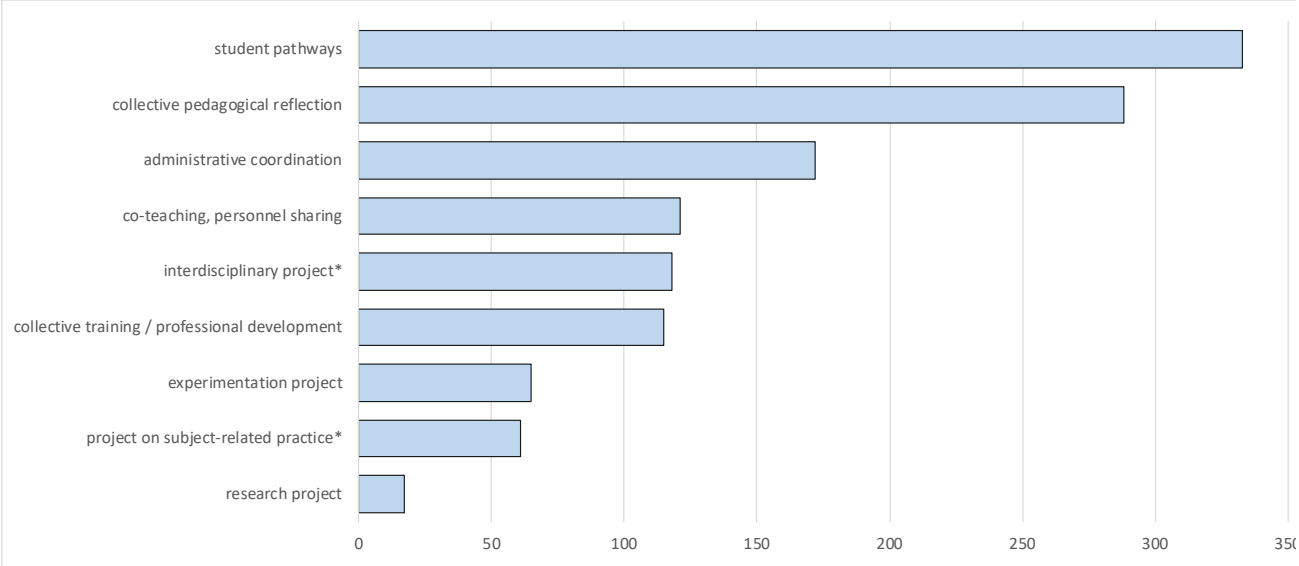
Figure 8.2. Size of ego networks: Number of schools ego collaborated with in the past 2 years



Note 1: N=332 (Full school leader database)
Note 2: *Mean and standard deviation after removing the outlier value of 60.

Ties are described by the types of collaboration reported. Overall, the most frequent focus of collaboration (Figure 8.3) is on student pathways, showing that this regional objective is the most reflected in cross-school work. Collective pedagogical reflection comes in the second place, which fits in the objectives of the second iteration of EDUNET networks (since 2017) oriented towards innovation, experience sharing and professional development (see Chapter 6). However, collective professional development and experimentation are less frequently indicated, even though these would correspond more explicitly to the regional goals since 2017.

Figure 8.3. Focus of collaboration by frequency of appearance



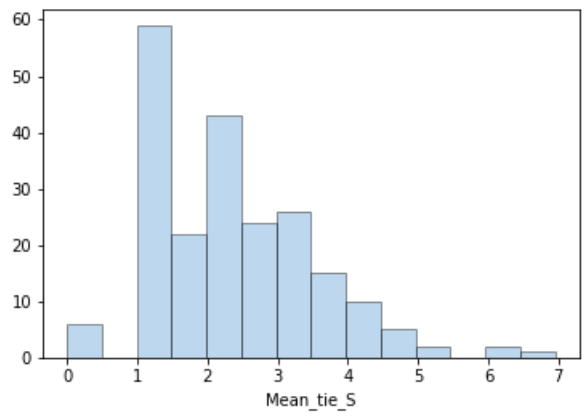
Note 1: N=332
Note 2: * Due to a technical error, these two foci were only given as an option for the first school the respondent selected. Therefore their frequency is not comparable to that of others, which appeared for each of the maximum five schools the respondent selected.

At the level of the ego networks, multiplexity refers to the multidimensionality of ties between nodes (Perry, Pescosolido and Borgatti, 2018[429]). In our case, there can be multiple types of collaboration between two schools. Multiplex ties are often stronger, can imply more frequent contacts and more support (Perry, Pescosolido and Borgatti, 2018[429]). Research has also shown that more multiplex ties in one's ego network can be associated with certain positive attributes, such as higher self-esteem and greater satisfaction with one's social relationships in the case of individuals (Perry, Pescosolido and Borgatti, 2018[429]). In both examples presented above, all ties are multiplex. The focus of collaboration seems to depend on the school type. Interestingly, working on student pathways is not restricted to ties between different school levels. In both examples, this focus is indicated between schools at the same level (primary schools in the first, lower-secondary schools in the second), and in the left example also between a lower- and an upper secondary school. In section 3 of this chapter, I will look at the association between tie multiplexity and the perception of various characteristics of the broader policy context, the EDUNET networks.

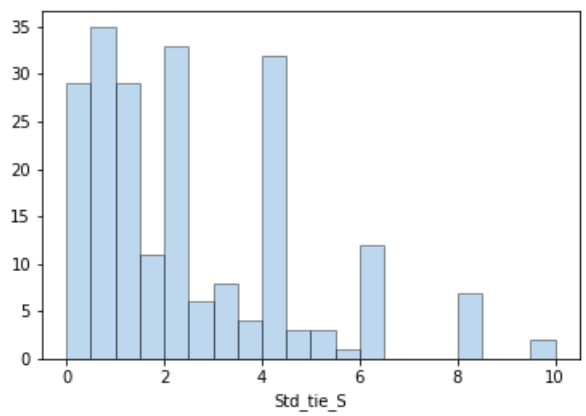
Numerous social network studies quantify the strength of ties through, for example asking about the frequency of interaction (Perry, Pescosolido and Borgatti, 2018[429]; Crossley et al., 2015[367]). While in this thesis, providing a qualitative understanding of the relationships was fundamental to draw links to teachers' knowledge dynamics, through the multiplexity of collaboration focuses it is also possible to define the strength of ties. To account for the technical error in the survey implementation indicated earlier, instead of a simple count of the number of collaborations, we standardise tie strength across the alters. Tie strength is thus defined as the proportion of indicated collaboration types to all possible collaboration types multiplied by ten. This measure allows for comparing the tie strength of alter 1, where there were ten

possible types of collaboration (including “other”), to the tie strength of alters 2-5, where the possible types of collaboration was eight. For alter 1, it is the same as the number of collaborations indicated. Figure 8.4 shows the distribution of mean tie strength (left figure) in the ego networks. We can see that the majority of ego networks fall in the range of 1-2 mean tie strength, which corresponds to only one type of collaboration indicated on average, so a general lack of multiplexity.

Figure 8.4. Distribution of mean tie strength and tie dispersion



Mean of “mean tie strength” = 2.29



Mean of “standard deviation of tie strength” = 2.44

Note: N=280 (Unique ego network database)

Another key characteristic of ego networks is the dispersion of ties, i.e. how different ego’s ties are in terms of their strength or multiplexity. We measure tie dispersion simply as the standard deviation of tie strength (Perry, Pescosolido and Borgatti, 2018[429]). The greater the standard deviation of tie strength, the bigger difference there is between the number of collaboration types leading to the different alters. Figure 8.4 (right figure) indicates that tie dispersion is generally low in the data, that is, the relationships to alters within an ego network are very similar in terms of strength (multiplexity). Fewer ego networks demonstrate higher dispersion, i.e. having some strong and some weaker ties.

8.1.2. Alters: attributes and their dispersion

The second perspective of ego network analysis focuses on alters, and looks at the distribution of their attributes. In the context of our study, we look at three attributes: school level, geographical location and EDUNET network membership of alters and ego.

With regards to school levels, primary school partners represent the highest proportion among alters, followed relatively closely by lower-secondary schools. Table 8.3 also shows the proportion of the various school types among all schools in the Academy. We can observe that although primary schools are the most popular partners in the data, their average proportion in ego networks is much lower than in

the whole population. It is the opposite for lower-secondary schools, which are exceptionally highly represented among alters compared to their proportion in the population.

In interpreting this result, we must take into account that school levels were not representative among egos (respondents) in the data. Indeed, we showed in Chapter 5 that primary schools were underrepresented, while lower-secondary schools were considerably overrepresented in the sample (i.e. among egos) (line three in Table 8.3). Nevertheless, a relatively straightforward explanation of the high proportion of lower-secondary schools among alters is that many schools collaborate with a neighbouring level. Lower-secondary schools are not only a "sandwich level", but also the one neighbouring primary schools, the most "populated" level. Indeed, contingency tables between ego's school level and each of the other school levels generally indicate a high representation of neighbouring levels among alters. Cramer's V values show significant moderate associations for kindergarten, primary and upper-secondary schools, and strong association for lower-secondary school alters[20].

Table 8.3. School levels among alters

	Kindergarten	Primary school	Lower-secondary school	Upper-secondary school	Adaptive teaching school
Number among alters altogether	48	290	179	85	1
Mean proportion of school level in ego networks	8.93%	45.55%	34.41%	11.02%	0.09%
Proportion of school levels among ego (respondents)	18.21%	41.07%	24.29%	8.57%	0.36%
Total proportion of school levels in the Academy	23.81%	62.20%	9.41%	4.35%	0.24%

Note: N=280 (unique ego network database)
Note: The mean proportion (second row) was calculated based on the proportion of a certain school level among alters in each ego network.

Looking at the geographical location of alters, the mean proportion of counties among alters is very close to their proportion in the data among egos (Table 8.4). Contingency tables reveal that in the vast majority of the cases all alters are from the same county as ego. Cramer V's values[21] indicate very strong significant associations between ego and alters' geographical location.

[20] Cramer's V: Kindergarten: 0.20, Primary: 0.28, Lower-secondary: 0.41, Upper-secondary: 0.29. All of them significant with p value close to 0. However, the number of observations is not very high due to the sample size, so results need to be treated with caution.

[21] Cramer's V: For county-16: .53, For county-17: .55, For county-79: .54, For county-86: .55. All of them significant with p value close to 0.

Table 8.4. Geographical location: counties among alters

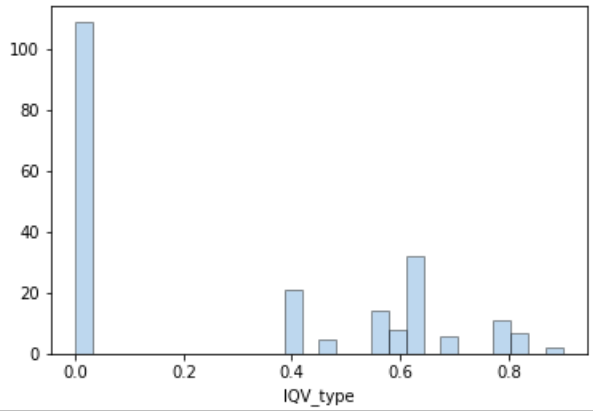
	Dep1	Dep2	Dep3	Dep4
Number among alters altogether	81	257	75	190
Mean proportion of county in ego network	10.06%	47.54%	9.63%	32.77%
Proportion of school levels among ego (respondents)	8.93%	46.07%	7.86%	29.29%
Total proportion of schools per county in the Academy	22.57%	33.98%	20.58%	22.87%

Note: N=280 (unique ego network database)
Note: The mean proportion (middle row) was calculated based on the proportion of a certain county among alters in each ego network.

Another widely used measure that describes the dispersion of alters in different categories in ego network analysis is Blau's H, or its standardised version, Agrasti's Index of Qualitative Variation (IQV index) (Crossley et al., 2015[367]). The IQV value is 0 when all alters are in the same group, and is 1 when alters are equally distributed in all categories. Figure 8.5 shows that for the majority of ego networks, alter dispersion is very limited both in terms of school level and geographical location. For school levels, although the majority of ego networks show no dispersion, there are a certain number with higher dispersion. In the case of geographical location, the result is not so surprising, as we would expect that the majority of collaborations between schools are local. The examples presented in Figure 8.1 belong to the very few ego networks that do show some dispersion in terms of the county. However, a closer examination of these networks reveals that ego and all alters are located close to county borders, which means that collaboration is still very much local in these cases too.

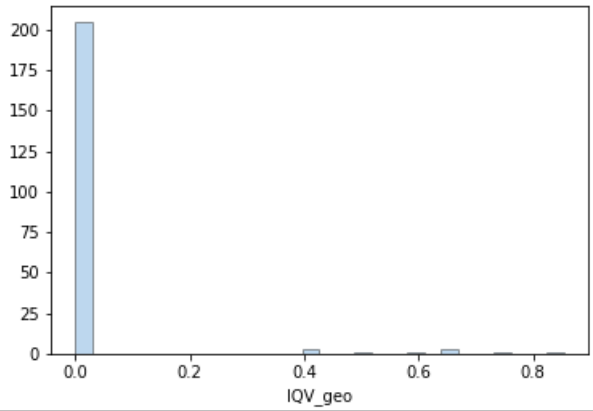
Figure 8.5. Dispersion of alters in terms of school level and geographical location

Distribution of IQV index for school levels



Mean: 0.30
Std: 0.32

Distribution of IQV index for geographical location (counties)



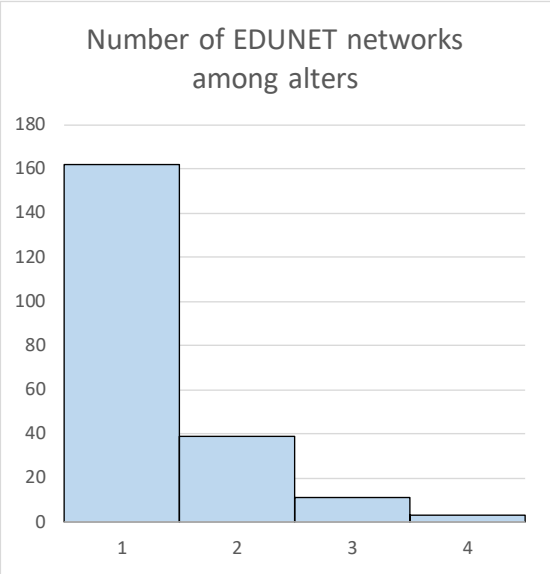
Mean: 0.03
Std: 0.13

Note: N=280 (unique ego network database)

A third attribute of the schools is which EDUNET network they belong to. Because of the very high number of EDUNET networks in the Academy (33 in total), the proportions of these among alters and the IQV index are less self-explanatory. Instead, we simply count the number of EDUNET networks among

alters in each ego network. Figure 8.6 shows that alters belong to the same EDUNET network in the majority of ego networks, but there are more than one networks present among alters in around one fourth of the ego networks, indicating that school collaboration is not purely the result of the EDUNET initiative of regional policy.

Figure 8.6. Number of EDUNET networks among alters



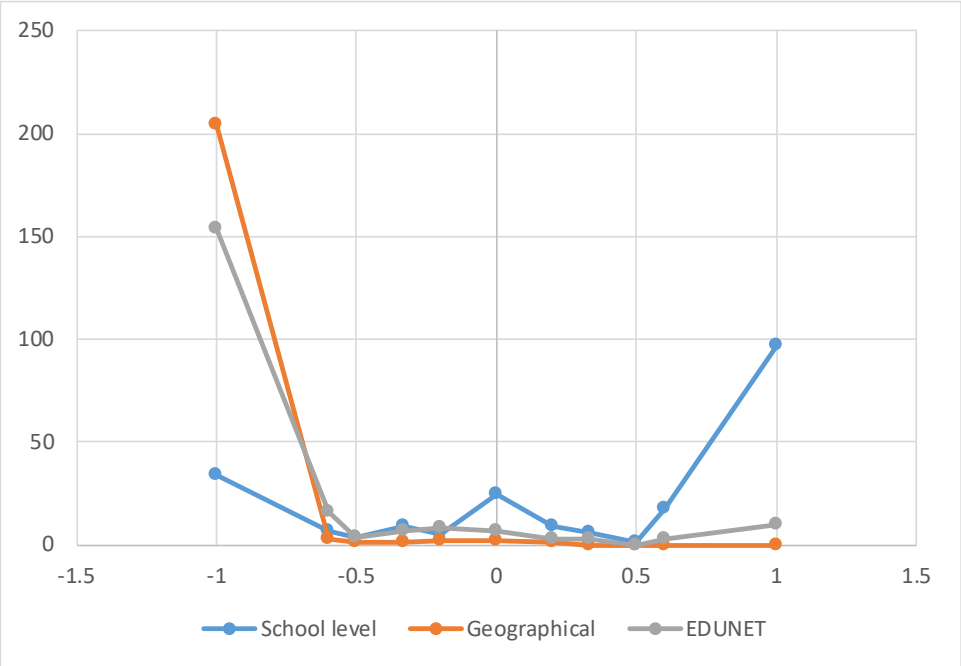
Note: N=280 (unique ego network database)

8.1.3. Ego-alter similarity

The third aspect of ego network analysis looks at homophily, or in other words, how similar alters are to ego with regards to the different attributes. The previous section touched upon this perspective when examining the contingency tables and Cramer's V values for ego and alters in terms of school levels and geographical location. While Cramer's V is able to show associations, the EI index is a special ego network measure designed to capture homophily specifically (Crossley et al., 2015[367]). It is based on the number of external (E) and internal (I) ties leading from ego to alters. External ties are those that lead to a different category, internal ones lead to the same category. The EI index is -1 in the case of perfect homophily, i.e. when all alters belong to the same category as ego, and is +1 for perfect heterophily, i.e. when all alters are different from ego (Crossley et al., 2015[367]). Figure 8.7 shows that almost all egos are perfectly homophile in terms of geographical location and EDUNET membership. On the other hand, egos are mostly heterophile in terms of school level, i.e. the majority chooses partners of a different school level. A closer look reveals that this heterophily reflects collaboration with neighbouring school levels in the vast majority of the cases. Indeed, in more than 90% of ego networks, all external ties lead to a neighbouring school level.

Figure 8.7. Ego-alter similarity

The distribution of EI index for school levels, geographical location and EDUNET membership



Note: N=280 (unique ego network database)

8.1.4. Relationships in view of policy objectives

Having described the characteristics of ego networks, we can now turn to exploring relationships between some of them. First, I will look into how the externally constructed EDUNET objectives are linked to the theme of school collaboration. This is therefore a first exploration of the mutual influence between vertical and horizontal outside views.

To do this, let us first examine how the EDUNET objectives laid out in Chapter 6 correspond to the collaboration themes explored in the questionnaire. The objectives can be realised through a mix of collaboration focuses, and any of these latter can be relevant for any of the objectives. However, there are some themes that correspond clearly and explicitly to particular objectives (Table 8.5). The objectives of the first iteration of EDUNET directly translates into collaboration on student pathways. It may also require administrative coordination, because it involves different school levels across which teachers and school leaders coordinate transition. Last, it may imply co-teaching and personnel sharing, for example to familiarise primary school students with lower-secondary teachers and new subjects. This practice is a quite frequent way of smoothing the transition between school levels in France. These objectives clearly invite collaboration between different school levels. The second iteration focuses on innovation and professional learning primarily and can therefore be directly matched with experimentation and research projects, training and professional development as well as collective pedagogical reflection. Co-teaching can be a powerful way to generate reflection on pedagogical practice when appropriately accompanied

with team reflection (Fluijt, Bakker and Struyf, 2016[430]), while personnel sharing is more a form of resource sharing that can support the functioning of schools, particularly in rural areas. It is less straightforward to map this collaboration theme on specific objectives.

Table 8.5. EDUNET objectives and collaboration themes

	EDUNET objective	Collaboration theme	Ties
First iteration (2014-2016) Focus: student pathways	Encouraging cross-cycle and cross-level links to streamline student pathways / Developing collaboration between primary, lower and upper secondary school teachers	Student pathways Project on subject-related practice	Cross-level
	Consider the student's journey as a whole, seek coherence and complementarity of learning and avoid rupture especially at key points of transition	Student pathways Administrative coordination Co-teaching, personnel sharing	Cross-level
Second iteration (2017-2021) Focus: innovation, professional learning	A "territorial incubator", promoting innovations consistent with educational policies	Experimentation project Research project Co-teaching, personnel sharing	
	A support system for professional development and reflection on practice	Collective training / professional development	Same level
	A synergy among actors, to allow for sharing problems encountered and solutions identified across different disciplines	Interdisciplinary project Collective pedagogical reflection	Same level
	A special professional development space, a proximity-based implementation	Collective training / professional development Collective pedagogical reflection	Geographical proximity

The above matching raises a number of questions with regards to the ego networks. A first question is whether the collaboration types can be structured into underlying factors. Conceptually it would be plausible to assume that student pathways, personnel sharing and administrative coordination all imply a strong element of coordination, such as scheduling visits and lessons in the other school, and aligning programmes. Experimentation and research projects, collective training, interdisciplinary project and pedagogical reflection on the other hand may imply more considerable reflection and knowledge construction. The distinction of these conceptual factors is not clear-cut, student pathways should of course also imply reflection and knowledge construction, and all collaboration requires a certain amount of coordination. Nevertheless, it makes sense to look into the data and explore if underlying factors can be distinguished. Therefore, I first performed exploratory factor analysis for the collaboration themes. The Kasier-Meyer-Olkin test indicated that the data is not suited for factor analysis (kmo=.492), and lavaan raised a large number of warnings for the parallel analysis also suggesting inadequacy. The attempted exploratory factor analysis also resulted in warnings and no factor structure emerged. With these set of items and this data we thus cannot identify any underlying factors for collaboration themes.

Another set of questions relates to whether certain collaboration themes can be associated to attributes of the ties, i.e. depend on the collaborating schools' profiles. For example, does the theme "student pathways" occur primarily between different school levels? Do collective training and pedagogical reflection occur primarily between schools of the same educational level? We have seen that schools rarely collaborate with schools in a different EDUNET network, but when they do, is that linked to particular collaboration themes? For this analysis, I transformed the database by extracting each ego-alter

relationship. In the transformed database, each observation corresponds to a tie, and there are 603 observations altogether. Relationships are classified in three groups in terms of school levels: internal ties, i.e. those between the same school levels, external neighbouring ties, those between neighbouring school levels (e.g. primary and lower-secondary schools) and external non-neighbouring ties. For EDUNET membership only two types of relationships exist: member of the same or different network.

The first hypothesis is that certain collaboration themes occur more frequently for certain types of relationships in terms of school levels. EDUNET objectives, particularly in the first iteration, intend to facilitate cross-level collaboration to support student pathways. We would thus expect that this theme occurs more frequently between neighbouring school levels. On the other hand, collective professional development and pedagogical reflection may often target a specific pedagogical context, for example, a particular grade or subject. This type of collaboration may thus be expected to occur more frequently between schools of the same level. Contingency tables and Cramer's V values reveal that there is no association between any of the collaboration themes and the type of relationship in terms of school level. This means that collaboration themes can occur with equal probability between schools of the same level, those that are neighbouring or non-neighbouring. This result is particularly surprising for the theme of student pathways and may require qualitative data to interpret.

The second hypothesis is that school collaboration across EDUNET networks is linked more to innovation and professional development related collaboration themes (second iteration). As the EDUNET networks were originally created to correspond to student pathways and conceived to collaborate along this theme, we can expect that this theme occurs primarily within EDUNET network. Again, chi square statistics reject this hypothesis. None of the collaboration themes are more or less linked to within or cross-EDUNET relationships.

8.2. School leaders' perception of local collaboration and the EDUNET device

While facilitating collaboration and networking among schools is today a popular policy tool in many countries, the purpose of collaboration differ substantially across contexts (Sartory, Jungermann and Järvinen, 2017[431]). In the United Kingdom, governmental incentives for establishing school networks often focus on raising achievement, such as the Teaching School Alliances model, which aims at improving weaker schools through school partnerships (Greany and Higham, 2018[269]). Similarly, school networks have been centrally set up or incentivised in Canada and the United States to foster local school improvement (Sartory, Jungermann and Järvinen, 2017[431]). In other contexts, collaboration among schools is more bottom-up, based on voluntary participation in partnerships and is focused on innovation and teachers' professional development (Sartory, Jungermann and Järvinen, 2017[431]). The context and purpose of school networks can influence the network structure and the nature of collaboration (Greany and Higham, 2018[269]).

As described above and in line with the conceptual framework, my research intends to provide insights both into horizontal (bottom-up) network structures and into the externally set up EDUNET network, which is a top-down initiative of the regional authorities. A set of items were developed to capture school leaders' perception of both of these. Items measuring the perception of horizontal networking do not mention the EDUNET initiative specifically, but ask about local collaboration and networking between schools in general.

8.2.1. Perceptions of local collaboration and networking: "Horizontal outside view"

Network effectiveness studies have been accumulating evidence on the various factors that facilitate the effectiveness of networks (CUREE, 2005[286]; Rincón-Gallardo and Fullan, 2016[288]; Muijs et al., 2011[52]). Chapter 3 provided a summary of these and listed a number of features of effective networks. These features can be grouped into four broad categories as the labels below indicate.

- Having specific shared goals focusing on teaching and learning – Objectives & Culture
- Placing professional learning at the centre – Objectives & Culture
- Establishing and maintaining strong and quality relationships based on trust – Culture
- Involving relevant stakeholders – Culture & Governance
- Drawing on external knowledge and expertise – Culture & Governance
- Distributed leadership and facilitation – Culture & Governance
- Taking into account the network context – Governance
- Having adequate resources, both money and time – Resources
- Developing skills to collaborate, facilitate and broker – Resources

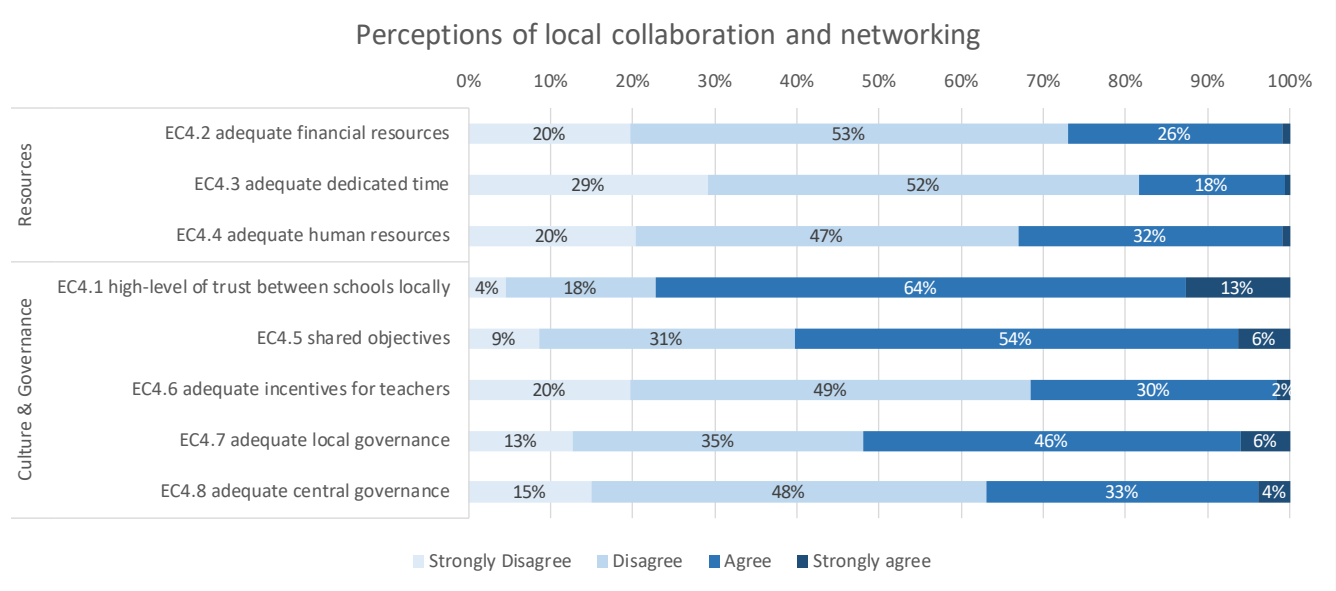
Taking into account that the labels objectives, culture and governance are not clearly separable, two broad groups would be: culture and governance, including also network objectives, on the one hand, and resources, including financial, human resources as well as time, on the other. The items developed for the questionnaire capture these two categories and the features above. Table 8.6 shows the descriptive statistics for each item.

Table 8.6. Perceptions of local collaboration and networking

Item code	Item	Response options / Tentative scales
Item stem	To what extent do you agree with the following statements about collaboration and networking between schools locally?	1: Strongly disagree 2: Rather disagree 3: Rather agree 4: Strongly agree
EC4.1	high-level of trust between schools locally	Network culture & governance
EC4.2	adequate financial resources	Network resources
EC4.3	adequate dedicated time	Network resources
EC4.4	adequate human resources	Network resources
EC4.5	shared objectives	Network culture & governance
EC4.6	adequate incentives for teachers	Network culture & governance
EC4.7	adequate local governance	Network culture & governance
EC4.8	adequate central governance	Network culture & governance

The data (Figure 8.8) reveals clearly that school leaders view culture and governance more positively than resources overall. The vast majority rather disagrees that local networks have adequate resources (73% for financial, 81% for time and 67% for human resources), while the majority rather agrees that network culture and governance are suitable. The only exception from this relates to incentives for teachers to collaborate: almost 70% of school leaders believe that there are no adequate incentives. We can also see that the proportion of those who strongly agree that the given statements hold is low: below 10% for all features, except for the level of trust, where it is 13%.

Figure 8.8. Perceptions of local collaboration and networking



Note: N=332

8.2.2. Factor analysis of local collaboration and networking constructs

Let us now examine if the assumed structure of resources and culture / governance can be validated. Similarly to Chapter 7, factor analytical methods are used to verify the underlying structure of data. As the adequacy tests of exploratory factor analysis are satisfying[22] and factor loadings for a two-factor structure seem adequate, I tested the model that corresponds to the conceptual design as laid out in Table 8.6 with confirmatory factor analysis.

The two-factor model fit the data significantly better than a model with only a single latent factor for network perception. However, fit indices, particularly RMSEA indicated misfit (Table 7.2). The first modification index suggests adding the residual covariance of items EC4.1 and EC4.5. This makes sense theoretically, as these two items measure something different from the other three. Indeed, trust and shared objectives both relate to the nature of relationship between members, while the other three items all relate to external governance aspects. After modifying the model, the fit becomes acceptable, although the upper confidence interval of RMSEA is still not entirely satisfying.

Table 8.7. Fit statistics of models of local collaboration and networking

	2-factor model	2-factor model with residual covariance
χ2	43.351	20.59
Degrees of freedom	19	18
CFI (scaled)	.986	.995
RMSEA (scaled)	.102	.064
90% CI for RMSEA (scaled)	(.079, .126)	(.038, .090)
SRMR	.046	.034

The indicators all show significant positive factor loadings, with standardised coefficients ranging from .610 to .947. There is a significant and strong positive correlation between the two factors (correlation coefficient .827), indicating that school leaders who perceive adequate resources locally, also see the culture and governance more positively. Ordinal alpha values were computed to verify scale reliability (Table 7.3). The alpha values are high for both scales, showing good internal consistency.

Table 8.8. Internal consistency of local collaboration and networking scales

Scale	Number of items	Ordinal Alpha
Resources	3	.855
Culture and governance	5	.891

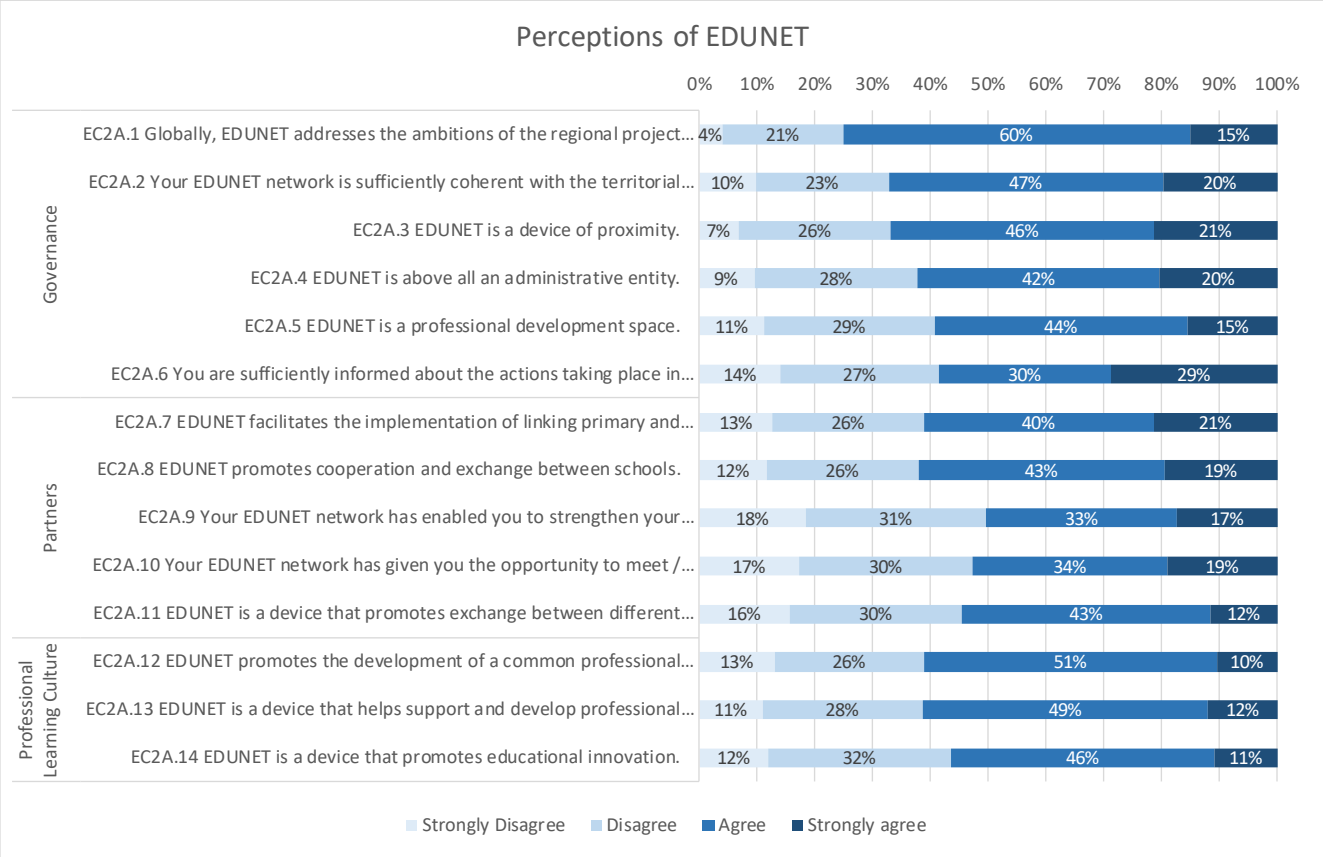
[22] Bartlett's test of sphericity – Chi square's p-value = 0; Kaiser-Meyer-Olkin [KMO] Test = 0.889; Parallel analysis suggests three factors.

Overall, the statistical results and conceptual considerations suggest that the modified two-factor model is both meaningful to work with and satisfies statistical requirements. Therefore, I will use this model in the following analysis.

8.2.3. Perceptions of the EDUNET network: "Vertical outside view"

The same set of questions were used to capture school leaders' perceptions as for teachers (see Chapter 7) developed by Harel (Harel, 2019[334]). Data shows that school leaders' perceptions are highly similar for the different elements: between 50% and 75% of school leaders rather agree with all of these statements (Figure 8.9). The highest level of agreement (75% of respondents) is on the statement that EDUNET addresses regional ambitions. The lowest is with half of the respondents agreeing that their EDUNET network strengthened their working relationships with colleagues and usual partners.

Figure 8.9. Perceptions of the EDUNET network



Note:N = 332

8.2.4. Factor analysis of EDUNET network perception constructs

While the adequacy tests of exploratory factor analysis[23] are satisfying, lavaan raised warning messages for the parallel analysis, suggesting an ultra-Heywood case, i.e. that a variable (or some variables) do not have unique variance. Exploratory factor analysis for both four and three factors raised such warnings as well, and resulted in a factor loading of greater than 1 for EC2A.2, suggesting that this variable constitutes a factor by itself. Four two factors, no warning was raised and EC2A.2 did not load on either of the factors. Clearly this item poses problems, I therefore excluded it from further analysis.

As noted in Chapter 7, a few items could belong to several constructs conceptually (EC2A.5 “EDUNET is a professional development space”, EC2A.8 “EDUNET promotes cooperation and exchange between schools”, and EC2A.11 “EDUNET is a device that promotes exchange between different school types”). I tested a three-factor model similar to that of the teacher sample, however, with a few small differences. A slightly different factor structure is indeed conceptually valid, as formal networks imply different expectations, responsibilities and benefits for teachers and school leaders. For example, whether a network is a professional development space, could simply be one of many goals of the network for school leaders, whereas for teachers it is about their opportunities to learn. The factor structure tested for school leaders is:

- Governance: EC2A.1, EC2A.3, EC2A.4, EC2A.5, EC2A.6.
- Partners: EC2A.7, EC2A.8, EC2A.9, EC2A.10, EC2A.11 (same as for teachers).
- Professional Learning Culture: EC2A.12, EC2A.13, EC2A.14.

As some items do not clearly belong to one or the other construct, I expected that some residual covariances would need to be added. Indeed the RMSEA index indicated misfit, and the first modification index suggested adding EC2A.9~~EC2A.10. Since both items refer to strengthening working relationships with colleagues, partners, it conceptually makes sense to add their residual covariance. In the second step the fit indices improved, however the upper confidence interval of RMSEA was still greater than .10. The first modification index in this second step suggested cross-loading of item EC2A.11 on the “Professional Learning Culture” factor, exactly as expected conceptually. Therefore a third model was tested including the two covariances, and finally this model showed fit (Table 7.13).

[23] Bartlett's test of sphericity – Chi square’s p-value = 0; Kaiser-Meyer-Olkin [KMO] Test = .921; Parallel analysis suggests four factors.

Table 8.9. Fit statistics of models of EDUNET networks

	3-factor model	3-factor model with residual covariance	3-factor model with residual covariance and cross-loading
χ2	138.4535	84.907	64.205
Degrees of freedom	62	61	60
CFI (scaled)	.979	.988	.992
RMSEA (scaled)	.115	.088	.074
90% CI for RMSEA (scaled)	(.101; .129)	(.073; .103)	(.059; .090)
SRMR	.047	.042	.037

The indicators show significant positive factor loadings, with standardised coefficients ranging from .72 to .976 with two exceptions. One exception is EC2A.4 which has a negative loading of -.508. This is expected, as EDUNET being "above all an administrative entity" is negative formulation vis-à-vis the intended objectives. The other is EC2A.11, the factor loading of which dropped from .78 to .34 after including its cross-loading on another scale. There is a significant and strong positive correlation between all three factors. It is important to highlight that the correlation coefficient between *Governance* and *Partners* is particularly high (.912), indicating that these two factors measure similar constructs. *Partners* and *Professional Learning Culture*, and *Governance* and *Learning* are also highly correlated (.847 and .796 respectively). Ordinal alpha values (Table 7.3) are high for all three scales. For *Partners* and *Learning*, they are almost "too high", suggesting that the items measure almost the same aspect of the construct.

Table 8.10. Internal consistency of local collaboration and networking scales

Scale	Number of items	Ordinal Alpha
Governance	5	.850
Partners	5	.935
Professional Learning Culture	3	.956

Visibly, the set of items exploring school leaders' perception of the EDUNET device are not well conceived to measure clearly separate underlying constructs. As the items relate to a specific context, it may not be worth to reconceptualise the questionnaire in future research. For this research, the model can only be used with caution as the highly correlated factors may cause multicollinearity. Therefore, only one of these factors will be used in each of the subsequent structural equation models.

8.3. How do perceptions of collaboration and networking relate to school networks?

This section further investigates the second hypothesis – **H2.1 Network and organisational culture are important factors in facilitating social processes** – this time through the lens of school leaders. It examines the ways in which school leaders' perceptions of collaboration and networks influence schools' social dynamics. As outlined above, two sets of constructs measure school leaders' perceptions. The "horizontal outside" perspective looks at their general perceptions of collaboration, while the "vertical

outside" view explores perceptions specifically related to a certain policy context, in this case, the EDUNET device.

Following Borgatti and Halgin's (Borgatti and Halgin, 2011[156]) typology of theoretical approaches to studying networks introduced in Chapter 4, this research is situated in the intersection of the "network theory" and "theory of networks" domains. This section looks at the impact of school leaders' perceptions (non-network variables) on schools' network (network variables), which lies in the realm of the theory of networks. The next section will explore the impact of school networks (network variables) on teachers' knowledge (non-network variables), which falls in the domain of network theory. In both cases, I will use structural equation modelling (SEM) to investigate the relationships between constructs and variables. Network measures can be used in classical statistical analysis, such as correlation and regression analysis, in the same way as non-network variables (Hanneman and Riddle, 2005[364]). However, integrating these variables in a SEM model makes this research unique: searches in academic databases indicate very little research using this model. One recent example is the work of Hayian Liu and colleagues (Liu, Jin and Zhang, 2018[432]). In order to design the SEM model, I first review relevant research in education.

Education research has explored the drivers and barriers of engaging in networking and collaboration. Conducting research on the implementation of reforms is a strong research tradition in the United States. In the past decade, some of this research has focused on studying networks, both as a result of reforms and as antecedents. Several studies have shown that reforms and interventions can shape teachers' and school networks. For example, Atterberry and Bryk demonstrated how the position of some actors changed as a result of a long-term professional development programme. In particular, the instructional coaches responsible for guiding the professional development became central actors in teachers' network over time (Atterberry and Bryk, 2010[433]). However, the study also pointed out that certain pre-existing social factors, such as levels of trust and willingness to deprivatise practice matter for the effect of interventions on networks. Case study findings suggest that if these levels are initially low, network characteristics may not change. Coburn, Choi and Mata (2010[165]) also looked at the change of networks as a result of social policies. Their research showed that social policies can change perceptions of homophily, i.e. who appears to be more 'alike'. Interventions can also increase teachers' knowledge of where the expertise lies, and thereby shape the ties in the network. Coburn and colleagues' findings also suggest that while materials seem to be durable resources, relational resources, such as coaches becoming brokers of information, are sensitive to continued external support (Coburn, Choi and Mata, 2010[165]; Coburn et al., 2012[167]).

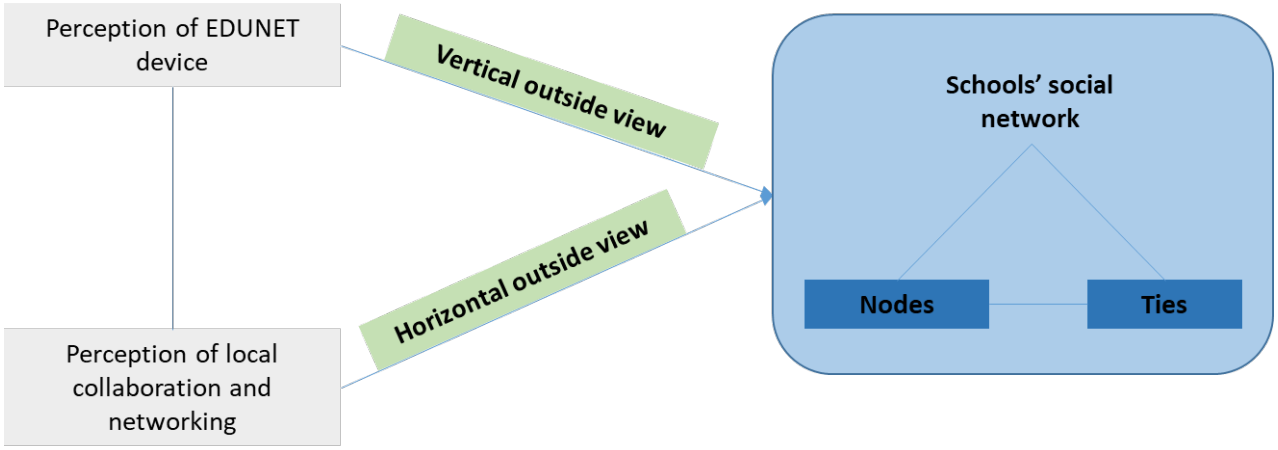
Penuel, Frank and Krause (Penuel, Frank and Krause, 2010[421]) examined the effect of leadership practices on teachers' network characteristics. The study showed that distributed leadership, i.e. leadership that is stretched over several people and relies on interactions, can increase levels of reform implementation, particularly when there is less access to professional development. Importantly, this research also demonstrated that teachers' perception of levels of trust and shared commitment for student

learning among colleagues make them more likely to implement reforms and change their practice. Using the framework of this thesis, Penuel and colleagues' result suggests that inside views influence vertical outside perspectives.

While some studies have investigated the relationships between social policies and the evolution of social networks, as well as various drivers of reform implementation, research on the impact of school leaders' views on the actual social networks of schools is scarce. Recent research findings suggest that certain types of leadership practice are conducive to collective professional learning. For example, Vanblaere and Devos demonstrated that both instructional and transformational leadership are associated with more participation in reflective dialogue, the former is also related to higher deprivatisation of practice, and the latter to more collective responsibility (Vanblaere and Devos, 2016[434]). These aspects of professional learning communities are relevant for teachers' social networks. However, further investigation is needed on the link between leadership views and school networks.

As part of the broad hypothesis (H2.1: Network and organisational culture are important factors in facilitating social processes), I investigate how perceptions of collaboration and networking in general and perceptions of the EDUNET device in particular, influence school networks. I hypothesise that both of these will have an impact on the characteristics of nodes and relationships Figure 8.10. I test this hypothesis using structural equation modelling (SEM) (see Chapter 5 for methodology).

Figure 8.10. Perceptions of collaboration and networking influence social dynamics



8.3.1. Perceptions and node (ego) characteristics

Based on the results of factor analyses described above, I will use one scale of each dimension of school leaders' perceptions so as to avoid multicollinearity: Professional learning culture (*EDUNET Learning Culture*) from the EDUNET perceptions and Culture and governance (*Network Culture*) from general perceptions. To describe school network characteristics, I will use the size of the ego network, the mean tie strength and the standard deviation of tie strength as a measure of tie dispersion. Figure 8.11 depicts the model, where only significant standardised regression and correlation coefficients are

indicated. While the model shows a good fit (Table 7.15), only few of the regression coefficients are significant.

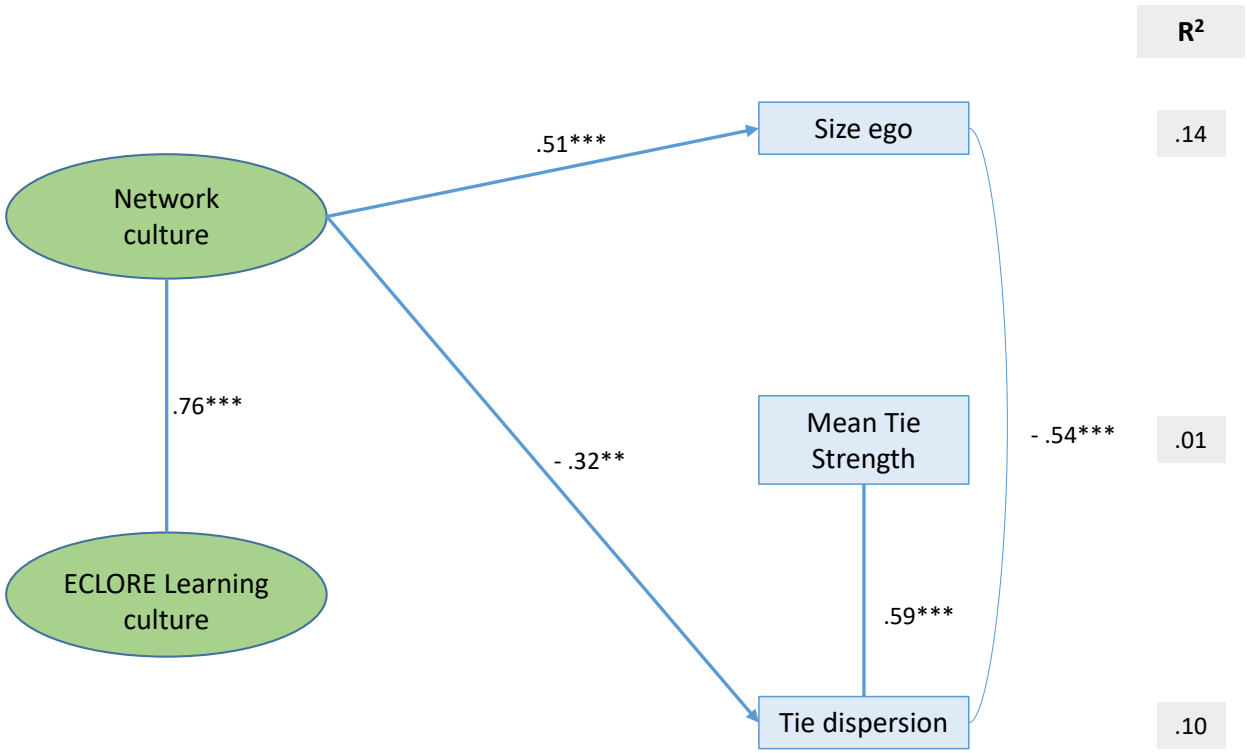
Table 8.11. Fit statistics for school network SEM model

FIT statistics	Values
χ^2	35.313
Degrees of freedom	36
CFI (scaled)	.994
RMSEA (scaled)	.057
90% CI for RMSEA (scaled)	(.039; .076)
SRMR	.043

The positive association between Network Culture and Size ego suggest that the more school leaders view local collaboration and networking as positive – higher levels of trust, shared objectives, adequate incentives and governance – the wider network they have with other schools. Interestingly, there is a negative association with tie dispersion, implying that the more positive school leaders' views are, the more similar their relationships are to different schools – at least in terms of number of collaboration themes. The fact that there is no significant relationship with mean tie strength suggests that positive views of the network culture and governance do not necessarily mean stronger collaboration with schools.

None of the relationships between perceptions of the EDUNET device and school network characteristics were significant. This suggests that what directly matters for schools' social networks is not how school leaders see an external policy device, but how they view their local environment. At the same time, school leaders' perception of the EDUNET device correlates highly with their general perception of local collaboration and networking. It is hard to establish a causal direction between these constructs conceptually. Possibly, they mutually influence each other. School leaders who perceive local network culture as positive are also able to benefit from the EDUNET device to further professional learning through local networks.

Figure 8.11. SEM: Impact of perceptions on networks



Note: *: p< .05, **: p<. 01, ***: p< .001

8.3.2. Perceptions and relationship (alter) characteristics

Similarly to the above, I will use one scale of each dimension of school leaders' perceptions so as to avoid multicollinearity. Conceptually, I hypothesise that school leaders' perceptions about the opportunities EDUNET created to establish new partnerships (*EDUNET Partners*) and their perceptions of the culture and governance (*Network Culture*) of local collaboration will have an impact on the diversity of their partners. Section 8.1.2 showed that ego networks had very little diversity in terms of geographical location and EDUNET membership. Therefore, I will focus only on diversity in terms of school levels. I use two measures: the number of different school levels among alters, and the ego-alter similarity measure (EI-index). There were no significant standardised regressions, suggesting that school leaders' perceptions are not linked to the diversity of alters. The correlation between school leaders' perception of EDUNET's partnership function and their views of the culture and governance of local networks are very high (.823, p<.001).

Overall, school leaders' perceptions explain only a fraction of the variations in the various network characteristics (as shown by the R^2 values in Figure 8.11), and none with regard to the diversity of ties.

8.4. Conclusions

In this chapter, I explored networks of schools as the broader social context of teachers. In line with my conceptual framework, I extended the two views identified by Sleegers and Leithwood (2010[415]) to take into account both horizontal networks and vertical ones (in the case of this study the top-down, centrally mandated EDUNET network). The first part of the chapter described schools' horizontal networks. Overall, the majority of schools collaborate with 0-3 schools, on average on two collaboration themes. Data showed that schools collaborate mostly with schools of different levels in the same geographical region and the same EDUNET network (these two latter are strongly connected). Interestingly, the collaboration theme does not seem to depend on the attributes of the schools. This is the most surprising for student pathways, which we would expect to be a more frequent theme between schools of neighbouring levels.

In addition to a description of the school networks, I also tested the second hypothesis of the second research question: "H2.1 Network and organisational culture are important factors in facilitating social processes". Structural equation modelling showed that the horizontal outside view, i.e. school leaders' perceptions of their horizontal network cultures matter more for their social network. More positive perceptions are associated with bigger school networks, and less diverse tie strengths. While no direct relationships were found between perceptions of the EDUNET network and the actual social networks, perceptions of the horizontal and vertical networks were strongly linked.

The extent to which school leaders' perceptions of networks and the actual social networks of schools influence teachers' knowledge dynamics remains an open question. Answering this question with my quantitative data requires merging the two databases, which is possible through the unique school codes. Unfortunately, a multi-level analysis is not possible due to the sample size. In future research, such an analysis could allow for expanding the understanding on the ways in which social structures and processes are linked to the various dimensions of teachers' knowledge.

Chapter 9. Teachers' knowledge in two schools: Case studies

This chapter examines the two main research questions through analysing qualitative data collected in two schools. It intends to provide a deeper understanding of processes underlying teachers' knowledge dynamics by looking into:

- the ways in which the three main types of functional dynamics – knowledge mobilisation, construction and diffusion – play out in teachers' work
- the types of social processes teachers and school leaders engage in
- the ways in which social processes drive the dynamics of teachers' knowledge.

I will pay particular attention to further investigating the results of quantitative analysis. I will present the two case studies separately and then discuss the results through a comparative analysis.

Qualitative research was conducted in two rural schools in the Bel-Mondo region. The selection of the schools was discussed in Chapter 5. Teachers in each school were selected by the school principal based on some guiding criteria of heterogeneity. I asked the school principals to select some teachers who have been engaged in one or more of the innovative projects going on in the school, some who were either not engaged from the beginning but were brought on board gradually or are engaged only marginally; and finally some who collaborate with other schools as well. I also asked to speak with a group of students as heterogeneous as possible in terms of grade levels, academic achievement and levels of engagement in innovative projects. Due to the covid-19 pandemic it was not possible to visit the schools in person as France was in lockdown at the time of data collection (November-December 2020). Instead, a number of individual and group interviews were conducted virtually. In "Legrand Secondary School"[24], it would only have been possible to organise an interview with the students in January 2021. However, the video-interview experience with students in "Piccoli Secondary School"[25] proved to be not very useful. Due to the health crisis, students were wearing masks, which with the low sound quality and students often speaking at the same time made it difficult to fully grasp what they were saying. Therefore, I renounced to

[24] *The fictive school name "Legrand" means "the big" in French ("mon grand / ma grande" is often used by parents for their children). It pays tribute to Michel Legrand (1932-2019) French composer, conductor and pianist.

[25] * The fictive school name "Piccoli" refers jokingly to "the small" (piccolo in Italian, piccoli in plural). It pays tribute to Michel Piccoli (1925-2020) French actor. Both Legrand and Piccoli were key artists of the French Nouvelle Vague.

conducting a discussion with students in the other school. All interviews have been transcribed (except for the student group discussion, which was briefly summarised) and are included in Annex D. In addition to the interviews, the school principals of both schools shared a number of documents and materials. The data sample and materials used for desk-research are summarised in Table 9.1 and Table 9.2.

The interviews were analysed by coding the transcripts along the main research questions of this thesis. First, they were colour-coded to characterise knowledge dynamics, based on the constructs determined by the theoretical framework: knowledge construction (yellow), mobilisation (blue), diffusion (green). Second, references to social processes were highlighted in a different colour (orange) and the dominant forms and spaces of these were coded. Third, instances of relationships between social processes and knowledge dynamics were marked on the margins. In addition, a grounded theory approach was used to identify emerging constructs and other elements (Creswell and Plano Clark, 2011[327]).

9.1. Case study 1: "Legrand Secondary School"

School "Legrand" is a lower secondary school situated in a small rural town with around 4000 inhabitants. It counts around 500 students, 70 staff members of which around 40 teachers. Only a small proportion of its student population is disadvantaged, with about 4% having serious learning difficulties. At the moment of the data collection, its principal had just been transferred to another school after having led School "Legrand" for three years. Five interviews were conducted with seven staff members altogether (Table 9.1).

Table 9.1. "Legrand Secondary School" – data sample

	Interviewees	Sex	Interview type
LSL1	Former school principal	F	Individual
LSL2	Deputy school principal	F	Individual
LT1	Teacher: Spanish	F	Individual
LT2	Teacher: Biology	F	Individual
LT3	Teacher: Biology	F	Group
LT4	Teacher: Technology	M	
LT5	Teacher: History and Geography	M	
Documents / Materials shared	Presentation of the school (slides); Information slides on three experimental projects; Leading a school at a distance (slides);		

The (former) principal defined two main objectives for the school:

- Success for all students (including those with difficulties or with special needs).
- Well-being at work and positive school climate (serenity, mutual trust and respect).

A presentation (set of slides) of the school shared by the principal in preparation for the interviews also reveals that the intention of the principal is to place pedagogical reflection at the heart of the project. This includes creating a space for teachers to meet amongst themselves as well as with parents, and to lead a number of innovative experimental projects.

- Welcome and support structure to prevent school dropout: a set of cognitive, psychological and pedagogical support measures targeted specifically at students in danger of early school leaving (e.g. absenteeism, rejection of learning and schooling).
- Memorisation / Cogni' Class project: inter-disciplinary project aiming to help students memorise information; led by a history-geography teacher. Teachers have a shared table of questions referring to content taught in their classes. At the beginning of a class, they use this table to ask a few questions from students, not necessarily of their own subject, to keep information in memory. The effectiveness of this new practice was measured through a control group: one class not using this technique.
- Positive evaluation project: cross-disciplinary pedagogical project aiming to encourage students and improve learning through positive evaluation; led by foreign language teacher. Teachers do not record student failures, only progress and achievement. They identify competences and knowledge not yet acquired, and provide support for students to further develop these. They record progress through using colours.
- Emotion management and student success – Emoti' Class project: cross-disciplinary and cross-professional project aiming to support students and teachers in expressing and managing their emotions, and through that improving communication. The project involves not only teachers from various disciplines, but also assistant and supervisory staff and health professionals, who hold workshops for students in small groups. The project is realised in partnership with the regional university's "Research Centre on Cognition and Learning". The partnership aims to create a dialogue between research and pedagogy through offering professional development and continuous pedagogical support to staff. The university helps conduct an experimental study design with pre- and post-tests.
- Class council project: cross-disciplinary project aiming to empower students to reflect on their own pathways and actively participate in class councils[26]. Students complete self-evaluation before the class council. Place attribution in the class councils deliberately breaks groups, e.g. the form teacher sits between two students. Form teachers distribute mark books (tri/semester results) individually to every student after council.

The context of innovative projects allows for studying how social processes are linked to the dynamics of teachers' knowledge.

[26] "Conseil de classe" – Meetings held at the end of each trimester (or semester) for each class to discuss students' progress and marks, involving all teachers, a parent and a student representative.

9.1.1. Knowledge dynamics in Legrand Secondary School

In this section, I describe the ways in which teachers' knowledge dynamics play out in Legrand Secondary School. Not so surprisingly, teachers do not explicitly refer to knowledge construction, nor knowledge per se. Rather, knowledge dynamics can be captured indirectly through discourses around experimentation, testing certain teaching practices, reflecting on problems, difficulties and teaching methods. The interviews included descriptions and a high number of mentions of the projects presented above (with the exception of the first one, which is linked to the overall school project), which allowed for analysing how the different aspects of knowledge dynamics are interlinked in the process of innovation.

The data demonstrates that knowledge construction often emerges from practice-based problems. Teachers face difficulties with certain students or classes, they observe students' behaviour and learning, and formulate a need to change. The following citations demonstrate this phenomenon:

> *"When I arrived to the secondary school [from a primary school], I discovered these class councils a bit, which eventually hasn't changed since I was a student at secondary school, and I didn't see too much interest in them for students. I found that the students were not very involved in this class council. So the experiment was to make sure that students think more about their pathways as students and do self-evaluation, and participate in this class council without necessarily being present but they are represented by the delegates." (LT5)*
>
> *"This is the case for memorisation for example. We come to a point where we lament 'Yeah, students don't learn anymore, they don't work at home anymore, etc.' But by lamenting, we don't really find a solution. We say 'Yeah, it's the parents' fault.', 'It is the student's fault.', 'It's the teacher's fault.' etc. 'Well, can we not find a solution to help them rather?'" (LT5)*

In some cases, personal convictions, values and dispositions also play a role in motivating change:

> *"I told myself I want to try this because I realise, over the years that I can no longer give bad marks to students, that I no longer want to put a red. I don't want to put yellow any more. I find it violent. I can no longer by personal conviction, by values." (LT1)*

Knowledge construction can also be driven by external stimuli, such as professional development and individual or collective knowledge mobilisation. For example:

> *"There was a time when there were a lot of articles on cognitive sciences. So with colleagues, I am thinking particularly of Ms. X, who started the emoti-class in fifth or fourth grade, well, we got particularly interested in it at that time." (LT3)*
>
> *"… we have this possibility of training throughout our career through these workshops. For my part, I enrolled in a workshop called 'Neurosciences', quite simply put, 'learning'. And from there I said to myself 'Okay, so this interests me. Because there, I have a concrete application that I can carry out in a classroom. I can test something." (LT1).*

The same teacher (LT1) who described professional development workshops as a possible spark for change in the context of the Memorisation / Cogni' Class project, said that reading literature did not serve this purpose in the case of the Positive Evaluation project. Rather, mobilising external knowledge sources through reading was a way to shape and reinforce the process of designing new practice:

> *"I did not go through a theoretical support to try something. [...] it was after that I said to myself 'But there are certainly things that exist in theoretical terms.' And then, I went to look for some theory to give my mill water to grind." (LT1)*

Knowledge mobilisation can also bring comparative elements and act as a form of validation when the new practice already exists in other national or cultural contexts:

> *"I also did it when I wanted to formalise the project, I wanted to draw a parallel or to try to enter into comparative things. I said to myself 'Hey, there are countries that are more advanced than others on this issue. This question of evaluation is also cultural.' So, it is also to take a step back and be able to situate yourself as an individual teacher and also as a local teaching collective, as a national teaching collective, to see how it all rose up too and how 'it's very, very, very cultural. So, I went looking for theoretical information as I went along, especially on the internet." (LT1)*

Overall, teachers do not seem to mobilise knowledge in a systematic way. Rather, they use various sources in various stages of their work, more based on their time, interest and motivation. The main source of external knowledge is the internet, where they use social media sites such as Twitter and Facebook, and institutional websites, such as that of the regional Academy. They access a variety of types of resources, including more theoretical-scientific pieces (e.g. articles on neuroscience, student evaluation), as well as practical resources (e.g. teaching techniques). Some search for general pedagogical sources, while others are more focused on disciplinary content and use for example radio programmes and magazines, which present popular science. While teachers do not evaluate the quality of the sources in a scientific way, they often select sources that they believe are valid. This may be true for institutional accounts on social media or institutional websites. However, several teachers also mentioned being part of practitioners' groups (e.g. on facebook), which from a scientific perspective, do not guarantee high quality, valid information. Validation of quality is thus primarily based on trust and reputation of certain sources.

In understanding the dynamics of knowledge, it is fundamental to ask when we can speak about knowledge construction. Can trying out new teaching methods be regarded as knowledge construction? Education research, organisational learning and innovation literature all distinguish between simply trying new things as opposed to having an approach to innovation, which is strongly linked to learning and knowledge construction [e.g. (Ellström, 2010[249]; Lundvall, 2013[244]; Nonaka, 1994[102]; Engeström and Sannino, 2010[188])]. As discussed in Chapter 3, such a systematic approach typically manifests in an innovation cycle. This does not only include the formulation of a problem, the mobilisation of external knowledge and the design of new practice, but also the trialling of this practice, the investigation of its

impact, potential adjustments and the consolidation of knowledge (Earl and Timperley, 2015[255]; Engeström and Sannino, 2010[188]).

In Legrand Secondary School, the former school leader seems to have played a major role in facilitating the construction of knowledge in this sense. In the interview, she describes the process explicitly. She first identified practice-based problems that teachers formulated or that she observed. Then, with her own words:

> *"And on the basis of these issues, I started to think. I shared them with teacher-researchers who were working on related topics to find out if we could build together and especially carry out an action that could take a little bit of time to produce effects. I.e. not one formal training at a time T, which does not modify practices. It's interesting, but it's not enough. But rather return regularly to the school with both formal times, with some theoretical contributions, distanced, which will feed teachers' thoughts and make them think. And the implementation of practical support in the field, where the teachers will try something and then evaluate it with the researchers and so on. Each time, that was the idea." (LSL1)*

It is worth noting that the idea that a one-off training session is not sufficient is also research-based (Cordingley and Bell, 2012[435]; Timperley et al., 2007[377]), showing that the school leader herself follows research-informed leadership practice. The interview confirms this: she claims to read research on various topics that interest her, in the form of scientific books, student data and effectiveness studies with comparative perspectives of what works. Concerning teachers, she specifies that while there are a few teachers who also mobilise research knowledge from time to time, this is certainly a minority. There are several reasons for this in her view. First, a lack of time, which is partly due to the increasingly diversified tasks teachers are expected to perform – this argument was also brought up by one of the teachers. In her words "people keep their noses to the grindstone", and reading research is not part of this. Interestingly, she mentions some national policies, such as the focus on student orientation / guidance, as a barrier, because it takes time away from questioning and changing practice. Second, a lack of habit, i.e. some prefer to stay in their comfort zone. Third, a lack of teacher mobility: she explains that changing one's environment helps question one's practice as a result of new stimuli.

The school leader's approach to canalise and structure teachers' interest in finding solutions to problems, and construct a systematic enquiry process around it, involving external stakeholders is also manifest in the language teachers and herself use. For example, she used the word "systematic / systematically" nine times in the interview. All interviews conducted in this school confirm that teachers use the term "experimentation" not simply as a word of everyday language, but with an understanding that reflects research knowledge. The special role of the (former) school principal in the process is recognised by the teachers too.

The new deputy principal, who arrived to the school a few months before the interviews, described the specificity of knowledge construction clearly. When asked about what she found different in this school after the first few months following her arrival, she said that the fact that teachers are engaged in innovative

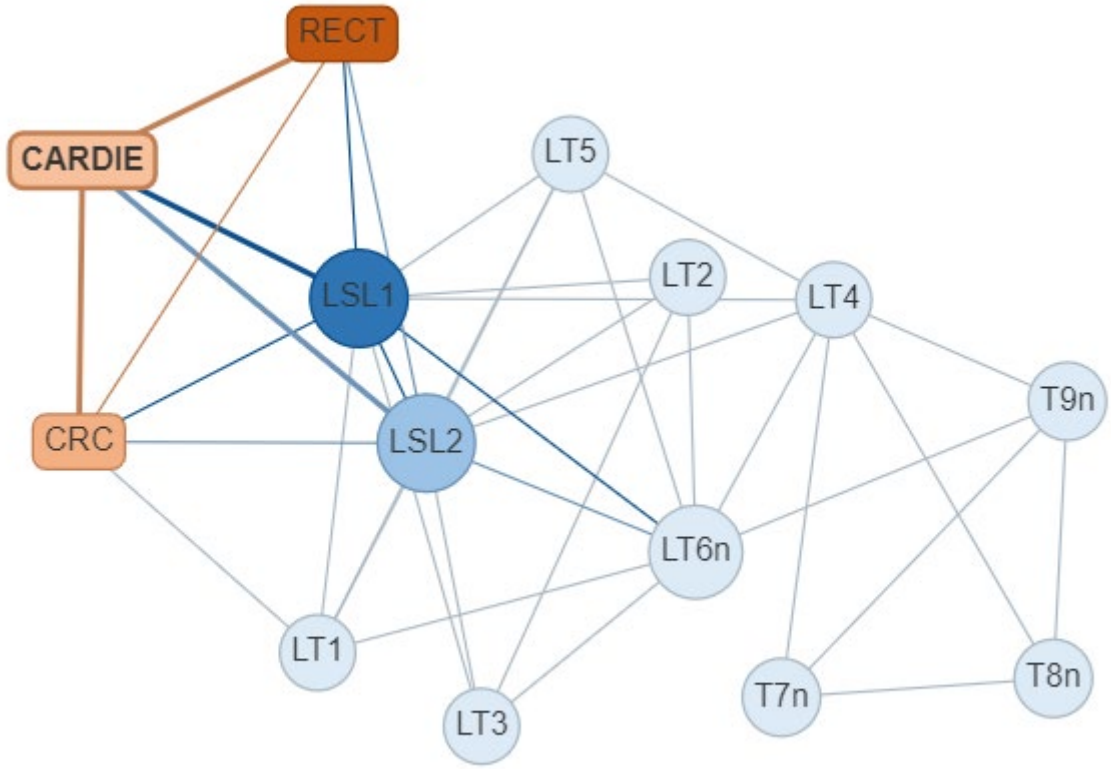
projects is not so particular. However, the way these projects include the perspective of evaluation to understand how well they work is special. In her previous experience, teachers were working on projects for pure personal interest and desire. The (former) school principal herself formulates the outcomes of knowledge construction, as well as its current limits in the school. In relation to evaluating students' competences – a major national policy planned in the 2007 and coming to fruition in the second half of 2010s (Eduscol, 2020[436]; Houchot et al., 2007[437]) – she says that new attitudes and practices are today in place and taken up by all teachers, which was not the case when she arrived to the school in 2017. She acknowledges that the level of expertise varies across teachers though. Concerning the work with emotions, the majority of teachers have recognised its importance, changed their perspectives and approach. This however is not yet true for the entire teaching staff.

Overall, the data demonstrates that Legrand Secondary School has intensive knowledge dynamics with deliberate construction of new knowledge to improve students' social-emotional and academic learning. It also shows that some actors play a key role in driving these dynamics. Let us now look at what social processes underlie these dynamics.

9.1.2. Social network of Legrand Secondary School

The various types, forms and platforms of social processes are described in section 3 below. This section maps the social network underlying teachers' knowledge construction in Legrand Secondary School. This network is built on qualitative data and is not meant to represent a fully accurate picture of each node and each tie specifically. Nevertheless, the interviews help distinguish a certain number of key roles in the social network, as well as provide information on the nature of tie formation.

Figure 9.1. Illustration of social network in Legrand Secondary School



Note: Social network data was not collected specifically through the interviews or otherwise. Therefore, this figure is an illustration of ties: edges represent ties that were flagged in the interviews. However, there may be other ties, not mentioned in the interviews.
Legend:
LT: teachers of Legrand Secondary School
LSL: school leaders of Legrand Secondary School
T: teachers of other schools
RECT: Rectorate of the Academy
CARDIE: Centre for Research, Development and Innovation in Education of the Academy
CRC: Centre for cognitive sciences of the local university

Figure 9.1 illustrates some of the ties that could be captured through the interviews. Blue nodes are individuals, orange nodes are institutions and the red node represents the regional authority. Two actors (nodes) are connected if they were involved in knowledge mobilisation or construction together. For example, two teachers working on the same project are connected, an institution is connected with an actor if it provided professional development to the actor [knowledge mobilisation] or they were co-conducting an experimentation project [knowledge construction].

Tie formation

As expected from network literature, teachers often form ties based on homophilie, i.e. they collaborate on projects with or seek advice from colleagues, with whom they share certain attributes. Teaching the same subject is the most straightforward attribute based on which teachers engage in

collaboration. Same subject teachers can form ties within the school, but also across schools. This latter is the case particularly for teachers of disciplines with a lower number of weekly lessons who are often isolated within their own schools (in that they are the only teachers of that particular subject). Both the biology and the technology teachers pointed to collaboration with their disciplinary colleagues from local schools. Shared interest, passion and common values are also important bases for tie formation:

> *"So there are also, I would like to say, affinities between colleagues. Maybe there are more special links, ways of looking at teaching, we'll say in common, which mean that at a given moment, we said to each other 'Well, do you want to take part in this, is it of interest to you? and (...) yes. That's how it's done, because I think that there is a relational element between teachers as well." (LT1)*

School principals also form ties based on homophilie. For example, the new deputy principal (LSL2) has kept contact with her former university fellow students and today they exchange on their practice. She also met colleagues through the EDUNET network of her former school with whom she kept in touch. The former school principal (LSL1) underlined the importance of shared values and trust in the formation of professional collaboration, and also pointed to barriers:

> *"[…] we had to work together on the same territories around shared projects. So, we got to know each other in those moments. And, within the framework of these interactions, there were intellectual affinities and common values. So, we kept these relationships even when moving away geographically. Because there is real trust and esteem. And we are not in relationships which, at some point, can be competitive. This is an important element in management personnel and it certainly impacts and degrades possible professional relationships." (LSL1)*

However, actors form ties through formal channels as well, which create ties between people with different backgrounds, knowledge and interest. In Legrand School, the former school principal set up collaboration with the local research centre (CRC in the figure), and teachers participating in some of the experimentation projects thus formed ties with researchers. She also solicited the CARDIE to provide professional development to teaching staff in the school. When teachers participate in professional development, they form ties with trainers. It is most often the school principal who is in direct contact with the CARDIE, which in turn, assigns trainers based on the particular demand. In addition, teachers sometimes work with teachers from other schools on projects, which can expose them to different working cultures and practices. The school leader (LSL1) explicitly underlined this effect when speaking of teacher mobility. In her view, changing schools or work environment often goes with rethinking their practice and opening up to news practices.

Tie formation based on difference in certain attributes (heterophily) also exist between teachers. The Spanish teacher (LT1) expressed strong interest in collaborating with the history-geography teacher on pedagogical issues because this latter had formerly been a primary school teacher. Primary school teachers in France receive a stronger general pedagogical training in France, as opposed to secondary

school teachers whose initial training focuses on subject knowledge primarily. This difference in knowledge and experience attracted the Spanish teacher as she felt that this could bring value for her. Forming ties based on heterophily is more rare generally and network literature underlines the importance of being able to locate expertise (Coburn, Choi and Mata, 2010[165]).

Network roles

A number of special network roles that are key for knowledge dynamics emerged clearly from the data. First, some actors have a role as ***facilitators*** in the network. The most obvious one is the school leader – in the case of Legrand, the former school principal – whose key role was underlined multiple times in several interviews. She was seen as the driver of innovation by encouraging teachers to reflect and launch projects:

> *"We were lucky enough to have the school principal for three years, who was exceptional, but really with a human dimension, I think really extremely rare, who trusted us, who wanted the school to progress and to unlock these chains. And so I felt comfortable proposing a project because I felt that I was supported by a will to make things happen. In other words, when she arrived, I said to myself, 'Well, the things that you're doing on your own in your corner, maybe I can propose them and make them […] a bit more objective and readjusted and eventually, we can enrich each other's practices. Because when there's a project like that, often something remains with the other colleagues and that's the most important thing, in fact" (LT1)*

The school principal played a facilitator role also during the process, for example by organising a meeting for a project when its project leader wanted to recruit colleagues and by providing support throughout the project. A teacher, project leader described her as a "driving force". Facilitators can be fundamental in crisis situations as well. When schools closed from one day to the next due to the covid-19 pandemic, the school principal reacted immediately and put in place a virtual space for staff to organise education at a distance but also to be able to share difficulties, ideas and practices.

Project leaders naturally play a role of facilitator in terms of knowledge dynamics. This is clearly the case of the Spanish teacher (LT1), who leads the positive evaluation project. Interestingly, she links her coordinating role to the fact that she is the form teacher in this class, underlining that this latter role naturally implies coordination across teachers teaching the same class. Facilitator roles can be played by external actors as well. For example, some school inspectors generate cross-school disciplinary projects, in response to the challenge of rural areas, where some teachers may find themselves isolated. The interviews suggest that this role is not systematic, it depends on the inspector's willingness and motivation. The biology teacher (LT2) said that while a former inspector recognised the problem and facilitated collaboration, this is not the case with the current one.

Another central network role in terms of knowledge dynamics is that of ***brokers***, i.e. actors who mediate between otherwise not well-connected groups (Brown and Duguid, 1998[224]; Haas, 2014[225]). Again, the school principal acts as broker, for example when disseminating the practices and knowledge

constructed locally. This happens either through her informal channels such as her close contacts with other school leaders, or through formal means. This latter is often organised by the regional authority (rectorate) or its research and development centre, the CARDIE. Such brokering also takes place within the school: for example, when the school principal shares information about the project in staff meetings. The school leaders' broker function is made possible as a result of their position in the network. Figure 9.1 shows that both school leaders are hubs in the network, i.e. they occupy a central position connected to a large number of nodes.

However, being a broker does not necessarily require having a large number of connections. A person who lies between two strongly connected communities can act as a broker if they transfer information from one community to the next. For example, the interviews suggest that the media teacher plays a broker role in this school. Although this teacher was not interviewed (and does not appear in the social network figure above), another teacher (LT2) explained that this person plays an important role in transferring information. As she teaches media in several local schools, she learns about projects, initiatives from other schools. She displays this information in the library for teachers in the form of calls/posters, talk about them as she meets colleagues and transfers some information via emails.

The technology teacher (LT4) has that position in the network: through the collaboration among technology teachers within the school district, he is connected to a number of schools, while he also seems well connected within his school. However, the interview suggested that this collaboration is primarily disciplinary and so the person does not transfer for example, more general pedagogical knowledge or information. He may be described as a potential or "silent" broker without actually fulfilling that role. The data does not confirm that the school is aware of such potential. It might be beneficial for the school to uncover these silent brokers and benefit from the value they may bring as a result of their positions.

Overall, the data collected in Legrand Secondary School demonstrates the value of social interactions in facilitating knowledge dynamics. Before discussing the various ways in which social processes are linked to the dynamics of teachers' knowledge, let me present the case of another school.

9.2. Case study 2: "Piccoli Secondary School"

The context and characteristics of Piccoli Secondary School are similar to those of Legrand. It is a lower secondary school situated in a small rural town with around 4400 inhabitants. It counts around 460 students, slightly under 70 staff members of which over 30 teachers. At the moment of the data collection, its principal had been leading the school for over four years. Six interviews were conducted in the school with seven staff members and a group of students (Table 9.2).

Table 9.2. "Piccoli Secondary School" – data sample

	Interviewees	Sex	Interview type
PSL	School principal	M	Individual
PT1	Teacher: Media*	F	Group
PT2	Teacher: Physical education	M	
PT3	Teacher: History and Geography	F	Group
PT4	Teacher: History and Geography	M	
PT5	Teacher: Technology	M	Individual
PT6	Teacher: Mathematics	F	Individual
PS	Students	Mixed	Group
Documents / Materials shared	Set of videos in which teachers present various projects; Set of videos recorded by students participating in a media project.		

Note: * Media teachers: "Professeur documentaliste" or CDI in French.

The school's main pedagogical focus is on psychosocial competences, which the principal defines as the "framework of the school's tapestry" and the central organising element of the school's project. The communication materials present the various pedagogical projects and actions as threads in this tapestry. The documents and the interviews outline the following main projects:

- Cogniclass: An initiative to facilitate student memorisation based on findings from cognitive sciences. Teachers use a digital tool, called memory wheel, which consists of questions from various disciplines focusing on the most fundamental knowledge elements. Teachers start the lesson by turning the memory wheel and asking students questions, not necessarily from their own discipline. The aim is to help students retain this fundamental knowledge in the long term.
- Intellab: Intellab is one hour of class per week for six grade students. Based on findings from the learning sciences, activities during the Intellab "lesson" aim to improve students' metacognitive competences through helping them to acquire cognitive strategies. They are centred around four themes: improving memorisation through games and exercises, increasing attention through concentration and attention-related activities, improving comprehension through raising awareness of obstacles to understanding (in particular reading text) and increasing self-confidence through evaluating progress, awareness of success and improving oral expression.
- Creative spaces: Fablab, animated by the technology teacher, is a space where students access a number of tools (machines) that they can use to realise a project. Students work on their projects alone or with fellow students, with the support of the technology teacher. The space is conceived to allow for students – independently of their academic achievements – to engage in activities following their personal interest. Low-achievers can find a sense for working and learning in this space, which can change their own vision of themselves and of schooling, and can also enrich the teacher's vision of their personality and potential. Medialab, facilitated by the media and the physical education teacher, is a space where students can work on collective media projects. The school has a video journal realised by students, which gained particular importance during confinement due to the Covid-19 pandemic. Medialab is a shared learning space where students

have access to materials (computers, cameras, softwares) and receive support from the two teachers as well as from each other to realise their projects.

- Orchestra class: An orchestra class of 30 students from mixed grades was launched in 2019 to provide access to musical practice for students coming from rural and underprivileged areas. The class has a 1h30 timeframe per week allocated to practicing collective music. In addition to developing students' musical competences, this project also supports students in gaining self-confidence, provides them with a sense of belonging to a group, and promotes values such as sharing, mutual respect and solidarity.
- International relations and the development of psychosocial competences: The school participates in a number of international collaborations including the Erasmus+ programme, eTwinning and school partnerships. The school also started to implement the open badge project, which allows for acknowledging and certifying students' transversal competences.
- Mediation within the school: A group of mediators, including students and adults, operates under the leadership of the school's education counsellor. Mediators receive training provided by one of the school's partners to help resolve conflicts peacefully through dialogue.

The semi-structured interviews aimed at exploring each facet of knowledge dynamics (see questions in Annex D).

9.2.1. Knowledge dynamics in Piccoli Secondary School

Similarly to Legrand, teachers' knowledge dynamics in Piccoli Secondary School can be captured through their discourses related to the innovative projects, the challenges they face and their reflections on practice.

The school leader played a key role in generating knowledge dynamics. Reflections on practice stem from observations of problems:

> *"We said to ourselves 'OK, we have third grade students who are completely lost. It's been two, three years that they haven't been following. They are there because we have a very peaceful and calm school climate. So they are there, but like a plant at the back of a room. What is their plan for the future? They don't have any.' And so there is a group of teachers who have formed around me, around the school psychologist, and we took the lunch break. And so there we met with these colleagues and we said to ourselves 'What do we do with them?' We absolutely have to think differently. We have to change the software completely." (PSL)*

Teachers' interest in engaging in pedagogical projects is often triggered by practice-based challenges, sometimes mixed with knowledge mobilised through professional development.

> *"In our school, there are students who are very pleasant, who have good contact with their teachers, but who have difficulty being independent, working at home. So we also started from what we had learned from our*

> *training courses and their difficulties. And so we decided on two axes, the memorisation axis and the axis, [and] concentration, attention." (PT3)*

The interviews demonstrate that knowledge mobilisation – accessing external, formal knowledge in this case – is a key element of the pedagogical experimentation and thus knowledge construction. In Piccoli Secondary School, the school leader creates opportunities for professional development in line with teachers' interest, needs and his own vision. He believes that informal training, which is tailored to the specific needs and interest of teachers is more fertile than centralised training sessions provided by the Academy. These latter, in his views, do not result in transfer.

A number of examples demonstrate the variety of informal learning opportunities in the school. For example, when teachers in the school started to think about developing students' cognitive functions, the school leader invited a teacher trainer colleague from another school who had already implemented "cogniclass". Another example resulted from the sanitary situation in 2020. The covid-19 pandemic called for using digital technologies to ensure pedagogical continuity during confinement. In the period when schools were already reopened (beginning of the 2020-2021 school year), but the sanitary situation was still unstable, the school decided to prepare for a potential future confinement. The school leader organised a half-day training session on the use of digital technologies. In almost all these examples, he drew on his personal-professional network to invite trainers, with whom he agreed on the scope of training in advance in order to best align it to the actual needs. In addition, some teachers mentioned participating in MOOCs, in particular in cognitive science topics.

When asked about locally initiated professional development, the school leader contended that while he believes this is the future, it is not yet fully operational:

> *"I think it's the future. I'm going to be direct but I think there should only be more that. That is, we identify the needs in a school and then we set up training even by looking for the trainer. Because it's not because you are a specialist, or it's not because you know something that you will be a good trainer. Because it responds to a very specific problem. […] Despite everything, even if the FIL [locally initiated training] is very good, it does not yet have the flexibility to be able to answer when the question is asked." (PSL)*

When it comes to accessing more formal professional development opportunities, schools seem to face practical barriers, in particular obtaining funding. What happens in reality is that already existing projects serve as justification for professional development:

> *'We take a project, we consolidate it, we work around it in order to give it an identity, a consistency, possibly sustainability, and then eventually use it as a tool that will allow us to recover funding for professional development in terms of training. ' And you see, very slowly, getting bigger like that. Basically, to enter a virtuous circle.*

This description of the process demonstrates the non-linear nature of knowledge mobilisation and construction. They mutually trigger and influence each other. From teachers' point of view:

> *"Last year, I also took training in cognitive science. […] And in fact I realised, listening to the theory of cognitive science, that it was very close to things that I had experimented with in primary education, without necessarily putting words on it, without putting the theory. That is, it is a little bit drawing personal experience closer to much more structured theory. And it appealed to me to put it in place this year, especially on memorisation and attention." (PT4)*

This account shows that professional development can serve to make hitherto tacit knowledge explicit, which in turn is re-invested to further change practice, and possibly consolidate knowledge.

While the dominant form of knowledge mobilisation in Piccoli Secondary School is informal training sessions, interviewees mentioned some other forms as well. For example, accessing sources on the internet, shared through social media by other practitioners and youtube videos. One teacher mentioned a website for teachers (lea.fr), which is a toolkit for teachers. The validity of some of these sources is hard to verify and teachers do not seem to have a systematic way of evaluating their quality. The major form of validation seems to be trust and the scientific reputation of certain authors. For example, several teachers mentioned the work of Jean-Luc Berthier, a specialist in cognitive sciences and teacher trainer, and Jean Philippe Lachaud, a researcher in cognitive neuroscience. Some teachers clearly stated that they do not seek out theoretical sources by their own initiative. As for the school principal, while he did not explicitly spoke about how he himself mobilises theoretical knowledge for his leadership practice, the interview demonstrated his knowledge of research. For example, "I answered something that will be found in the literature on the issue of leadership" shows that he not only reads research but also translates it to his practice.

Several teachers also described various concerns related to knowledge mobilisation and construction. First, professional development does not necessarily imply knowledge mobilisation. For example, a teacher who participated in the training on psychosocial competences, said she did not really understand what these are. She perceived the training as a push coming from the school leader: "it's the principal who asked us to do these things" (PT6), adding that she understood that it was important. She expressed a gap between theory and practice, and claimed that it was hard to put this in practice. In addition, from her point of view, work around developing students' psychosocial competences in the school is essentially realised through a separate workshop for students. She did not clearly see the new knowledge translated into disciplinary practice. In the interview, she acknowledged that it may have impacted her practice without being aware of it. Due to the limits of teacher self-report (interviews), we cannot say whether this statement indicates the integration of knowledge in practice. Direct observations over time may allow for ascertaining that explicit knowledge indeed became tacit.

Second, teachers may perceive the relevance and quality of professional development differently. While most teachers only spoke about professional development under a positive angle, one teacher (again PT6) also underlined that some of these are useless and even infantilising. Relevance is related to the teacher's need and interest. For example, this teacher tended to speak highly of disciplinary

(mathematics) training sessions, whereas more negatively of general pedagogical ones. When it is not perceived as relevant and of quality, training cannot quite be considered as knowledge mobilisation, because teachers either do not feel they learned from them or cannot translate the knowledge in their practice. The link between experience and knowledge mobilisation is also expressed by the technology teacher who pointed out that in order that any resource resonates, one should have already been exposed to situations that have allowed them to understand what the resource says.

Third, teachers currently do not have access to all types of informal learning opportunities, in particular some that could potentially be strong drivers of knowledge construction. The technology teacher (PT5) described a working group type of informal learning that used to exist at the beginning of his career as a teacher. The working group was an informal support group that helped teachers analyse their practice systematically through a certain number of tools. A group was constituted for two years during which it was supported by someone whose role was rather coaching than training. The teacher underlined that the most important feature of such a support group is that it is based on trust and free expression. The group brings awareness to the factors that caused difficulties and develops its own solution. In his view, this kind of awareness, which requires taking distance from one's own practices and being able to analyse practice, does not exist today. Nevertheless, he made references to a certain procedure of practice analysis[27], which is the basis of such reflexive groups and for which online tools exist.

Another type of informal learning, which teachers do not or rarely engage in, is peer-observation and peer-reflection. The school principal explained that while several teachers solicited him to visit and observe their classes, they do not visit each other's lessons. It seems that despite interest in the analysis of practice – expressed by the technology teacher and by the school principal ("I have colleagues who told me 'it would be good if we had practice analysis'.") – the deprivatisation of teaching practice remains difficult. Interestingly, such peer-observation is more easily realised across school levels. On some occasions, visits are organised to the local primary school and primary teachers come and observe some lessons in Piccoli Secondary School. As the school principal put it: "it's a start".

Finally, an important gap in knowledge mobilisation seems to be the lack of training for trainers. The technology teachers (PT5) is also a teacher educator who gives disciplinary training to other technology teachers in the Academy. When asked whether any form of professional development was available for such teacher educators, the teacher explained that not only there was no such training, but even when he asked for it he was denied. With his own heated words:

> *"So meeting with the inspector at the end of the year. So, here I am talking about the meetings of trainers, [...] because ok, I am one of the trainers, [...] I have been validated etc. but this does not prevent me from being left alone with myself and my own values and my own feelings about the message I am going to bring etc. 'Is it not time, or would it not be desirable to have a group linked to… a group of trainers, training for trainers?' For*

[27] Groupes d'Entraînement à l'Analyse de Situations Éducatives (GEASE) : Educational Situational Analysis Training Groups https://www.analysedespratiques.com/gease-et-analyse-des-pratiques/

> *the regulation and precisely, to have the good word [...] of our hierarchical superiors and to be able to once again re-channel our approaches. Well there is none of that, the answer from my inspector was [...] 'Listen, Mr. X, if you are where you are today it is because we have full confidence in you.' Here we are, we always come back to the limits of the system. That is to say that today, we are tenured, well that's it, I'm good for my career, I will not be worried, I am a civil servant […] there are no more stakes. [...] Why is that that today, I want to evolve but behind no one pays me interest […]" (PT5)*

Again, we can ask whether and to what extent we can speak of knowledge construction in Piccoli Secondary School. Contrary to Legrand, in this school there is no conscious effort to validate new practices through measuring their impact. However, knowledge construction manifests in the school principal's intention to develop pedagogical coherence across different projects. Describing the work on psychosocial competences as a tapestry and defining it as the connecting element across the different actions, reflects a willingness to define a common knowledge base that underlies different practices:

> *"What I am trying to do is to knit the link between the different projects [...] You see, our PSC [psychosocial competences] project today, we presented it to the CARDIE, for example, last year at the National Innovation Day, as a framework. And I take this image here. […] for me, it is to allow the threads of the tapestry to pass over each other and to become entangled, each with its own colour. […] And when you step back, that's when the pattern appears."*
>
> *"The question of psycho-social competences is something that is close to my heart, but it came about gradually because we had to find the common denominator at some point. All the actions, OK. 'What do they have in common?' It was the question of open-mindedness, critical thinking, creativity. What we will call 21st century skills. But today, I bring them more and more into the 21st century skills. And this drives colleagues to exchange." (PSL)*

However, the interviews show that not the entire staff shares this vision yet. Some teachers speak about their projects but say they are not involved in the work on psychosocial competences, while others, who claim to be involved in this work, speak of this as a separate project, without any references or understanding of underlying links. Teachers do not perceive the existence of a common locally constructed knowledge base. Rather, they tend to see the development of their own knowledge and practice, and that of their immediate colleagues with whom they work on the same project. In sum, teachers perceive that knowledge construction happens at the level of this minimal community of practice, while the school leader sees it happening at the level of the school's community. The only teacher who spoke about the connections was the one involved in drafting the school's pedagogical project:

> *"I think that Mr. XXX [the principal] was also very attached to the PSC [psychosocial competences] in his choice of projects and in the orientations he gave. It's true that this is perhaps the common point which links all the big projects of the school. To be able to integrate all the students as much as possible. [...] We may not be aware*

> *of it, but when [...] we had to take part in the drafting of the school project, we saw that each time we came back to the PSC and that it was really the stakes for our school." (PT3)*

The variation in perceptions may reflect a phase in the process of social knowledge construction. However, knowledge construction can also freeze in this state and never fully ripen. Understanding the conditions that are necessary for the further development of knowledge construction would require studying the processes over time.

9.2.2. Social network of Piccoli Secondary School

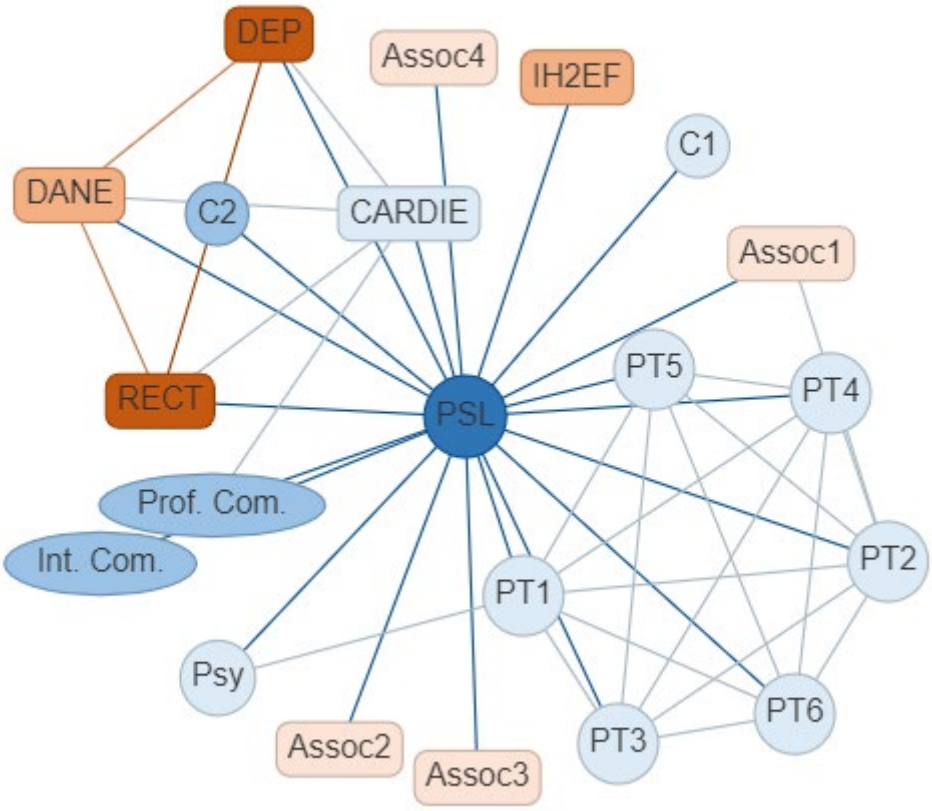
The main mechanisms of tie formation are similar to what I described for Legrand Secondary School. The principal summarised the reasons for professional tie formation perfectly:

> *"I would say that first of all, it's affinity. It's because I get on well with them. I think that must represent 70% of the elements of collaboration. Then it's the project approach. Are you in this project? Oh yeah, that's nice. Can I come and have a look? Or can I join it? That's the second point. The third point is a bit like the second one, I say, for example, 'I've got this project. Who wants to come?' Which means that people will come to this group even though they don't know each other. And when they meet in this context, they will find common grounds. On these occasions, I would often start with ice-breakers. […] and afterwards that leads to great professional friendships." (PSL)*

The same network roles emerge from these interviews, with a similar social pattern: the school principal playing a crucial role as a facilitator of social interactions as well as of knowledge dynamics. In fact, this network role defines his identity as a school leader: "I am not the boss, I am the manager, I am the facilitator". The school principal is also conscious of the various social roles teachers take on in the projects: "people who come either as spectators, actors or leaders" (PSL).

In the following, I briefly discuss the school principal's ego-network based on the interviews. This discussion aims to shed a different light on social networks (compared to the description of Legrand school), and present how the diversity (breadth) of an ego network determines both social and knowledge processes.

Figure 9.2. Illustration of the ego network of Piccoli's school principal



Note: Social network data was not collected specifically through the interviews or otherwise. Therefore, this figure is an illustration of ties: edges represent ties that were flagged in the interview with the school principal. However, there may be other ties, not mentioned in the interviews.
Legend:
PT: teachers of Piccoli Secondary School
Psy: school psychologist
C: colleague from outside the school, C2 is a teacher with a teacher educator role
Assoc: local associations: Sports, Arts, Health and Home for the Elderly
RECT: Rectorate of the Academy
DEP: County level authority
CARDIE: Centre of Research, Development and Innovation in Education of the Academy
DANE: Digital delegation of the Academy
IH2EF: Centre for school leader training
Prof. Com: Professional community including individuals and institutions: teachers and other educational professionals more broadly
Int. Com: International community of educational professionals and institutions

Figure 9.2 demonstrates the diversity of the ego network of Piccoli's school principal. It is visually clear that the principal has a diverse network with distinctively different types of connections. Orange nodes represent institutions or organisations, blue nodes individuals (teachers and other personnel) and the darker blue ellipses communities including both individuals and organisations. All ties refer to interactions related to knowledge dynamics.

Not counting Piccoli school staff (PT and Psy), the principal mentioned nine partners specifically. One type of partners consists of individuals, usually educational professionals such as teachers, teacher educators or school leaders of other schools. As explained in the section above, the school principal actively mobilises this personal-professional network to address teachers' and the school's professional development needs. The interview did not reveal how these ties were created, but they are clearly used purposefully in line with professional expertise in a particular domain. The principal himself mobilises knowledge most often in the digital space, where he accesses and exchanges resources with the wider community. This professional community extends to the international space: he mentioned connections to colleagues in Canada (Quebec), and visits to Denmark and Norway. Every mention of these social contacts refers to some form of knowledge process, primarily knowledge construction and mobilisation. For example:

> *"I went to Denmark last year. […] I went with two other colleagues. And on Twitter, we shared a lot of what we had seen. […] And there were colleagues who said 'Oh, that's nice and so on'. And one thing leading to another, we built this project together."*
>
> *"For example, last time I asked a colleague in Quebec to send me a document he had posted on the issue of digital leadership." (PSL)*

A second type of external partners are organisations in the local community. The principal mentioned collaboration with the local sports club, health association, artists and a home for the elderly. Although the type of collaboration was not detailed for each of these, some certainly strongly influence professional knowledge. For example, the local health association trained school staff (not only teachers, but also pedagogical assistant staff and animators) and provide continuing support to the school related to their work on psychosocial competences.

A third set of partners are educational authorities and institutions. Relationships with the regional and local authority are necessary to implement some of the pedagogical projects. For example, the local authority signs off on investments in furniture, and this is related to pedagogical innovation (creating innovative learning spaces). However, contrary to other partners, there is no transaction of knowledge here. Rather, these ties are primarily administrative. On the other hand, links to the CARDIE imply knowledge dynamics, in particular knowledge diffusion. The CARDIE plays a central role in facilitating the dissemination of locally constructed knowledge, for example, by inviting actors to present their work in events linked to research and innovation. The principal also exchanges with the CARDIE on this function explicitly, i.e. how sustainable locally constructed knowledge is and to what extent it is integrated in a broader knowledge base. The principal is also involved in training other principals as an associated expert of the Centre for School Leadership Training (IH2EF). This function allows his to disseminate his own knowledge and competences in leadership.

In sum, both the diversity and strength of the school principal's social ties are key for facilitating knowledge dynamics. The different types of ties imply slightly different dynamics: some are more focused

on knowledge mobilisation, others on construction and yet others on dissemination. I will now explore the mechanisms through which social processes enact dynamics in knowledge.

9.3. Discussion

In this section, I will explore social processes and analyse their roles in knowledge dynamics based on the two case studies presented above. I will also discuss the conditions under which social processes enact positive knowledge dynamics and investigate the different impacts of horizontal and vertical social relationships.

9.3.1. Social spaces, interactions and networks

Spaces for social interactions can be more or less formal. The dominant spaces and forms of social interaction between teachers are *informal* in both schools. Teachers talk in the school canteen during the lunch breaks, in the corridors or staff room before, in-between and after classes. The school library (Centre of Documentation and Information [CDI] in France) also seems to be an important space in schools, where teachers can meet and exchange informally. As Piccoli school's media teacher describes:

> *"The CDI is a place where there is a lot of traffic, a lot of people saying 'well, you and your students in the Medialab can do this, I want to do that. Couldn't you help us?"*
>
> *"I see a lot of colleagues coming to work here, setting up their sessions. And often it's 'What do I want to bring? How am I going to do it? And what is the tool that can help me to do it better?" (PT1)*

Teachers also communicate in writing, primarily through email and via "Pronote", the official online platform provided for schools[28]. They describe these interactions using words that reflect mutuality: exchange, sharing, concertation and discussion, and without exception, indicate these informal spaces as the primary forms of collective reflection. In terms of duration, these informal exchanges seem limited by their space (e.g. one teachers refers to "taking a quarter of an hour here and there") to shorter interactions, which may not be conducive to a more profound construction or consolidation of knowledge. Indeed, almost all interviewees in both schools stated that they lack time for more concertation. With the exception of one teacher (LT1) who contended that the school leader allocated time for concertation, all focused on the lack of dedicated time for longer exchanges.

While several *formal* spaces also appear in the interviews, these are usually mentioned with their limitations. First, teachers have a staff meeting every three-four weeks, called "*pedagogical council*". Legrand's school leader's (LSL1) perception of these meetings differ slightly from that of the teachers. She describes pedagogical councils as "the most relevant instances on pedagogical practice", which have

[28] An online platform called "Pronote" is used at the secondary level primarily to record students' marks. The functionalities also allow for assigning homework and for internal communication among teachers, communication with students and parents (more information: https://fr.wikipedia.org/wiki/Pronote).

pre-defined topics and to which teachers prepare in advance with their disciplinary teams. On the other hand, teachers see these meetings primarily as a space for administrative coordination, although with the theoretical possibility that it could be used for pedagogical knowledge sharing or reflection:

> *"So, our pedagogical council is more about sharing information on how we are going to operate. Not at the disciplinary level." (LT2)*
>
> *"We can request it [concertation, sharing]. I think this is indeed a very appropriate place to talk about this kind of practice, indeed. Having said that, there is often a very, very busy agenda. For example, given the year we have just passed, the pedagogical council, it was spent on constant readjustments of practices because of the health context for example." (LT1)*
>
> *"I was very surprised by this. Because when I heard about pedagogical councils, I thought they were talking about pedagogical projects, but in fact they are more like logistical councils or administrative organisation councils, things like that, but not very pedagogical." (PT4)*

In Legrand school, some meetings towards the end of the year are dedicated to prepare some of the projects for the next academic year. The interviews did not make it clear if this happens on one or several occasions, how many teachers participate and what the exact frame is. In some cases, such meetings are initiated by a teacher who leads a project and who recruits colleagues to participate.

Another formal space is the "general assembly" or "*administrative council*", which brings together not only the teaching staff, but the whole personnel of the school, including support staff, as well as representatives of parents and students. From the perspective of knowledge dynamics, this space serves primarily for formal dissemination: in Legrand school for example, the school leader presents the state of the art of all projects. Teachers rarely mentioned this meeting in the interviews as a space for dialogue. The only mention confirmed its role as a formal dissemination channel. The new deputy principal of Legrand school mentions another formal meeting ("Health and citizenship committee"), but overall her observation is in line with the above: teachers' exchanges related to the various projects are mostly informal.

Finally, *collective professional development* is an important social space for facilitating knowledge dynamics. Teachers describe different forms of professional development. First, there are formal, top-down courses offered by the regional authority (rectorate). The interviews confirm the exploratory data presented in Chapter 6: while school leaders and particularly inspectors can ask the rectorate for professional development on a certain topic, the bureaucratic procedure is very heavy and takes a long time. Some interviews (e.g. LT2, LT3) suggests that the local inspector plays a key role in making disciplinary professional development happen, however it is also contingent on the budget and the insector. Overall, these factors imply that in reality, such courses do not address immediate needs and do not function as vehicles for local knowledge construction. Teachers in Legrand gave one example for a formal professional development course that their school leader asked for in relation to the reform on "competence-based

evaluation". This course was an occasion that functioned as a social space for a number of teachers and served well as a form of collective knowledge mobilisation. In addition, teachers highlighted significant differences in access to such courses across disciplines. For example, a technology teacher explained that in his discipline there are no formal training sessions any more, however they organise "*district meetings*", which correspond to three days of training annually, and which bring together all technology teachers from the school district.

Interviewees described locally initiated professional development (FIL[29]) more positively, suggesting that such courses involve less administration and are better suited to address local needs in a more immediate fashion. However, they highlighted that these happen very rarely, only for more major experimentation projects such as the one on emotions in Legrand. In addition, they cannot yet flexibly address needs in a timely manner. Finally, peer-observation could be an informal professional learning space, if teachers jointly reflect on one another's practice. Some teachers acknowledge the high potential of peer-observation for knowledge construction, however, they do not or very rarely engage in this. Lack of time and conflicting timetables are among the primary reasons cited.

An increasingly more important space for social interactions is the *digital space*. Before the covid-19 pandemic, the digital space was primarily informal. The majority of interviewees cited various digital social network sites, facebook and twitter in particular, where they interact with or simply "follow" colleagues and fellow professionals. Social media platforms are not the only ones that allow for sharing and interaction in the digital space. More and more online tools have social functions. The principal of Piccoli school mentioned Canvas and Genially for instance, specifying that he uses both for collective knowledge sharing and construction.

> *"For example, since the period of confinement... I used to do that but now it has kind of snowballed. All the documents, the infographics, for example, all the graphic design work... And I use the Canvas software for that and I put it in open source, in editable form. And a lot of colleagues have said, 'Oh well, that's great, because now I just have to change the school's logo and put mine on. And then I save time. But it goes both ways. There are lots of documents that I do very quickly, because in fact a colleague simply says to me 'Well, I did that if you want. […] So, you see, this is really a collective construction. And there is a colleague who is working on a document presenting the time allocation of schools. We're going to present it in January or February. But we said to ourselves that we would like to try to do something nice, a bit dynamic. And we are working together on Genially. And there should be six or seven schools working on it." (PSL)*

As all meetings had to be digital in confinement during the pandemic, the digital space became a formal social space. This is manifest in the data as well, for example, in Legrand school, the principal transferred staff meetings to the digital space. These special circumstances facilitated social interactions to an extent: staff meetings in Legrand became more frequent, giving more space for collective reflection

[29] "Formation d'initiative locale", also described in Chapter 6.

and sharing. Although some teachers reported that these meetings served primarily organisational purposes and did not provide much space to more profound reflections, knowledge sharing and construction.

We can also distinguish social processes in terms of their scope, i.e. ***the breadth of the social network*** they cover. While within school collaboration among teachers and with school leader cover the majority of social processes mentioned in the interviews, some interactions go beyond these social groups. First, boundary-crossing social interactions occur *across professions within the school*. There are interactions between the school leader(s) and teachers of course. More importantly, some teachers in Legrand Secondary School, also collaborate with teaching assistants and supervisors in the framework of the Emoti' Class project. Similarly, in Piccoli, some projects involve for example, the school psychologist.

Second, teachers interact *with students and parents*. Although interactions with students is teachers' daily work, it is important to note that these are the basis for teachers' knowledge dynamics. It is through these interactions that they evaluate student learning and identify difficulties and needs. In addition, when a group of teachers conduct longer-term projects with students, it is sometimes the final product of students' work that brings teachers together and creates the opportunity for exchange:

> *"… sharing is often done at the time of production. In fact, the others know that there are projects but we will learn about the project and what was done etc. at the time of production because often it is done in the school, in a public way, sometimes parents come too. […] And it is at this moment that in fact, we really get to know the teaching practices or what has been done." (*

Interaction with parents is also fundamental. In the initial stages of an innovative project, parents are most often viewed as a barrier to knowledge construction, because they oppose to change. Teachers in Legrand Secondary School invest time in communicating with parents, in particular in the framework of major experimentation projects. For example, the leader of the positive evaluation project regularly interacts with parents to explain the goal and process of experimentation, and collect their perceptions of change and feedback at different points in time.

Third, boundary-crossing can occur across the physical boundaries of schools, while still remaining in the same social group, when teachers interact *with teachers from other schools*. This is a less frequent form of social interaction: in several interviews, it only came up following explicit questions. The main forms of boundary-crossing that were cited are:

- In the framework of larger projects for students and teachers usually organised by the region in a top-down manner (e.g. on climate change). Again, student learning and final products acted as intermediaries for bringing teachers of different schools together.
- Through personnel sharing: in rural areas certain subject teachers (e.g. media) are shared across several schools, which gives them the opportunity to meet teachers and staff from other schools.

- In the case of disciplines with low weekly class hours (e.g. technology, media, biology), there is only one subject teacher in a school. Subject teachers in the local district organise regular meetings to exchange on discipline-specific practices and co-construct knowledge. This is not systematic however. While the technology teacher community in the district seems strong, a biology teacher in Legrand School highlighted that in her previous school situated in an even more rural area, geographical distance and lack of infrastructure were major barriers to create such a social space.
- Through visits across school levels: teachers from Piccoli school and from a local primary school, mutually visited each other's schools and assisted to lessons. Such visits do not seem to be systematic however.

Finally, boundaries can be crossed *both physically and across professions*. Teachers in Legrand school work with researchers from the local university on some of the experimentation projects. Both schools work with the CARDIE and the regional authority. Piccoli school partners with a number of local associations as well. Larger regional student projects (mentioned above) also provide opportunities to work with partners from the local community.

The digital space allows for substantial boundary-crossing extending to geographically more distant regions both within and outside France, to other countries across the globe. However, this global scope was present in one interview only: the principal of Piccoli school reported that he regularly interacts with colleagues across the country and beyond.

9.3.2. Social processes as drivers of knowledge dynamics

The role of social processes in facilitating knowledge dynamics was made explicit in most interviews. As one teacher explained the purpose of working together: "to be able to bring our own brick to the wall" (LT2). The colour coding used to analyse the transcripts showed visually very clearly that social processes are inseparable from knowledge dynamics. In all interviews orange was used to highlight text that referred to interactions between teachers, social platforms such as meetings, collective professional development, face-to-face or online discussions and partnership building. The orange colour often had to be used in conjunction with the colours used to mark knowledge processes or in close alternation (e.g. a word / phrase in yellow, then a word / phrase in orange). A number of elements emerge in terms of how social processes make an impact on the dynamics of teachers' knowledge.

First, social interactions can drive *structural dynamics*. The theoretical framework distinguishes dynamics between types of knowledge such as tacit and explicit or theoretical and practice-based knowledge. As explained in Chapter 4, this aspect could not be studied in the quantitative component of this thesis, and the nature of qualitative data is not the most favourable either, as it lacks direct observation. However, some evidence did emerge from the interviews that suggest that social processes facilitate structural dynamics. In particular, a teacher described that working together with colleagues helps put words on phenomena that had not been explicit before:

> *"And the fact that we can update these vocabulary terms a little. […] There are codes. There are even vocabulary, terms that I never used or things that I never presented to students. (LT2)*

Second, social processes facilitate various forms and stages of *knowledge construction*. This is the most impacted type of knowledge dynamics based on interview coding. Teachers describe the benefits of interacting, sharing and exchanging with colleagues in a number of ways. Through discussions with colleagues, they enrich one another's practice and thinking, they share difficulties, provide feedback and guidance to each other. Social interactions also help building a shared language and understanding, as well as harmonise practices. The following few citations manifest this impact:

> *"[in inter-disciplinary projects]…we are obliged to communicate between us, teachers. To know how one approached such or such concept. Even if it is a common theme, we do not necessarily approach in the same way depending on the disciplines. And the fact that we can update these vocabulary terms or the methodology a little, can improve the coherence of the theme we work on." (LT2)*
>
> *"…this year, I'm lucky to be able to work with several adults, so we can readjust each other, get feedback on our practice in order to improve things. And it is very important because all alone we progress less quickly." (LT1)*
>
> *"And then at the start of the school year, I sent information that summarised the decisions that had been taken collectively by the way, which were re-adjusted collectively so that everyone was aware of what we meant by positive evaluation." (LT1)*
>
> *"I find that in the exchanges, there was a richness of point of view. There was a vocabulary. Because each of the projects allowed us to bring to each other vocabularies, perhaps sometimes in a rather reduced field. And this vocabulary, applied to notions, to other notions, is very fertile." (PSL)*

Both school leaders explicitly highlight the importance of social processes in the dynamics of knowledge and teaching practices. The former school principal of Legrand School describes an instance, where she purposefully got someone out of professional isolation and brought in the collective social space:

> *"There is a colleague […] who has been there for years and who is very self-effacing and who never felt authorised […] to intervene in the collective and make her contributions. She's an arts teacher. She has low self-confidence, in fact. […] I exchanged a lot with her so that she could propose other projects which would serve the collective and which, in the end, would feed all the other actions for the students. But with her own competences. So, for example, we created living exhibition spaces in the school which allowed students to discover different arts, obviously. For the teachers too, by the same token. To enhance the value of her discipline, and to participate in the animation of this school, through the confrontation with beauty. And as a result, she became responsible for temporary exhibition spaces where she brought in artists, etc. […] she was able, by this means, to take part in new actions which helped build this collective. And finally, this lady ended*

> *up taking part in projects, for example […] on the question of emotions because at a given moment, it awakened something in her or brought something back." (LSL1)*

Similarly, the school principal of Piccoli School pointed to the risk of isolation, explaining that a teacher who tends to work alone also tends to be pedagogically "locked-up". When such a teacher joined a collective project, the school principal was able to observe a real change in their thinking. Both of these instances show that interactions with the school principal as a first step and gradually more with colleagues facilitate reflection, bring about change in practice, and in turn can lead to more dynamics in pedagogical knowledge.

Third, social interactions can also positively influence *knowledge mobilisation*. In Piccoli Secondary School, the school principal regularly mobilises his social network to provide need-based informal training to his teachers. He reaches out to his contacts and invites them as trainers, thus generating knowledge mobilisation opportunities for his staff. This can be regarded as indirect influence of social interactions on knowledge mobilisation. Collective professional development, either the formal top-down courses offered by the regional authority or locally initiated professional development, can create opportunities for social interaction in a setting where the primary objective is knowledge mobilisation. Such direct impact was less clear from the interviews. The majority of references to training courses did not specify the extent to which these provide space for extensive social interactions *in situ*. One exception is the technology teacher's (LT4) district meetings, in which participants have extensive social interactions reinforcing knowledge mobilisation. Some teachers also mentioned that informal social processes allow them to learn new knowledge, including disciplinary content and general pedagogical knowledge.

9.3.3. Conditions for impact and barriers: attitudes, dispositions, relational context and leadership

Despite the generally positive impact of social dynamics on the dynamics of knowledge emerging from the data, this impact does not go by itself. Indeed, the interviews present a number of conditions that are necessary for social dynamics to exert a positive impact. We must first note that not all forms of interactions drive knowledge dynamics to the same extent. Educational research pointed to the importance of distinguishing types of collegiality and collaboration already in the 90s (Little Warren, 1990[404]). Little (1990[404]) conceptualised the continuum of teacher-to-teacher social relations with increasing demands for collective (as opposed to individual) autonomy and teacher initiative. On one end of the continuum, teachers are completely independent and do not influence each other, on the other end, they are interdependent. Types of exchanges and interactions between teachers can have varying influence on their knowledge and practice. For example, only short interactions with limited scope such as anecdotal story telling about the classroom or students do not foster reflections and bring about change (Little Warren, 1990[404]). Conditions for impact on knowledge dynamics can be identified at the following levels in the data: at the level of the individual teacher, at the relational level, at the organisational level and finally, at the level of the broader network and policy context.

First, the interviews highlighted that ***individual attitudes and dispositions*** are important for forming the types of ties that are conducive for knowledge dynamics. A number of teachers in both schools expressed willingness and interest in working together, a desire to exchange and learn from one another. Many also stressed the importance of accepting to be vulnerable. In order to be open for feedback, curious to learn new knowledge and be able to construct new knowledge and practices collectively, teachers must be able to expose themselves to one another:

> *"The reality is that when we confront each other after the… 'yeah, well, what are they going to think? If I say that I'm doing this thing in my class and so on.' When you go through this phase. Afterwards, it's very stimulating. We're going to learn a lot of things with our colleagues and we're going to confront our ideas. We'll evolve. We move forward." (PT2)*

Accepting one's own vulnerability is a key element of a trustful relationship. However, data suggests that for many teachers, deprivatising and exposing their practice to the collective is difficult. In addition, several interviews suggested that some teachers demonstrate a certain degree of inertia with regards to their habits. One interview (LT1) also raised the issue that many parents resist to experimentation, innovation and change, which can make teachers' work more difficult and implies additional efforts from them to bring all actors on board. In sum, resistance to change from any actors can impede or slow down the dynamics of knowledge.

Second, at the relational level, the ***quality of social ties*** matter for the nature of interaction that takes place between teachers. Some teachers emphasised mutual respect as a basis for collective construction:

> *"And what the teachers say at [Legrand] is that, even if the personalities are different, the experiences and the levels of practice too, there is a will and a possibility to work with one another. That is, there is a great respect for the words and practices of each person and a great desire to exchange and work and build together despite our differences. […] People finally accept to expose themselves and put themselves in danger in front of others." (LSL1)*

Collegiality and horizontality also seem to be key conditions for moving towards teacher interdependence or collective autonomy (Little Warren, 1990[404]). As the Spanish teacher in Legrand expressed with regards to work on emotions:

> *"So the school nurse, the educational advisor and I, the form teacher, and sometimes the monitor, really work together. There is no hierarchical relationship. We are really in a horizontal relationship. We can suggest things to each other. […] I think that there is also an understanding between us. There are human affinities and there is co-construction on this aspect, on the aspect 'How will the group deal with emotions today? How do you see things, etc.' There, I feel I am in a team spirit and collaboration." (LT1)*

The same teacher made it clear that individual dispositions and trusting relationships are in fact necessary conditions for teachers to move beyond their comfort zone. She contrasted her previous experience when she had the status of a substitute teacher and never spent longer time in the same school to the current one:

> *"… I hadn't really gone all the way with anything. And now I've settled in this school. This is my fifth year. So I've had more comfort, more time to reflect. I know my colleagues better. I have a slightly larger comfort zone and I said to myself, 'Well, this is the time to roll out, to try something and to go all the way with what you want to do because you are in conditions where it is possible to consult each other.'" (Lt1)*

Third, at the ***level of the organisation***, *leadership practice* emerged as a determining condition. In both schools, teacher interviews clearly referred to the person of the school principal and did not include any other leaders such as deputy principals or informal middle leadership. Several teachers spoke about the *individual characteristics of the principal* that included attitudes and dispositions such as trust in teachers and "human dimension", as well as knowledge and competences such as ideas about pedagogical practice, "will to advance the school". Some also described specific practices, such as co-ordination of actions, continuous support and putting in place processes that allow for formalising new practices. Interviews with the school principals themselves reflect both the individual attitudes and some of the practices described by teachers. In addition, these interviews demonstrate the principal's knowledge of leadership research in both schools and its deliberate and systematic application in their practice.

Both interviews show the vision of the school principals of creating a professional learning culture in the school and capture the process through which they carried this out. Legrand's school principal (LSL1) assessed the context upon her arrival to the school and made deliberate action. She observed the social dynamics and recognised that there were opposing groups of teachers, some who opposed to certain pedagogical approaches and some who were experimenting with innovative methods but were isolated in their initiative. She then started to work on social processes, for example, by constructing social spaces for everyone and involving isolated teachers in collective work (as cited above). In parallel, she also observed teachers' expertise and competences, and identified strengths and gaps. She started to strengthen knowledge processes by creating appropriate professional development opportunities, making links to external partners and putting in place experimentation projects.

While the pedagogical focus differs somewhat, leadership practice and processes are similar in Piccoli school. An additional element of this principal is an explicit will to nurture distributed leadership (Woods and Roberts, 2015[438]). The principal mentioned several times the term leader in relation to teachers, described his own role as facilitator and expressed the importance of teachers being able to do things by themselves, without his presence.

A key question relates to the stability of such a learning culture. In Legrand the principal interviewed had just left the school to take up a new role. Teachers unanimously agreed that this change

would not affect their work on the various projects. As school principals in France are encouraged to change schools every 4-5 years, the principal in Piccoli school deliberately prepares continuity:

> *"So, we will also have to prepare the arrival of someone else as head of school. That's also a factor. And so, I always say that they have to think about it, they have to know from A to Z the technical and pedagogical system, the partnerships, the financial stakes so that the projects can last. Because if it only goes through the head, we just have to remove the head, put in another one and everything is lost." (PSL)*

Despite the attitudes, knowledge and competences of school leaders to facilitate social dynamics and through that, knowledge dynamics, some organisational factors constitute barriers to these dynamics. In both schools, knowledge processes take place primarily in informal spaces and interactions. Formal platforms (e.g. pedagogical council meetings) mostly focus on administrative matters responding to national and regional demands, and coordination at the school level. Research has found that such informal spaces and interactions help develop more enduring relationships that allow for the transfer of tacit knowledge and complex information (Finnigan and Daly, 2012[439]). However, informal interactions reported in the interviews are usually short and do not allow for deeper reflection and sharing apart from a few sporadic instances. In the absence of substantive, structured exchanges among teachers, knowledge dynamics will be limited (see section below). In addition, the various social and knowledge processes need coordination. While instances of coordination were found in both schools (e.g. end of year staff meeting in Legrand where projects for the next year can be presented, weekly newsletter by Piccoli's principal), again, formal spaces were not strategically used for coordination.

Finally, at the ***level of the broader network***, we can observe the same conditions as at the lower levels. The school principals as *individuals* are open to change, they access and apply research both on pedagogical and leadership-related knowledge, and have a desire to work together with their colleagues (e.g. other heads of schools) and other partners. Both school principals underscored the importance of good, trusting relationships and invest effort in developing strong social ties that allow for sharing difficulties and exchange ideas freely. The case studies also demonstrated that boundary-crossing relationships foster knowledge mobilisation: the schools' relationships with local research centres and the CARDIE help creating needs-based professional development opportunities and foster knowledge construction with the help of researchers. Ties to other schools and different community partners also provide opportunities to widen teachers' and school leaders' horizon and knowledge.

Overall, the above findings are in line with research on teacher collaboration and professional learning communities. The conditions that have been identified in the data are reflected in a systematic review that mapped personal, group and organisational characteristics that facilitate and hinder collaboration, innovation and professional learning among teachers (Vangrieken et al., 2015[318]). However, it is worth noting that I describe relational level conditions rather than team characteristics. In fact, these two are not easily separable in my data, presumably because there was no data collected purposefully at the team level. Focus groups with project teams or specific questions on team characteristics may have allowed a better separation. Because team dynamics was not the main focus of my research and the

conditions due to the pandemic limited data collection, such a separation remains to be explored in future research.

9.3.4. Social processes beyond the school: the broader network and policy context

Social dynamics can be examined at increasingly broader social levels in line with the framework presented in Chapter 8. The first level relates to social processes within the school (internal perspective). The second to social relations between the school and its partners including other schools, and actors from the local and broader community with whom the school has horizontal relationships (external horizontal perspective). The third is concerned with social relations that are in some sense imposed on the school by the local, regional or national policy context (external, vertical perspective). In the sections above, I presented drivers and barriers to internal social dynamics. In this section, I will discuss these in relation to horizontal and vertical external social ties.

Concerning the **horizontal external perspective**, the data puts in evidence intensive social dynamics in the broader environment of both schools. The same conditions are relevant for these external relationships to exert positive impact on knowledge dynamics. Both teachers and school principals emphasise trust-based relational ties, collegiality and horizontality. However, they also point out that these are not always met. Legrand's school principal contended that competition between school heads is a major barrier to sharing knowledge. Showing vulnerability by exposing one's difficulties is a basis for knowledge construction at the leadership level as well. School leaders' career progression in France puts them in a situation, which is detrimental to such level of trust (Figure 9.3):

> *"… there are always, between certain people, power games, games of positions which mean that jealousy can occur in relation to promotions or to what people might think about promotion." (LSL1)*

Both school leaders base those collaborations with other schools that go beyond simple co-ordination on strong social ties, i.e. choose their partners whom they trust.

Figure 9.3. School leaders' career progression: hermit crabs looking for bigger shells

The image represents hermit crabbs stacked on each other in increasing size of shells. They are looking to swap their shell for one size bigger.

Note: School heads' career progression in France manifests in leading increasingly larger schools. In the pursuit of progression, they aspire for "bigger shells" like hermit crabs as they grow.
Source: Thehansindia.com (https://www.thehansindia.com/posts/index/Education-and-Careers/2015-08-10/Are-you-in-vacancy-chain-or-looking-for-new-shell-like-hermit-crab-Career-growth-message-for-corporate-employees/169106).

It is worth underlining that some of the hierarchical relationships also play a positive role in certain aspects of knowledge dynamics. In particular, the CARDIE, which is situated within the regional rectorate, helps both schools disseminate their local initiatives more broadly in the region. The CARDIE organises activities (e.g. Innovation Day) and facilitate platforms where innovations are shared. They explore promising initiatives, projects across the region and solicit school leaders to share these. Thus, when horizontality is associated with competition, such vertical relationships are a work-around for knowledge diffusion. Despite the efforts of the CARDIE, most local actions remain local and do not have sustainable impact on teachers according to Piccoli's principal:

> *"I was talking about it with X [CARDIE coordinator] because we've known each other for a while now and I was saying to him… 'How many actions have you been able to follow that exist today?' It's like a field of flowers. It blooms and then it dies but it doesn't stay. It's not to be pessimistic, it's to be realistic. This leads to changes in staff attitudes, to an increase in competences, but at the same time, this increase in competences or this professional development is very, very subject to the future head. In which school will they go? It will be another head, who is completely different. And that's the paradox. It's very centralised but from one school to another, there are school cultures that have nothing to do with one another." (PLS)*

The ***external vertical perspective*** of social dynamics explores the impact of initiatives, policy interventions that are imposed on schools in a top-down manner. In the case of the Academy of Bel-Mondo, the EDUNET networks aim to foster relationships between schools (see Chapter 6 and Chapter 8). Overall, the initial findings from the exploratory study with regard to EDUNET were confirmed in the case studies. Perceptions of the impact of EDUNET vary to a great extent. Both school leaders in Legrand contended that EDUNET created new relationships (in particular across school levels), and this can be particularly important in a rural context. However, the former school principal stressed that real knowledge sharing happens in parallel to formal network meetings with only a limited number of colleagues with whom the quality of ties allows for deeper collaboration. The size of the network seems more suited for co-ordination than for actual knowledge construction. Legrand's school leader expressed that with such a high number of members, naturally not everyone is equally invested and real construction takes place in smaller groups (LSL1).

The top-down nature of the EDUNET network has both advantages and disadvantages. On the plus side, the imposed themes can generate reflection on local challenges and practices (LSL1, LSL2), can facilitate the harmonisation of some good practices (LSL2) and can provide a common logic or frame, which facilitates territorial coherence (LT3). While these are examples of positive impact on knowledge dynamics, none of the interviews demonstrate deeper collective knowledge construction that can be traced back to the EDUNET network. On the minus side, the hierarchical and top-down nature of the EDUNET network (which reflects the nature of the French education system) implies that the intentions and sense-making does not reach the level of the teachers, or at least not uniformly. Some teachers feel that what happens in EDUNET does not concern them, the objectives are unclear and there is no shared language (e.g. PT6, LT5). The fact that the district inspector is a member of the coordinating committee

seems to impede free sharing of knowledge because they are hierarchical superiors to primary school directors. In addition, school leaders also perceive the network as a form of accountability due to its imposed and top-down nature, and thus feel less prone to opening up and exposing their difficulties (LSL1).

Lack of resources also hinder EDUNET's impact on knowledge processes. In particular, lack of dedicated time is a barrier. As already noted in the exploratory study, primary school directors are not easily substituted and cannot necessarily attend meetings (PSL). Lack of dedicated time for teachers to engage in within-school projects is already a problem, let alone getting involved in cross-school initiatives (e.g. PSL, PT6). Real knowledge construction within a network requires a long-term investment (e.g. LT2) and the timeframe of network mandate is not necessarily compatible with that. The regular change of rectors and of school leaders who take on leadership roles in the EDUNET network was again mentioned as a barrier to stability and long-term planning (LT2, LT5).

Overall, perceptions of the EDUNET networks are mixed among teachers with fewer teachers expressing positive feelings than those articulating scepticism. Even school leaders who are more directly involved in the network and who acknowledge its potential for knowledge and innovation, formulated doubts about its value. For example, Piccoli's school head claimed that he could do without EDUNET, i.e. did not need it for what he has achieved and does not see its value for what he would like to achieve (PSL). The strongest added-value based on the data seems to be exchange around student pathways, which is the main objective of the first iteration of EDUNET. Another element in which some actors see potential is the co-ordination of local professional development. However, data suggests that the various social devices have not yet achieved their full potential in terms of facilitating knowledge dynamics among practitioners.

The distinction of horizontal and vertical external perspectives is useful to understand what the different types of social relationships can bring to the dynamics of knowledge. I have shown that both vertical and horizontal links can be important for knowledge mobilisation. Professional development provided or organised by regional-level bodies, such as the CARDIE or a local university (vertical link) can bring in new knowledge not necessarily perceived as an explicit need by teachers but sometimes able to respond to practical challenges and help codify tacit knowledge. At the same time, locally initiated professional development is much appreciated by teachers and school leaders alike, who perceive that these address their direct needs, contrary to central PDs. Knowledge construction seems to require a high level of trust and is therefore primarily generated by strong horizontal relationships, which are free from hierarchy and competition. However, vertical links can be important for knowledge dissemination (diffusion), particularly when competition at the local level is a barrier to sharing knowledge. Vertical links also have the potential of facilitating the integration of locally constructed knowledge in a more global knowledge base.

9.3.5. Limits of knowledge dynamics

While social processes have the potential for fostering knowledge dynamics, there are also a number of barriers to social knowledge construction and some significant limits to knowledge dynamics in both schools, as well as in the broader community.

Even though this research did not explicitly explore the ***structural dynamics*** of teachers' knowledge (see details in Chapter 4), some information emerges from the data related to this aspect. The few mentions of gaining new vocabulary (cited above) that enabled some teachers to put words on their practices imply a certain degree of codification. This mainly occurred as a result of professional development. However, teachers did not seem to have a shared vocabulary to describe the new knowledge constructed through the various innovative and experimentation projects. Even when questions directly asked about this, they tended to describe classroom practices rather than a more abstract, codified knowledge. This suggests a lack of dynamics between tacit and explicit knowledge or – somewhat related to this – between practice-based and more formal research knowledge. In reality, without structural dynamics, we cannot fully speak of knowledge construction, only perhaps practice design. In addition, it is more difficult to transfer knowledge that is not codified (see Chapter 2) as it usually requires direct observation. Therefore, a lack of structural dynamics also impedes knowledge diffusion.

In both schools, there was a clear effort, particularly from the part of the school principal, to foster teachers' ***knowledge mobilisation*** through opportunities for professional development. In line with what the exploratory data suggested (see Chapter 6), training opportunities offered by the regional authority (Academy) are not always perceived as relevant. Both school leaders highlighted that these are not flexible enough to address local needs in a timely manner. Not even locally initiated professional development, which is specially designed for this purpose. Instead, school principals prefer drawing on their own personal-professional network to offer needs-based training opportunities. Knowledge mobilisation literature describes push and pull mechanisms in practitioners' use of research (Langer, Tripney and Gough, 2016[440]). The rationale for push mechanisms is to make sure that there is an appropriate in-flow of knowledge emerging from research in order to keep teachers' knowledge updated. However, when this is disconnected from practitioners' perceived needs, as demonstrated in the interview with the mathematics teacher in Piccoli (PT6), transfer will be more challenging. Teachers will be less likely to be able to connect that research knowledge to their practical knowledge, and structural dynamics may not occur. Pull mechanisms on the other hand, are more likely to effectively link practice and theory and thus lead to uptake and change in practice. Such pull mechanisms occur when teachers themselves take the initiative to seek out and read sources based on their interest and needs. However, the interviews suggest that this happens rarely. Another form is professional development that is tailored to the actual context, as described, for example, by Piccoli's school principal. The case studies suggest that in these schools, push and pull mechanisms co-exist, however they cannot yet be strategically used to reinforce each other.

In both case studies, **knowledge construction** is captured through innovation and experimentation with new practices. While there is a real effort to indeed bring these projects to the level

of knowledge construction, this mostly manifests in the vision of the school principal in both schools. Teachers' accounts are less convincing with regard to the extent to which coherent local knowledge is actually constructed. Sometimes these projects are separate from daily teaching practice (e.g. medialab, intellab, etc.). Often it is one committed teacher who invests real effort, while the others do not quite follow in terms of knowledge and expertise. One example in Legrand school is that of the positive evaluation project, which, according to the project leader, is not even well understood across the teachers who are involved, let alone the full teaching staff. In her own words:

> *"There has not been an in-depth reflection on positive evaluation, but perhaps a form of initiation on the part of all teachers. That said, when we got out of confinement, I noticed some reflections. I found it very good that people express themselves, but that sometimes showed a form of incomprehension." (LT1)*

Overall, it is rare that these projects extend to a more profound and regular re-evaluation of practice. While this may be a certain stage of development of the projects, it may also be due to the lack of time allocated for longer and deeper exchanges. Indeed, the most frequent complaint of all teachers related to the lack of dedicated time for such profound exchanges. As mentioned above, education literature underlines the necessity for space, time and culture of systematic reflection so that collaboration around innovative ideas can ripen into structured construction of knowledge, which in turn, leads to sustained improvement of teaching practices (Little Warren, 1990[404]; Vangrieken et al., 2015[318]; Martínez Orbegozo, 2020[441]).

The fourth aspect of functional dynamics laid out in the conceptual framework in Chapter 4 is ***integrating local knowledge in the global knowledge base***. Findings from education research suggest that this is often the missing piece in the puzzle (Enthoven and de Bruijn, 2010[193]). My research is in line with these findings. A necessary condition for knowledge integration would be the codification of locally constructed knowledge, so that it can be widely disseminated. As I explained above, this condition is not quite met. What can be disseminated at this stage is the description of practices, i.e. the ways in which the different projects are implemented. Although Legrand's experimentations have the potential for going beyond practice descriptions and constructing knowledge, this stage has not yet been reached. In addition, the competitive context can be a barrier for natural knowledge diffusion. Data suggests that central (regional) devices such as the CARDIE can help overcome this barrier.

9.4. Conclusion

In this chapter, I presented the findings from qualitative data. Overall, findings with respect to the links between social processes and knowledge dynamics from the two case studies seem to converge. The first hypothesis relating to this question (2.1: Network and organisational culture are important factors in facilitating social processes) was strongly confirmed. Qualitative data showed in particular that school leadership plays a very important role in facilitating teachers' collaboration. This is in line with leadership research (Leithwood et al., 2006[424]; Vangrieken et al., 2015[318]). A competitive context in a network can

hinder knowledge sharing and thus be a barrier to most aspects of knowledge dynamics. In addition, a bureaucratic network context can also hinder forms of knowledge mobilisation that are directly linked to local needs. High levels of administrative processes and long time, strongly impedes the potential of social devices such as "locally initiated professional development".

Data also revealed insights into the second hypothesis (2.2: Social structures and the nature of social ties in a network influence the dynamics of knowledge). The case studies demonstrated that the school principal's social ties facilitate knowledge mobilisation (e.g. organising collective learning opportunities capitalising on social relationships) and construction. Both high quality ties with teachers and boundary-crossing relationships with external partners are important for providing opportunities to widen teachers' and school leaders' horizon and knowledge. The school principal's vertical social ties with the regional authority and central institutions (e.g. CARDIE) are also fundamental for knowledge diffusion. In addition, teachers' social interactions contribute to building a shared language and understanding, facilitate knowledge sharing and exchange. They also enrich teachers' reflection and practice, however, high quality social ties (e.g. mutual respect and trust) are necessary for collective construction.

Finally, the case studied refined the understandings with regard to the third hypothesis (2.3: Social processes and devices and actors' engagement with these influence the dynamics of knowledge). Informal social interactions dominate among teachers, allowing them to learn new knowledge and share. These have been increasingly more complemented with interactions in the digital space (partly as a result of the pandemic), which have the potential to facilitate knowledge sharing. However, these interactions often remain superficial due to a lack of extended and dedicated time. Formal social spaces focus primarily on administrative matters and provide little space for knowledge construction and diffusion. Some social processes, such as peer-observation and needs-based local professional development are not widely used. A key social device is collective learning, which can drive knowledge construction, particularly when it is needs-based and local. It can also function as a social space for teachers to exchange and be a form of collective knowledge mobilisation. Central network (supra-network) devices are key for the diffusion of knowledge, particularly in a competitive context. However, qualitative data suggests that EDUNET network devices in their current form do not play a key role in collective knowledge construction.

Overall, social dynamics have complex relationships with knowledge dynamics, and there are still several limits and barriers to knowledge dynamics. In the last chapter I will bring quantitative and qualitative findings together, and examine the extent to which they align.

Chapter 10. Discussion: teachers' knowledge dynamics in networks

In this last chapter, I bring together the results from all the different sources of data: theoretical and desk-based research, quantitative and qualitative. In the first two sections, I will discuss the two research questions and their corresponding hypotheses in view of the different data sources. In addition, this discussion will allow for reflecting on the conceptual framework of this thesis: understanding and measuring the role of social processes in teachers' knowledge dynamics. I will also consider the validity of the quantitative instrument and suggest directions for improvement. In the third section, I will broaden the horizon and interpret the conceptual and empirical relationships of social and knowledge processes, and propose a framework for understanding these. I will also reflect on the implications of my research for "networked leadership" – a term I will develop in view of my research. Finally, I will highlight some important limitations of my research and suggest directions for future research.

10.1. Research question 1: How can we characterise teachers' knowledge dynamics?

The first research question essentially operationalises the conceptual framework of the study, which aimed at understanding and describing teachers' knowledge dynamics in their complexity. Therefore discussing findings related to this question involves reflecting on the conceptual framework and on the instrument.

The conceptual framework of this thesis defined four components of knowledge dynamics: mobilisation, construction, diffusion and integration. It considered these in a systems view in which these processes are mutually interdependent, co-exist and interact in non-linear ways as teachers engage in social processes. Based on an initial conceptualisation of each component, I set out to design an instrument capable of answering these. The development drew on a rich field of educational research, a number of existing instruments and the exploratory study, which revealed important elements of the context of the empirical study. Overall, the instrument gave rich insights into the questions around how we can characterise the dynamics of teachers' knowledge (Box 10.1). In order to better understand the ways in which these processes play out, and to gain insight into the relationships between them, I also collected qualitative data through the exploratory study and two case studies.

Box 10.1. Characterising knowledge dynamics: Recapitulation of sub-questions

Knowledge mobilisation [quantitative and qualitative data]:

- What types of knowledge sources do teachers engage with and where do they access them?
- How do teachers engage with various knowledge sources?

Knowledge construction [quantitative and qualitative data]:

- What kind of reflection and enquiry processes do teachers engage in?
- Who do they interact with in these processes?
- What is the content, object and purpose of knowledge construction?
- What structural dynamics occur during these knowledge processes? How do teachers translate research knowledge for practice?

Knowledge diffusion [quantitative and qualitative data]:

- How do teachers consciously disseminate knowledge?
- What platforms are used for knowledge diffusion?

Knowledge integration [qualitative data]:

- How is new knowledge validated and consolidated?
- How is knowledge managed at the professional community / network level?
- What mechanisms exist for integrating locally constructed knowledge in integration?

Hypothesis 1.1: Knowledge mobilisation, construction and diffusion are closely linked.

Note: Insights into the questions above were given in Chapter 7.

The complexity of the quantitative instrument did not make it possible to statistically test the relationships between knowledge mobilisation, construction and diffusion with the given sample size (295). However, qualitative data seems to support the hypothesis that while it is possible to distinguish the different aspects of knowledge dynamics, they are strongly linked. The interconnectedness was demonstrated through the experimentation and innovation projects teachers engage in, and in which knowledge dynamics manifests. These involved projects with a specific focus to enhance student learning: improve memorisation; increase students' reflections on their own learning, ambitions and pathways; improve students' emotion regulations with a view to increasing concentration and learning.

In the two case study schools, knowledge processes cannot quite be described as well-structured cyclical and iterative inquiry processes. Rather they are messy and unstructured. They can be initiated from different sources and motivations: by an individual teacher or the school leader, inspired by a professional development programme (so knowledge mobilisation) and by a local challenge. They include a variety of social processes (e.g. participating in collective professional development, short exchanges

with other teachers or professionals) and also teachers' engagement with their material environment (e.g. individually seeking out sources on the internet).

The various aspects of knowledge dynamics play out in these social and socio-material processes as an ensemble. For example, in a school-based professional development course, teachers access new knowledge (mobilisation), develop ideas on how they can use this in their practice (construction), and share their experiences, knowledge with others (diffusion). Accessing external, formal/explicit knowledge is a key element of pedagogical experimentation and thus of knowledge construction. Numerous similar examples in the interviews demonstrate the non-linear nature of knowledge mobilisation, construction and diffusion and the ways in which these can mutually trigger and influence each other. Nevertheless, my research showed that it is possible to analyse a situation / process through these different angles. In this sense, the analysis of the aspects of knowledge dynamics are like a prism that splits up the white light into beams of different colours.

The usefulness of this analysis lies in a deeper understanding of the different factors that facilitate or hinder the various aspects of dynamics. The conceptual framework understands social and knowledge dynamics as a complex system, in which social dynamics "tie together both structural and functional knowledge processes". Knowledge transforms and evolves over time, and spreads across space as a result of social and socio-material dynamics. Understanding the ways in which the different elements of this complex system interact and the mechanisms that drive the evolution of the system is the main value of characterising both the social and the knowledge processes.

My study showed that the overall conceptual framework is both meaningful and useful. I will now look more in-depth into how this was operationalised, what findings I obtained and what improvements should be made in the future.

10.1.1. Instrument validation and improvement

In Chapter 7 and Chapter 8, I examined the validity of the instrument with statistical methods. I will now discuss validity in light of both quantitative and qualitative data. To do this, I analysed the interviews conducted in both schools with respect to the following questions:

- Are the aspects captured through the items of the instrument mentioned by the teachers and school leaders?
- Are there any additional aspects that emerged from the interviews beyond the items included in the instrument?
- Do the different items really belong to the corresponding dimension of knowledge dynamics?

I will now briefly summarise the main findings for knowledge mobilisation, construction and diffusion.

Knowledge mobilisation

The mobilisation dimension aimed to capture the ways in which teachers access different knowledge sources, translate and apply them for their practice. It also included their active engagement in research processes. Although with varying intensity, all items were touched upon in the interviews except for one. The one that did not come up – "verifying the quality of research findings" – was also reported in the questionnaire as an activity in which teachers do not engage very often. Teachers mostly verify the quality of sources based on "trustworthiness", i.e. the reputation of the blog, platform or author they consult. Verifying the quality of research itself requires scientific literacy (e.g. knowing what sample sizes, research methods and analyses are adequate for certain questions), which teachers may not have or may not apply in their practice. This implies that the item may need to be revised to specify the difference between verifying the quality of sources and that of research.

Although the three-factor model was supported by quantitative analysis, engagement with practical sources versus research/scientific sources may need to be distinguished better in future research. For example, it would be worth separating out some sources, such as consulting institutional sites (which probably feature validated knowledge) and professional social media groups (e.g. "pedagogical café" in France, institutional twitter accounts), as these were mentioned several times in the interviews. A recently developed, very detailed questionnaire by the Monash University in Australia (Rickinson et al., 2020[442]) could be adapted and integrated with my questionnaire for future research.

The case studies question the inclusion of active engagement in research in the knowledge mobilisation dimension. In the qualitative research, active participation in research activities was shown to be an inherent part of knowledge construction, because it was hardly separable from innovative/experimental projects. Therefore, future research should consider moving this aspect to the construction dimension. In addition, the interviews suggest that teachers' data collection and use does not always/often follow a rigorous scientific procedure. In Legrand school, teachers worked with researchers on some experimentation projects, and data collection and analysis was thus supervised by researchers. However, most often teachers talk about collecting students' or parents' perceptions through questionnaires, or even just relying on their personal observations, impressions to note change in students' learning or attitudes. These forms of data use should not be confounded with rigorous scientific methods. The items in this construct could therefore be refined to specify the type of data collection, analysis and use.

An aspect that was not part of the knowledge mobilisation questions, but that could only be considered as such in the interviews, was participation in professional development. While collective professional development is a space for knowledge sharing (which is why it was included in the diffusion dimension), it also is a major source for teachers to access new knowledge. The cases studies showed that professional development does not necessarily imply knowledge mobilisation as teachers do not necessarily perceive it as relevant and of quality. Nevertheless, in future research participation in training could be moved in the mobilisation dimension. In addition, a number of different forms of training were

mentioned in the interviews, such as one-off on-site training, on-site training accompanied by ongoing support (e.g. coach/inspector), locally initiated but off-site course and centrally designed professional development. Qualitative data, as well as existing evidence, suggests that the different forms have different impact on teachers (Cordingley and Bell, 2012[435]; Cordingley et al., 2005[378]; Timperley et al., 2007[377]). In my research the focus was not understanding the impact of various forms of professional development, however these could be distinguished if the research questions necessitate.

Knowledge construction

The construction dimension in my questionnaire was designed to capture collective knowledge construction at two social levels: within school (community of practice) and in the wider network. It focused on three interrelated factors of knowledge construction: reflection on practice, instruction-related construction and innovation. Again, the interviews had explicit references to all aspects captured in questionnaire items – although with varying emphases –, perhaps except for "we prepare lessons together". Qualitative data reinforced the finding that teachers do not engage in peer-observation and school leader interviews also gave insights into the reasons (fear of judgement, lack of culture for deprivatisation of teaching practice). However, this does not mean that teachers do not give feedback to each other. Interviews suggest that such activity happens through informal discussions outside the classroom, in which teachers share their difficulties with each other and provide advice to one another. In such a context, it would be valuable to add an item that relates to feedback on practice but without direct peer observation.

With regard to the two social circles, qualitative interviews suggest that knowledge construction may have different forms and different focuses in the community of practice and the wider network. For example, in the French context it seems that collaboration beyond the school tends to focus on specific areas, such as facilitating student pathways (in line with regional policy objectives). In addition, teachers with certain characteristics may be more prone to engage in such boundary-crossing activities. With regard to student pathways, it is teachers teaching the first or last grades of a school level (primary, lower or upper-secondary) are more likely to engage in that work. Teachers who teach subjects with low number of lessons per week tend to share their teaching work across a number of local schools and thus necessarily engage with teachers from more schools. Therefore, future research should consider distinguishing some forms of collective knowledge construction that relate to their immediate community (colleagues) from those that pertain to the wider network.

Knowledge diffusion

Finally, the knowledge diffusion dimension encompasses the intentional dissemination of knowledge through written communication channels and face-to-face or online exchanges, and the more unintentional forms of diffusion that occur through participation in collective professional learning and working various partners. A specific component relates to the mediation of research and literature. There were a number of items that were not touched upon in the interviews and also a number of terms that were

not used. Research mediation activities (synthesising or presenting literature) were not mentioned at all, which is partially in line with quantitative findings (very small proportion of teachers report engaging in such activities often, but still about one forth from time to time). The terms “knowledge sharing workshops” and “locally initiated training” were also very rarely mentioned. Again, this corresponds to quantitative data with low levels of participation reported. This is interesting because the French terms used in the questionnaire were identified through the exploratory study. Exploratory interviews were conducted with regional actors, and those local actors (school leaders) who are actively engaged in the co-ordination of the EDUNET networks at the county or regional levels. All these actors used the terms often and seemed to have a shared understanding of these. Data obtained from teachers seems to suggest a discrepancy between regional “language” (vocabulary) and that of teachers. It also may indicate that some regional initiatives and ideas have not yet reached the local level.

This finding can have diverging implications for instrument validity. On the one hand, it is valuable to include such terms in the questionnaire, precisely because data can then reveal such important findings. On the other hand, the use of these terms may have distorted the data with regard to participation in collective professional learning, because teachers may not have reported certain activities because of the specific terms used in the items. Future research should thus be more careful with the use of highly context-specific terms, and if a decision is made to use them, they should be complemented with more neutral or general language.

While participation in collective professional development is an important platform for knowledge diffusion (Sun et al., 2013[409]), the interviews suggest that informal conversations in the corridor, staff room, café and canteen are the prominent spaces for knowledge sharing and exchange among teachers. Therefore, these forms should be more explicitly distinguished in the questionnaire, potentially through a separate construct relating to “knowledge/experience sharing”.

Qualitative data also makes it clear that it is most often the school leader who takes charge of intentional dissemination. School leaders also revealed some fundamental information about knowledge diffusion beyond the school. Therefore, this diffusion dimension should probably be part of the school leader questionnaire (as well).

Finally, with regard to partners and communication channels, some small improvements are suggested based on the interviews. The examples for communication channels could be revised (adding twitter, and online platforms provided for schools such as Pronote in France). Among the partners, it would be worth separating certain types of non-teaching professionals, such as those working in schools (e.g. school psychologist, teaching assistants) and those working in different institutions (e.g. associations, health).

Reflections on the instrument in view of the quantitative and qualitative data converge on the idea that the three dimensions of knowledge dynamics are strongly connected. This reinforces that a systems view of knowledge dynamics is appropriate. At the same time, I have shown the value of distinguishing the different aspects. While the instrument overall covered the vast majority of the elements emerging from

qualitative data, I flagged a number of areas where it could be improved. In addition, a more in-depth analysis of the qualitative data in the future, including a quantitative analysis of interview coding (actually counting the number of times the various elements appear) would provide further insights into the relative importance of these for the particular constructs.

10.2. Research question 2: How do social dynamics influence teachers' knowledge dynamics?

Moving to the second research question of this thesis ("How do social dynamics influence teachers' knowledge dynamics?"), in this section, I will bring together the results of the quantitative component and the qualitative case studies to examine the relationships between social dynamics and the transformation of teachers' knowledge. Table 10.1 summarises the main results from the two main data sources.

Table 10.1. Findings

Constructs	Quantitative results	Qualitative results
Research question 2: How do social dynamics influence teachers' knowledge dynamics?		
Hypothesis 2.1: Network and organisational culture are important factors in facilitating social processes		
	Teacher data:	
	Teachers who perceive the EDUNET networks as beneficial for creating a professional learning culture and for establishing new relationships, also appear to engage more with their wider network. [Quite strong link]	The organisational culture, particularly, school leadership plays a very important role in facilitating teachers' collaboration.
	School leader data:	
	1. School leaders' perceptions of the culture of horizontal collaboration is associated with bigger horizontal school networks. [Strong link]	When the network context is characterised by competition, it can negatively influence collaboration among schools, particularly knowledge sharing.
	2. The more positive school leaders' perception of the culture of horizontal collaboration is, the more stable (the less dispersed) the strengths of ties are in their horizontal school networks. [Moderate link]	A bureaucratic network context can hinder knowledge mobilisation, which responds to local needs. High levels of administrative processes and long time, strongly impedes the potential of social devices such as "locally initiated professional development".
	3. School leaders' perceptions are not linked to the diversity of their partners (number of different school levels among partners, the similarity of partners to the school itself). [No link]	Central co-ordination of a network (supra-network in the case of EDUNET) can facilitate collaboration between schools. The regular EDUNET co-ordinators' meeting allow for local networks to exchange.
Hypothesis 2.2: Social structures and the nature of social ties in a network influence the dynamics of knowledge		
Knowledge mobilisation	4. Collaborating with a diverse set of actors facilitates active engagement in research. [Quite strong link]	The school principal's social ties facilitate knowledge mobilisation indirectly when these are used to organise collective learning opportunities. (Adding to #5, Supporting #8)

	5. Collaborating with different actors is associated with higher engagement with practical knowledge sources and formal research. [Moderate link]	Boundary-crossing relationships foster knowledge mobilisation by creating needs-based professional development opportunities and by providing opportunities to widen teachers' and school leaders' horizon and knowledge. (Adding to #5)
Knowledge construction	6. Collaborating with external actors facilitates knowledge construction with the wider network, related to reflection and innovation [moderate links], as well as cross-school projects [moderate link] and cross school-level projects [quite strong link].	Teachers' social interactions facilitate knowledge sharing and exchange, enrich teachers' reflection and practice through sharing difficulties, providing feedback and guidance to each other. (General finding supporting #6 and #7)
	7. Collaborating with different actors is moderately associated with both reflection and innovation-centred knowledge construction among teachers within a school. [moderate links]	Social interactions also help building a shared language and understanding, as well as harmonise practices. (General finding supporting #6 and #7)
		The school principal's social ties both with teachers and with external partners are key for facilitating knowledge construction. (Adding to #4, Supporting #6, #7)
		The quality of social ties (e.g. mutual respect and trust) matter for the nature of interaction that takes place between teachers and is a necessary condition for collective construction. (Adding to all)
Knowledge diffusion	8. Collaborating with external partners and participating in collective professional learning are highly correlated. [Strong link]	The school principal's social ties, particularly to the regional authority, plays a key role in knowledge diffusion. (Adding to #9)
	9. Relationships with external partners is weakly associated with dissemination. [Weak link and lower significance level]	Horizontal social ties in a competitive context hinder knowledge diffusion. Vertical relationships in this case can be an important means for dissemination and diffusion. (Adding to #9)
Hypothesis 2.3: Social processes and devices and actors' engagement with these influence the dynamics of knowledge		
Knowledge mobilisation	10. Participating in collective professional learning is weakly associated with active engagement in research. [Quite weak link]	Informal social interactions among teachers allow them to learn new knowledge. (General finding supporting #4, #5 and #10)
	11. Participation in collective professional learning is not associated with engaging with practical knowledge sources or research. [No link]	Collective learning can function as a social space for teachers and be a form of collective knowledge mobilisation. (Contesting #11?)
Knowledge construction	12. Construct-related consideration: Knowledge construction items inherently carried social dynamics, as they captured collective reflection, instructional design and innovation with colleagues or the wider network.	Social interactions in the digital space facilitate knowledge sharing and collective construction. (Adding to #6, #7)
	13. Teachers' participation in professional learning is weakly associated with instruction-related knowledge construction among teachers within a school. [Weak link and lower significance level]	Some social processes, such as peer-observation and needs-based local professional development, could drive knowledge construction but are not widely used. (Supporting #13)
		Collective professional development can drive knowledge construction, this impact is greater for informal, needs-based professional learning. (Contesting #13)

Knowledge diffusion	14. Construct-related consideration: Both of the social dynamics measures were part of the knowledge diffusion dimension. Therefore, the impact of social dynamics is measured on knowledge dissemination only.	Central network (supra-network) devices are key for the diffusion of knowledge, particularly in a competitive context. E.g. events such as the Innovation day create space for the diffusion of innovation (new knowledge).
	15. Participation in collective learning is particularly strongly associated to knowledge dissemination. [Strong link]	Social processes at the network (supra-network) level, such as interactions between central and network co-ordinators facilitate the diffusion of knowledge.

In line with international research on leadership and networks [e.g. (CUREE, 2005[286]; Muijs et al., 2011[52]; Greany and Higham, 2018[269])], the first hypothesis of this research question (2.1: **Network and organisational culture are important factors in facilitating social processes**) is generally supported by all data sources. School leaders' positive perceptions of local collaboration and networking – higher levels of trust, shared objectives, adequate incentives and governance – seem to be associated with more collaboration with other schools, although no positive association was found with the strength of collaboration. Quantitative data suggests that it is the culture of horizontal collaboration that matters directly for schools' social networks, rather than that of an external policy device. However, school leaders' perception of horizontal and vertical network culture are strongly linked. Qualitative data, both from the exploratory phase and the case studies, provided more nuanced understandings of social mechanisms and relationships. They showed that bureaucratic processes can work against the intentions of central administration, and a competitive context can hinder knowledge sharing and co-construction. They also put in evidence that central administration (regional authority in my research) and vertical structures have important roles in facilitating social processes, for example, through organising network co-ordinators' meetings.

I would like to note that it is not necessarily straightforward to distinguish between the second (2.2: **Social structures and the nature of social ties in a network influence the dynamics of knowledge**) and third hypothesis (2.3: **Social processes and devices and actors' engagement with these influence the dynamics of knowledge**). The three hypotheses were formulated along the three aspects of social dynamics identified in the conceptual framework in a networked perspective: the context (e.g. policy context, governance, leadership), characteristics (structure, nodes, ties) and devices (activities, tools, technologies). While this is a meaningful conceptual distinction, in reality these aspects are strongly interlinked and therefore it is not always easy to tease out the findings in the various hypotheses. Nevertheless, the findings from the different data sources converge, and overall support both hypotheses.

Considerations regarding the constructs noted in the section above also become apparent in the table. As a result of the fact that the quantitative and qualitative components examined slightly different aspects of certain constructs, the two sets of results do not have a one-to-one correspondence and quantitative findings for some dimensions appear for a different dimension in qualitative data. For example, engagement in research was an integral part of experimentation projects (in Legrand Secondary School in particular) and these were considered as knowledge construction, therefore, qualitative findings show

up with regard to this second dimension. Similarly, collective professional learning was interpreted as a form of social process and an aspect of knowledge diffusion in the questionnaire, whereas it was viewed as knowledge mobilisation (learning new knowledge) in the interviews. Related findings can thus be found in all dimensions.

The table demonstrates three ways in which qualitative findings add to quantitative results: they can support questionnaire findings, contest them and reveal more details (add to them). Overall, most quantitative findings are supported by the interviews. The compiled findings suggest that while social processes clearly influence teachers' knowledge dynamics, this relationship varies across dimensions and are conditional on the nature and strength of social ties.

In two instances, findings seem contradictory. With regard to the impact of collective professional learning on engaging with practical knowledge sources or research, there was no association in the questionnaire data, while in the interviews collective learning was actually a form of knowledge mobilisation. However, we must note that participating in professional development courses or workshops seems to be a distinct form of learning new knowledge, which is clearly different from accessing, interpreting and applying various sources individually (i.e. the way in which engaging with practical / research knowledge was conceptualised in the questionnaire). Another opposing finding relates to the impact of collective professional learning on knowledge construction. The interviews did show examples for professional development, which inspired teachers to start reflecting on their practice and developing new ideas. However, the school principal interviews suggest that this impact is more important when professional development is tailor-made and addresses specific needs. The interviews also revealed a certain number of barriers with respect to the impact of social processes on knowledge dynamics. On one hand, locally initiated professional development courses are rare and they do not flexibly address teachers' needs. This latter could explain why, even when teachers participate in such courses, these do not necessarily drive them to engage with resources. On the other hand, some of the informal opportunities (such as more in-depth knowledge sharing workshops, peer-observation) are believed to be impactful but teachers very rarely engage in these. We can thus assume that one of the reasons for a lack of link between collective learning and knowledge mobilisation/construction is that the forms of collective learning available and in which teachers engage are not the most effective ones.

Qualitative results not only help interpret why certain links are stronger, weaker or missing, but also reveal important information on the conditions and functioning of social dynamics. In particular, the interviews demonstrated that these conditions appear at the individual, relational, organisational, as well as the broader network level. The following attributes make social processes "work", i.e. help them function as drivers of knowledge dynamics:

- *Individual characteristics:* attitudes and dispositions such as willingness and interest in working together, a desire to exchange and learn from one another, ability to show oneself vulnerable, openness to feedback. Individual teachers' and school leaders' knowledge and competences are

also important factors, because they provide the “cognitive input” for social interactions, which in turn, can drive sharing and collective knowledge construction.

- *Quality of social ties:* mutual respect, collegiality and horizontality among teachers.
- *Density and diversity of social ties:* dense social network within the school (many ties), and diverse ties that connect teachers with other professionals within and outside the school.
- *Knowledge of the value of social ties*: knowledge of the value/function of particular ties helps using them strategically. For example, external ties are important for driving teachers’ engagement in research, vertical ties matter for knowledge diffusion. Strategic use of actors with diverse ties (e.g. the school principal plays an intermediary role between teachers and external partners, teachers that are shared across several schools can play a brokering role).
- *Organisational factors:*
    - Leadership – individual characteristics of the school principal: trust and respect for teachers. Knowledge about and ability to reflect on pedagogy (e.g. vision of student learning and ability to guide pedagogical practices). Knowledge about and competence in leadership (e.g. ability to co-ordinate actions, provide continuous support and leverage emerging ideas, knowledge, practices).
    - Leadership – as social practice and organisational characteristics: a shared vision of a professional learning culture in the school and the collective ability to facilitate processes to achieve this vision. Informal and formal spaces for knowledge processes that (together) allow for deep reflection and enquiry on practice, structured exchanges among teachers and regular knowledge sharing. Co-ordinated knowledge processes in the formal spaces.
- *Broad network characteristics*: reflect all the conditions above, including individual and relational characteristics, and educational leadership characteristics at the level of the broad network (whether formal or informal).

It is worth reflecting on the relationships among the three hypotheses. In particular, the global context of the network, including its culture, governance and leadership, timeframe and geographical coverage, are crucial factors for creating social structures, and shaping the density and nature of ties in these (Coburn, Choi and Mata, 2010[165]). They are also important for putting in place social processes and devices (activities, tools, social technologies). These social dynamics then matter for knowledge processes, including mobilisation, construction, diffusion and also the integration of locally constructed knowledge in the public knowledge base (even though this aspect was less studied in my research). However, these relationships are not simply linear (network/policy context → social dynamics → knowledge dynamics). Network leadership needs to understand how social structures, processes and devices can drive knowledge dynamics in order to facilitate the right types of social dynamics. In the next section, I provide some initial thoughts on the wider implications of my research.

10.3. Reinterpreting relationships: networked leadership

My research also deepens the understanding on teachers' and leaders' social and knowledge dynamics as they are embedded in the broader policy context and social environment. The conceptual framework (Chapter 4) delineated three social levels – communities of practice, broader network, education system – and featured horizontal and vertical relationships at these levels. In Chapter 8, I adapted and extended the framework proposed by Sleegers and Leithwood (2010[415]). In addition to the "inside" or internal view, which looks at the capacity of schools to create supportive environments for teacher learning and change, and the "outside" or external view, which studies the implementation of externally developed school improvement policies (Sleegers and Leithwood, 2010[415]; Thoonen et al., 2012[413]), I proposed to distinguish between horizontal and vertical outside perspectives. I will now re-examine these conceptual proposals in view of the emerging findings.

10.3.1. Horizontal-vertical, inside-outside

Both the exploratory study, questionnaire data and the case studies showed that local networks could be looked at from two angles. The horizontal angle reveals bottom-up, self-organising networks: teachers working with teachers from other schools, schools collaborating with each other and establishing relationships with other partners, including research centres, local associations and others. These collaborations are usually based on local needs and initiatives, and shared interest (e.g. Piccoli school working with local associations on climate issues, Legrand school working with a research centre on experimentation projects). The vertical angle shows the construction of networks, such as EDUNET, centrally co-ordinated with a top-down, external policy objective. Collaboration within these networks are derived from national objectives, which the regional authority tries to align to regional challenges. They can but do not necessarily coincide with teachers' and school leaders' needs. In terms of nodes and ties, the two types of networks overlap, because the EDUNET networks include all local schools by mandate. The data also showed that one can impact the other: some school principals met colleagues through the EDUNET network and if they felt mutual affinity and shared common challenges and goals, they formed their own horizontal network.

The distinction of these two angles proved to be meaningful because it helped nuance the understanding of networks. Quantitative data showed that schools' horizontal networks is influenced by the way in which they view the local culture of collaboration, but is not affected by their views on the vertical network device. Qualitative data (both from the exploratory phase and the case studies) suggest that the primary social space for knowledge construction is the horizontal networks. Vertical networks can however enrich horizontal collaborations, and school leaders' views on whether the horizontal and vertical network cultures are conducive for professional learning are strongly associated.

Of course, networks are not always – in fact, almost never – purely vertical or purely horizontal. Network literature underlines tensions between co-existing horizontality and verticality in inter-organisational partnerships. Even flat and horizontal networks can have internal hierarchies, and even

highly trust-based networks can be exposed to external risks, such as accountability, which undermine their horizontality (Greany and Higham, 2018[269]). Whether a network is formed completely bottom-up or it is mandated or externally incentivised matters for establishing deep collaborations (Popp et al., 2014[278]). For example, a network can be created based on existing relationships between schools but in reaction to a certain central policy. An example for that is the teaching school alliances created in England in the framework of the "self-improving school-led system" policy. Some of these alliances perceived the creation of a formal network as a natural evolution based on already existing informal horizontal networks, while others did not welcome the introduction of hierarchical relationships (a designated leading school) in formerly horizontal systems (Greany and Higham, 2018[269]).

The notions of horizontality and verticality are important to interpret network tensions and as my research has shown, contribute to better understanding the potential for networks to facilitate knowledge dynamics. If this distinction is useful for understanding the links between social and knowledge dynamics in the external view, it also makes sense for the internal perspective. Horizontal and vertical relationships have been examined in relation to power and hierarchical structures in leadership literature, among others, in the critiques of the notion of distributed leadership (Lumby, 2013[426]). My conceptual framework therefore also considered these notions at the school level.

Bringing together the way in which I conceptualised social dynamics (in Chapter 4) and the proposed conceptual extension of the Sleegers-Leithwood framework (2010[415]) (Chapter 8), results in a two-dimensional framework depicted in Table 10.2, in which the two dimensions should be interpreted as continuums rather than dichotomies. I argue that this framework is useful for thinking about the ways in which social and knowledge processes are linked. Table 10.2 shows an initial mapping of knowledge processes across these two dimensions.

Table 10.2. Two dimensions of understanding SD and KD

	Horizontal	Vertical
Internal	Within school knowledge dynamics through horizontal collaboration Knowledge construction Knowledge sharing	Within school knowledge dynamics involving vertical processes (e.g. knowledge dissemination and coordination through leaders, in centralised spaces) Knowledge dissemination, diffusion
External	Schools establishing horizontal collaboration and networks with each other and with other partners Knowledge construction Knowledge sharing / Knowledge mobilisation	Relationships between schools and local and regional authorities (e.g. centrally coordinated and top-down policy implementation) Knowledge dissemination, diffusion, integration

In the **top left quadrant**, the framework considers horizontal social processes within the school, i.e. collaboration and exchange among teachers and between teachers and other school staff (e.g. school

psychologist, pedagogical counsellor in the French context). In the two case studies, these consist primarily of informal processes that constitute the basis for reflection on and exchange of practice, information and knowledge, and the development of innovative projects and practices. The **bottom left quadrant** describes horizontal processes across schools and between schools and other actors (e.g. researchers) and types of organisations (e.g. universities, local associations). Again, the emphasis is on exchange and the co-construction of projects, initiatives, practices. Schools can also solicit each other for providing teacher training, thus facilitating knowledge mobilisation.

The **top right quadrant** takes account of the vertical processes within a school, primarily between teachers and the school principal and deputy principal in the French context (in the absence of formal middle leadership). The data showed that these social processes are important for knowledge co-ordination: the school principal plays a role in igniting knowledge mobilisation (e.g. through organising professional development), in facilitating knowledge sharing and dissemination. Finally, the **bottom right quadrant** reflects vertical processes in the external view. These relate to hierarchical relationships in the education system. In the French system, for example, between the school and the regional authority, or teachers and their inspectors. Again, these are fundamental for knowledge dissemination and diffusion, as well as the central co-ordination of knowledge processes. As noted above, the horizontal-vertical dimension is not a dichotomy; the continuum includes social interactions involving power relations both within and outside the school.

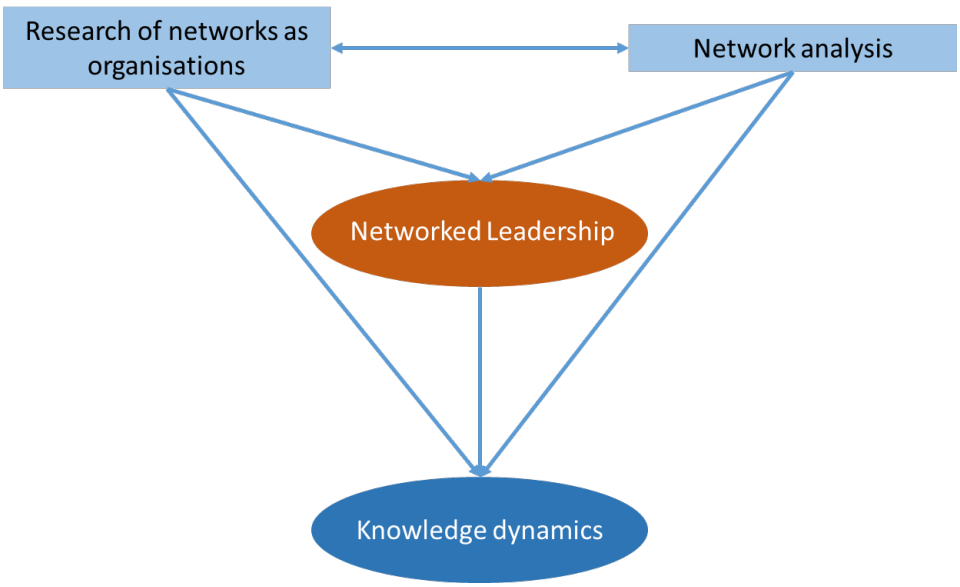
While this is a simple – and perhaps somewhat simplistic – framework, it is useful in that it sheds light on the different values/potentials of the different social spaces and processes in teachers' knowledge dynamics. It also has implications for understanding governance and leadership in a networked perspective. This is discussed next.

10.3.2. Implications for networked leadership

The findings of this thesis underline that social dynamics do not automatically drive all dimensions of knowledge dynamics. Instead, there are complex relationships between them, mediated by a number of factors and conditions. Situated in the intersection of the theory of networks and network theory (Borgatti and Halgin, 2011[156]), my research studied both formal networks as social organisations and used networks as an analytical lens (social network theory) to gain insight into these complex relationships (Figure 10.1).

The policy analysis in Chapter 3 showed that the "network imperative" implies great demands and pressures for schools as organisations and teachers. If the policy objective is to facilitate teachers' knowledge dynamics, then actors in the education system – including educational authorities, institutions, school leaders and teachers – need to understand how exactly social processes can drive knowledge mobilisation, construction and diffusion. Only then will it be possible to drive social dynamics strategically. Therefore, my research has consequences for, what I term, "networked leadership". To explain what this concept means, I will situate it in leadership research.

Figure 10.1. Understanding networked leadership and knowledge dynamics through research



In leadership literature, the concept of "distributed leadership" has been the most strongly associated with a networked perspective. The term "distributed leadership" acknowledges leadership beyond formal positions and even beyond simply a group of individuals taking on leadership responsibilities (shared leadership). While various conceptualisations exist, the most prominent ones view leadership practice as the overall influence, which is dispersed and shared across different sources (Gronn, 2010[443]). The unit of analysis in this view is the 'configuration' of leadership or leadership activity (Gronn, 2010[443]), rather than the individual leaders, and leadership is seen as the product of interactions taking place between people in the school (Spillane, 2005[444]). Typically, a social network research approach is aligned with this analytical conceptualisation, which is consistent because both are concerned with patterns emerging from multiple interactions.

Another understanding of distributed leadership relates to the deliberate sharing of leadership practice among formal and informal leaders. This functional understanding has led to a normative use of distributed leadership. This view has been widely criticised because it disregards the existence of hierarchical relationships, authority and power (Lumby, 2013[426]). It was seen as a new form of managerialism, in which power relationship between followers and leaders become blurred (Bush and Glover, 2014[425]). Yet, I have shown that acknowledging the difference between horizontal and vertical relationships, and power issues is important for understanding the impact of social processes on knowledge. Some critiques also pointed to the fact that the notion of distributed leadership tends to understate the role of senior leaders (Crawford, 2012[445]; Gronn, 2010[443]). However, a meso- or macro-level analysis of networked leadership cannot disregard a functional perspective of distributed leadership. Research on networks as social organisations focus on the network governance aspects of leadership and thus tend to contribute to a structural-positional analysis of distributed leadership. In this sense, the focus is on the co-ordination of activities and hence, on leadership practices of individuals,

including formal and informal leaders. My investigation has shown that both network research areas are relevant to understanding leadership and the ways in which it contributes to teachers' knowledge dynamics.

An increasing number of studies explicitly examine leadership and knowledge beyond the school, both from an analytical and an organisational network perspective (Daly, 2010[446]; Muijs et al., 2011[52]; Brown and Poortman, 2018[20]). Taking into account the larger context and extending the notion of leadership beyond the school, led to the emergence of the concept of system leadership (Bush and Glover, 2014[425]; Hopkins, Nusche and Pont, 2008[447]; Hargreaves, 2011[448]). Boylan (2016[449]) distinguishes three meanings of system leadership:

1. Leadership beyond the school as an organisation – leadership within the meso-system.
2. Leadership practice informed by systems thinking and complexity theory, i.e. leaders embracing and strategically nurturing horizontal school networks while also being aware of vertical relationships.
3. System-wide leadership or leadership of the macro system. Leadership in this sense is used descriptively to denote higher-level leaders (e.g. executive headteachers in England) whose actions influence system-wide change. It is also used normatively to indicate that school principals *should* lead system wide change (Boylan, 2016[449]).

Investigating leadership in professional development and collaborative networks, Boylan argues that system leadership should extend to teacher leaders instead of focusing only on school principals and headteachers. Referring to Spillane's and Gronn's conceptualisations of distributed leadership, he proposes to extend the understanding of leadership not just to the meso-level (e.g. cross-school networks), but also to the macro level of the education system (Boylan, 2016[449]). At all levels, and with respect to all three meanings of system leadership, Boylan suggests that leadership analysis should include "system teacher leadership" and "system leadership from below", where the latter refers to "the way in which the collective activity of teachers can have systemic effects" (Boylan, 2016, p. 68[449]).

Two recent studies contribute further to understanding the role of networked leadership in knowledge processes. Townsend (Townsend, 2015[450]) proposes networked leadership as an extension of Gronn's concept of hybrid leadership (2010[443]) to account for the changed leadership configurations that "enquiry school networks" imply. These comprise (the already existing) leadership at the school level and leadership of the network, which involves extended roles of school leaders as well as the emergence of both formal and informal new roles. Networked leadership pertains to creating and maintaining relationships between network members as well as to leading knowledge processes (Townsend, 2015[450]). These new roles necessitate a deliberate and strategic distribution of leadership, in its functional sense.

Díaz-Gibson et al. look at leadership in Educational Collaborative Networks, i.e. bottom-up initiatives and top-down formal programmes in which schools and other organisations and agents collaborate to achieve common educational goals (Díaz-Gibson et al., 2017[289]). These networks are

characterised by a non-hierarchical leadership, in which "information and expertise substitutes for an authority structure" (Díaz-Gibson et al., 2017[289]). Taking a functional view of leadership, the study focuses on the characteristics of effective leadership practices. In line with much of the literature on networks as organisations, the authors draw the attention to relational and structural leadership strategies. Similarly to Townsend, the authors stress that networked leadership involves explicit strategies to building internal and external links in order to facilitate knowledge construction and diffusion (Díaz-Gibson et al., 2017[289]). Again, while it is relevant to understand emerging leadership patterns (the analytical view of distributed leadership), it is also necessary to consider the strategic co-ordination of the network (functional-normative view of distributed leadership).

My research findings imply the need to understand 1) what leadership means in networks, and 2) how deliberate leadership practice can drive different knowledge dynamics. To bring these together, I propose an understanding of networked leadership as a combination of system leadership and distributed leadership including both its analytical and functional view (Table 10.3). Networked leadership in this sense has two components. "Leadership of networks" refers to the strategic and deliberate leading of networks as social organisations/entities. "Leadership in networks" refers to what leadership means in the web of relationships among actors in the system. The table describes how the three meanings of system leadership identified by Boylan (Boylan, 2016[449]) and the two views of distributed leadership relate to these components.

Table 10.3. Networked leadership

	System leadership	Distributed leadership
Leadership of networks (networks as formal social organisations/entities)	**[Meaning 1]** Leadership of formal networks within the meso-level (beyond the school) **[Meaning 2]** Strategic leadership of both horizontal and vertical networks (system awareness)	**[Dominant view: Functional]** The deliberate distribution of leadership roles to lead the network. **[Secondary view: Analytical]** Leadership as interactions among members of the network with emerging leadership roles.
Leadership in networks (networks as the web of relationships among actors in the system)	**[Meaning 1]** Leadership within the meso-level (beyond the school) through self-organising relationships **[Meaning 2]** Embracing and nurturing horizontal networks; while being aware of vertical relationships **[Meaning 3]** Formal leaders leading system-wide change at the macro-level, being conscious of the dynamics and emerging patters of the networked nature of the system.	**[Dominant view: Analytical]** Leadership as the product of interactions among the actors at the level of the analysis (within-school/micro level, across-school/meso level, system/macro level). Leadership as the emerging pattern of influence. **[Secondary view: Functional]** The deliberate distribution of leadership roles based on the positions actors occupy in the social network.

This conceptualisation not only brings analytical clarity to how we should understand networked leadership, but also has implications for the methodological aspect of leadership research. In particular, it shows the ways in which both research on networks as organisations and the analytical lens of networks (social network analysis) can contribute to understanding different aspects of leadership (Figure 10.1). The former brings insight to leadership as a process and intentional activity, whereas the latter contributes to understanding leadership as sometimes unintentional, emerging influence.

My research presented how the two areas of network research can help understand teachers' knowledge dynamics. Network analysis shed light on the links between the culture and structure of horizontal networks, the ways in which externally created formal networks influence horizontal social processes. It showed how the social network of school leaders can drive knowledge mobilisation, construction and diffusion both within and beyond the school. The analysis of a formal supra-network, EDUNET, showed the role of social devices and processes in the various knowledge processes, and – importantly – drew the attention to not just the drivers but also the barriers to knowledge dynamics. In sum, my findings have implications for how "leadership of networks" and "leadership in networks" can enhance the understanding of leading knowledge processes.

10.4. Methodological reflections: Limitations and future research directions

In the first section of this chapter, I already pointed to weaknesses of the quantitative instrument and proposed improvements to the specific constructs and items. In this final section, I will reflect on the research design and methods from a broader perspective, highlight the various limitations and suggest improvements and directions for future research.

10.4.1. Research design

Overall, the combination of two mixed method designs: an exploratory and an explanatory design was suitable to address the research questions. The exploratory phase gave valuable insights to the development of the quantitative instrument and the design of the qualitative case studies. In addition, it was extensive enough (with its in-depth interviews and event observations) to also provide valuable qualitative data that was presented in Chapter 6. As discussed in section 2 above, the qualitative case studies provided insights into the quantitative results and added valuable additional perspectives. Of course, other mixed-method approaches, such as concurrent triangulation or nested designs may also be conceivable, and could shed light on different aspects of the questions under study.

The clear disadvantage of my research design was its complexity. Its planning and implementation took a substantial amount of time (and resources in consequence!). Although I planned to draw on quantitative findings in order to sample schools for qualitative data collection, this was not possible due to the sample size. In addition, the complexity meant that on some other dimensions, it had to be reduced. In particular, I conducted the research on one site (one region in France) only, and therefore my findings lack a comparative aspect. This obviously imply that the generalisability of findings is limited. In future research, these findings should be cross-validated and compared to other contexts, both in France and in other countries.

10.4.2. Data and sample

Regarding the target population, the two distinct groups, teachers and school leaders, targeted in both the quantitative and qualitative research provided different types of insights into the questions.

Interviews with regional educational actors, and the comparison of data across these target groups contributed with invaluable insights into some of the research questions. The following are some important limitations of the samples:

Quantitative component

Although the sample sizes for both the teacher and school leader datasets can be considered as acceptable in social research, and they were almost representative in terms of some key demographic indicators, the may still include some typical social research biases. First, due to the data collection procedure, response was voluntary. This can result in self-selection bias (de Leeuw, Hox and Dillman, 2008[335]), meaning that the most motivated, the most trained teachers respond to the questionnaire, or – worse – those who are particularly interested in expanding their knowledge in various ways. Such self-selection can naturally distort the results. Second, the new teacher population was slightly underrepresented in the teacher sample. Research suggests that this group may have special characteristics with regard to knowledge (Paniagua and Sánchez-Martí, 2018[277]), and thus they could have resulted in slightly different findings. Third, the nature of self-reports naturally implies social desirability bias (de Leeuw, Hox and Dillman, 2008[335]), and this is particularly an issue in the policy context described in Chapter 3 (i.e. pressures on teachers to use research, innovate and engage in collaboration). However, it must be noted that any sample would have had this bias, and to some extent, qualitative data compensated for this. This represents a bias particularly with regards to the knowledge mobilisation dimensions that maps teachers' engagement with and in research.

A particular regret I have with regard to the school leader response rate, is its unsuitability for social network analysis. SNA requires a response rate of over 60-70% in order to analyse the structure of the network. In retrospect, it is unrealistic to expect such a response rate to an online questionnaire without specific personal efforts to mobilise the target group. Such a large-scale data collection for social network analysis requires substantially more resources.

Qualitative component

I must underline that the volume of qualitative data was limited in several respects. First, the number of interviews conducted within each school was quite small. In social research, the suitable data sample for qualitative research is determined by saturation (Corbin and Strauss, 2008[331]). In my case studies, I cannot prove that I have reached saturation. This limitation is primarily due to the special context in which I had to conduct my research, namely in the midst of the covid-19 pandemic. At the time of data collection (autumn 2020), it was not possible to travel in France, therefore on-site visits and face-to-face interviews were impossible. In addition, teachers and schools were overwhelmed with new challenges, and I simply could not organise and conduct a more extensive data collection.

Second, only two case studies were conducted in very similar school contexts. This has the advantage that data are comparable, while it has the drawback that findings are less generalisable. Future research should be directed at sampling different school contexts with respect to school size, educational

level (primary, lower-, upper-secondary) and other characteristics (e.g. student population, rural versus urban context).

10.4.3. Analyses methods

I would like to emphasise that my research was exploratory in nature in several ways. I developed new concepts and frameworks, and tested them through a complex mixed-method design. I used a number of different analysis methods, some of which have rarely been combined until now. Such exploratorations naturally carry risks. In this section, I will highlight some of the methodological issues that may have arised.

A first difficult decision concerned the choice of analysis methods in factor analysis and structural equation modelling. Although all choices were based on methodological literature, I must highlight that there is often no consensus in this literature and some areas are very much still in progress.

- *Using EFA and CFA in a two-step approach*

This is a debated choice and some scholars warn that such an approach generates bias when conducted on the same dataset [e.g. (Fokkema and Greiff, 2017[347])]. A true validation of the construct presented in my study requires cross-validation on a different dataset, and I would like to invite the research community to do so.

- *Using non-parametric statistics and estimators (DWLS) specific to ordinal variables*

Whether a 5 point frequency scale or a 4 or 5 point disagree-agree scale can be considered as continuous variable is debated. While methodologists seem to agree that they shouldn't (particularly not disagree-agree scales), the practice in social research is still to consider them as such. The problem is that a number of statistical methods require that the data is normally distributed and this is often not the case in social research using such scales. Based on these considerations, I (mostly) followed methodologists' recommendations.

However, I discovered that this methodological field is still very much in progress, and research is not robust enough in terms of how to use these methods well and what inferences one can make. In terms of software, the lavaan R package incorporates these methods, but it sometimes raises warning messages, on which literature does not provide appropriate guidance. In addition, interpreting the results of these methods may require different thresholds than those applied for continuous variables (e.g. maximum likelihood). Some authors showed that cut-off values may be different, but did not give guidance on what values to use (Xia and Yang, 2019[357]). A possibility for future research would be to run the analyses using different estimators (e.g. ML). Ideally, this should be done after adapting the response options to a 7 or 9 point likert scale so that the variables can be considered as continuous in a more straightforward manner.

- *Complexity of the questionnaire and sample size*

A very important limitation of my research is that the data derived from the teacher questionnaire was very complex (with a high number of dimensions, constructs and items. It is not easy to reconcile

complexity with a relatively limited sample size. As a result, it was not possible to test whether the main dimensions of knowledge dynamics (mobilisation, construction and diffusion) measure underlying constructs. The model had to be reduced and only constructs within these dimensions could be tested. Future research with substantially larger sample sizes could validated the three constructs.

The SEM models examined in the study sometimes also proved to be too complex for the sample size. Although I tried to eliminate warning messages, the results should certainly be tested and cross-validated on larger samples in the future.

- *Combining SEM and ego network measures*

While SEM models in general can include any standard statistical measures, using network measures in a SEM model seems to be an innovative approach. Some research forums and one study (Liu, Jin and Zhang, 2018[432]) suggested that this is possible, however, more methodological research and guidance would be needed to demonstrate the feasibility/robustness of this approach.

- *Qualitative coding approach*

As mentioned in Chapter 5, qualittive researchers have diverging views and practices regarding counting codes and quantifying qualitative analysis. Although in this research, I chose not to do this (justified in Chapter 5), it could be an interesting additional analyses of my dataset that could potentially put in evidence the volume of different social and knowledge dynamics in the case studies. It would be ideal, however, if at least two raters coded it.

- Broadening qualitative data

Unfortunately, observations and site visits were not possible in the context of my research. Such types of data could enhance the understanding of knowledge dynamics. I already noted that structural dynamics, i.e. the interplay between tacit and explict knowledge could only be analysed through observations and possibly the analysis of materials (e.g. lesson plans, project designs) teachers produce. This would be a very interesting area for future research.

- *Caution with regard to causality*

I must note that SEM does not imply causality. When I use words such as “influence” and “impact”, they relate to the theoretical viewpoint of this study: social dynamics as drivers of knowledge dynamics. However, in the complexity / systems view that my conceptual framework emphasises, the various elements usually mutually influence each other. While I looked at the “impact” of social processes, in reality knowledge processes can also drive social processes. For example, a professional development programme may bring together teachers who had formerly not collaborated and may allow for new tie formation. Examining the directions of causality more in-depth would require additional analyses of all data sources, and potentially collecting additional data.

- *Some data remain unanalysed*

Finally, I would like to mention that the questionnaire included some questions, which I did not include in the analysis. For example, the pedagogical topics related to knowledge mobilisation and the few open-ended questions. These could provide additional insights into teacher knowledge dynamics if analysed in the future.

Overall, in this chapter I have shown that my analyses provide genuine insights into the research questions and contribute to enhancing the sociological understanding of teachers' professional knowledge. I have offered directions for future research, both from a conceptual and an empirical perspective. The new concept of networked leadership also provides food for though for policy and practice.

Chapter 11. Conclusions

Making students' experience rich, and their learning meaningful and valuable in a constantly changing and complex environment, has put increasingly more pressure on education systems to adapt and change. Research has tried to understand educational change in (at least) three fundamental ways. First, through exploring leadership to understand how to navigate the system and how to drive change. Second, by investigating teachers, and in particular, how teachers' knowledge and practice transforms and can be transformed to address new challenges. Third, increasingly more effort has been dedicated to studying the web of relationships among actors, organisations and artefacts, and how these networks can drive change. As these research areas develop, it is time to establish conceptual connections between them to widen methodological and analytical possibilities. My research put a strong focus on linking the second and third areas, and also contributed to the conceptual-analytical development of the first.

In the introduction to this thesis, I identified three objectives. First, to investigate what the context of the teaching profession on professionalism imply for teachers' knowledge; and how models and conceptualisations of teachers' knowledge translate into various educational contexts. Second, to examine the conceptualisation of the dynamics of teachers' knowledge within the context of the transformation of education systems and schools. Third, to investigate teachers' professional knowledge and the mechanisms underlying the dynamics of this knowledge in networks (beyond the school as an organisation). To address these objectives I engaged in theoretical-conceptual analyses (Part I) and conducted empirical research (Part II.).

The first part of this thesis demonstrated that much of the policy debate is characterised by a lack of profound understanding of teachers' knowledge and learning, and a variety of different models and traditions. A critical examination of the various scientific understandings of these key concepts showed that social and socio-material approaches are highly relevant for investigating the dynamics of teachers' knowledge in their social environment. Nevertheless, certain theories and methods of other disciplines – such as organisational theories and educational research – needed to be considered to account for the specificities of the educational context. Notably, I analysed the educational context through three dominant paradigms: evidence, innovation and networks. I demonstrated their importance for the social environment of teachers today and shed light on the interlinkages of the three topics. Through critical policy analysis, I pointed to various tensions these paradigms create for professional practice. Overall, this first part deepened the understanding of teachers' professional knowledge and the underlying mechanisms of its transformation within the context of the restructuration of education systems and policies.

Based on the theoretical investigations and policy analyses, I designed a theoretical-conceptual framework for a sociological investigation of teachers' knowledge. The framework has three key elements: professional knowledge, the newly developed concept of knowledge dynamics and social dynamics. The conceptualisation of professional knowledge builds on sociological and educational theories and elicits some aspects of teachers' knowledge that are central to its transformation. Drawing on socio-material approaches, the framework lays out a novel conceptualisation of knowledge dynamics. It distinguishes between structural and functional dynamics, and identifies several dimensions of each, while emphasising that these should be viewed as a system. The empirical research demonstrated the value of this conceptualisation. I illustrated the system view through the metaphor of "knowledge dynamics as a prism" that allows to see the ingredients of knowledge dynamics (the white light) by showing their aspects such as mobilisation, construction, diffusion and integration (different colours). Finally, the conceptual framework distinguished three levels of teachers' social world: communities of practice, networks and the broader education system. I conceptualised social dynamics as the product of horizontal and vertical relationships and processes within and across these three levels. The empirical research widened the understanding of social processes and highlighted the diverse roles that they play in the dynamics of knowledge.

The second part of this thesis presented a complex empirical research that aimed to investigate the research questions distilled from the theoretical-conceptual work:

- How can we characterise the dynamics of teachers' knowledge?
- How do social dynamics influence teachers' knowledge dynamics?

I designed a complex mixed method study to address these questions, comprising quantitative and qualitative elements. The context of a formal supra-network (a set of school networks) set up by a regional authority (Academy) in one region of France was selected for fieldwork.

Initial exploration of the field showed that the knowledge dynamics underlying networks is complex and multiple social parameters are important for facilitating them. Social ties involve hierarchical relationships that can be detrimental to horizontal social processes, and can act as barriers to knowledge co-construction and diffusion. Tensions between horizontality and hierarchies also matter for the extent to which the various network devices allow for sharing and diffusion of knowledge. Quantitative data capturing teachers' perspectives helped unpack the relationships between social processes and levels of knowledge mobilisation, construction and diffusion. Data from school leaders put in evidence some key characteristics of horizontal school networks. It also demonstrated that school leaders' perceptions of their horizontal network cultures matter more for their social network. Finally, two qualitative case studies contributed to a deeper understanding of the nature of social processes and ties – including horizontal and vertical relationships – and the ways in which these relate to the different aspects of knowledge dynamics.

I offered an extensive discussion of the results bringing together the different data sources. The discussion highlighted a number of ways in which the instrument to measure knowledge dynamics could be improved in the future. I then reflected on the conceptual framework and extended it in view of the

findings. Importantly, I discussed the practical implications of the findings for the leadership of and in networks. Building on theories of distributed and system leadership, I developed the concept of networked leadership. This concept incorporates what it means to intentionally lead knowledge dynamics in a network, and at the same time, helps comprehend leadership as emerging influence in a networked context. This is important because encouraging collaboration and building networks per se will not necessarily help transform education systems or enrich students' learning and experience. Instead, practitioners and policy makers need to understand the ways in which social processes can drive change. This thesis contributes to this understanding and the findings can thus be useful for regional and local policy makers, school leaders and teachers.

I must reiterate that my research is exploratory in nature in many respects. First, it developed a new concept (knowledge dynamics) and an instrument to measure this complex concept. Second, it sought to understand the relationships between social processes and teachers' knowledge dynamics in their complexity at several social layers. While the investigation was primarily sociological, it built on multiple disciplines and theories to offer a comprehensive view of these relationships. Third, the research design was complex and unique. Not only was it a mixed-methods study consisting of quantitative and qualitative components (with exploratory and explanatory functions), but it also used a number of different analytical techniques. Notably, combining structural equation modelling with network analytical measures is a new and promising avenue of research. However, exploration naturally involves risk-taking and it will be important to conduct further research to confirm or question/reject the findings of this thesis.

I flagged a number of methodological limitations of this study that future research could address. In addition to those, some directions for research also emerge from the conceptual work and empirical findings. As network research has grown hugely in the past two decades, a systematic review and meta-analysis of research findings would now be timely. Such secondary research is extremely valuable for organising and systematising findings and for identifying research gaps. My conceptual framework, including its extension with the concept of networked leadership, offers an interesting starting point for both secondary and new primary research.

Understanding educational change in the networked reality of the 21st century is key if we want to adapt flexibly to societal transformation. The focus on the social dynamics among educational actors (teachers, school leaders, researchers, inspectors, regional educational leaders, etc.) and their impact on the dynamics of teachers' professional knowledge is only a piece of the complex educational puzzle. Notably, students and parents are key actors in teachers' social environment. While interactions with and within these groups have not been the focus of this research, these can play important roles in teachers' knowledge and educational change more broadly. Future research should thus extend the scope of the social world and study social processes (within and outside the classroom) involving students and parents. Ultimately, research should also extend to unpack the social mechanisms that matter for students' learning and enrich their educational experience.

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UNIVERSITÉ DE STRASBOURG

ÉCOLE DOCTORALE SCIENCE HUMAINE ET SOCIALES
PERSPECTIVES EUROPÉENNES

Société, Acteurs, Gouvernement en Europe, UMR 7363

THÈSE présentée par :

Nóra RÉVAI

soutenue le : 2 décembre **2021**

pour obtenir le grade de : **Docteur de l'université de Strasbourg**

Discipline/ Spécialité : Sociologie

Les dynamiques des savoirs professionnels des enseignants dans des réseaux sociaux

THÈSE dirigée par :
M NORMAND Romuald — Professeur, Université de Strasbourg

RAPPORTEURS :
Mme PROITZ Tine — Professeur, Université du Sud-Est de la Norvège
Mme TUBARO Paola — Directrice de Recherche, CNRS, Université Paris Saclay

AUTRES MEMBRES DU JURY :
M CORDAZZO Philippe — Professeur, Université de Strasbourg
Mme POORTMAN Cindy — **Professeur Assistante, Université de Twente (Pays Bas)**
M TULOWITZKI Pierre — Professeur, Haute École Spécialisée de la Suisse du Nord-Ouest FHNW

INVITÉS : (le cas échéant)

Résumé de la thèse en français

Savoirs des enseignants : Introduction et justification

L'enseignement en tant que pratique sociale s'inscrit dans un environnement en évolution rapide et continue. Les mégatendances sociétales, telles que la numérisation, la mondialisation, le changement climatique, les inégalités croissantes et les changements démographiques, transforment l'éducation. Pour naviguer dans cet environnement complexe, les enseignants doivent continuellement s'adapter au changement, notamment sans jamais cesser de développer leurs compétences. De plus, dans les dernières décennies, la pression sociale sur les enseignants s'est alourdie. Les attentes de la société à leur égard sont complexes : les enseignants doivent répondre aux besoins individuels de groupes d'élèves de plus en plus hétérogènes, ils doivent développer des compétences transversales ou « compétences du XXIe siècle », collaborer avec leurs collègues ainsi qu'avec d'autres professionnels, et travailler avec les parents. Pour comprendre la transformation du système éducatif et des politiques éducatives, il est essentiel de s'interroger sur la nature et la dynamique des savoirs des enseignants et sur les nouvelles conditions de leur apprentissage professionnel à la lumière des tendances sociales émergentes.

Le *premier objectif* de cette thèse est d'*étudier l'impact du contexte général de la profession enseignante et des discours relatifs au professionnalisme sur les savoirs des enseignants* et *comment les modèles et conceptualisations de ces savoirs se transposent dans divers environnements éducatifs.* Pour ouvrir un espace critique, j'explorerai les contributions, mais aussi les limites de ces modèles. J'étudierai également comment se manifeste le savoir dans des domaines plus difficiles à codifier, tels que la collaboration, le leadership, les organisations et les réseaux. Cette recherche vise à contribuer à une meilleure compréhension des savoirs professionnels dans le contexte plus large de la restructuration des systèmes et des politiques d'éducation, et de leurs effets sur un groupe professionnel à une histoire et une identité unique (Sachs, 2010[1]).

Le *deuxième objectif* de cette thèse est d'*examiner la conceptualisation de la dynamique des savoirs des enseignants dans le contexte de la transformation des systèmes éducatifs et des établissements scolaires*. Il s'agira d'explorer la complexité des interactions et des échanges entre les différents acteurs éducatifs enseignants, chercheurs, décideurs politiques, etc. en vue de proposer une alternative aux modèles normatifs et prescriptifs des interrelations entre les savoirs et les pratiques professionnelles.

Cette thèse se propose d'aller au-delà de l'établissement scolaire en tant qu'organisation *et d'étudier les savoirs professionnels des enseignants*, en particulier, *les mécanismes qui sous-tendent la dynamique de ces savoirs dans les réseaux*. Elle cherchera à explorer et à examiner de manière critique les conceptualisations du savoir et de l'apprentissage, et à proposer un cadre théorique-conceptuel capable de rendre compte de la complexité des processus. Il s'agira également d'étudier empiriquement la dynamique des savoirs des enseignants dans les réseaux.

Discours sur le professionnalisme des enseignants dans la recherche et les politiques de l'éducation : quelles conséquences pour les savoirs des enseignants ?

Dans ce chapitre, je retrace l'évolution de l'analyse sociologique des professions et de la professionnalisation. Je présente, en particulier, les notions d'Evetts qui distinguent le professionnalisme occupationnel du professionnalisme organisationnel (Evetts, 2011[2]) et les concepts de Sachs quant aux professionnalismes managérial et démocratique (Sachs, 2010[3]). Afin de bien saisir les discours des politiques publiques, j'analyse un certain nombre de documents et de publications de l'OCDE à l'aune de ces notions sociologiques. J'ai démontré que si les discours des organisations internationales ont tendance à être normatifs et fonctionnalistes, et se conforment principalement aux professionnalismes organisationnel et managérial, les différentes formes de professionnalismes coexistent souvent, parfois de manière contradictoire.

Dans la deuxième partie du chapitre, je discute de la place qu'occupent les « savoirs » dans la littérature sur le professionnalisme et je présente les manières dont la littérature sociologique et éducative conceptualise le savoir. Les diverses théories relèvent de différentes traditions épistémologiques. La perspective ontologique s'intéresse à la nature du socle des savoirs « professionnels » (Brante, 2010[4]). Le point de vue sociolinguistique appréhende différentes formes de savoirs en distinguant les discours horizontaux des discours verticaux dans lesquels ces savoirs s'incarnent (Bernstein, 1999[5]). La perspective pratique et analytique se concentre sur les traditions du savoir dans la formation des enseignants (Whitty et Furlong, 2017[6]) et sur les aspects du savoir (Winch, Oancea et Orchard, 2015[7]). Enfin, j'illustre l'impact des différentes conceptualisations sur les politiques éducatives à l'aide des concepts de Kuhlee et Winch : l'enseignant en tant que « artisan », « technicien » et « professionnel » (Kuhlee et Winch, 2017[8]).

Globalement, cette vue d'ensemble et cette analyse démontrent qu'une grande partie du débat politique est marquée par une profonde incompréhension de ce qui constitue le savoir et l'apprentissage, ainsi que par une variété de différents modèles et traditions. Pour entreprendre une étude sociologique sur les savoirs des enseignants, il faut passer en revue les différentes interprétations scientifiques de ces concepts, et examiner d'un œil critique leurs forces et leurs limites.

Examen et critique des conceptualisations des savoirs et de l'apprentissage des enseignants

Les théories du savoir s'inscrivent dans une vaste littérature recouvrant de nombreuses disciplines différentes : la psychologie cognitive, la sociologie, les sciences de l'information, l'économie et la philosophie ; chacune d'entre elles possède ses propres approches conceptuelles, typologies et réflexions sur le savoir, qui sont uniques mais se recoupent.

Dans ce chapitre, je passe en revue la littérature sur les différentes conceptualisations du savoir, ainsi que les processus et les facteurs qui en affectent la dynamique. Je commence par les approches cognitives qui considèrent le savoir comme étant la propriété d'un individu. Bien que cette vision ait été critiquée et qu'une approche plus sociale du savoir s'impose désormais dans la littérature théorique, elle prévaut encore dans la recherche empirique sur l'éducation. Ensuite, j'aborde deux domaines principaux de la littérature qui conceptualisent le savoir comme un attribut social. Le premier est celui de la littérature sur la gestion organisationnelle, qui s'intéresse principalement à la « gestion des savoirs » en tant que facteur d'efficacité et d'innovation organisationnelles. Le second est celui de la littérature sociologique qui étudie le savoir en tant que partie intégrante des processus sociaux et de l'environnement social. Je souligne comment chacun de ces domaines améliore notre compréhension des savoirs et de l'apprentissage des enseignants, et je mets en évidence leurs limites. Grâce à cette analyse critique des différentes théories, j'identifie les fondements théoriques et conceptuels qui conviennent le mieux pour l'étude empirique de cette thèse.

Approches cognitives : la cognition individuelle et l'apprentissage en tant qu'acquisition

Selon les approches issues de la psychologie cognitive, la connaissance a une forme définie et est considérée comme une propriété de l'esprit d'un individu, tandis que l'apprentissage est essentiellement un concept cognitif qui se comprend comme le développement des savoirs ou l'acquisition de savoirs (Paavola, Lipponen et Hakkarainen, 2004[9]). Selon ce point de vue, qui a dominé les sciences de l'apprentissage et les sciences cognitives, l'esprit est un récipient de savoirs et l'apprentissage le processus qui remplit le récipient (idem). Il s'agit de comprendre comment l'esprit individuel « opère avec le savoir ». La recherche effectuée sur le changement des savoirs individuels des enseignants à l'issue de leur formation en éducation repose sur l'approche cognitive. Celle-ci a également permis d'étudier l'interaction entre différents types de savoirs, tels que les connaissances déclaratives et procédurales (Anderson, 1982[10]), ou les connaissances théoriques et fondées sur la pratique (Wilson et Demetriou, 2007[11] ; OECD, 2000[12]). La recherche en éducation sous l'angle de l'approche cognitive s'attache à décrire en quoi consistent les savoirs des enseignants et comment ils évoluent.

Bien que l'approche cognitive individuelle ait mis en lumière un certain nombre de mécanismes importants dans l'apprentissage des enseignants, elle ignore totalement le fait que la pratique

professionnelle des enseignants s'inscrit dans un environnement social. Les éléments suivants illustrent les principales limites de l'approche cognitive individuelle :

- des processus sociaux autres que l'apprentissage formel, tels que l'expérience professionnelle et la collaboration avec des collègues façonnent également les savoirs des enseignants.
- L'apprentissage conceptualisé comme l'acquisition des savoirs déjà existants ne prend pas en compte l'émergence de nouveaux savoirs, par exemple ceux issus des interactions sociales des professionnels et de la pratique elle-même (Putnam et Borko, 2000[13] ; Mason, 2008[14]). Pourtant, la participation des enseignants à la réflexion collective et aux processus d'innovation débouche souvent sur de nouveaux savoirs (Voogt et al., 2011[15]) qui font partie de leur processus d'apprentissage.
- L'approche cognitive individuelle tend à appréhender le savoir et l'apprentissage de manière linéaire. Elle suppose une série de relations linéaires entre les différents éléments : l'apprentissage formel des enseignants, l'évolution de leurs connaissances, et les changements dans la pratique de l'enseignement. Or, en réalité, ces éléments sont en interaction continue et dynamique les uns avec les autres.

Approches de gestion : la gestion des savoirs et l'apprentissage organisationnel

Dans les sciences de l'information et de la gestion, le savoir est conceptualisé en termes d'informations, de données, de messages et de codes (Hess et Ostrom, 2007[16] ; Davenport et Prusak, 1998[17]). Bien que ces définitions semblent se démarquer des théories psychologiques et sociologiques, les sciences de l'information et de la gestion ont élaboré des concepts clés sur le savoir dont certains ont ensuite été repris par la recherche sociologique et en éducation.

Les sciences de l'information et l'économie s'inspirent souvent de la distinction entre les **savoirs tacits et explicits**. Les savoirs explicits sont ceux qu'on peut exprimer par des mots ou d'autres représentations symboliques (par exemple, un texte) d'une manière compréhensible par une autre personne (Bennet et Bennet, 2008[18]). Les connaissances tacites sont classées en deux catégories : (1) les savoirs qui ne sont pas formalisables, c'est-à-dire impossibles à décrire en termes propositionnels, et (2) les savoirs implicites ou difficilement formalisables (Kimble, 2013[19]). La **codification** est le processus par lequel les savoirs sont convertis en messages transmissibles (Cowan et Foray, 1997[20]), rendant ainsi les connaissances implicites explicites. Les études économiques s'intéressent aux coûts et aux avantages de la codification et considèrent l'apprentissage comme la transmission de connaissances explicites, pour laquelle la codification est une condition préalable.

Cependant, cette conceptualisation soulève un certain nombre de problèmes :1) La perception dichotomique des connaissances tacites et explicites est problématique. 2) En plus des connaissances de type « savoir quoi » et « savoir-faire », les connaissances de type « savoir pourquoi » et « savoir qui » sont également importantes. Ces types de savoirs procéduraux peuvent n'être que partiellement ou pas du tout

codifiables. 3) La codification n'est pas toujours synonyme de progrès (elle implique la construction de nouvelles connaissances tacites), et les connaissances codifiées ne sont pas automatiquement transmissibles en raison de la nature contextuelle de certains savoirs (Johnson, Lorenz et Lundvall, 2002[21]).

Les processus de codification dans les communautés d'enseignants peuvent revêtir diverses formes au cours de la formation initiale des enseignants, de la collaboration et du développement professionnels ou de la participation des enseignants à la recherche. Ces processus façonnent les savoirs des enseignants et peuvent accroître la mesure dans laquelle ils peuvent être partagés, ainsi que la transmissibilité et l'accessibilité des savoirs au sein de la profession enseignante. Cependant, les conditions et les circonstances dans lesquelles les processus de codification produisent ces effets doivent encore être explorées et clarifiées.

Les théories de la **gestion des savoirs** et de l'**apprentissage organisationnel** - deux concepts fortement liés - ont gagné du terrain dans la littérature pédagogique. Elles plongent leurs racines dans les théories de l'apprentissage situé et du constructivisme social, selon lesquelles le savoir n'est pas une propriété individuelle ni un résultat. Au contraire, le savoir ne peut être interprétée que comme faisant partie des situations dans lesquelles il « a lieu » (Lave et Wenger, 1991[22]). Les travaux de Brown et Duguid sur l'apprentissage organisationnel (Brown et Duguid, 1991[23]) et les recherches de Peter Senge sur les organisations apprenantes (Senge, 1990[24]) sont les deux courants de pensée les plus influents dans ce domaine.

Les théoriciens de l'apprentissage organisationnel soulignent l'importance de l'apprentissage tant individuel que collectif (Wang et Ahmed, 2003[25] ; Senge, 1990[24] ; Argyris et Schön, 1978[26]), et les processus de connaissance jouent un rôle clé dans le développement des organisations apprenantes. En fait, l'apprentissage organisationnel correspond aux changements qui se produisent dans les savoirs et implique l'acquisition, la diffusion, le perfectionnement, la création et la mise en œuvre des savoirs (Wang et Ahmed, 2003[25]). Ikujirō Nonaka et Hirotaka Takeuchi, qui ont étudié les processus de transfert et de création de savoirs dans les entreprises japonaises, ont mis au point le modèle le plus influent (Nonaka et Takeuchi, 1995[27]). Ce dernier présente la création de savoirs comme une spirale à quatre niveaux : d'abord, le niveau individuel, puis en « remontant », les niveaux du groupe et de l'organisation et le niveau interorganisationnel. Le modèle SECI se compose de quatre phases de la « spirale du savoir » : la *socialisation* (comment le savoir tacit est transmis entre les employés), l'*externalisation* (une conversion du savoir tacit en savoir explicit), la *combinaison* (de divers éléments de savoir explicit pour créer un nouveau savoir) et l'*internalisation* (nouveau savoir internalisé par les individus grâce à l' « apprentissage par la pratique ») (Nonaka et Takeuchi, 1995[27]).

Les théories et modèles de gestion s'intéressent essentiellement aux entreprises industrielles qui œuvrent dans un environnement concurrentiel basé sur le marché. S'il existe de nombreuses similitudes dans le fonctionnement des organismes du secteur public, telles que les hôpitaux ou les établissements scolaires, il existe également des différences significatives entre ces secteurs.

Approches sociales : cognition sociale et apprentissage situé

Les théories sociales du savoir peuvent expliquer certains des mécanismes plus complexes, non linéaires et sociaux dont la plupart des approches cognitives et de gestion ne tiennent pas compte. L'idée que l'apprentissage ne peut être séparé de son contexte social est devenue le fondement du constructivisme social (Vygotsky, 1978[28]). Le constructivisme social met l'accent sur la nature collaborative de l'apprentissage, estimant que les fonctions cognitives trouvent leur origine dans les interactions sociales. Dans ce sens, l'apprentissage n'est pas simplement l'acquisition de savoirs, mais plutôt le processus par lequel les apprenants sont intégrés dans une communauté de savoirs. L'accent est mis sur les activités (« apprendre ») plutôt que sur les résultats ou les produits (« savoir ») (Paavola, Lipponen et Hakkarainen, 2004[9]). Les questions fondamentales sont les suivantes : comment peut-on transférer le « savoir » situé et comment les interactions sociales le transforment ? Quelles sont les caractéristiques des collaborations, des communautés, des réseaux sociaux qui réussissent à partager/transférer le savoir ? La recherche relative aux enseignants dans ce domaine comprend l'étude de la collaboration entre enseignants, des communautés de pratique, de l'activité et de l'apprentissage professionnel des enseignants, et des organismes d'apprentissage [voir par ex. (Gherardi, 2008[29])].

Communautés de pratique

Dans le domaine des études fondées sur la pratique, qui explorent le savoir en tant que processus se déroulant au sein de pratiques situées, la théorie de l'apprentissage situé de Lave et Wenger (Lave et Wenger, 1991[22]) et les travaux de Brown et Duguid sur l'apprentissage organisationnel (Brown et Duguid, 1991[23]) figurent parmi les plus influents. Ils ont introduit la notion de *communautés de pratique* (CdP), qui a évolué par la suite et est aujourd'hui integré dans la littérature sur les *communautés d'apprentissage professionnel* (CAP) [par ex., (Stoll et al., 2006, p. 223[30])]. Voir le Tableau 1 pour une comparaison des deux concepts.

Tableau 1. Caractéristiques des communautés de pratique et des communautés d'apprentissage professionnel

	Communautés de pratique (CdP)	Communauté d'apprentissage professionnel (CAP)
Fondement théorique	Cognition située, apprentissage social et gestion des savoirs	Organisation apprenante
Adhésion	Communauté : individus travaillant ensemble vers un objectif commun au sein de l'organisation ; participation volontaire	Communauté : l'ensemble de l'organisation ou un groupe élargi ; l'adhésion se fait en vertu du statut de membre de la faculté
Leadership	Au sein des équipes de collaboration ; leadership distribué avec des leaders formels et informels	L'accent est souvent mis sur le rôle de la direction de l'établissement dans la formation et le fonctionnement des CAP
Culture organisationnelle	Vision commune, accent mis sur la collaboration et la confiance, exception : Le modèle de Brown et Duguid, où la CdP peut constituer une contre-culture pour l'organisation, bien qu'ils appellent à une reconnaissance organisationnelle des CdP	Vision commune, accent mis sur la collaboration et la confiance
Partage des savoirs	Se produit au sein de la communauté, savoir socialement construit, accent mis sur l'aspect social de l'apprentissage	Par le biais de mécanismes tels que l'enquête collective, les réunions et journaux de bord des groupes d'étude, le dialogue réflexif, l'accompagnement par les pairs, etc.

Source : Adapté de (Blankenship et Ruona, 2007[31]).

Les CdP et les CAP sont des concepts utiles pour étudier l'échange social et culturel, et examiner comment se forme la pratique sociale des enseignants. Outre la pratique, ces concepts aident également à comprendre le développement de l'identité professionnelle. Néanmoins, une application conséquente de la littérature sur les CdP dans le domaine de l'éducation déboucherait sur une vision fortement performative, qui proposeraitdes listes de contrôle pour développer des communautés plus performantes (Davenport et Hall, 2002[32]). Ces comptes rendus axés sur la performance comportent le risque d'idéaliser les communautés de pratique et de négliger certaines des tensions inhérentes aux individus et entre eux. Ces tensions pourraient être considérées comme étant nuisibles à la performance de la communauté, alors qu'en réalité, elles peuvent jouer un rôle crucial dans la création de savoirs (Engeström, 2001[33]). Les approches interprétatives plutôt que performatives (Davenport et Hall, 2002[32]) sont plus utiles pour comprendre les processus.

Une autre préoccupation concernant la littérature sur les CdP est qu'elle a tendance à trop se concentrer sur les processus locaux, négligeant le contexte plus large. Bien que certains auteurs se livrent à une analyse des limites des CdP (Davenport et Hall, 2002[32]), la majorité des études restent centrées sur le local et ne tiennent pas compte du réseau plus large dans lequel les CdP sont intégrées, ni de la manière dont celui-ci les influence et les remodèle.

Capital social et théorie des réseaux sociaux

Outre les approches cognitives sociales, la théorie du capital social et des réseaux sociaux est également très pertinente dans l'étude des savoirs et de l'apprentissage des enseignants dans leur environnement social. La théorie du capital social part du principe qu'un investissement dans les relations sociales aura des retombées positives (Lin, 2001[34]). Il y a quatre explications courantes à ce postulat :

1) les relations sociales facilitent le flux d'informations ; 2) les liens sociaux peuvent exercer une influence sur les agents qui jouent un rôle dans les décisions concernant l'individu ; 3) les ressources des liens sociaux peuvent être considérées comme les références sociales d'un individu ; 4) les relations sociales renforcent l'identité et la reconnaissance (Lin, 2001[34]). Lin, Burt, Putnam et d'autres chercheurs ont grandement contribué à conceptualiser la théorie du capital social et à la traduire en une méthodologie de recherche opérationnelle. En parallèle, un certain nombre de chercheurs ont travaillé sur la théorisation des structures sociales.

La théorie émergente des réseaux sociaux a contribué à clarifier les dimensions clés du capital social. En particulier, elle a permis de séparer analytiquement le capital social structurel et le capital social relationnel. Le premier découle de la « position »" qu'occupe un acteur dans un réseau social. Cette position est basée sur les modèles des liens sociaux entrants et sortants que l'individu peut avoir et sur la « structure » globale qui émerge de la configuration des liens dans un réseau(Wasserman et Faust, 1994[35]). Ce dernier, à savoir le capital social relationnel, correspond à la qualité des liens entre les acteurs et à la manière dont ils influencent les relations entre eux (Bourdieu, 1986[36] ; Coleman, 1990[37]) et la manière dont ceux-ci influencent le flux des ressources [dans (Liou et Daly, 2014[38])].

Les approches théoriques de l'étude des réseaux peuvent être classées selon qu'elles visent à comprendre l'impact des réseaux sociaux sur les caractéristiques des individus ou des collectifs, ou inversement : l'impact des caractéristiques individuelles ou collectives sur les réseaux sociaux (Tableau 2) (Borgatti et Halgin, 2011[39]).

Tableau 2. Types de théories sur les réseaux sociaux

	Variable dépendante (résultat)	
Variable indépendante (antécédent)	**Variable hors réseau**	**Variable de réseau**
Variable hors réseau	Pas une théorie des réseaux	Théorie expliquant les conséquences des caractéristiques des réseaux
Variable de réseau	Théorie expliquant les causes des caractéristiques des réseaux	Théorie expliquant les relations entre les caractéristiques des réseaux

Source : Adapté de (Borgatti et Halgin, 2011, p. 1177[39])

La théorie des réseaux sociaux propose une approche pertinente et précieuse pour comprendre comment le contexte social des enseignants influence leurs savoirs et leur apprentissage. La recherche a toujours montré que le degré auquel les savoirs pénètrent dans un réseau (par exemple, le réseau d'apprentissage professionnel des enseignants) et sont partagées et utilisées par les membres dépend largement des caractéristiques du réseau (Baker-Doyle et Yoon, 2011[40]). Une cartographie des caractéristiques existantes du réseau, telles que l'identité des acteurs centraux, la nature des cliques, la manière dont les liens se forment, l'absence de liens, etc., peut utilement éclairer ces efforts. À l'inverse, les caractéristiques du réseau peuvent changer suite à une attention et un effort explicites (Coburn, Choi et Mata, 2010[41] ; Hubers et al., 2017[42]).

Approches sociomatérielles

Historiquement, les approches sociomatérielles se sont développées dans le domaine de la gestion et des théories organisationnelles en s'inspirant fortement des théories sociales. Si les théories de Giddens et de Bourdieu ont eu une grande influence dans ce domaine, c'est la discussion de Bruno Latour sur le savoir et la réalité qui est à l'origine du virage sociomatériel. Latour considère le processus de construction sociale comme un assemblage impliquant à la fois des acteurs humains et non-humains (Kale-Lostuvali, 2016[43]). Les deux principales approches analytiques sociomatérielles - la théorie de l'acteur-réseau (ANT) et la théorie de l'activité historico-culturelle (CHAT) – ont été utilisées pour étudier le savoir et l'apprentissage dans l'éducation. Dans la CHAT, le concept d' « apprentissage expansif » d'Engeström constitue la base d'un modèle de création de savoirs qui diffère de manière fondamentale du modèle de Nonaka et Takeuchi. Il s'appuie sur l'observation que ce que les gens (par exemple les enseignants) apprennent, n'est pas, le plus souvent, quelque chose de fixe et de prédéfini. Ce faisant, Engeström rejette également une conceptualisation de l'apprentissage fondée sur l'acquisition ou la participation, car l'apprentissage implique non seulement la construction de nouveaux objets et concepts, mais aussi la transformation et la création de la culture (Engeström et Sannino, 2010[44]).

Dans ce chapitre, j'ai montré que les théories sociales et sociomatérielles sont pertinentes pour étudier l'apprentissage des enseignants et l'évolution de leurs savoirs, car elles sont ancrées dans leur environnement social et matériel. Ces théories rendent compte des interactions sociales et de leur impact sur les processus de connaissance et d'apprentissage, ainsi que des interactions entre les différents éléments du système, y compris les objets, les technologies ou même les concepts abstraits. Si les travaux sur les CdPs, les CAP, sur les réseaux sociaux et les assemblages sociomatériels ont considérablement amélioré la compréhension des savoirs et de l'apprentissage des enseignants, un certain nombre de questions liées au professionnalisme des enseignants abordées au chapitre 1 doivent également être prises en considération. Il est essentiel de compléter les théories sociologiques par des recherches en éducation qui peuvent aborder les spécificités de l'enseignement et de l'environnement éducatif. En particulier, il est impératif de prendre en compte les différents types et sources de savoirs à l'œuvre dans l'enseignement, ainsi que de reconnaître les différentes échelles des processus de savoir et de les intégrer dans l'enquête.

Données probantes, innovation et réseaux : Trois paradigmes influents pour les savoirs des enseignants

Dans ce chapitre[30], je décris trois paradigmes majeurs et fortement liés entre eux qui ont eu un impact considérable sur l'environnement social et la pratique des enseignants au cours des deux dernières décennies : les données probantes, l'innovation et les réseaux. Je donne un bref aperçu de la recherche qui sous-tend les trois paradigmes, je montre comment ils se manifestent dans les politiques publiques et

[30] Ce chapitre s'inspire de mon travail publié comme document de travail : (Révai, 2020[101]).

j'examine quelles en sont les principales conséquences pour la pratique. Pour traiter de l'émergence de chaque paradigme, je passe en revue la littérature sur le développement des concepts et des modèles qui les reflètent. Je souligne également certains débats ou résultats clés issus de la recherche en éducation. Pour illustrer la manière dont ils ont influencé les politiques éducatives, je m'appuie sur des rapports de l'OCDE et des documents de politiques publiques nationales. Un certain nombre d'exemples provenant de divers pays, dont la France, illustrent la mise en œuvre des politiques publiques, afin de situer la partie empirique de cette thèse dans le contexte. Enfin, pour comprendre ce que les politiques publiques liées aux données probantes, à l'innovation et aux réseaux signifient pour la pratique et l'environnement social des enseignants, j'examine le discours de l'OCDE relatif aux trois paradigmes. Je m'appuie sur l'analyse critique des politiques publiques pour révéler les incohérences entre les discours et les mesures de politiques publiques (programmes) (Diem et al., 2014[45]).

Paradigme 1 : la pratique fondée sur des données probantes

Une question prédominante qui ressort de la réflexion sur les professions et la professionnalisation de l'enseignement est celle de la pratique fondée sur des preuves. L'idée centrale de la littérature sur les professions et le professionnalisme - l'absence d'un socle de connaissances systématique et solide qui puisse constituer de manière cohérente le fondement scientifique de la pratique de l'enseignement – s'accorde bien avec les programmes politiques performatifs. C'est la conférence phare de Hargreaves en 1996 (1996[46]) qui a jeté les bases du paradigme de la profession fondée sur la recherche. L'hypothèse selon laquelle la recherche a le potentiel d'améliorer la qualité de la pratique de l'enseignement et donc d'améliorer l'apprentissage des étudiants, s'est répandue dans la recherche et les politiques publiques de l'éducation. Dans cette optique, le renforcement du lien entre la recherche et la pratique est désormais considéré comme un levier fondamental pour concrétiser la promesse du modèle fondé sur les données probantes. (Levin, 2011[47] ; OECD, 2000[12] ; OECD, 2007[48] ; Dumont, Istance et Benavides, 2010[49]).

Le modèle fondé sur les données probantes a des implications tant pour le programme de recherche et les chercheurs que pour les professionnels. Premièrement, la recherche en éducation devrait produire des données probantes pour la pratique, à partir d'une méthodologie rigoureuse et de manière cumulative. Deuxièmement, les enseignants, en tant que praticiens professionnels, devraient accéder à ces données cumulées et les assimiler en permanence grâce à la formation initiale et au développement professionnel. Les discussions, enquêtes et initiatives politiques qui ont suivi se sont donc concentrées sur deux éléments fortement corrélés :

1. Qu'est-ce qu'une « bonne donnée probante » et comment pouvons-nous la produire ?

On peut distinguer trois types d'attitudes à l'égard de la pratique fondée sur les données probantes ou éclairée par les preuves. Premièrement, les « partisans purs et durs » de la pratique fondée sur des données probantes, qui croient en la primauté des essais randomisés contrôlés (ERC), à la possibilité de leur application directe dans la pratique de l'enseignement et à l'impact positif irréfutable de ce type de données sur l'enseignement et l'apprentissage (Goldacre, 2013[50] ; Hargreaves, 1996[46]). Deuxièmement,

les « sceptiques », qui rejettent la pertinence des données probantes et de la recherche dans le domaine de la pratique et remettent en question la légitimité de la théorie et de la recherche en éducation pour les enseignants (Biesta, 2007[51] ; 2010[52] ; Hammersley, 2005[53]). Enfin, on trouve ceux qui se situent au milieu les « justes milieux », qui adoptent une interprétation plus large et généralement davantage orientée vers la pratique de la recherche en éducation, et qui plaident en faveur d'une « pratique étayée par la recherche », c'est-à-dire qu'ils estiment que la façon dont cette recherche modèle les attitudes et les décisions des enseignants est utile et importante pour la pratique de l'enseignement (Kvernbekk, 2015[54] ; Winch, Oancea et Orchard, 2015[7]). En dehors des « sceptiques », les chercheurs en éducation se sont intéressés à l'exploration des processus grâce auxquels la recherche peut appuyer ou informer la pratique de l'enseignement.

2. Comment faciliter la mobilisation des savoirs, c'est-à-dire l'appropriation de la recherche par les enseignants ?

L'objectif ultime en termes de savoirs des enseignants dans ce paradigme est d'établir des mécanismes efficaces permettant de diffuser les données probantes et d'aligner les pratiques d'enseignement sur celles-ci à grande échelle. Le modèle de la pratique fondée sur les données probantes a engendré un riche domaine d'études portant sur la dynamique des savoirs qualifiée de noms différents : transfert de connaissances, diffusion, échange, mise en pratique des savoirs, mobilisation des savoirs, entre autres (Levin, 2008[55]). La compréhension de la mobilisation des savoirs s'éloigne de plus en plus des interprétations linéaires du transfert de connaissances pour l'interpréter comme un processus dynamique et itératif impliquant des interactions sociales, des boucles de rétroaction et la co-création (Campbell et al., 2017[56] ; Best et Holmes, 2010[57]). Dans ce modèle, les chercheurs et les résultats de la recherche ne sont pas les seuls à faciliter le changement systémique. Au contraire, tous les acteurs du système façonnent le processus de création, de synthèse et d'application des savoirs par le biais de leurs interactions, leur collaboration et leur -cocréation. (Van De Ven et Johnson, 2006[58] ; Van De Ven, 2007[59]). Néanmoins, les associations linéaires dominent encore souvent le discours sur la politique de l'éducation et caractérisent certaines des pratiques existantes (Fenwick et Farrell, 2017[60]).

Le débat sur la pertinence de la recherche pour les enseignants et son utilisation a donné lieu à divers « sous-paradigmes », tels que les pratiques fondées sur des données probantes, éclairées par des données probantes, étayée par la recherche ou inspirées par la recherche. Ceux-ci ont été repris par un certain nombre de politiques publiques nationales et ont figuré dans les discours internationaux, exerçant des pressions apparemment contradictoires sur les enseignants, les établissements scolaires et les systèmes éducatifs. Les approches plus souples considèrent la recherche et l'utilisation de données probantes comme faisant partie de la construction de nouveaux savoirs qui intègrent des savoirs professionnels-pratiques et des savoirs issus de la recherche formelle.

Paradigme 2 : l'innovation

Alors que les services publics prennent le virage managérial et performatif (« new public management »), une autre question s'invite dans les politiques de l'éducation : « l'impératif d'innovation ». La production et le développement de l'innovation sont devenus des exigences prépondérantes dans les services éducatifs. L'innovation étant étroitement liée au savoir, et plus particulièrement à la création de savoirs, cet impératif politique est un élément contextuel important dans cette thèse.

Malgré un intérêt croissant et l'élargissement des champs d'application, il n'existe pas à ce jour de noyau théorique commun qui sous-tende la littérature sur l'innovation (Lundvall, 2013[61]). Lundvall identifie trois grands courants dans la recherche sur l'innovation :

- un volet évolutif qui vise à poser les bases pour mieux comprendre le changement économique en étudiant les moteurs de l'innovation et ce qui la freine, ainsi que les agents générateurs d'innovation
- une approche technico-économique axée sur les conditions permettant de tirer profit de l'innovation dans l'industrie et les autres secteurs
- une théorie socio-économique de l'innovation qui vise à comprendre l'innovation en étudiant les acteurs impliqués et la façon dont ils interagissent dans le processus d'innovation (Lundvall, 2013[61]).

Alors que les premières recherches sur l'innovation étaient axées sur les investissements dans la recherche et le développement (R&D) et la diffusion des connaissances scientifiques, au cours des deux dernières décennies, l'innovation a été de plus en plus considérée comme une fonction d'apprentissage et de création de savoirs (Ellström, 2010[62]). Lundvall propose que les futures recherches se concentrent sur la relation entre l'innovation et l'apprentissage, également l'un des sujets les plus important , et il considère que la théorie socio-économique est la mieux adaptée à cet objectif (Lundvall, 2013[61]).

Dans la plupart des modèles fondés sur la pratique, l'innovation prend racine dans un problème ou une question pratique et est comprise comme un processus de résolution de problèmes visant à améliorer la pratique de l'enseignement (Paniagua et Istance, 2018[63] ; Melkas et Harmaakorpi, 2012[64]). Des procédures et des méthodes spécifiques ont été développées pour engager les enseignants et les écoles dans un processus d'innovation. Il s'agit notamment de la recherche-action ou de la recherche par les praticiens, de l'enquête collaborative et de la recherche fondée sur la conception. Les enseignants intègrent diverses sources de savoirs dans le processus d'innovation (Earl et Timperley, 2015[65]). Ils mobilisent les savoirs existants et facilitent les processus de transfert entre les dimensions tacite et explicite de la connaissance. Le cycle d'innovation (Earl et Timperley, 2015[65] ; Engeström et Sannino, 2010[44]) comprend généralement la conception de nouveaux matériaux, méthodes ou processus qui sont ensuite testés. Au cours de cette phase, les savoirs mobilisés sont discutés et négociés permettant la création de nouveaux savoirs. Les observations et l'analyse des données pendant l'essai ajoutent au processus de création de savoirs et peuvent conduire à une modification du produit ou du processus

d'innovation. Les connaissances sont ensuite consolidées et peuvent être généralisées. Rendre publics ces savoirs créés localement et les rendre accessibles à ceux qui ne font pas partie de la communauté professionnelle au sein de laquelle ils ont été produits demande de faire l'effort de les diffuser.

Un important corpus de recherche dans le volet socio-économique explore la **diffusion de l'innovation**. La diffusion est « le processus par lequel une innovation est communiquée par certains canaux au fil du temps parmi les membres d'un système social » (Rogers, 1962, p. 5[66]). Dans ses premières interprétations, la diffusion était principalement perçue comme un processus linéaire de transmission d'informations d'une source à un récepteur. Rogers (1962[66]) décrit la diffusion comme un modèle de convergence, dans lequel la communication implique la création et l'échange d'informations entre les participants pour parvenir à une compréhension mutuelle. Le volet de recherche socio-économique et la théorie de la diffusion ont élargi le concept d'innovation en y intégrant la perspective des adoptants et en faisant du savoir un élément central. En ce sens, le savoir est également le résultat de l'innovation créée à la suite du processus d'innovation. Dans cette perspective, l'innovation et le savoir sont devenus intimement liés, rendant indissociable l'étude des processus de savoir et d'innovation.

À mesure que la recherche sur l'innovation dans le secteur public s'est développée au cours des dernières décennies, l'**intérêt politique** s'est accru. À tel point qu'ile est rapidement devenu un « impératif d'innovation » dans le contexte politique, ce qui se reflète à la fois dans les discours politiques nationaux et dans le travail des organisations internationales depuis le début des années 2000. L'impératif d'innovation incite les enseignants à remettre continuellement en question leur routine quotidienne, à expérimenter de nouvelles idées et à les partager au sein de leur établissement et entre établissements. En raison de cet impératif d'innovation, on attend également des établissements scolaires qu'ils créent les conditions pour innover. Cependant, mon analyse critique des discours politiques a révélé un certain nombre d'antagonismes au sein des politiques éducatives, qui font en sorte que les attentes envers les acteurs éducatifs sont controversées. Je développe deux de ces antagonismes en particulier :

- Autonomie professionnelle par opposition à contrôle central pour l'innovation
- L'innovation pour explorer et résoudre des problèmes par opposition à l'innovation pour mettre en place des « méthodes d'enseignement modernes/efficaces ».

Les études sur l'impact des politiques d'innovation axées sur l'impératif de changement ont montré que ces politiques peuvent être contre-productives. Elles peuvent conduire à l'innovation en soi, alors qu'en réalité elles constituent un frein au changement (Paniagua et Sánchez-Martí, 2018[67]).

Paradigme 3 : les réseaux

Alors que la théorie des réseaux sociaux considère les réseaux comme une lentille analytique, dans le paradigme des réseaux, ces derniers sont compris comme étant des formes d'organisations telles que les partenariats inter-organisationnels entre établissements scolaires ou les réseaux d'apprentissage professionnel des enseignants. Le paradigme du réseau est fortement lié aux deux premiers paradigmes

décrits ci-dessus. Les documents de politiques publiques nationales (par ex., en Angleterre) et les organisations internationales (par ex., la Commission européenne, l'OCDE) considèrent souvent les réseaux dans l'éducation comme des structures normatives. Ils sont vus comme les moteurs de la diffusion de l'innovation, ou comme le « méso-niveau fondamental de la mise à l'échelle de l'innovation » (OECD, 2003[68] ; 2013[69]). On pense également qu'ils jouent un rôle central dans la mobilisation des savoirs et, à ce titre, qu'ils peuvent faciliter la mise en œuvre de pratiques fondées sur des données probantes dans l'éducation.

Un nombre croissant de recherches a contribué à remettre en question et à approfondir le discours positif général qui a entouré les réseaux ces dernières années. Un examen systématique a montré que l'impact des réseaux sur l'implication et l'apprentissage des élèves, ainsi que sur les compétences, les savoirs et les pratiques des enseignants, fluctuait (CUREE, 2005[70]). On a observé des effets positifs dans les établissements scolaires, dans le développement de communautés d'apprentissage professionnelles, sur les performances et le climat scolaires, dans l'amélioration des compétences en matière d'adaptation des nouvelles idées, dans les changements dans l'organisation des établissements et des classes, et sur les structures de gestion (Muijs et al., 2011[71] ; CUREE, 2005[70]).

Si les réseaux semblent avoir un impact positif dans un certain nombre de dimensions, la plupart des études et des examens soulignent que l'ampleur de cet impact peut varier considérablement. Elles mettent également en évidence un certain nombre de conditions relatives à l'efficacité des réseaux, que j'ai regroupées en fonction des caractéristiques des réseaux :

- Objectifs du réseau : avoir des objectifs communs spécifiques axés sur l'enseignement et l'apprentissage; placer l'apprentissage professionnel au centre
- Liens de réseau : établir et maintenir des relations solides et de qualité fondées sur la confiance ; impliquer les parties prenantes concernées ; s'appuyer sur des connaissances et des compétences externes
- Gouvernance et leadership du réseau : Leadership et facilitation distribués ; coordination et gouvernance
- Capacité de mise en réseau : développer des compétences en matière de collaboration, de facilitation et de courtage
- Structures et ressources du réseau : disposer de ressources adéquates, tant financières qu'en termes de temps
- Le contexte du réseau : prise en compte du contexte du réseau (Muijs et al., 2011[71] ; CUREE, 2005[70] ; Rincón-Gallardo et Fullan, 2016[72]).

Comme les deux paradigmes précédents, l'impératif de collaboration et de réseau génère également de nouvelles responsabilités et engendre des pressions sur les enseignants et les établissements. Le contexte politique plus large dans lequel les réseaux opèrent peut susciter des attentes

contradictoires, dont les quatre suivantes : 1) entre la centralisation et les hiérarchies d'une part, et les solutions développées localement qui répondent aux besoins locaux d'autre part ; 2) entre la concurrence et la collaboration ; 3) entre la responsabilité externe et la collaboration et l'innovation locales ; 4) entre la complexité des attentes et les ressources disponibles.

Dans ce chapitre, j'ai voulu illustrer l'importance de trois éléments pour l'environnement social des enseignants aujourd'hui : les données probantes, l'innovation et les réseaux. Tous trois ont été omniprésents dans les politiques publiques nationales, les discours internationaux ainsi que dans la recherche en éducation. Bien que les trajectoires politiques de chacun d'entre eux mériteraient une analyse plus approfondie (un thème pour une autre thèse), cette discussion a permis de mettre en lumière à la fois les liens entre ces trois éléments, ainsi que les diverses tensions qu'ils génèrent dans la pratique.

Si les données probantes, l'innovation et les réseaux ont été présentés séparément, il apparaît clairement dans la discussion que ces trois domaines sont fortement liés, en particulier en ce qui concerne les savoirs et l'apprentissage des enseignants. Premièrement, l'évolution des savoirs des enseignants relie les données probantes et l'innovation. Deuxièmement, les réseaux incarnent souvent le contexte des données probantes et de l'innovation. Pour étudier les savoirs et l'apprentissage des enseignants, ces liens doivent être bien compris et servir de base conceptuelle.

Une autre conclusion importante est que ces trois sujets sont la cause de discours politiques ambigus et contradictoires. L' « agenda politique » qui en résulte, c'est-à-dire l'ensemble des réformes envisagées selon une trajectoire globale souhaitée , qui peuvent s'avérer incohérentes et contradictoires, ont des conséquences pour les enseignants, les établissements et le système scolaires (Greany et Higham, 2018[73]). Les principales tensions suivantes se dégagent :

- Une poussée vers une pratique fondée sur les données probantes et l'innovation en même temps. Bien que la recherche ait démontré le lien étroit qui existe entre les deux, ils ne sont pas souvent bien conceptualisés et s'opposent dans les politiques publiques.
- Une incitation à l'innovation locale, à la collaboration et à la mise en réseau dans un contexte mondial de forte responsabilisation, de normalisation et de concurrence.

En résumé, pour comprendre les processus de connaissance et d'apprentissage des enseignants tels qu'ils sont intégrés dans l'établissement en tant qu'organisation et dans le contexte social plus large, il faut prendre en compte les trois paradigmes et conceptualiser clairement les liens entre eux.

Cadre théorique et conceptuel et questions de recherche

Dans les trois premiers chapitres, j'ai présenté les fondements théoriques de l'étude sur les savoirs et l'apprentissage des enseignants, et j'ai mis en évidence les diverses tensions causées par les discours dominants sur le professionnalisme et les savoirs des enseignants. Un certain nombre de conclusions et de questions qui ont émergé doivent être prises en compte pour les besoins d'une étude sociologique.

Dans ce chapitre, je développe un cadre conceptuel approprié pour l'étude empirique des savoirs des enseignants. Je discute ensuite des fondements théoriques de ce cadre et de la manière dont les domaines pertinents de la recherche sociale et pédagogique peuvent être intégrés pour former un fondement théorique cohérent. Enfin, je formule les principales questions de recherche pour les besoins d'une étude sociologique sur les savoirs.

Cadre théorique et conceptuel

L'examen comparatif des théories et les analyses critiques des politiques menées dans les trois premiers chapitres constituent le fondement du cadre théorique pour étudier les savoirs professionnels des enseignants et leur transformation dynamique. Pour répondre aux principaux objectifs de cette thèse énoncés dans l'introduction, le cadre théorique doit satisfaire trois critères. Il doit :

- saisir la complexité des savoirs professionnels en lien avec la pratique de l'enseignement
- prendre en compte le contexte et les processus sociaux dans lesquels s'inscrivent les savoirs et les pratiques des enseignants
- tenir compte de l'environnement politique des systèmes éducatifs dans lesquels opèrent les établissements et les enseignants.

Mon étude empirique doit s'appuyer sur des théories qui conviennent à une étude sociologique sur le savoir et l'apprentissage. Dans la section suivante, je souligne le fondement théorique de ma recherche.

À partir des conceptualisations sociologiques des savoirs professionnels (Brante, 2010[4] ; Bernstein, 1999[5]), des théories de l'éducation (Winch, Oancea et Orchard, 2015[7]) et des concepts en sciences cognitives, j'examine deux composantes principales des **savoirs professionnels** :

- le savoir « théorique-scientifique » est associé à une connaissance déclarative, explicite, exprimée dans des discours verticaux.
- Le savoir « fondé sur la pratique »" ou le savoir « pratique » englobe des interprétations contextuelles, des savoirs techniques et une réflexion critique. Il peut s'exprimer dans des discours verticaux et horizontaux, et peut se rapporter à des dimensions explicites et tacites.

La distinction entre les différents aspects, formes et dimensions du savoir est importante car mon étude porte sur la transformation du savoir, qui implique une dynamique entre ces dimensions.

Pour conceptualiser la **dynamique des savoirs** en accord avec ma conceptualisation des savoirs professionnels, je m'appuie sur des approches sociomatérielles telles que les travaux de Nerland et Jensen (2012[74]) et des modèles de création de connaissances dans la recherche socio-matérielle (comme l'apprentissage expansif d'Engeström). Je les complète avec des modèles de diffusion reposant également sur des théories sociales. Je distingue deux types principaux de dynamique du savoir dans l'espace-temps.

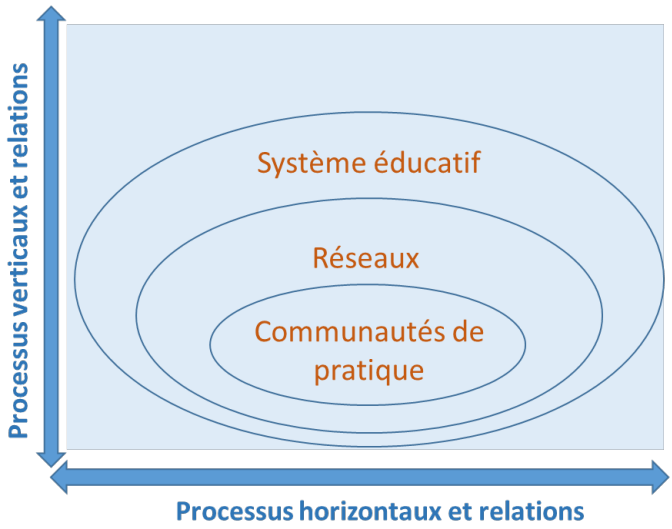
La *dynamique structurelle* fait référence aux interactions entre les différentes sources et divers types de savoirs. Il s'agit notamment de : la dynamique entre les formes explicites et implicites de connaissances, et la dynamique entre les savoirs théoriques-scientifiques (fondées sur la recherche) et les savoirs fondées sur la pratique.

La *dynamique fonctionnelle* fait référence à « ce qui arrive au savoir » en terme d'objectif (fonction) de son évolution. Je distingue les dimensions suivantes :

- Construction (ou création, ces termes étant utilisés de manière interchangeable) de savoirs : l'émergence de nouveaux savoirs lorsque les enseignants (potentiellement avec d'autres acteurs) s'impliquent dans un processus de recherche (innovation), mobilisent les sources de savoirs existantes, négocient la signification et construisent de nouvelles pratiques pour répondre à des problèmes particuliers.
- Mobilisation des savoirs : les enseignants accèdent aux sources de connaissances internes et externes, les interprètent et les évaluent, pour lestransposer dans leur environnement.
- Diffusion des connaissances : la propagation de nouveaux savoirs dans une communauté ou un réseau plus large, y compris par un effort conscient et intentionnel (diffusion des connaissances) et par la diffusion non intentionnelle (Greenhalgh et al., 2004[75]).
- Intégration des savoirs : la consolidation et la systématisation conscientes des nouveaux savoirs construits localement dans différentes communautés ou réseaux, et leur incorporation dans une base de connaissances accessible au public (Enthoven et de Bruijn, 2010[76]).

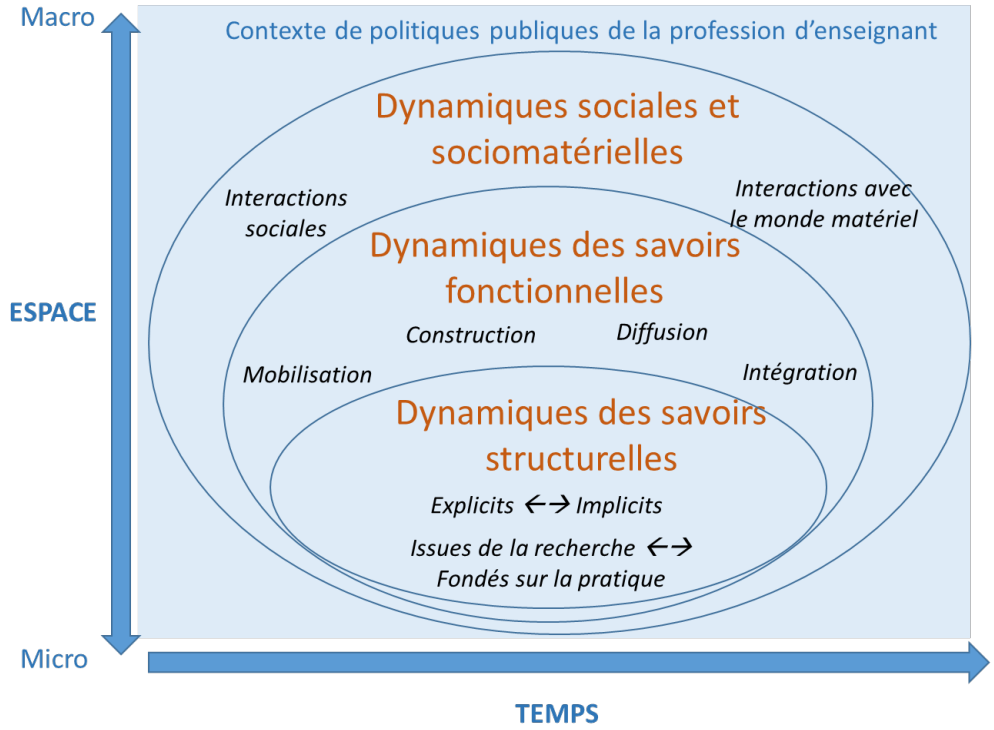
Afin d'explorer les **dynamiques sociales** par lesquelles les connaissances des enseignants se transforment, je m'appuie sur la théorie des réseaux sociaux et les recherches sur les réseaux en tant que formes d'organisations, et je définis trois niveaux sociaux (Graphique 1). Premièrement, l'environnement social immédiat des enseignants, leur(s) communauté(s) de pratique, qui est le plus souvent, mais pas nécessairement (!), située au sein de l'organisation scolaire. Deuxièmement, le réseau élargi, qui implique de franchir des frontières de différents types - institutionnelles, professionnelles, épistémologiques. Troisièmement, l'environnement social du système éducatif, notamment les autorités locales, régionales et nationales ainsi que les institutions et organismes éducatifs (par exemple, l'Inspection, les institutions de formation des enseignants). En outre, je tiens compte des relations et des processus tant horizontaux que verticaux.

Graphique 1. Les trois niveaux de la dynamique sociale



En regroupant les éléments conceptuels développés ci-dessus - savoirs professionnels, dynamique des savoirs et dynamique sociale - je propose un cadre conceptuel (Graphique 2) qui considère la dynamique des savoirs des enseignants par le biais de deux dimensions : le temps et l'espace. La dimension temporelle capte l'émergence, la transformation et l'évolution constantes des savoirs. L'espace correspond aux différents niveaux sociaux où se déroulent les processus de connaissance : de l'enseignant individuel, des dyades, des petits groupes et des communautés au sein d'un établissement (micro) en passant par les communautés et réseaux plus larges (méso) pour finir au niveau régional ou national des systèmes éducatifs (macro). L'espace comprend également l'environnement matériel des enseignants, comme les objets et les technologies dans la salle de classe, l'établissement et le monde matériel au sens large.

Graphique 2. Cadre conceptuel de la dynamique des savoirs des enseignants



Dans ce cadre, la dynamique structurelle se produit par le biais de la dynamique fonctionnelle, et que la dynamique sociale lie les processus de connaissance tant structurels que fonctionnels.

Questions et hypothèses de recherche

Le savoir se transforme et évolue en tant que résultat des dynamiques sociales et sociomatérielles. Par conséquent, sur le plan analytique, la question principale consiste à comprendre les relations entre les dynamiques sociales et sociomatérielles, d'une part, et les dynamiques structurelles et fonctionnelles de la connaissance, d'autre part.

Question de recherche 1 : Comment pouvons-nous caractériser la dynamique des savoirs des enseignants ?

Compte tenu du cadre conceptuel de la dynamique des savoirs présenté ci-dessus, la première question d'ordre général de la recherche porte sur la manière dont les enseignants mobilisent et construisent les savoirs, sur la manière dont ceux-ci sont diffusés (y compris la dissemination intentionnelles et la diffusion pas forcément intentionnelles) et sur la manière dont les nouveaux savoirs sont intégrés dans une socle de connaissances publique plus large.

Hypothèse 1.1 : La mobilisation, la construction et la diffusion des savoirs sont étroitement liées.

La recherche sur l'innovation fondée sur la pratique suggère que différents processus de savoir concourent en parallèle et se complètent. Cette hypothèse repose sur l'idée qu'il est possible de mesurer

les différents aspects de la dynamique des savoirs et de montrer la variété et les niveaux de mobilisation, de construction et de diffusion des savoirs dans lesquels les enseignants s'impliquent.

Question de recherche 2 : Comment la dynamique sociale influence-t-elle la dynamique des savoirs des enseignants ?

Il faut encore s'efforcer de bien comprendre comment les différentes caractéristiques et mécanismes du réseau influencent la dynamique des savoirs des enseignants. Pour chaque dimension du réseau, on peut se demander comment ses différents aspects - contexte, caractéristiques et dispositifs - sont liés à la manière dont les enseignants mobilisent et construisent les savoirs, à la manière dont ceux-ci sont diffusées au sein et au-delà du réseau.

Hypothèse 2.1 : Le réseau et la culture organisationnelle sont des facteurs importants pour faciliter les processus sociaux.

Le contexte global du réseau, notamment son leadership, la collégialité par rapport à la concurrence, l'horizontalité par rapport aux hiérarchies, sont des facteurs déterminants pour l'intensité et la gamme des processus sociaux dans lesquels les acteurs s'impliquent. Le leadership de l'établissement scolaire et du réseau peut s'avérer particulièrement important dans la création de cultures qui favorisent la dynamique des savoirs.

Hypothèse 2.2 : Les structures sociales et la nature des liens sociaux dans un réseau influencent la dynamique des savoirs.

Les caractéristiques spécifiques du réseau, sa structure, les attributs de ses membres et la nature des liens entre eux peuvent influencer la dynamique des savoirs de façons diverses. Une certaine connaissance de la structure et des liens sociaux peut conduire à une construction plus intense des savoirs et en faciliter la diffusion.

Hypothèse 2.3 : Les processus et dispositifs sociaux et l'implication des acteurs à leur égard influencent la dynamique des savoirs.

On suppose que des processus sociaux plus intensifs influencent positivement les niveaux de mobilisation et de construction des savoirs des enseignants. Les dispositifs de réseau, c'est-à-dire la gamme d'activités, d'outils et de technologies à l'œuvre, peuvent influencer la dynamique des savoirs des enseignants. Par exemple, la recherche-action ou l'enquête collaborative sont des technologies sociales qui peuvent faciliter le mélange de différents types et sources de savoirs.

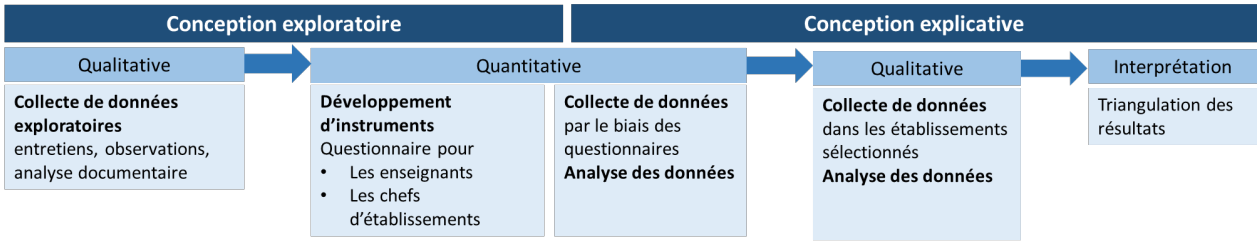
Conception de l'enquête, méthodologie et données

Conception de l'enquête

Afin de mieux comprendre la dynamique des savoirs des enseignants, j'ai utilisé une étude à méthode mixte, combinant des éléments quantitatifs et qualitatifs. J'ai combiné une **conception**

exploratoire et une **conception explicative** comme deux conceptions de méthode mixte. L'élaboration d'instruments appropriés nécessite une phase exploratoire (Creswell et Plano Clark, 2011[77]) qui implique d'identifier des instruments existants pertinents et de réaliser une recherche exploratoire qualitative pour comprendre le contexte et déterminer les domaines et questions qui conviennent. Une conception explicative a fait suite à l'élaboration des instruments, dans laquelle les données quantitatives obtenues par le biais de questionnaires ont été la principale source d'analyse, et les données qualitatives ont servi à expliquer les résultats quantitatifs initiaux (Creswell et Plano Clark, 2011[77]). Le plan de recherche figure dans le Graphique 3.

Graphique 3. Conception de l'enquête



Le fait de limiter l'enquête à un seul contexte permet d'étudier ces nouveaux concepts dans un domaine relativement homogène, réduisant ainsi les risques que les différences dans la dynamique des savoirs résultent essentiellement de différences de contexte, plutôt que de différences dans les caractéristiques particulières du réseau que nous voulons étudier. Par conséquent, l'enquête empirique cible les enseignants et les établissements scolaires d'une région de France. J'ai choisi la région de Bel-Mondo (Académie de Bel-Mondo) pour l'application de l'enquête empirique, car l'autorité régionale (rectorat) a mis en place un réseau innovant, appelé EDUNET, depuis 2013. Ce réseau offre des possibilités d'étudier différents aspects de la dynamique des savoirs en raison de ses objectifs multiples.

Volet quantitatif : l'enquête sur la dynamique des savoirs

Cette section aborde le processus de **conception de l'enquête** tel que décrit par Groves et ses collègues (2004[78]). La composante quantitative comporte deux questionnaires : l'un destiné aux enseignants, l'autre aux chefs d'établissement de la région de Bel-Mondo, en France. Le questionnaire destiné aux enseignants ciblait l'ensemble de la population des enseignants des établissements publics de l'académie de Bel-Mondo, y compris ceux des écoles maternelles, primaires, collèges et lycées de tous types. De même, le questionnaire destiné aux chefs d'établissement ciblait tous les directeurs d'école de l'académie de Bel-Mondo, de la maternelle au lycée, ainsi que les inspecteurs de l'éducation nationale (IEN) qui, en France, sont chargés de la gestion des établissements de l'enseignement primaire. Le Tableau 3 résume les dimensions qui ont été retenues à des fins de mesure dans cette recherche à partir du cadre conceptuel.

Tableau 3. Dimensions à mesurer dans les instruments destinés aux enseignants et aux chefs d'établissement

Composants	Dimensions	Enseignants	Chefs d'établissement
Dynamique des savoirs	Mobilisation des savoirs	X	
	Construction du savoir	X	
	Diffusion des savoirs	X	
Réseau	Contexte du réseau	X	X
	Liens de réseau	X	X
	Dispositifs de réseau	X	X
Conditions d'organisation et de réseau	Ressources	X	X
	Culture	X	X

La phase exploratoire a permis d'élaborer les instruments quantitatifs. Elle a consisté en une recherche documentaire, des données collectées par le biais d'entretiens semi-structurés et de groupes de discussion avec les principales parties prenantes de ce réseau, ainsi que par le biais de l'observation des événements du réseau. Les questionnaires ont été élaborés à partir d'instruments pertinents existants identifiés par la recherche documentaire et la recherche exploratoire. Le développement s'est appuyé sur une méthodologie d'enquête (de Leeuw, Hox et Dillman, 2008[79]) et a nécessité un examen par différents acteurs.

La **collecte de données** s'est faite par le biais de questionnaires en ligne, en trois vagues, entre mai 2019 et janvier 2020. Un test ANOVA effectué sur toutes les variables de contenu a montré que les ensembles de données sur les enseignants et les chefs d'établissement peuvent être considérés comme un seul ensemble de données chacun. Le traitement des données comprenait le nettoyage des données, le traitement des non-réponses - les réponses vides et les « abandons précoces » [31]ont été supprimés - et une analyse des variables démographiques. Le Tableau 4 présente l'échantillon final. J'ai procédé à une analyse détaillée de ce dernier afin de vérifier la représentativité de la population (géographique, niveau scolaire, sexe et expérience) tant en termes de répondants que d'établissements.

[31] Les répondants qui n'ont rempli que les variables de fond et démographiques, mais n'ont répondu à aucune des questions de contenu.

Tableau 4. Fréquence et taux de réponse

	Nombre total de réponses enregistrées dans Limesurvey	Nombre de réponses vides (valeurs manquantes pour toutes les variables)	Nombre d'abandons précoces (qui n'ont répondu à aucune question de contenu, seulement aux variables démographiques)	Nombre de réponses analysées (Total - Vide - Abandons précoces)	Population complète visée*	Taux de réponse XXX / Population totale
Enseignants - Total	532	133	100	295**	18870	1.6%
Chefs d'établissement Total	567	124	111	332	1905	17%

Note : * d'après les statistiques régionales de 2018, enseignants du niveau pré-primaire, primaire et secondaire.
** Quatre aberrations démographiques ont également été supprimées.
Source : Les données relatives à la population sont tirées des statistiques régionales de 2018 : (Académie de Bel-Mondo, 2019[80]).

Méthodes d'analyse

Dans cette section, je présente les principales méthodes d'analyse des données quantitatives. Tout d'abord, pour le choix des méthodes appropriées, j'examine les échelles de Likert afin de déterminer si on peut les considérer comme des variables d'intervalle en fonction de la littérature méthodologique, et je justifie mon choix d'utiliser principalement des statistiques non paramétriques pour les échelles d'accord-désaccord, et des statistiques paramétriques pour les échelles de fréquence.

Afin d'examiner si les constructs définis pour caractériser les différentes dimensions de la dynamique des savoirs sont bien reflétés dans le questionnaire, j'effectuerai une analyse des items à l'aide de statistiques descriptives, une analyse des échelles et un test de la validité structurelle des échelles à l'aide d'une analyse factorielle. J'explique mon choix de suivre la recommandation de Gerbing et Hamilton (Gerbing et Hamilton, 1996[81]) d'utiliser l'analyse factorielle exploratoire AFE comme étape préliminaire et l'analyse factorielle confirmatoire (AFC) comme deuxième étape pour examiner le modèle et parfaire l'ajustement si nécessaire. Comme tous les items sont de type échelle de préférence (mesurés sur des échelles à 5 et 4 points), j'ai choisi les options d'analyse qui conviennent le mieux aux données ordinales. L'analyse factorielle s'appuie sur des corrélations polychoriques (Muthén, 1993[82]) avec l'estimateur des moindres carrés pondérés par la diagonale (DWLS), spécialement développé pour les données non normales et les échantillons de petite taille (Gana et Broc, 2019[83]). J'ai ajusté les modèles en utilisant la version 0.6-6 de laavan (Rosseel, 2012[84]) dans la version 4.0.2 de R (R Core Team, 2020[85]). Je présente trois statistiques de qualité d'ajustement : l'indice comparatif d'ajustement (CFA), le résidu de la racine quadratique moyenne normalisée (SRMR) et l'erreur quadratique moyenne d'approximation (RMSEA) avec des intervalles de confiance de 90 % (Hu et Bentler, 1999[86] ; Byrne, 2005[87]). Pour la fiabilité des échelles, j'utilise le package psych de R pour calculer les valeurs alpha ordinales.

Pour examiner les relations entre différents constructs, j'utilise la modélisation par équations structurelles (MES), qui permet de quantifier la dépendance de certaines variables ou constructs sur d'autres en combinant l'AFC et les régressions linéaires (Schreiber et al., 2006[88]). L'approche MES convient à une recherche exploratoire, car elle permet d'identifier des relations multiples entre des constructs complexes. J'ai choisi d'utiliser une approche en deux étapes (d'abord CFA puis MES) en raison de la nature exploratoire de ma recherche et de la petite taille de l'échantillon.

Analyse des réseaux sociaux

L'analyse des réseaux sociaux permet de bien comprendre les relations sociales entre les individus ou les organisations, et fournit un outil pour leur analyse approfondie. En élaborant le questionnaire sur les réseaux sociaux destiné aux chefs d'établissement, j'avais pour objectif initial de mettre en œuvre une approche du réseau entier et de recueillir des données sur les liens entre les établissements scolaires auprès de tous les chefs d'établissement de la région, de la maternelle au deuxième cycle du secondaire. Pour cartographier les relations d'un établissement avec d'autres établissements, j'ai opté pour un modèle à choix fixe, dans lequel les chefs d'établissement ont été invités à sélectionner un maximum de cinq autres établissements (d'après une liste de tous les établissements) avec lesquels ils ont collaboré sur des projets pédagogiques au cours des deux dernières années. Cependant, l'analyse du réseau entier nécessite un taux de réponse très élevé (75 %) (Borgatti, Carley et Krackhardt, 2008[89]), par conséquent, seule, l'analyse du réseau *égocentré* était possible avec mes données. Dans cette section, je démontre que les données se prêtent à une telle analyse.

En me basant sur le livre *Social network analysis for Ego-nets* de Crossley et ses collègues(Crossley et al., 2015[90]), je traite des différents types de mesures de réseaux égocentrés adaptés à mes données. Il s'agit notamment de la tendance centrale des liens, de la dispersion des liens, de la tendance centrale des alters, de la dispersion des alters et des mesures de similarité entre ego et alter.

Composante qualitative

J'ai choisi une approche d'étude de cas multiples (Creswell et Plano Clark, 2011[77]) à cette fin, car elle permet d'explorer les questions de recherche – de caractériser la dynamique des savoirs des enseignants et leurs relations avec les processus sociaux - au sein d'un établissement. Avec les données collectées, il était impossible d'obtenir un échantillonnage intentionnel des participants basé sur des résultats quantitatifs, j'ai donc sélectionné des établissements présentant des niveaux plus élevés de dynamique des savoirs en fonction de la recommandation de l'Académie et de l'analyse des documents disponibles.

En raison de la pandémie de covid-19 (la France était en confinement en novembre-décembre 2020), il n'a pas été possible de venir en personne pour les observations. J'ai utilisé les documents disponibles sur les sites Internet des établissements ainsi que ceux fournis par les chefs d'établissement,

et j'ai mené un certain nombre d'entretiens semi-structurés, individuellement et en petits groupes (Corbin et Strauss, 2008[91]). À partir de la spirale d'analyse des données de Creswell, j'ai analysé les principales étapes décrites dans la littérature méthodologique (Creswell et Plano Clark, 2011[77]) : gestion des données ; lecture, mémorisation, codage déductif et inductif ; description, classification et interprétation.

Réseaux d'établissements : Gouvernance régionale et dynamiques locales

Dans ce chapitre, j'examine le contexte et le fonctionnement du supra-réseau à l'étude (« EDUNET ») et j'identifie les facteurs qui peuvent faire en sorte qu'un tel dispositif social anime la dynamique des savoirs des enseignants. J'examine la construction de savoirs locaux par les enseignants et la diffusion de savoirs professionnels dans le réseau EDUNET. Pour situer le contexte plus large de l'étude de cas, je présente d'abord quelques éléments relatifs au contexte éducatif français en portant une attention particulière à la gouvernance régionale. Je décris ensuite le fonctionnement du réseau et les tensions existantes entre la gouvernance régionale et les dynamiques locales pour comprendre comment les processus de connaissance prévus sont liés aux dynamiques réelles.

Sur le plan théorique, je m'appuie sur les concepts de la théorie des réseaux sociaux et sur la recherche sur les réseaux en tant que formes d'organisations. Les données collectées dans la phase exploratoire de cette étude comprennent sept entretiens semi-structurés, un groupe de discussion et l'observation de deux événements de réseau. En outre, une recherche documentaire a permis d'analyser plusieurs documents officiels. Je présente l'analyse sous la forme d'une étude de cas, en suivant les trois dimensions principales des réseaux formels du cadre conceptuel : le contexte, les dispositifs et les caractéristiques du réseau.

L'analyse du contexte du réseau - objectifs, délais, gouvernance - montre que les objectifs du réseau sont en réalité un assemblage complexe de buts individuels et centraux, ainsi que d'idées sur la manière de les réaliser. Les données exploratoires suggèrent qu'il n'existe pas de compréhension commune claire relativement au savoir parmi les acteurs. La compréhension implicite qu'ont les documents concernant les savoirs ou les compétences des enseignants recoupe en partie les points de vue des acteurs, mais les deux présentent également des éléments distincts. La description et l'analyse de divers dispositifs sociaux - ateliers de développement professionnel et de partage des savoirs initiés localement - mettent en évidence leur potentiel pour conduire les processus de connaissance, mais révèlent un certain nombre de difficultés. Parmi celles-ci, l'absence de culture d'échange et de mise en réseau parmi les enseignants et les établissements, ainsi que les échéanciers divergents entre la création d'une culture d'échange et les exigences institutionnelles.

Le chapitre conclut en soulignant les effets incertains de la création de communautés d'apprentissage professionnel qu'entraîne la réglementation bureaucratique. Les données mettent en évidence les tensions entre la **gouvernance** centralisée **des réseaux** et la nature intrinsèquement décentralisée de la création et du partage des savoirs professionnels ainsi que de l'émergence de

pratiques pédagogiques innovantes. Compte tenu de cette tension, il faut se demander dans quelle mesure les différents **dispositifs de réseau** facilitent la mobilisation, la construction, la diffusion et l'intégration des savoirs.

Le développement professionnel initié localement offre-t-il aux enseignants des occasions de mobiliser des savoirs qui répondent aux besoins locaux ? Les données exploratoires suggèrent que les injonctions bureaucratiques peuvent entraver la mobilisation des savoirs fondées sur les besoins au sein des communautés de pratique, comme le suggère également la recherche sur les communautés d'apprentissage professionnel (Stoll et Seashore Louis, 2007[92]). En outre, il peut y avoir une tension entre la pression exercée par la gouvernance centrale pour la transmission des savoirs dans des domaines particuliers et leur « discours d'attraction » soulignant l'importance de s'appuyer sur les besoins réels des enseignants et des établissements.

Bien sûr, les enseignants et les établissements accèdent parfois aux savoirs disponibles, les interprètent, les traduisent et les transforment pour répondre à leurs besoins. Mais ces savoirs ne sont pas pour une grande part ancrés dans leurs pratiques locales. L'ampleur du processus d'adaptation - la possibilité de mélanger différents types de savoirs, leur réinterprétation, leur transcription et leur transformation dans un processus réflexif et itératif (Mausethagen, Prøitz et Skedsmo, 2018[93] ; Brown et Poortman, 2018[94]) - est discutable. Les ateliers de partage des connaissances sont censés faciliter ces formes de dynamiques au niveau local au sein des établissements et entre eux. Cependant, le manque de temps et de ressources alloués sont perçus comme des obstacles à cette démarche.

Un examen plus approfondi de réseaux spécifiques montre que la dynamique de la connaissance qui sous-tend les réseaux est plus complexe que la formalisation administrative des **relations**. Les liens sociaux impliquent des relations hiérarchiques qui peuvent entraver les processus sociaux horizontaux et limiter les possibilités de co-construction et de diffusion des savoirs. Les tensions entre horizontalité et hiérarchie ont une incidence sur le degré auquel les différents dispositifs de réseau permettent l'échange et la diffusion des savoirs. En outre, les mécanismes permettant de faire remonter à la surface les savoirs construits localement ne sont pas clairs.

Pour résumer, l'étude de cas a démontré que le cadre conceptuel de la dynamique sociale et de la connaissance peut être employé dans une enquête sociologique structurée sur la connaissance des enseignants dans un contexte de réseau. Elle a montré que, bien que la création et le partage de savoirs puissent être d'un réel intérêt pour les enseignants et les acteurs locaux en leur permettant de répondre à leurs défis et à leurs besoins, de multiples paramètres sociaux sont essentiels pour favoriser une telle dynamique des savoirs dans les réseaux. Dans les prochains chapitres, je me pencherai sur ces paramètres en vue de comprendre les relations entre les différentes caractéristiques des réseaux et la dynamique des savoirs approfondie par le biais de données quantitatives et qualitatives.

Mesurer la dynamique des savoirs des enseignants

Ce chapitre se penche sur les deux principales questions de recherche. La première question principale de recherche : « Comment pouvons-nous caractériser la dynamique des savoirs des enseignants ? ». Je cherche, plus précisément, à appréhender quels types de savoirs intéressent les enseignants et comment ils mobilisent, construisent et diffusent les savoirs. Une nouvelle conceptualisation de la dynamique des savoirs des enseignants - telle que décrite dans le cadre conceptuel du 3- doit être validée par des données empiriques. Dans ce chapitre, je présente une façon de mesurer la dynamique des savoirs et je décris l'instrument quantitatif développé à cette fin. J'applique plusieurs approches pour valider cet instrument. En premier lieu, j'examine si le questionnaire reflète bien les constructs établis pour caractériser les différentes dynamiques. L'analyse des items à l'aide de statistiques descriptives de la dynamique des savoirs des enseignants dans les réseaux EDUNET fera l'objet d'une comparaison avec des recherches antérieures dans la mesure du possible, ainsi qu'avec des données qualitatives recueillies dans deux établissements dans le cadre de deux études de cas (au 8). En second lieu, j'effectue une analyse d'échelle et un test de la validité structurelle des échelles à l'aide d'une analyse factorielle.

Le chapitre aborde ensuite la deuxième question de recherche : « Comment les dynamiques sociales influencent-elles la dynamique des savoirs des enseignants ? ». J'explorerai les relations entre les constructs à travers la modélisation par équations structurelles.

Comment les enseignants mobilisent-ils leurs savoirs ?

Les résultats statistiques et les considérations conceptuelles suggèrent qu'il est possible d'appréhender la mobilisation des savoirs grâce à un modèle à trois facteurs. Ces trois facteurs sont : la consultation et utilisation des sources de savoirs pratiques, la consultation et utilisation de la recherche et la participation active dans la recherche. Les données suggèrent que les enseignants consultent et utilise plus souvent des sources de savoirs pratiques que des savoirs formels issus de la recherche en général. Toutefois, près de la moitié des enseignants déclarent lire habituellement ou presque toujours des documents de recherche. En outre, les enseignants s'impliquent beaucoup moins souvent activement dans la recherche qu'ils ne consultent et n'utilisent les sources de recherche. Seuls, 16 % des enseignants déclarent collecter et analyser des données qualitatives souvent (habituellement ou presque toujours), 8 % font de même avec des données quantitatives, tandis que 18 % mènent souvent des recherches-actions. Environ un tiers des enseignants ne s'impliquent jamais dans ces activités (38 %, 43 %, et 30 % respectivement).

Comment les enseignants co-construisent-ils les savoirs ?

Cette dimension comprend deux sous-dimensions : la co-construction des savoirs avec les collègues enseignants, et la construction collective avec le réseau plus large (enseignants d'autres établissements). Dans ces deux sous-dimensions, on distingue trois aspects principaux : la réflexion sur

la pratique, la conception pédagogique et l'innovation. Malheureusement, aucun des modèles ne présente d'ajustement, cette partie de l'instrument ne semble donc pas mesurer de constructions latentes claires. Cependant, en limitant l'analyse factorielle à la construction de savoirs avec des collègues enseignants, on obtient seulement un modèle à trois facteurs.

La grande majorité des enseignants déclarent qu'ils réfléchissent souvent (habituellement ou presque toujours) au progrès de chaque élève et aux problèmes plus généraux liés à l'enseignement et à l'apprentissage (72 % et 61 % respectivement). Cependant, ils s'observent mutuellement en classe dans une proportion considérablement plus faible : près de trois enseignants sur quatre ne pratiquent jamais l'observation par les pairs. Cette privatisation de la pratique pédagogique a également été rapportée dans l'entretien exploratoire et dans les entretiens des études de cas, et s'explique par la peur d'être jugé. Les enseignants s'engagent beaucoup moins dans la réflexion avec leurs réseaux plus larges.

Seuls, moins d'un quart des enseignants déclarent s'impliquer dans l'une de ces formes de co-construction de l'enseignement souvent (presque toujours ou habituellement). La majorité des enseignants, soit plus de 70 %, déclarent produire conjointement du matériel pédagogique ou préparer des cours ensemble au moins quelques fois par an. Cependant, l'enseignement conjoint est une forme moins typique de co-construction entre collègues enseignants. Il est peut-être plus intéressant de noter que plus de 40 % des enseignants affirment ne jamais développer de nouvelles idées avec leurs collègues sur la manière d'enseigner une matière particulière. Les enseignants co-construisent beaucoup moins de connaissances par le biais de la conception pédagogique avec leurs réseaux plus larges : plus de 60 % d'entre eux déclarent ne jamais s'engager dans ces activités avec des enseignants ou des partenaires d'autres organisations. Ces données suggèrent que l'activité de conception pédagogique est à la fois socialement et spatialement délimitée.

Les données confirment que le contenu des matières, les niveaux des classes, les établissements eux-mêmes et les degrés d'enseignement scolaire constituent des frontières qu'il est de plus en plus difficile de franchir. Seuls, 12 % des enseignants ne développent jamais de projets interdisciplinaires, la proportion d'enseignants ne développant jamais d'initiatives entre classes de différents niveaux est double (25 %), environ 36 % ne travaillent jamais sur des projets entre établissements, et près de la moitié des enseignants (43 %) ne développent jamais de projets interscolaires avec leurs collègues. Néanmoins, ces données signifient également que la majorité des enseignants s'impliquent dans les différents types d'innovations « transfrontalières » au moins de temps en temps. Les données confirment également que les organisations scolaires ne constituent pas seulement une frontière physique mais aussi une frontière sociale en termes d'innovation. La majorité des enseignants déclarent qu'ils ne s'impliquent jamais dans une innovation transfrontalière avec des collègues en dehors de leur école.

Comment les connaissances sont-elles diffusées ?

On n'a pas pu utiliser le modèle hypothétique à quatre facteurs relatif à la diffusion des connaissances - participation à l'apprentissage professionnel collectif, diffusion, médiation des savoirs,

collaboration avec des partenaires externes – en revanche, la solution à trois facteurs (à l'exclusion de la médiation des savoirs) montre une adéquation raisonnable. La grande majorité des enseignants déclarent ne jamais faire l'effort délibéré d'organiser ou d'animer des forums de diffusion (65 % et 72 % respectivement). Cependant, si quelqu'un d'autre organise un tel forum (réunion, atelier), plus de la moitié d'entre eux s'engagent à préparer des documents à cette fin, au moins de temps en temps. En ce qui concerne la collaboration avec des partenaires externes, environ la moitié des enseignants ont déclaré n'avoir jamais travaillé avec des formateurs d'enseignants et des professionnels d'autres secteurs au cours des 12 mois précédant l'enquête. La proportion est plus importante pour les deux autres groupes : plus de 60 % n'ont jamais collaboré avec des inspecteurs et 80 % ne l'ont jamais fait avec des chercheurs. Une fois de plus, ces résultats suggèrent que le dépassement des limites, dans ce cas entre les professions, ne concerne qu'une minorité d'enseignants. Par conséquent, ces derniers peuvent s'avérer essentiels en apportant des savoirs externes à leur communauté de pratique au sein de l'établissement. Pourtant, cela ne semble pas être le cas. Il n'y a pas de corrélation forte entre le fait de se connecter fréquemment avec des partenaires externes et les différentes formes de diffusion.

Caractériser la dynamique des savoirs des enseignants dans les réseaux

Dans l'ensemble, les résultats des modèles d'équations structurelles suggèrent que les hypothèses 2.2 et 2.3, c'est-à-dire que la dynamique sociale est liée à la dynamique des savoirs, sont partiellement étayés. Le fait d'avoir des liens sociaux avec des partenaires externes est davantage fortement associé à des niveaux plus élevés de mobilisation, de construction et de diffusion des savoirs, que le fait de participer et de bénéficier de l'apprentissage professionnel collectif. Les associations ne sont pas particulièrement fortes dans la plupart des cas, ce qui indique que d'autres facteurs sociaux ou individuels jouent un rôle clé dans la dynamique des savoirs. Les partenaires externes semblent être importants dans l'implication active dans la recherche et pour construire des savoirs avec le réseau élargi, c'est-à-dire avec les enseignants et les partenaires d'autres établissements. L'apprentissage professionnel collectif n'est pas très fortement lié à la plupart des formes de dynamique des savoirs, à l'exception de la diffusion des savoirs.

Pour l'hypothèse 2.1, c'est-à-dire que la culture de réseau et la culture organisationnelle sont des facteurs importants qui facilitent les processus sociaux, seul l'effet de la culture de réseau a pu être testé avec les données. Nous avons vu que la majorité des enseignants ne perçoivent pas EDUNET comme un dispositif propice à l'apprentissage professionnel. Dans la plupart des cas, la perception de la culture d'apprentissage professionnel du réseau EDUNET n'a qu'un faible effet indirect sur la dynamique des savoirs des enseignants. Les enseignants qui perçoivent EDUNET comme un dispositif favorisant l'apprentissage professionnel et l'innovation, ont également tendance à être davantage connectés avec les partenaires externes et à participer davantage à l'apprentissage professionnel collectif, bien que les associations ne soient pas fortes. Cela tend à montrer que le réseau EDUNET n'est pas encore une plateforme d'apprentissage social majeure pour les enseignants. Le seul cas où la perception du réseau avait un lien direct avec la dynamique de la connaissance était celui concernant le développement de

l'innovation avec le réseau plus large. Il fallait s'y attendre compte tenu de l'objectif des réseaux EDUNET, mais il faut noter que l'effet direct, même sur cet élément, est très faible.

Comme le souligne la littérature, les facteurs organisationnels jouent un rôle crucial tant dans la dynamique sociale des enseignants que dans la dynamique des savoirs. L'une des raisons qui pourrait expliquer la relative faiblesse des associations est l'importance de ces facteurs-là dans l'équation. Le chapitre suivant permet de comprendre un aspect fondamental des organisations scolaires : le leadership scolaire. La conception de l'étude explicative permet d'approfondir les raisons de la relative faiblesse des liens entre la dynamique sociale et la dynamique des savoirs. Les entretiens qualitatifs visent à révéler la manière dont les enseignants mobilisent, construisent et diffusent les savoirs via leurs interactions sociales et l'étendue de ces actions. Ils explorent également les autres facteurs potentiels qui déterminent leur implication dans les processus de connaissance.

Leadership, réseaux d'établissements et dynamique des savoirs

Ce chapitre explore la deuxième question de recherche : « Comment la dynamique sociale influence-t-elle la dynamique des savoirs des enseignants ? » du point de vue des chefs d'établissement. Il examine en particulier les structures sociales et la nature des liens sociaux dans un réseau, ainsi que la manière dont elles sont liées aux perceptions des chefs d'établissement quant au potentiel des réseaux pour les connaissances des enseignants. Pour ce faire, j'analyse les données recueillies par le biais du questionnaire destiné aux chefs d'établissement. Le chapitre explore également les relations entre les interactions sociales entre les établissements et la dynamique des savoirs des enseignants en reliant les ensembles de données des enseignants et des chefs d'établissement.

Je commence ce chapitre en élargissant le cadre de Sleegers et Leithwood (2010[95]) à la relation entre les aspects structurels et culturels de l'organisation scolaire et l'apprentissage des enseignants. Ce cadre comprend deux visions du changement. La « perspective interne » se concentre sur la capacité interne de l'école à créer un environnement propice à l'apprentissage des enseignants. La « perspective externe » concerne les facteurs externes à l'école, tels que les initiatives de réforme et les interventions locales, régionales ou nationales (Sleegers et Leithwood, 2010[95]). Sleegers et Leithwood (2010[95]) présentent ce cadre comme étant principalement l'influence générée par les interventions politiques descendantes.

Pour comprendre l'impact des processus sociaux sur les savoirs des enseignants de manière plus complète, je propose d'élargir le cadre de Sleegers et Leithwood en vue de mon cadre conceptuel qui distingue entre une perspective externe verticale et une perspective externe horizontale. La première est ce que Sleegers et Leithwood décrivent comme la perspective externe et, dans cette étude, elle explore l'impact des réseaux EDUNET (reflété à la fois dans les questionnaires des enseignants et des chefs d'établissement) sur la dynamique des savoirs des enseignants. La deuxième se concentre sur la compréhension des processus sociaux horizontaux qui émergent au-delà des murs d'un établissement.

Dans mon étude, elle explore les réseaux d'établissement indépendamment du contexte politique, et leur impact sur la dynamique des savoirs des enseignants. La perspective interne examine les indicateurs organisationnels de la pratique du leadership grâce à la perception des enseignants quant aux ressources et à la culture à des fins d'apprentissage professionnel (questionnaire des enseignants) et par le biais de données qualitatives collectées et analysées dans deux études de cas. Il faut également souligner que ces trois perspectives ne sont pas indépendantes. La perspective extérieure verticale peut influencer à la fois la perspective extérieure horizontale et intérieure. La construction unique de ma recherche permet d'étudier non seulement ces trois perspectives mais aussi les interrelations entre elles.

Réseaux sociaux des établissements

Cette section présente une analyse détaillée du réseau égocentré des établissements en s'appuyant sur le questionnaire destiné aux chefs d'établissement. Puisque la recherche explore l'impact des processus sociaux sur les savoirs des enseignants, le questionnaire sur le réseau social s'est intéressé aux différents types de collaborations pédagogiques entre les établissements. La taille du réseau égocentré, c'est-à-dire le nombre d'établissements avec lesquelles les chefs d'établissement ont indiqué avoir collaboré au cours des deux années précédant la collecte des données, varie entre 0 et 15. Plus de la moitié des répondants ont indiqué qu'ils collaborent avec 1, 2 ou 3 autres établissements, tandis que 18 % ne s'impliquent pas du tout dans la collaboration.

La collaboration porte le plus souvent sur le parcours des élèves, c'est-à dire que cet objectif régional est en première position en ce qui concerne le travail inter-établissements. La réflexion pédagogique collective arrive en deuxième position, tandis que le développement professionnel collectif et l'expérimentation sont moins fréquemment indiqués, alors qu'ils correspondent plus explicitement aux objectifs régionaux d'EDUNET depuis 2017. La majorité des établissements ont indiqué deux types de collaboration en moyenne. Les données ont montré que les établissements collaborent surtout avec d'autres de différents niveaux dans la même région géographique et le même réseau EDUNET (ces deux derniers sont fortement connectés). Curieusement, le thème de la collaboration ne semble pas dépendre des attributs des établissements. C'est ce qui surprend le plus en ce qui a trait au parcours des élèves, car on s'attendait à ce qu'il soit un thème plus fréquent entre établissements de niveaux voisins.

Perception des chefs d'établissement à l'égard de la collaboration locale et du dispositif EDUNET

Les chefs d'établissement ont été interrogés sur la gouvernance et la culture de la collaboration locale, ainsi que sur les ressources allouées. L'analyse factorielle a confirmé ces deux constructs globaux. Les données révèlent clairement que les chefs d'établissement considèrent la culture et la gouvernance de manière plus positive que les ressources. Les perceptions des chefs d'établissement sur le dispositif EDUNET portent sur trois aspects : la gouvernance, les partenaires et la culture d'apprentissage professionnel. L'analyse factorielle a révélé un modèle fragile à trois facteurs avec des facteurs fortement

corrélés. Les données montrent que les perceptions des chefs d'établissement sont très similaires à l'égard des différents éléments : entre 50 % et 75 % d'entre eux sont plutôt d'accord avec toutes les déclarations.

Comment les perceptions de la collaboration et du travail en réseau sont-elles liées aux réseaux d'établissements ?

J'ai également testé la deuxième hypothèse de la deuxième question de recherche : « H2.1 La culture de réseau et la culture organisationnelle sont des facteurs importants qui facilitent les processus sociaux ». La modélisation par équations structurelles a montré que la perspective extérieure horizontale, c'est-à-dire la perception qu'ont les chefs d'établissement de la culture de leur réseau horizontal est plus importante pour leur réseau social. Des perceptions plus positives sont associées à des réseaux scolaires plus grands et à des forces de liens moins diverses. Bien qu'on n'ait trouvé aucune relation directe entre les perceptions du réseau EDUNET et les réseaux sociaux réels, les perceptions des réseaux horizontaux et verticaux étaient fortement liées.

Les savoirs des enseignants dans deux collèges : Études de cas

Ce chapitre examine les deux principales questions de recherche à l'aide de l'analyse de données qualitatives recueillies dans deux collèges (aux noms fictifs de : Legrand et Piccoli). Il permet d'améliorer la compréhension des processus qui sous-tendent la dynamique des savoirs des enseignants en examinant :

- comment les trois principaux types de dynamiques fonctionnelles - mobilisation, construction et diffusion des savoirs - évoluent dans le travail des enseignants.
- les types de processus sociaux dans lesquels s'impliquent les enseignants et les chefs d'établissement
- comment les processus sociaux déterminent la dynamique des savoirs des enseignants.

Étude de cas n° 1 : le collège Legrand

Cinq entretiens ont été menés auprès de sept membres du personnel de l'établissement d'enseignement secondaire Legrand. On s'est intéressé à la dynamique des savoirs et à la manière dont les processus sociaux y sont reliés dans le contexte d'un certain nombre de projets innovants. Les données montrent que la construction de savoirs naît souvent de problèmes liés à la pratique, les enseignants étant confrontés à des difficultés et exprimant un besoin de changement. Cependant, des stimuli externes peuvent également la motiver, tels que le développement professionnel et la mobilisation de savoirs individuels ou collectifs. En général, les enseignants ne semblent pas mobiliser les savoirs de manière systématique. Ils utilisent plutôt diverses sources à différentes étapes de leur travail, davantage en fonction de leur temps, de leur intérêt et de leur motivation. Dans l'ensemble, les données démontrent que le collège Legrand a une dynamique de savoirs intensive grâce à une construction délibérée de nouveaux savoirs

dans l'optique d'améliorer l'apprentissage socio-affectif et scolaire des élèves. Elles montrent également que certains acteurs et certaines interactions sociales jouent un rôle clé dans la conduite de cette dynamique.

Étude de cas n° 2 : le collège Piccoli

Six entretiens ont été menés dans l'établissement auprès de sept membres du personnel et d'un groupe d'élèves. Comme pour le collège Legrand, on peut bien comprendre la dynamique des savoirs des enseignants du collège Piccoli par le biais de leurs discours sur les projets innovants, les défis auxquels ils sont confrontés et leurs réflexions sur la pratique. Les entretiens montrent que la mobilisation des savoirs - l'accès à des savoirs externes, formels dans ce cas - est un élément clé de l'expérimentation pédagogique et donc de la construction des savoirs. Au collège Piccoli, le chef d'établissement crée des possibilités de développement professionnel en fonction des intérêts et des besoins des enseignants et de sa propre vision. Il estime que la formation informelle, qui est adaptée aux besoins et aux intérêts spécifiques des enseignants, est plus fructueuse que les sessions de formation centralisées offertes par l'Académie. Les enseignants ne perçoivent pas qu'il existe un socle de connaissances commun construit localement. Ils ont plutôt tendance à voir le développement de leurs propres savoirs et pratiques, et de ceux de leurs collègues immédiats, c'est-à-dire la construction de savoirs au niveau de cette communauté de pratique restreinte. En revanche, le chef d'établissement voit que cela se passe au niveau de la communauté de l'établissement.

La diversité et la force des liens sociaux du chef d'établissement sont essentielles pour faciliter la dynamique des savoirs. Les différents types de liens impliquent des dynamiques légèrement différentes : certains sont plus axés sur la mobilisation des savoirs, d'autres sur leur construction et d'autres encore sur leur diffusion.

Discussion

Dans cette section Discussion, j'explore les processus sociaux et j'analyse leurs rôles dans la dynamique des savoirs en m'appuyant sur les deux études de cas présentées. Je discute des conditions dans lesquelles les processus sociaux mettent en œuvre une dynamique positive de la connaissance et j'étudie les différents impacts des relations sociales horizontales et verticales.

Dans l'ensemble, les conclusions relatives aux liens entre les processus sociaux et la dynamique des savoirs tirées des deux études de cas semblent converger. La première hypothèse relative à cette question (2.1 : Le réseau et la culture organisationnelle sont des facteurs importants pour faciliter les processus sociaux) a été fortement confirmée. Les données qualitatives ont montré en particulier que le rôle de la direction de l'école est très important dans la stimulation de la collaboration des enseignants. Ceci est conforme à la recherche sur le leadership (Leithwood et al., 2006[96] ; Vangrieken et al., 2015[97]). Un environnement concurrentiel au sein d'un réseau peut entraver le partage des savoirs et donc constituer un obstacle à la plupart des aspects de la dynamique des savoirs. De plus, un environnement

de réseau bureaucratique peut également entraver les formes de mobilisation des savoirs qui sont directement liées aux besoins locaux. Le niveau élevé des processus administratifs et la longueur des délais entravent fortement le potentiel des dispositifs sociaux tels que le « développement professionnel initié localement ».

Les données ont également permis de mieux comprendre la deuxième hypothèse (2.2 : Les structures sociales et la nature des liens sociaux dans un réseau influencent la dynamique des savoirs). Les études de cas ont démontré que les liens sociaux du chef d'établissement facilitent la mobilisation des savoirs (par exemple, l'organisation de séances d'apprentissage collectif en capitalisant sur les relations sociales) et leur construction. Tant les liens de grande qualité avec les enseignants que les relations transfrontalières avec les partenaires externes sont importants si on veut pouvoir élargir l'horizon et les savoirs des enseignants et des chefs d'établissement. Les liens sociaux verticaux du chef d'établissement avec l'autorité régionale et les institutions centrales (p. ex., CARDIE) sont également fondamentaux pour la diffusion des savoirs. En outre, les interactions sociales des enseignants contribuent à la construction d'une compréhension et d'un langage communs, facilitent le partage et l'échange de connaissances. Elles enrichissent également la réflexion et la pratique des enseignants, mais des liens sociaux de grande qualité (p. ex., le respect et la confiance mutuels) sont nécessaires à la construction collective.

Enfin, les études de cas ont permis d'affiner les savoirs relatifs à la troisième hypothèse (2.3 : Les processus et dispositifs sociaux et l'implication des acteurs dans ceux-ci influencent la dynamique des savoirs). Les interactions sociales informelles sont prédominantes parmi les enseignants, leur permettant d'acquérir de nouveaux savoirs et de les partager. Elles s'accompagnent de plus en plus d'interactions dans le monde numérique (en partie à cause de la pandémie), qui ont le potentiel de favoriser le partage des savoirs. Cependant, ces interactions restent souvent superficielles parce qu'elles demandent qu'on s'y consacre longtemps, et le temps manque. Les espaces sociaux formels se concentrent principalement sur les questions administratives et offrent peu d'espace pour la construction et la diffusion des savoirs. Certains processus sociaux, tels que l'observation par les pairs et le développement professionnel local basé sur les besoins, ne sont pas largement répandus. L'apprentissage collectif est un dispositif social clé, qui peut encourager la construction de savoirs, en particulier lorsqu'il se fonde sur les besoins et qu'il est local. Il peut également fonctionner comme un espace social d'échange pour les enseignants et constituer une forme de mobilisation des savoirs collectifs. Les dispositifs de réseau central (supra-réseau) sont essentiels à la diffusion des savoirs, en particulier dans un environnement concurrentiel. Cependant, les données qualitatives laissent entendre que les dispositifs du réseau EDUNET, dans leur forme actuelle, ne jouent pas un rôle clé dans la construction de savoirs collectifs.

Discussion : dynamique des savoirs des enseignants en réseau

Dans ce dernier chapitre, je rassemble les résultats de toutes les différentes sources de données : recherches théorique et documentaire, quantitative et qualitative.

Question de recherche 1 : Comment pouvons-nous caractériser la dynamique des savoirs des enseignants ?

La première question de recherche opérationnalise essentiellement le cadre conceptuel de l'étude, qui visait à comprendre et à décrire la dynamique des savoirs des enseignants dans sa complexité. Le cadre conceptuel de cette thèse a défini quatre composantes de la dynamique des savoirs : mobilisation, construction, diffusion et intégration. Il les examine dans une vision systémique dans laquelle ces processus sont mutuellement interdépendants, coexistent et interagissent de manière non linéaire lorsque les enseignants s'impliquent dans des processus sociaux.

Les données qualitatives semblent soutenir l'hypothèse selon laquelle, s'il est possible de distinguer les différents aspects de la dynamique des savoirs, ils sont fortement liés. J'ai démontré cette interconnexion par le biais des projets d'expérimentation et d'innovation dans lesquels les enseignants s'impliquent, et dans lesquels la dynamique des savoirs se manifeste. Dans les deux établissements étudiés, les processus de savoir ne peuvent pas être décrits comme des processus d'enquête cycliques et itératifs bien structurés. Ils sont plutôt désordonnés et non structurés. Les différents aspects de la dynamique des savoirs évoluent comme un ensemble dans une variété de processus sociaux et au niveau de l'implication des enseignants avec leur environnement matériel. Néanmoins, ma recherche a montré qu'il est possible d'analyser une situation/un processus sous ces différents angles. Dans ce sens, l'analyse des aspects de la dynamique des savoirs est comme un prisme qui divise la lumière blanche en faisceaux de différentes couleurs.

La valeur de cette analyse réside dans une bien meilleure compréhension des différents facteurs qui facilitent ou entravent les divers aspects de la dynamique. Le cadre conceptuel comprend les dynamiques sociales et de la connaissance comme un système complexe, dans lequel les dynamiques sociales « relient les processus de savoir structurels et fonctionnels ». Les savoirs se transforment et évoluent dans le temps, et se répandent dans l'espace sous l'effet de la dynamique sociale et sociomatérielle. Comprendre la manière dont les différents éléments de ce système complexe interagissent et les mécanismes qui animent l'évolution du système est la principale utilité de la caractérisation des processus sociaux et de savoir.

Je discute de la validité de l'instrument à la lumière des données quantitatives et qualitatives. Pour ce faire, j'ai analysé les entretiens menés dans les deux établissements en fonction de trois questions :

- Les aspects appréhendés par les items de l'instrument sont-ils mentionnés par les enseignants et les chefs d'établissement ?
- Y a-t-il des aspects supplémentaires qui ont émergé des entretiens au-delà des éléments inclus dans l'instrument ?
- Les différents items appartiennent-ils réellement à la dimension correspondante de la dynamique de la connaissance ?

Les principaux résultats concernant la mobilisation, la construction et la diffusion des connaissances mettent en évidence qu'un certain nombre d'améliorations sont possibles à l'avenir.

Question de recherche 2 : Comment la dynamique sociale influence-t-elle la dynamique des savoirs des enseignants ?

Le Tableau 5 résume les principaux résultats obtenus à partir des deux principales sources de données.

Tableau 5. Constatations

Construct	Résultats quantitatifs	Résultats qualitatifs
Question de recherche 2 : Comment la dynamique sociale influence-t-elle la dynamique des savoirs des enseignants ?		
Hypothèse 2. : Le réseau et la culture organisationnelle sont des facteurs importants qui facilitent les processus sociaux.		
	Données sur les enseignants :	
	Les enseignants qui perçoivent les réseaux EDUNET comme étant propices à la création d' une culture d'apprentissage professionnel et l'établissement de nouvelles relations, semblent également s'impliquer davantage dans leur réseau élargi. [Lien assez fort].	La culture organisationnelle, en particulier la direction de l'établissement, joue un rôle très important dans la stimulation de la collaboration des enseignants.
	Données sur le chef d'établissement :	
	1. La perception qu'ont les chefs d'établissement de la culture de la collaboration horizontale est associée à des réseaux scolaires horizontaux plus importants. [Lien fort]	Lorsque le contexte du réseau est caractérisé par la concurrence, il peut influencer négativement la collaboration entre les écoles, en particulier le partage des connaissances.
	2. Plus la perception de la culture de collaboration horizontale par les chefs d'établissement est positive, plus les forces des liens sont stables (moins dispersées) dans leurs réseaux scolaires horizontaux. [Lien modéré]	Un contexte de réseau bureaucratique peut entraver la mobilisation des savoirs, laquelle répond aux besoins locaux. Le niveau élevé des processus administratifs et la longueur des délais entravent fortement le potentiel des dispositifs sociaux tels que le « développement professionnel initié localement ».
	3. Les perceptions des chefs d'établissement ne sont pas liées à la diversité de leurs partenaires (nombre de niveaux scolaires différents parmi les partenaires, similarité des partenaires avec l'établissement lui-même). [Pas de lien].	La coordination centrale d'un réseau (supra-réseau dans le cas d'EDUNET) peut faciliter la collaboration entre les écoles. Les réunions régulières des coordinateurs EDUNET permettent aux réseaux locaux d'échanger.
Hypothèse 2.2 : Les structures sociales et la nature des liens sociaux dans un réseau influencent la dynamique de la connaissance		
Mobilisation des savoirs	4. La collaboration avec un ensemble diversifié d'acteurs facilite l'implication active dans la recherche. [Lien assez fort]	Les liens sociaux du chef d'établissement facilitent indirectement la mobilisation des savoirs lorsqu'ils sont utilisés pour organiser des séances d'apprentissage collectif. (Complément au point 5, appui au point 8)

	5. La collaboration avec différents acteurs est associée à une implication plus grande dans les sources de savoirs pratiques et la recherche formelle. [Lien modéré]	Les relations transfrontalières favorisent la mobilisation des savoirs en créant des occasions de développement professionnel fondées sur les besoins et en offrant des possibilités d'élargir l'horizon et les connaissances des enseignants et des chefs d'établissement. (Ajout au n°5)
Construction du savoir	6. La collaboration avec des acteurs externes facilite la construction de savoir avec le réseau plus large, en lien avec la réflexion et l'innovation [liens modérés], ainsi que les projets inter-établissements [lien modéré] et les projets inter-catégoriels [lien assez fort].	Les interactions sociales des enseignants facilitent le partage et l'échange de savoirs, enrichissent la réflexion et la pratique des enseignants grâce au partage des difficultés, au retour d'information et aux conseils des uns et des autres. (Constatation générale à l'appui des points 6 et 7)
	7. La collaboration avec différents acteurs est modérément associée à la réflexion et à la construction de savoirs centrées sur l'innovation chez les enseignants d'un établissement. [liens modérés]	Les interactions sociales contribuent également à la construction d'une compréhension et d'un langage communs, ainsi qu'à l'harmonisation des pratiques. (Constatation générale à l'appui des points 6 et 7)
		Les liens sociaux du chef d'établissement, tant avec les enseignants qu'avec les partenaires extérieurs, sont essentiels à la construction des connaissances. (Ajout au point 4, appui aux points 6, 7)
		La qualité des liens sociaux (p. ex., le respect et la confiance mutuels) importe pour la nature de l'interaction qui a lieu entre les enseignants et constitue une condition nécessaire à la construction collective. (Ajout à tous les points)
Diffusion des savoirs	8. La collaboration avec des partenaires externes et la participation à un apprentissage professionnel collectif sont fortement corrélées. [Lien fort]	Les liens sociaux du chef d'établissement, notamment avec l'autorité régionale, jouent un rôle clé dans la diffusion des savoirs. (Ajout au point 9)
	9. Les relations avec les partenaires externes sont faiblement associées à la diffusion. [Lien faible et niveau de signification inférieur].	Les liens sociaux horizontaux dans un contexte de concurrence entravent la diffusion des savoirs. Dans ce cas, les relations verticales peuvent constituer un moyen important de diffusion et de dissémination. (Ajout au point 9)
Hypothèse 2.3 : Les processus et dispositifs sociaux et l'engagement des acteurs dans ces derniers influencent la dynamique de la connaissance		
Mobilisation des savoirs	10. La participation à l'apprentissage professionnel collectif est faiblement associée à l'implication active dans la recherche. [Lien assez faible].	Les interactions sociales informelles entre enseignants leur permettent d'acquérir de nouveaux savoirs. (Constatation générale à l'appui des points 4, 5 et 10)
	11. La participation à l'apprentissage professionnel collectif n'est pas associée à l'utilisation de sources de connaissances pratiques ou à la recherche. [Pas de lien]	L'apprentissage collectif peut fonctionner comme un espace social pour les enseignants et être une forme de mobilisation des savoirs collectifs. (Contestant le point 11 ?)
Construction du savoir	12. Considération liée à la construction : Les éléments relatifs à la construction des savoirs sont intrinsèquement porteurs d'une dynamique sociale, car ils rendent compte de la réflexion collective, de la conception pédagogique et de l'innovation avec des collègues ou un réseau plus large.	Les interactions sociales dans l'espace numérique facilitent le partage des connaissances et la construction collective. (Ajout aux points 6, 7)
	13. La participation des enseignants à l'apprentissage professionnel est faiblement associée à la construction de savoirs liés à l'enseignement parmi les enseignants d'un établissement. [Lien faible et niveau de signification inférieur].	Certains processus sociaux, tels que l'observation par les pairs et le développement professionnel local basé sur les besoins, pourraient être à l'origine de la construction des savoirs mais ne sont pas largement répandus. (À l'appui du point 13)

		Le développement professionnel collectif peut conduire à la construction de savoirs, cet impact est plus important pour l'apprentissage professionnel informel, fondé sur les besoins. (Contestant le point 13)
Diffusion des savoirs	14. Considération liée à la structure : Les deux mesures de la dynamique sociale faisaient partie de la dimension de la diffusion des savoirs. Par conséquent, l'impact de la dynamique sociale est mesuré par rapport à la diffusion des savoirs uniquement.	Les dispositifs de réseau central (supra-réseau) sont essentiels à la diffusion des savoirs, en particulier dans un environnement concurrentiel. Par exemple, des événements tels que la journée de l'innovation créent un espace pour la diffusion de l'innovation (nouveaux savoirss).
	15. La participation à l'apprentissage collectif est particulièrement bien associée à la diffusion des savoirs. [Lien fort]	Les processus sociaux au niveau du réseau (supra-réseau), tels que les interactions entre les coordonnateurs centraux et ceux du réseau, facilitent la diffusion des savoirs.

Dans l'ensemble, les conclusions des différentes sources de données convergent et étayent globalement les trois hypothèses. Le tableau illustre de trois façons différentes comment les résultats qualitatifs s'ajoutent aux résultats quantitatifs : ils peuvent étayer les résultats du questionnaire, les contester et révéler plus de détails (les compléter). Dans l'ensemble, la plupart des résultats quantitatifs sont confortés par les entretiens. Les résultats compilés suggèrent que si les processus sociaux influencent clairement la dynamique des savoirs des enseignants, cette relation varie selon les dimensions et est conditionnée par la nature et la force des liens sociaux. Les résultats qualitatifs permettent non seulement d'interpréter les raisons de la plus grande force, faiblesse ou l'absence de force de certains liens, mais révèlent également des informations importantes sur les conditions et le fonctionnement des dynamiques sociales. En particulier, les entretiens ont démontré que ces conditions apparaissent au niveau individuel, relationnel, organisationnel, ainsi qu'au niveau plus large du réseau.

Réinterpréter les relations : le leadership en réseau

Dans cette section, je résume la manière dont j'ai conceptualisé la dynamique sociale (au 3) et l'élargissement conceptuel proposé du cadre de Sleegers-Leithwood (2010[95]) (au chapitre 8). Il en résulte un cadre bidimensionnel présenté dans le Tableau 6, dans lequel il faut interpréter ces deux dimensions comme des continuums plutôt que comme une dichotomie. Je soutiens que ce cadre est utile à la réflexion sur ce qui lie les processus sociaux et de savoirs. Le Tableau 6 offre une première cartographie des processus de savoir par le biais de ces deux dimensions.

Tableau 6. Deux dimensions de la compréhension des dynamiques structurelles et de connaissance

	Horizontal	Vertical
Interne	Dynamique des savoirs au sein de l'établissement grâce à la collaboration horizontale Construction du savoir Partage des savoirs	Dynamique de la connaissance au sein de l'établissement impliquant des processus verticaux (par exemple, diffusion et coordination des savoirs par l'intermédiaire des chefs d'établissement, dans des espaces centralisés) Dissémination des savoirs, diffusion
Externe	Les établissements développent une collaboration horizontale et des réseaux entre eux et avec d'autres partenaires. Construction du savoir Partage des savoirs/ Mobilisation des savoirs	Les relations entre les écoles et les autorités locales et régionales (par exemple, la coordination centralisée et la mise en œuvre de politiques descendantes). Dissémination des savoirs, diffusion, intégration

Bien que ce cadre soit simple - et peut-être quelque peu simpliste -, il s'avère utile dans la mesure où il met en lumière les différentes utilités/potentialités des différents espaces et processus sociaux dans la dynamique des savoirs des enseignants. Il a également des implications permettant de comprendre la gouvernance et le leadership dans une perspective en réseau.

Les résultats de cette thèse soulignent que la dynamique sociale ne motive pas automatiquement toutes les dimensions de la dynamique de la connaissance. Au contraire, il existe des relations complexes entre elles, influencées par un certain nombre de facteurs et de conditions. Situé à l'intersection de la théorie expliquant les conséquences des caractéristiques des réseaux et de la théorie expliquant les causes des caractéristiques des réseaux (Borgatti et Halgin, 2011[39]), ma recherche a étudié à la fois les réseaux formels ainsi queles organisations sociales et a utilisé les réseaux comme une lentille analytique (théorie des réseaux sociaux) pour mieux comprendre ces relations complexes.

L'analyse des politiques publiques du 2a montré que l' « impératif de réseau » entraîne de grandes exigences et des pressions au niveau des des établissements en tant qu'organisations et au niveau des enseignants. Si l'objectif politique est de faciliter la dynamique des savoirs des enseignants, alors les acteurs du système éducatif - y compris les autorités éducatives, les institutions, les chefs d'établissement et les enseignants - doivent comprendre comment les processus sociaux peuvent précisément stimuler la mobilisation, la construction et la diffusion des connaissances. Ce n'est qu'à cette condition qu'il sera possible de piloter les dynamiques sociales de manière stratégique. Ma recherche a donc des conséquences sur ce que j'appelle le "leadership en réseau". Dans cette dernière section, je développe le concept de leadership en réseau à partir des conceptualisations du leadership distribué (Spillane, 2005[98] ; Gronn, 2010[99]) et du leadership de système (Boylan, 2016[100]). Le leadership en réseau se compose de deux éléments : « le leadership des réseaux« " et « le leadership dans les réseaux » (Tableau 7).

Tableau 7. Leadership en réseau

	Leadership du système	Leadership distribué
Animation de réseaux (réseaux en tant qu'organisations/entités sociales formelles)	**[Signification 1]** Leadership des réseaux formels au niveau méso (au-delà de l'établissement) **[Signification 2]** Leadership stratégique des réseaux horizontaux et verticaux (conscience du système).	**[Perspective dominante : fonctionnelle]** La distribution délibérée des rôles de leadership pour diriger le réseau. **[Perspective secondaire : analytique]** Le leadership en tant qu'interactions entre les membres du réseau ayant des rôles de leadership émergents.
Leadership en réseau (les réseaux comme le réseau de relations entre les acteurs du système)	**[Signification 1]** Leadership au niveau méso (au-delà de l'établissement) par le biais de relations auto-organisées. **[Signification 2]** Englober et nourrir les réseaux horizontaux, tout en étant conscient des relations verticales. **[Signification 3]** Les leaders formels conduisent le changement à l'échelle du système au niveau macro, en étant conscients de la dynamique et des modèles émergents de la nature en réseau du système.	**[Perspective dominante : analytique]** Le leadership est le produit des interactions entre les acteurs au niveau de l'analyse (au sein de l'établissement/au niveau micro, entre les établissements/au niveau méso, au niveau système/macro). Le leadership comme modèle émergent d'influence. **[Perspective secondaire : Fonctionnelle]** La distribution délibérée des rôles de leadership en fonction des positions occupées par les acteurs dans le réseau social.

Cette conceptualisation apporte non seulement une clarté analytique sur la façon dont nous devons comprendre le leadership en réseau, mais a également des implications quant à l'aspect méthodologique de la recherche sur le leadership.

Réflexions méthodologiques : Limites et orientations futures de la recherche

Dans cette dernière partie, je réfléchis à la conception et aux méthodes de recherche dans une perspective plus large, je souligne les diverses limites et je suggère des améliorations et des orientations en vue de recherches futures. Celles-ci concernent la conception de la recherche, les données et l'échantillon (tant quantitatif que qualitatif) et les méthodes d'analyse.

Conclusions

Pour que l'expérience des élèves soit fructueuse et que leur apprentissage ait du sens et de la valeur dans un environnement complexe et en constante évolution, les systèmes éducatifs sont de plus en plus contraints de s'adapter et de changer. La recherche a tenté de comprendre le changement en éducation de trois manières fondamentales (au moins). En premier lieu, en examinant le leadership pour comprendre comment naviguer dans le système et comment influencer le changement. En deuxième lieu, en étudiant les enseignants, et en particulier la manière dont leurs savoirs et leurs pratiques se transforment et peuvent être transformées pour relever de nouveaux défis. En dernier lieu, en consacrant de plus en plus d'efforts à l'étude du réseau de relations entre les acteurs, les organisations et les artefacts, et en s'intéressant à la manière dont ces réseaux peuvent influencer le changement. À mesure que ces domaines de recherche se développent, il est temps d'établir des connexions conceptuelles entre eux afin d'élargir les possibilités méthodologiques et analytiques. Mes recherches ont mis l'accent sur

l'établissement de liens entre les deuxième et troisième domaines, et ont également contribué au développement conceptuel et analytique du premier.

Je dois réaffirmer que ma recherche est de nature exploratoire à plusieurs égards. Tout d'abord, elle a développé un nouveau concept (la dynamique des savoirs) et un instrument pour mesurer ce concept complexe. ensuite, elle a cherché à comprendre les relations entre les processus sociaux et la dynamique des savoirs des enseignants dans leur complexité à plusieurs niveaux sociaux. Bien que l'enquête ait été principalement sociologique, elle s'est appuyée sur de multiples disciplines et théories pour offrir une vision globale de ces relations. Enfin, la conception de la recherche était complexe et unique. Non seulement il s'agissait d'une étude à méthodes mixtes comprenant des composantes quantitatives et qualitatives (avec des fonctions exploratoires et explicatives), mais elle a également utilisé un certain nombre de techniques analytiques différentes. Notamment, la combinaison de la modélisation par équations structurelles à l'aide de mesures analytiques de réseau constitue une voie de recherche nouvelle et prometteuse. Cependant, l'exploration implique naturellement une prise de risque et il sera important de mener d'autres recherches pour confirmer ou remettre en question/réfuter les résultats de cette thèse.

J'ai signalé que cette étude avait un certain nombre de limites méthodologiques que les recherches futures pourraient aborder. En outre, certaines orientations de recherche émergent également de ce travail conceptuel et des résultats empiriques. La recherche sur les réseaux s'étant considérablement développée au cours des deux dernières décennies, il serait opportun de procéder à un examen systématique et à une méta-analyse des résultats de la recherche. Une telle recherche secondaire est extrêmement précieuse pour organiser et systématiser les résultats et pour identifier les lacunes de la recherche. Mon cadre conceptuel, y compris son élargissement au concept de leadership en réseau, offre un point de départ intéressant pour les recherches secondaires et primaires.

Il est essentiel de comprendre l'évolution de l'éducation dans la réalité en réseau du XXI^{e} siècle si nous voulons nous adapter avec souplesse aux transformations de la société. L'accent qui est mis sur les dynamiques sociales entre les acteurs de l'éducation (enseignants, chefs d'établissement, chercheurs, inspecteurs, responsables régionaux de l'éducation, etc.) et leur impact sur la dynamique des savoirs professionnelles des enseignants n'est qu'une pièce du puzzle éducatif complexe. Les élèves et les parents sont notamment des acteurs clés de l'environnement social des enseignants. Bien que les interactions avec ces groupes et en leur sein n'aient pas été l'objet de cette recherche, elles peuvent jouer un rôle important dans les savoirs des enseignants et, plus largement, dans le changement en éducation. Les recherches futures devraient donc s'étendre au monde social et étudier les processus sociaux (à l'intérieur et à l'extérieur de la classe) impliquant les élèves et les parents. En fin de compte, la recherche devrait également s'étendre à la découverte des mécanismes sociaux qui comptent pour l'apprentissage des élèves et enrichissent leur expérience éducative.

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