ACTA UNIVERSITATIS GOTHOBURGENSIS
GOTHENBURG STUDIES IN EDUCATIONAL SCIENCES 500

Teachers' Professional Competence and Working Conditions in Swedish Schools

Relationships with student achievement

Mari Paloniemi Lindström

UNIVERSITY OF GOTHENBURG

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Abstract

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Since the introduction of compulsory schooling in the 1960s, Swedish teacher education has undergone extensive reforms. In recent years, the teaching profession in Sweden has also faced challenges related to recruitment, retention, and a decline in status. These changes have likely resulted in varying levels of competence and specializations across different subjects and grades, contributing to inequalities in teacher distribution and a growing achievement gap between schools and student groups. However, there is limited understanding of how these variations in teacher competence influence student achievement.

The presence of well-qualified teachers with appropriate subject-specific specializations, combined with favourable working conditions, is likely to improve both student learning and teacher job satisfaction. Addressing disparities in teacher qualities and allocation is essential to reducing the achievement gaps that emerge in early schooling. Therefore, this thesis aims to investigate how various aspects of teachers' professional competence and working conditions are related to student achievement in Swedish middle school context (grades 4-6). Grounded in different frameworks of teacher competence, it explores the relationships between these factors and student achievement. Statistical analyses are conducted using data from two international large-scale assessments, TIMSS and PIRLS (with added Swedish register data), to investigate the relationships between teacher competence and student achievement in mathematics, reading, and overall performance in grade 6.

The thesis comprises an integrative essay and three empirical studies. The three empirical studies each focus on different aspects of teachers' professional competence and working conditions that influence student outcomes in the

Swedish context. Study I investigates how the formal level of teacher education, subject-specific specialization, and teaching experience are related to grade 4 students' mathematics performance. A latent construct of formal teacher competence emerges as a strong predictor of student achievement. Study II examines the extent to which different teacher qualifications, teachers' reading specializations, reading comprehension activities, and cognitive activation strategies in grade 4 are related to student performance across multiple subjects in later grades. Finally, Study III investigates the influence of teachers' working conditions and school climate on teacher job satisfaction and student achievement in grade 4.

The collective findings from these empirical studies have implications for policy and teacher education, highlighting the importance of formal teacher education in enhancing student performance in mathematics and emphasizing the importance of subject-specific expertise in improving student outcomes in both mathematics and Swedish. Furthermore, the results suggest that teachers' reading comprehension activities in grade 4 and using different cognitive activation strategies may have a long-term, positive cross-subject influence. Finally, results from the third study suggest that while teachers' workload and job satisfaction improved between the two PIRLS cycles, the changes were insufficient to prevent the decline in students' reading performance. Notably, the pandemic that occurred between these cycles may have had an unexpected influence on teachers' perceptions of workload and job satisfaction. Although grade 4 students mathematics achievement improved between the two most recent TIMSS cycles, the increase may have been even greater if not for the combined negative influence of teachers' workload, job satisfaction, and school climate perceptions. The results from the third study highlight the importance of a safe and orderly school climate for both teacher job satisfaction and student performance.

Contents

List of tables and figures

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Chapter 1 Introduction

In recent years, concerns about teacher education and teacher quality have emerged both nationally and internationally (Alatalo et al., 2021; Darling-Hammond, 2017; Hanushek & Rivkin, 2012). Many countries have undertaken reforms related to teacher education, recruitment, and attrition, and Sweden is no exception. Sweden has introduced multiple reforms targeting at improving teacher education, as well as introducing teacher licensure to enhance the quality and status of the teaching profession (Lindström & Beach, 2015; Prop. 1984/85:122; Prop. 2010/11:20; Ringarp & Parding, 2018; SOU 1999/2000:135; SOU 2010/11:UbU5). These reforms were driven by fundamental social transformations, such as advances in information technology and increasing multiculturalism, requiring not only teachers to address but also the teacher training to adapt to them (Furuhagen et al., 2019). Furthermore, the establishment of a licensure system was emphasized to ensure teachers meet high standards of suitability and competence. This licensing system was designed with the intention of protecting students' right to educational quality and acknowledging their dependent position within the school context (Prop. 2010/11:20).

Despite these efforts, a significant proportion of teachers in Swedish schools remain unqualified and unlicensed (The Swedish National Agency for Education, 2021, 2024a). Currently, only about 72% of the Swedish teachers are qualified to teach in the compulsory schools (have a license), with the highest qualification rates in primary school classes (grades 1-3 at approximately 77%) and lower rates in middle school classes (grades 4-6 at approximately 68%) and lower secondary classes (grades 7-9 at approximately 70%) (The Swedish National Agency for Education, 2024b). Improving teacher qualifications is and has been one of the priority areas for the Swedish National Agency for Education (The Swedish National Agency for Education, 2021). The agency recently reported that among the unlicensed teachers currently working in the compulsory schooling, 63% lack any post-secondary pedagogical education. Nearly half do hold other forms of post-secondary qualifications, although these often have limited relevance to the subjects they teach. Furthermore, a large proportion of these unqualified teachers are concentrated at the middle-school (grades 4-6) and lower secondary levels

(grades 7-9)[1]. Despite these reforms and challenges, there remains a limited understanding of how factors such as the possession of subject-specific licensures and the lack of qualified teachers impact student learning and achievement in the Swedish primary and middle school context.

Another major challenge in ensuring teacher quality is the recruitment of new teachers. The Swedish National Agency of Education (2021) projects a total recruitment need of around 131 000 full-time positions by 2035, which corresponds to a recruitment need of an average of 8 700 full-time positions per year. The demand is expected to peak in the coming years before gradually declining, however in total, approximately 153 000 teachers and preschool teachers will need to complete their education by 2035 to address attrition within the profession and substitute unqualified teachers with qualified ones. Based on current enrollment and graduation trends, a shortfall of at least 12 000 qualified teachers and preschool teachers is expected by 2035. This shortfall suggests that schools will continue to recruit unqualified teachers.

Another layer of challenge in ensuring teacher quality is the unequal allocation of qualified, well-educated teachers across schools (Beach et al., 2019; Hansson & Gustafsson, 2016). This imbalance in allocation has contributed to a widening achievement gap between schools and student groups (Hansson & Gustafsson, 2016; Yang Hansen & Gustafsson, 2019). The Swedish Educational Act emphasizes inclusive education, requiring schools to adapt to individual needs, prevent social exclusion, and provide equal access to education. Schools must not only offer equal educational opportunities but also ensure that all students have the necessary conditions to meet national knowledge standards, regardless of factors such as family and language background (SFS 2010:800, 2010). Despite the intentions of the Education Act, inequalities within and between schools continue to grow, and the influence of home background on student achievement is becoming more pronounced (Gustafsson & Yang Hansen, 2018; Gustafsson et al.,

[1] The group of completely unqualified primary school teachers includes individuals who hold a teaching license but do not meet primary school requirements, those with a post-secondary degree but no teaching license, those with some pedagogical education but no degree, and those with no post-secondary pedagogical education at all. Swedish and mathematics have the highest percentages of qualified teachers in compulsory school. Among teachers of grades 1-3, nearly 90% hold a license in Swedish and mathematics, while in grades 4-6, the percentages drop to 80% for both subjects. In contrast, Swedish as a second language and technology have the lowest percentages of qualified teachers. In grades 4-6, only about 33% of teachers are licensed in Swedish as a second language, and 50% in technology (The Swedish National Agency for Education, 2024b).

2013; Yang Hansen & Gustafsson, 2019; The Swedish National Agency for Education, 2023).

To address all these challenges, it is essential for the Swedish education system and policymakers not only to increase the number of qualified, licensed teachers but also ensure that teachers' working conditions are attractive enough to retain and attract them. Additionally, it is important to improve teachers' professional competence and reduce disparities in access to skilled teachers. To improve teachers' professional competence, it is essential to identify effective teacher qualities that both level out and enhance students' learning opportunities and support equitable achievement. This focus is crucial from both a policy and teacher education perspective. Given the significant number of unqualified teachers in primary- and middle-schools, it is essential to investigate if and how various aspects of teacher quality relate to student achievement, especially in middle school (grades 4-6 in Sweden) where the number of unqualified teachers amounts to almost one-third of teachers. While an increasing number of studies have addressed the implementations and consequences of recent school reforms (Börjesson et al., 2017; Hallsén, 2013; Håkansson Lindqvist et al., 2022), as well as issues such as widening achievement gaps and educational equity (e.g., Yang-Hansen & Gustafsson, 2019), there is still limited research on how variations in teacher quality and specializations are related to student performance in middle school education, especially in the wake of the recent teacher education reforms.

Research aims

Against this background, this thesis aims to identify specific aspects in teachers' professional competence that could positively influence middle school students' learning and achievement. It is vital to understand how various aspects of teachers' professional competence can help mitigate the influence of students' background characteristics on their performance. From a teacher education perspective, identifying the key qualities that contribute to student learning is essential, particularly given the variations in educational backgrounds among Swedish teachers and the potential future teacher education reforms.

Given the challenges Sweden faces in recruiting and retaining teachers, this thesis will also examine how working conditions and more affective aspects of the teaching profession, such as workload, sense of safe and orderly schools, and job satisfaction relate to student achievement. Despite the best formal qualifications,

teachers' perceived working conditions and job satisfaction are likely to influence how they exercise their professional competence in classrooms (Collie & Mansfield, 2022; Malinen & Savolainen, 2016).

This leads to the aim of this thesis, namely, to investigate how various aspects of teachers' professional competence – including educational background, subject-specific qualifications, teaching quality, and working conditions – relate to student achievement in Swedish middle schools (grades 4–6). The following research questions are suggested to answer the aims of this thesis:

1. How does teachers' professional competence relate to student achievement?
2. What long-term effects of teachers' professional competence can be found?
3. What are the interrelationships between teachers' working conditions, job satisfaction, and student achievement?
4. Are potential changes in teachers' working conditions and job satisfaction related to changes in student achievement over time?

The thesis comprises an integrative essay and three empirical studies. Each of the studies concern different aspects of teachers' professional competence and working conditions.

Study I utilizes TIMSS 2019 data to investigate which measures of formal teacher competence are related to student mathematics achievement in grade 4. It also explores the relationship between formal competence and students' socio-economic backgrounds. This cross-sectional study employs two-level structural equation modeling.

Study II utilizes PIRLS 2016 data, supplemented with additional register data, to investigate how teachers' formal qualifications and teaching quality are related to students' PIRLS reading achievement, as well as their grade 6 performance in mathematics, Swedish, and their overall grade point average score (GPA). The addition of register data enabled the study to account for students' prior achievement allowing for a more thorough investigation of teacher effects on student achievement in grade 6. This cohort study employs two-level structural equation modeling.

Study III utilizes two cycles of PIRLS assessments (2016 and 2021 cycles) and two cycles of TIMSS assessments (2019 and 2023 cycles) and investigates if changes in teachers' perceptions of workload, job satisfaction, and safe and orderly school climate are related to changes in student achievement in reading and

mathematics in grade 4. This study employs mediation analysis, with aggregated, teacher level data.

The first two studies focus on teachers' formal qualifications and subject-specific specializations, while the second study also investigates aspects of teaching quality. In contrast, the third study centers on trend-analyses regarding changes in teachers' working conditions and job satisfaction. Student achievement measures in this thesis primarily focus on mathematics and reading in grade 4. The second study, with the additional data added to the PIRLS 2016 sample, also investigates student performance in mathematics, Swedish, and overall grade point average score (GPA) in grade 6, alongside the PIRLS reading score. The unique structure of Swedish primary and middle school education – where teachers typically remain with the same group of students from grades 4 to 6 – enhances the study's longitudinal perspective of teacher effects. The third study focuses on both mathematics and reading outcomes in grade 4, with an additional focus on teachers' job satisfaction. In summary, each of the studies deals with different aspect of teachers' professional competence in relation to student achievement.

Table 1 An overview of conducted studies

Studies	Data	Explanatory variables	Dependent variables
1 Does formal teacher competence matter for students' mathematics achievement? Results from Swedish TIMSS 2019	TIMSS 2019	Specialization/s, Teaching experience, Professional development, Formal level of education	Mathematics Achievement
2 Teachers' Qualifications and Their Reading Instruction in Grade 4: Short-Term and Long-Term Effects	PIRLS 2016, Register data	Formal level of education, Teaching experience, Reading specialization/s, Reading comprehension activities, Cognitive activation	PIRLS reading achievement, Grade in Swedish, Grade in mathematics, GPA-score
3 Teachers' working conditions and student achievement pre- and post-COVID-19: synthesizing evidence from PIRLS and TIMSS in Sweden	PIRLS 2016, 2021, TIMSS 2019, 2023	Time, Workload, Job satisfaction, Safe and orderly school	Mathematics Achievement, Reading Achievement, Job satisfaction

Outline of the thesis

This chapter has presented the overall aims and research questions of this thesis, as well as provided an overview of the conducted studies (see Table 1). In Chapter 2, the theoretical frameworks underpinning this thesis are presented. Following this, in Chapter 3 a review of previous research regarding effective teachers and relations to student outcomes is presented. Thereafter, in Chapter 4, a contextual background to the diverse landscape of teacher qualifications and specializations within the Swedish compulsory school system is provided. Next, in Chapter 5, a presentation of the method; data and samples, methods of analysis, as well as the validity and ethical considerations of the thesis are given. In Chapter 6, the results are presented and discussed. The concluding remarks in Chapter 7 provide a reflection on the strengths, limitations and methodological challenges of this thesis, as well as its contributions and directions for future research. Finally, in Chapter 8, a Swedish summary is presented.

Chapter 2 Framing Teachers' Professional Competence

How teachers' professional competence contribute to high-quality teaching and their effectiveness is a disputed matter and several frameworks have been provided to shed light on what qualities are most relevant. In educational research, essential teacher characteristics are often grouped under broad umbrella conceptualizations such as teachers' professional competence, teacher/teaching quality, and teacher knowledge. These concepts are often used interchangeably and sometimes lack explicit definitions (Darling-Hammond, 2021; Ingvarson & Rowe, 2008; Kane et al., 2021).

The label professional competence is used in this thesis to describe the capacity that teachers have to meet the complex demands within a specific teaching context by drawing on various psychosocial resources, including cognitive, functional, personal, and ethical knowledge and skills. It encompasses teachers' professional knowledge and affective-motivational characteristics, and the ability to apply and adapt knowledge effectively (Goe, 2007; Guerriero & Révai, 2017; Shulman, 1987). Professional competence, is widely regarded as a multifaceted concept, allowing for various definitions (Baumert & Kunter, 2013; Blömeke, 2017; Kaiser & Koenig, 2019; Stoof et al., 2002; Tigelaar & van der Vleuten, 2014) making it difficult to settle for a common conceptualization. However, a common feature across domains is the ability of professionals to perform complex core tasks by integrating and applying appropriate context- and domain-specific knowledge, skills and attitudes (Stoof et al., 2002). Building on this general conceptualization, Tigelaar and van der Vleuten (2014) emphasize that definitions of professional competence across different fields share some key characteristics. These include the ability to address diverse encounters specific to a particular area of practice and the use of knowledge, skills and judgement to manage these situations effectively. Moreover, they propose that professionals rely on a unique context-dependent knowledge base that enables them to make informed decisions. Before exploring the key components of teachers' professional competence that are particularly

salient for this thesis, I will in this chapter first discuss several useful models that illustrate how this competence is enacted in teachers' practice.

Models and frameworks of teachers' professional competence

In the field of education, scholars have developed comprehensive models of teachers' professional competence that encompass a wide range of characteristics essential for effective teaching. While some models primarily focus on input factors, such as certifications and experience, and their direct relationships to student outcomes (e.g., Akiba et al., 2007; Clotfelter et al., 2010; Darling-Hammond, 2000), others adopt a more multidimensional perspective that consider the interplay of various elements influencing teachers effectiveness (e.g., Creemers & Kyriakides, 2007; Goe, 2007; Nilsen & Gustafsson , 2016). For example, Goe's (2007) framework of teacher quality expands the understanding of teacher quality by incorporating multiple dimensions – such as qualifications, characteristics, teaching quality, and effectiveness – while still emphasizing their distinctions. Central to many of these models, including Goe's (2007), is the use of students' standardized test scores as an indicator of teacher impact (Charalambous et al., 2020; Chetty et al., 2014; Goe, 2007; Goldhaber et al., 2013; Touitou et al., 2019).

Effectiveness frameworks, such as those proposed by Goe (2007) and Hanushek and Rivkin (2012), provide a foundational understanding of teacher quality by emphasizing characteristics, qualifications, practices, and measures of student test scores. However, Goe's (2007) widely used framework, while comprehensive, presents a relatively static view of teacher quality, placing limited emphasis on the dynamic interplay between teaching quality and contextual factors, such as school environment and school climate. Similarly, value-added models, including that of Hanushek and Rivkin (2012), focus on teachers' qualifications and student gains – both short- and long-term – while placing less focus on the contextual factors that shape teaching and learning.

Since the introduction of Goe's framework, significant effort and progress have been made in identifying dimensions of teacher quality that effectively promote student learning (Klieme et al., 2022; Praetorius et al., 2018; Senden et al., 2021). Concurrently, research has increasingly highlighted the complexity of modeling and measuring teacher and teaching effects (e.g., Blömeke, 2017; Blömeke et al., 2022; Nilsen & Gustafsson, 2016). For instance, research suggests

that teaching quality may mediate the relationship between teacher quality and student outcomes (Blömeke et al., 2022; Fauth et al., 2019; Senden et al., 2021), indicating that teacher quality alone may be insufficient for student progress. This relationship challenges the traditional assumptions that investing in teacher qualifications alone will lead to better educational outcomes. Advancements in effectiveness frameworks have also led to the development of multi-level frameworks that account for the interdependence between various levels of influence. For example, higher-level policies and school conditions interact with and influence lower levels, such as teachers and classroom practices (e.g., Creemers & Kyriakides, 2007; Scheerens & Blömeke, 2016). These advancements reflect a more comprehensive approach to describing and addressing the complexity of educational effectiveness, of teaching and learning, and the different layers and levels of influence.

More comprehensive frameworks, such as the one proposed by Creemers and Kyriakides (2007), provide a broader approach to evaluating educational effectiveness. Their Dynamic Model of Educational Effectiveness not only moves beyond the narrow focus of assessing students' basic skills, offering a hierarchical framework that examines how student-, teacher/classroom-, and school-level factors interact to shape various student outcomes, both cognitive and affective. The model emphasizes the critical role of teaching and learning processes while recognizing the influence of school-level policies and broader societal values on these processes. The dynamic model also highlights the importance of adaptive teaching to address diverse student needs, acknowledging that the effectiveness of teaching often depends and varies on student backgrounds and characteristics. Moreover, Creemers and Kyriakides (2007) advocate for the use of longitudinal research methods to investigate the interplay between school and teacher effects on student outcomes over time. This longitudinal approach is particularly valuable for understanding the processes of change and for uncovering how effectiveness factors function and evolve over time (Creemers & Kyriakides, 2007).

Similarly, Scheerens and Blömeke (2016) propose an educational effectiveness model that integrates research on school effectiveness and teacher education effectiveness, also conceptualizing the educational system as a set of hierarchical layers. At any level, the system functions as a "black box", where inputs (e.g., teacher characteristics and resources) are transformed into outputs (e.g., student performance). Inside this black box, various processes or "throughput" occur, and transform the inputs into outputs (see Figure 1). Teachers are considered inputs into school- and classroom-level processes, with teaching as a core process within

the black box. A key distinction in this model is between teacher characteristics and teacher behaviour, which is manifested in the act of teaching. The model also incorporates the influence of the external environment, recognizing that contextual factors outside the school system, such as teacher education, play a pivotal role in shaping the quality and competencies of teachers entering the system (Scheerens & Blömeke, 2016).

Despite the strengths of the above models, none fully align with the specific concepts and questions explored in this thesis.

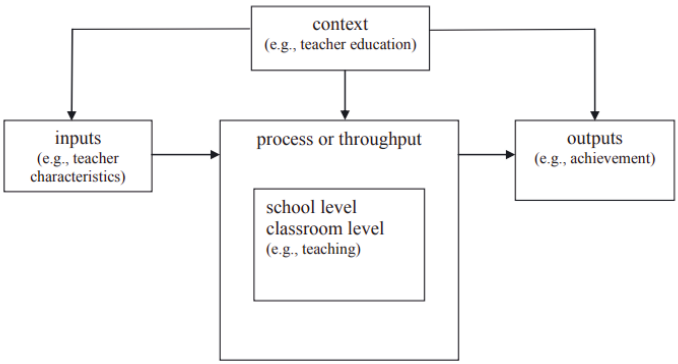

Figure 1 Graphic representation of Scheerens and Blömeke's (2016) Basic model of school effectiveness

Note. From Scheerens and Blömeke (2016), p.72.

A framework that complements the focus of this thesis, focusing on teachers while offering a holistic perspective on teacher and teaching effectiveness, is that proposed by Guerriero and Révai (2017). They define teacher competence as the capacity to apply and adapt knowledge effectively, aligning with the conceptualizations of professional competence proposed by Stoof et al. (2002) and Tigelaar and van der Vleuten (2014). The framework situates professional competence as an indicator of teacher quality, encompassing the capacity to meet complex demands within specific teaching contexts by drawing on various psychosocial resources, including cognitive, functional, personal, and ethical knowledge and skills.

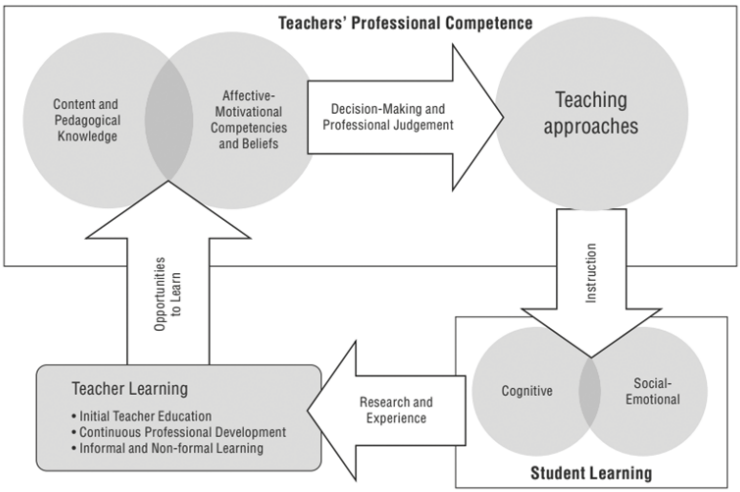

Figure 2 Graphic representation of Guerriero and Révai's (2017) Conceptual framework of teachers' professional competence
Note. From Guerriero and Révai (2017), p. 261

The key knowledge components in Guerriero and Revaí's (2017) framework, including specific content knowledge and its practical application, align closely with Shulman's (1986, 1987) seminal concepts of content knowledge (CK) and pedagogical content knowledge (PCK). Shulman defines content knowledge as an understanding of subject matter and its organizing structures, while pedagogical content knowledge integrates content and pedagogy to facilitate effective teaching.

Additionally, Guerriero and Révai's (2017) framework incorporates teachers' affective and motivational competencies (comparable to Goe's (2007) teacher characteristics), recognizing their importance alongside the cognitive competencies (see Figure 2). This perspective integrates theoretical knowledge with practical and affective-motivational dimensions, offering a holistic understanding of teacher and teaching quality compared to frameworks such as Goe's (2007). Competence is viewed as dynamic and process-oriented, emphasizing teachers' ability to apply and adapt knowledge through decision-making and professional judgement (Blömeke, 2017).

Similar to Creemers and Kyriakides' (2007) and Scheerens and Blömeke's (2016) models, Guerriero and Revaí's (2017) framework extends beyond conventional measures of student achievement. It incorporates two interconnected dimensions of "student learning": students' cognitive

development and socio-emotional growth. These dimensions not only serve as measures of student outcomes but also provide a foundation for teachers to reflect, gain experience, and advance their own professional learning, thus extending beyond static measures of effectiveness (Guerriero & Révai, 2017).

Furthermore, teachers' professional competence encompasses a variety of teaching practices (teaching approaches), such as adapting to various students and settings, engaging students actively, using various forms of evaluation, and managing the classroom effectively (Guerriero & Révai, 2017; Toledo et al., 2017). These teaching approaches closely align with what Goe (2007) describes as teacher practices (or teaching quality) in her model, however, with the difference that they in Guerriero and Revaí (2017) framework are distinct parts of a dynamic interaction rather than a component of teacher quality. A coherent and integrated knowledge base is also fundamental to the teaching profession (Guerriero, 2017; Toledo et al., 2017), as teachers must make context-specific judgements about teaching methods to optimize student learning. This perspective resonates with previous understandings of teacher knowledge as a critical component of teaching quality (Baumert & Kunter, 2013; Blömeke & Delaney, 2012; Blömeke & Kaiser, 2017; Shulman, 1987; Toledo et al., 2017). What distinguishes Guerriero and Revaí's framework is its emphasis on dynamic, continuous interactions among its components rather than viewing them as linear relationships (Blömeke, 2017; Guerriero & Révai, 2017).

Key components of teachers' professional competence

While the previous section reviewed a handful of influential models of teachers' professional competence and effectiveness, this section outlines the key components most relevant to this thesis.

Drawing on the models of Goe (2007), Scheerens and Blömeke (2016), and Guerriero and Revaí (2017) I propose three key themes of teachers' professional competence that are particularly salient for this thesis. I adopt the terminology initially introduced by Goe (2007) and later similarly applied by Scheerens and Blömeke (2016): inputs, processes, and outcomes. Inputs refer to the resources teachers bring to the classroom; teachers' coursework, grades, subject-specific education, degrees, certifications and more. Inputs also incorporate personal attributes (e.g., gender) and affective-motivational characteristics/competencies (e.g., attitudes, motivation, and beliefs of teachers). From the perspective of

Guerriero and Revaí's (2017) framework, the input domain encompasses teacher knowledge, specifically content knowledge and pedagogical knowledge. While this thesis does not directly measure these aspects due to limitations in the data typically available in ILSAs, they can be inferred from components of the initial training pre-service teachers undergo (e.g., coursework and subject-specific specializations). Processes involve the classroom practices, the influences of working conditions, and the learning opportunities teachers provide, also referred to as teaching quality. The input and the process dimensions, teacher and teaching quality, are often conflated; however, they represent distinct yet interrelated constructs that influence educational outcomes (Blömeke et al., 2016; Teig & Nilsen, 2022). In this thesis, teaching quality is conceptualized as separate from teacher quality. This distinction is grounded in the Guerriero and Revaí (2017) framework, which differentiates teaching approaches and instruction from the cognitive and affective-motivational dimensions. Furthermore, recent research within the field also suggests that teaching quality mediates the relationship between teacher quality and student outcomes (Blömeke et al., 2022a; Blömeke et al., 2016; Fauth et al., 2019; Nilsen & Gustafsson, 2016), further underscoring both its distinct nature and its interconnected role within the dynamic educational process. Finally, outcomes concern both the cognitive and socio-psychological outcomes of students. It should be noted, however, that students' socio-psychological outcomes are not examined in this thesis. Another outcome inferred from Guerriero and Revaí's (2017) framework is the process by which teachers learn as they experience and evaluate students' cognitive and socio-emotional development. These experiences then serve as new inputs that enhance teachers' knowledge base.

Inputs

The conceptual framework of teachers' professional competence (Guerriero & Révai, 2017) is based on the principle that the initial teacher education equips teachers with the initial qualifications and characteristics that build their content knowledge (Baumert et al., 2010; Clark et al., 2017; Darling-Hammond, 2021; Krauss et al., 2008). Ensuring that teachers are equipped with subject-matter knowledge and instructional strategies that are systematically tested and proven effective across different educational settings is critical for addressing the diverse needs of students, irrespective of their backgrounds and characteristics (Ingvarson & Rowe, 2008). In their framework, Guerriero and Révai (2017) argue that to meet

the complex expectations set in the rapidly changing school environments, teachers need to be lifelong learners. Teachers are suggested to learn through ongoing professional development and regular update to teachers' knowledge and skills through both non-formal (structured) and informal (experience-based) learning experiences. Non-formal learning opportunities – such as conferences, seminars, workshops, and professional collaborations – are seen as essential for teachers to build and adapt their knowledge and skills to their specific teaching contexts. At the same time, informal learning, including hands-on teaching experiences and incidental learning moments, is equally important for introducing teachers to foundational knowledge and skills in teaching and learning. To encompass all these varied forms and contexts of learning experiences, the Guerriero and Revaí (2017) framework adopts the broad term "teacher learning" to express the diverse learning opportunities teachers encounter that then shape the cognitive and affective-motivational factors contributing to teachers' professional competence. In contrast to other frameworks, such as Goe's (2007), which often overlook the ongoing nature of teacher learning, this approach emphasizes all these learning experiences as teachers' "opportunities to learn". These opportunities to learn, shape not only teachers' content and pedagogical knowledge but also contribute to the development of their affective-motivational competencies and beliefs (Guerriero & Révai, 2017).

A foundational influence on the Guerriero and Révai (2017) framework is Shulman's (1987) seminal work on teacher knowledge, which emphasizes the necessity of both deep subject-matter (content) expertise and the pedagogical knowledge necessary to transform this content into effective teaching strategies. Shulman (1986) emphasized that "mere content knowledge is likely to be as useless pedagogically as content-free skill" (p. 8), highlighting the interplay between content knowledge and pedagogy in effective teaching. Shulman introduced the concept of pedagogical content knowledge (PCK), a specialized form of knowledge that enables teachers to transform subject matter into instructional strategies that promote comprehension among students. These are the main inputs that teachers need to have. While PCK is central to Shulman's (1987) teacher knowledge framework, he also identified other categories of this knowledge (see Table 2). Four of these – General pedagogical knowledge (GPK), Knowledge of learners and their characteristics, Knowledge of educational contexts, and Knowledge of educational ends, purposes, and values, including their philosophical and historical grounds – address general dimensions of teacher knowledge. Although not the primary focus of Shulman's early work, these

categories contribute to a more comprehensive understanding of teacher knowledge.

Shulman's (1987) knowledge base aligns well with Guerriero and Revaí's (2017) framework, which highlights the interplay between cognitive resources and affective-motivational factors in shaping teachers' teaching approaches and behavior in classrooms. The cognitive resources encompass the professional knowledge base of teachers, including both content knowledge and pedagogical knowledge. These, in conjunction with affective-motivational factors, shape teachers' instructional practices and professional behaviors.

Table 2 Shulman's major categories of Teacher Knowledge

General pedagogical knowledge, with special reference to those broad principles and strategies of classroom management and organization that appear to transcend the subject matter
Content knowledge, knowledge of subject matter and its organising structures
Pedagogical content knowledge, that special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding
Curriculum knowledge, with particular grasp of the materials and programs that serve as "tools of the trade" for teachers
Knowledge of learners and their characteristics
Knowledge of educational contexts, ranging from the working of the group or classroom, the governance and financing of the school districts, to the character of communities and cultures
Knowledge of educational ends, purposes, and values, and their philosophical and historical grounds

Note: Shulman (1987), p.8

Processes

While much research emphasizes the components of teacher knowledge and their impact on student achievement, there is a growing recognition of the interaction

between teaching processes and teachers' working conditions, and the influence of the affective and motivational dimensions on teaching (Collie et al., 2012; Lauermann, 2017; Skaalvik & Skaalvik, 2017). Explanations of teachers' well-being and performance are often based on occupational research frameworks, including those that integrate job stress and motivational perspectives (Borg et al., 1991; Demerouti et al., 2001; Fox et al., 2023; Nunes et al., 2024; Redin & Erro-Garces, 2020). A core assumption of all job theories is that certain physical, social, or psychological aspects of the job, as well as the organizational environment, influence employee well-being and, indirectly, their behaviour, health and performance (Bakker et al., 2023; Nunes et al., 2024; Spector, 2022).

Despite considerable research on teachers' working conditions and affective-motivational aspects (such as job satisfaction and motivation) in education, theoretical models linking these factors to teacher competence and quality frameworks remain limited. This gap underscores the need of more context-specific approaches that connect workplace conditions and the affective-motivational aspects to existing frameworks of teacher competence. Many frameworks do emphasize the significance of these aspects (Blömeke, 2017; Gess-Newsome, 2015; Guerriero & Révai, 2017; Shulman, 2015), however, they lack a clear connection to workplace conditions and their influence on effective teaching.

Demands and resources

The Job Demands-Resources (JD-R) model (Demerouti & Bakker, 2011), which is applicable within many work settings, offers a more comprehensive understanding of how working conditions influence teachers and teaching. It recognizes the interplay between environmental conditions and personal characteristics, such as knowledge and motivation, in shaping teacher performance and influencing student outcomes. Thus, it offers an additional lens for investigating teacher effectiveness.

As the teaching profession is a profession associated with high levels of strain and consequently high attrition rates (Craig, 2017; Madigan & Kim, 2021b), the Job Demands-Resources (JD-R) model provides an aspect in explaining the occupational satisfaction and well-being of teachers (Bakker et al., 2023; Schaufeli & Taris, 2014). Integrating various job stress and motivational perspectives of work life (Bakker & Demerouti, 2017; Demerouti & Bakker, 2011) it provides insights into how job demands and resources influence job performance through employee well-being. It also highlights how individuals employ both proactive and reactive work behaviours to manage strain (Bakker & Demerouti, 2014; Bakker &

Demerouti, 2017), contributing with perspectives on the role of affective-motivational factors in influencing teacher performance in classrooms.

The JD-R model assumes that all job characteristics can be modelled using two distinct categories, namely job demands and job resources (Demerouti et al., 2001). Job demands are defined as the physical, psychological, social, or organizational aspects of the job that require sustained physical, cognitive, and/or emotional effort and are thus associated with certain physiological and/or psychological costs (Bakker et al., 2023; Demerouti et al., 2001). Job resources, in turn, are defined as the physical, psychological, social or organizational aspects of the job that have motivational potential, and are functional in achieving work goals, but also regulate the effect of job demands, and stimulates learning and personal growth (Bakker & Demerouti, 2017). The employee health and well-being results from a balance between positive (resources) and negative (demands) job characteristics. The demands and resources initiate two different processes: the health impairment process and motivational process. For example, high job demands lead to increased effort and strain, ultimately draining the employees' resources (the health impairment process). Further, high job resources lead to increased motivation and engagement and consequently leads to increased creativity and improved performance (the motivational process) (Bakker & Demerouti, 2014; Bakker et al., 2023).

The JD-R does not restrict itself to specific job demands or job resources. It is a flexible model and can be tailored to a much wider variety of work settings and can be folded into other models to contribute additional dimensions of understanding of what influences the processes. Thus, the JD-R model can offer a meaningful explanation of teacher job satisfaction and well-being while being used to understand associated outcomes. In other words, it means that it is possible to study how teachers' job demands and/or resources coincide with teachers' affective-motivational competencies, their teaching performance, and student achievement.

Bridging Knowledge, Judgement, and Practice

Professional knowledge and affective-motivational factors alone cannot fully explain the complexity of teaching (Guerriero & Révai, 2017; Leijen et al., 2022; Shulman, 1986). Effective teaching requires the ability to make informed, rapid decisions by analysing and evaluating specific learning episodes in relation to contextual and situational factors, such as students' abilities, motivation, prior

knowledge, lesson goals, and curriculum objectives (Blömeke & Kaiser, 2017; Kind & Chan, 2019; König & Pflanzl, 2016; Leijen et al., 2022).

Teachers' beliefs and competence are foundational in shaping teaching practices. Pajares (1992), in his research synthesis on teachers' beliefs and practices, argues that teachers' educational beliefs critically influence their teaching behaviours, including how they define and approach tasks and engage with subject content. Within the framework of teachers' professional competence, these skills are collectively referred to as decision-making and professional judgement and bridge that gap between teachers' formal knowledge, affective-motivational competencies, and their teaching approaches and instruction. Teachers make pedagogical decisions based on their knowledge and various contextual factors, such as school policies, the specific students they teach, and particular events that occur in the classroom (Guerriero & Révai, 2017; Shulman, 1987).

Key components of this decision-making process include noticing or perceiving critical classroom situations, reasoning and interpreting events based on their pedagogical knowledge and experiences, and applying this knowledge to adapt teaching to specific contexts. This highlights the importance of integrating theoretical knowledge with situational awareness to inform effective instructional practices (Guerriero & Révai, 2017; Shulman, 1987).

Teaching approaches represent the practical application of teachers' professional competence. They encompass strategies selected through professional judgement to organize and manage teaching and learning processes. These approaches include curriculum and lesson planning, classroom management, instructional strategies, differentiation and learning support, and student assessment. Research consistently identifies these elements as central to teaching quality (Baumert et al., 2010; Black & Wiliam, 2010; Fauth et al., 2019; Klieme et al., 2022; König & Kramer, 2016; Praetorius et al., 2018; Senden et al., 2021; Teig & Nilsen, 2022; Voss et al., 2011). Additionally, through teaching approaches teachers' professional competence translates into instructional practices tailored to the specific classroom contexts. This dynamic interplay highlights the influence of not only cognitive dimensions but also personal, situational and social factors on teaching. It emphasizes how professional judgement, situational awareness, and selection of instructional strategies interplay to shape teacher instruction (Blömeke et al., 2015; Blömeke & Kaiser, 2017; Guerriero & Révai, 2017).

Teacher instruction, and the quality of that instruction, has been extensively explored in research, and conceptualizations and operationalizations vary across

studies and countries (see Senden et al., 2021). Guerriero and Revaí (2017) describe instruction, or teaching practice, as the practical implementation of the teaching approaches, manifested through teachers' interactions with the students. However, their framework does not explicitly specify which dimensions of instruction are most essential or influential. In contrast, other frameworks have been developed to assess and define various dimensions of instructional quality (or teaching quality). Some of these concern more generic dimensions, others more subject-specific (sometimes referred to domain or content-specific), differing in their focus of study (Schlesinger et al., 2018; Senden et al., 2021). Research in Germany and the U.S. (e.g., Klieme et al., 2009; Pianta & Hamre, 2009) has been particularly influential in developing these models, leading to frameworks such as the German Three Basic Dimensions (TBD) model (Klieme et al., 2009). This model identifies three key dimensions of instructional quality: classroom management, cognitive activation, and student support.

Classroom management, fundamental and the most generic aspect of teaching quality, typically involves establishing clear rules and routines, maximising time on task, and effectively managing student behaviour. Student support encompasses differentiation, adaptive and supportive teaching strategies, and teacher-student interactions among many other things. Cognitive activation, a more content-specific aspect, focuses on instructional approaches and learning tasks that engage and challenge students in higher-order thinking and promote deep conceptual understanding. The level of cognitive activation depends on the selection and implementation of tasks and activities in the classroom (Klieme et al., 2022; Praetorius et al., 2018; Senden et al., 2021; Teig & Nilsen, 2022).

Through teachers' instruction, the complex composition of teachers' professional competence finally reaches the students (Guerriero & Révai, 2017).

Outcomes

Teachers could be considered high-quality if their students demonstrate greater learning gains than would have been predicted given the students' prior performance (Goe, 2007). While this focus offers valuable insights and facilitates cross-study comparisons, it also highlights a limitation.

In the narrowest definition of teacher effectiveness – where effectiveness is determined only by student achievement gains – a teacher may be labelled as effective simply because his or her students performed better on a test than predicted by prior achievement. However, this definition overlooks other factors

that contribute to student performance, making it an oversimplified and insufficient measure of true teacher effectiveness (Goe et al., 2008). Scholars such as Fenstermacher and Richardson (2005), Creemers and Kyriakides (2007), and Goe et al. (2008) underscore the need to consider additional dimensions of student learning and teacher impact within the effectiveness frameworks. Fenstermacher and Richardson (2005) argue that student success in learning requires a combination of circumstances far beyond a teacher's actions in the classroom. This makes it problematic to evaluate teacher effectiveness solely through standardized achievement measures, as such metrics provide a narrow view on a teacher's effectiveness. Focusing only on teacher qualities (such as qualifications and characteristics) and on student achievement gains fails to account for other contextual influences, such as the effect of other teachers, peers, school resources, community support, school leadership, and school climate and culture (Admiraal & Kittelsen Røberg, 2023; Fenstermacher & Richardson, 2005; Goe et al., 2008; Gottfried, 2014; Johnson et al., 2012). Since teachers' impact student learning and growth through a range of processes and practices they employ, it is reasonable to assume that teacher effectiveness can be more accurately understood as the result of multiple interconnected factors (Burke & Sass, 2013; Dijk et al., 2019; Goe et al., 2008; Gustafsson & Nilsen, 2016; Hamre et al., 2013; Li et al., 2017; Muijs et al., 2014; Skourdoumbis, 2014).

In other words, the debate over whether teacher quality is determined by students' standardized test results encompasses a range of perspectives. Guerriero and Révai (2017), as well as Creemers and Kyriakides (2007), adopt a more holistic view of outcomes in their frameworks, arguing that education extends beyond what is measurable in standardized tests. They highlight the importance of other forms of learning that may be equally critical for students' knowledge growth. Furthermore, within the Guerriero and Révai (2017) framework, the experiences teachers gain from evaluating students' learning can also be viewed as learning outcomes. These experiences contribute to teachers' professional growth by enhancing their understanding of the processes that influence students' cognitive and socio-emotional development, thus deepening their teacher knowledge. Regardless of approach, this thesis uses students' test results in combination with measures of teachers' professional competence and practices to understand the complex interplay between them.

Chapter 3 Previous Research on Effective Teachers

In recent decades, educational research has increasingly emphasized the importance of qualified teachers for student outcomes (e.g., Hattie, 2009; Hill et al., 2019; König & Pflanzl, 2016; Seidel & Shavelson, 2007). Research has highlighted the importance of ensuring highly qualified teachers for all student, especially in mathematics (Clotfelter et al., 2007; Darling-Hammond, 2000, 2017; Rosas & Campbell, 2010) and for students from disadvantaged home backgrounds (Allen & Sims, 2018). However, a vast body of research investigating the different aspects of teacher and teaching quality has arrived at conflicting and inconclusive results (Coenen et al., 2018; Goe, 2007; Wayne & Youngs, 2003) regarding which teacher qualities are of greatest importance for student outcomes.

One explanation for this inconsistency lies in the methodological challenges associated with evaluating teacher and teaching effectiveness. Traditional measures for assessing the quality of teachers, such as experience, level of education, or other measurable attributes, do not necessarily reflect the actual differences in the quality of teaching provided to students. Hanushek and Rivkin (2012) argue that measures of qualifications and characteristics fail to capture how teaching quality varies across student demographics, community context, or specific schools, indicating that such metrics may not fully account for the complexity of teaching effectiveness. Moreover, establishing a clear link between specific teacher characteristics, such as education programs and degrees, and student outcomes is challenging. This difficulty is compounded by significant variations in teacher preparation programs and degree requirements, which complicates, for example, cross-country comparisons (Boyd et al., 2009; Cochran-Smith et al., 2015; Harris & Sass, 2011; Levi et al., 2024; Mayer, 2021). Additionally, the conceptual frameworks of some of the renowned studies in the US (e.g., Pianta et al., 2012) and in Europe (e.g., Kunter et al., 2013; Nilsen & Gustafsson, 2016) within this field, suggest that the relationship between teacher quality and student achievement is not direct. Instead, teaching quality is considered a mediator, meaning that teacher quality may influence student performance indirectly via

teaching quality, adding another layer of complexity to drawing definitive conclusions.

Despite the difficulties in evaluating the impact of teachers, this chapter attempts to review some key findings on teachers' professional competence and quality in mathematics and reading education, offering a selection of the extensive body of research in this field. It focuses on two main subheadings, under which relationships with achievement are explored: inputs (such as teacher education and teacher knowledge) and processes (teaching quality). While the findings are relevant to the studies of this thesis, some studies focus on lower and upper secondary schools (e.g., Baumert et al., 2010). Some studies employ large-scale surveys (e.g., Blömeke et al., 2016), which are particularly relevant to this thesis due to their analytical methods and samples. In contrast, other studies are small-scale (e.g., Clarke et al., 2017) but offer insights into the various components of teacher and teaching quality. The literature search was guided by keywords related to teacher knowledge base and teacher quality, including aspects such as teacher specialization and experience.

The Inputs

Formal qualifications and teacher knowledge

When examining teachers' educational credentials, much research has focused on the importance of holding a Master's degree. While many studies suggest that a Master's degree, in general, has little to no impact on student achievement (see Coenen et al., 2018; Clotfelter et al., 2007; Clotfelter et al., 2010; Goe, 2007; Rivkin et al., 2005), evidence suggests that advanced subject-specific degrees, particularly in mathematics or science, positively influence student achievement (Blömeke et al., 2016; Coenen et al., 2018; Gustafsson & Nilsen, 2016; Harris & Sass, 2011; Wayne & Youngs, 2003). For instance, Blömeke et al. (2016), using multi-level structural equation modeling on grade 4 student and teacher data from 47 countries participating in the TIMSS 2011 assessment, found that teachers' formal level of education was, on average, the strongest predictor of students' mathematics achievement across all countries.

Additionally, prior research has emphasized the importance of teachers' specialized knowledge for effective teaching practices (Baumert et al., 2010; Hill, 2007; Piasta et al., 2009; Porter et al., 2024). Studies have shown that teachers with stronger subject-specific training in mathematics not only tend to improve student

performance (Baumert et al., 2010; Blömeke & Delaney, 2012; Blömeke et al., 2022; Toropova et al., 2019) but also possess higher levels of pedagogical content knowledge. This enhanced PCK, which integrates content knowledge with teaching strategies, has been linked to better student achievement (Hill, 2007; Hill et al., 2019; Krauss et al., 2008).

For instance, in the U.S, Hill (2007) investigated middle-school teachers' mathematical knowledge for teaching and its relationship with teachers' subject matter preparation, certification type, and teaching experience. Using multiple-choice assessments of teachers' content knowledge administered to a nationally representative sample of teachers, she found that those with more mathematics coursework and subject-specific certifications (and high school teaching experience) tended to demonstrate higher levels of teaching-specific mathematical knowledge. The study employed regression analysis, revealing that the teachers scoring higher on mathematical content knowledge measures generally had stronger subject matter preparation, as indicated by the number of mathematics courses completed. Teachers with a mathematics-specific certifications scored approximately a quarter of a standard deviation higher than their peers with other certifications.

Baumert et al. (2010) on the other hand, as part of the German COACTIV project, investigated the importance of content knowledge and pedagogical content knowledge in high-quality teaching and student progress in secondary mathematics. This one-year study involved a representative sample of grade 10 mathematics teachers and their classes. The teachers were selected based on their distinct teacher training programs, which correspond with Germany's tracking system implemented after grade 4. In this system, prospective teachers choose to qualify either for the academic track or other secondary tracks, a distinction expected to result in differences in both CK and PCK. The findings revealed that teachers' levels of CK and PCK were strongly influenced by the type of training program they had completed. Using multilevel structural equation modeling, the study revealed that PCK had a significant positive impact on students' learning gains, mediated through teacher instruction, cognitive activation and individual learning support.

The above conclusions apply to the teaching of mathematics. In contrast, within the teaching of reading, only a limited number of studies have attempted to directly link teachers' knowledge of language and literacy to their instruction and with students' reading outcomes, yielding mixed findings (Hudson et al., 2021). However, in the U.S, Porter et al. (2024) investigated the relationships between

teachers' knowledge of language and literacy and students reading outcomes at the end of kindergarten and first-grade. The study assessed teachers' content knowledge of the English language and literacy instruction, analysing data from 9640 students and 512 teachers across 112 schools using multi-level mixed-effects modeling to account for nested structures. The findings revealed that, after controlling for student variables, teachers' knowledge of language and literacy significantly predicted students' foundational reading skill scores but not their reading comprehension scores. In addition, the number of years since obtaining teacher certification and possessions of advanced degrees did not predict student outcomes in neither foundational reading skills nor reading comprehension. In other words, having an advanced degree may not significantly impact students' overall reading achievement (Porter et al., 2024).

Clark et al. (2017), on the other hand, investigated in a smaller study the reading instructional knowledge of 87 elementary education preservice teachers from two teacher education program (program A and B) in the U.S. These programs differed in the number of required reading methods courses. Program A required five courses, while program B required two. Using a 75-item literacy information knowledge scale, the study measured preservice teachers' content and pedagogical content knowledge in areas such as phonological awareness, phonics, fluency, comprehension, and vocabulary. Contrary to expectations, preservice teachers from program B scored significantly higher across all knowledge domains. Possible reasons for these unexpected results may stem from course content, with program A offering less integrated instruction on all components of reading. For example, program A emphasized phonics but included a children's literature course that did not directly contribute to the assessed content. The findings highlight that the number of courses alone does not guarantee relevant subject matter knowledge; rather, it is the content of the courses that is of importance in teacher education.

Research further suggests that a teacher's effectiveness may vary across subjects (Cohen et al., 2018) as well as across grade levels (Ost, 2014). Assigning subjects to teachers based on their educational specializations can enhance student outcomes (Cohen et al., 2018), while repeatedly teaching the same grade can help teachers deepen their knowledge base and refine their instructional practices (Blazar, 2015; Ost, 2014). Aligning teaching assignments with teachers' subject specializations allow them to focus on a narrower range of content, enabling them to develop deeper knowledge and allocate more time to mastering specific subjects (Bastian & Janda, 2018). The importance of teacher specialization for students' performance is supported by recent research both internationally and in Sweden,

in both mathematics (Coenen et al., 2018; Hill et al., 2019; Johansson et al., 2023; Toropova et al., 2019) and reading (Johansson et al., 2023; Johansson & Myrberg, 2019; Leino et al., 2022; Myrberg et al., 2019).

Very extensive research has further focused on the importance of teacher certification and licensure on student achievement. However, this question is, if even possible, more difficult to investigate than other teacher qualifications. The reason for this is that the regulations for teacher certification and licensure differ and vary between different countries, but also within countries (for example, in the USA different rules apply for teacher licensure and certificate within each state). Regardless, Wayne and Young's (2003) main conclusion in their review of teacher characteristics and student achievement gains is that certification that refers to adequate training for the subject matter is of importance for student outcomes. Goe's (2007) research synthesis of teacher quality and student achievement further suggest that certification for student learning and licensing for mathematics teaching, are positively related to students' mathematics achievement in all grades, but particularly in secondary school. Clotfelter et al. (2010) and Hill (2007) confirm these findings and suggest that subject-specific certification, particularly in mathematics, generates higher student achievement. In Sweden, while research on licensure and certification is limited, holding a license in Swedish and in mathematics appears also to be important for student achievement. Johansson et al. (2023) investigated these relationships using school-level panel data from teacher and student registers. The study analyzed data from 2013 to 2016 using fixed-effects regression techniques to examine within-school changes. The results indicated stronger teacher effects on student outcomes in mathematics. The impact of mathematics teaching license on student performance was greater than the effect of a Swedish teaching license (Johansson et al., 2023).

Teaching experience

In terms of teaching experience, scholars have reported very different methods of measuring the relationship between teacher experience and student outcomes. Moreover, inconclusive results have been reported regardless of method and school subject. Most studies assume a linear relationship between teacher experience and student outcomes, while others use categorical variables (allowing heterogenous effects of teacher experience across categories). Others, on the other hand, distinguish only between the first years of experience and all the following years after. The latter choice largely derives from prior empirical findings

suggesting that only early-year experience makes difference in explaining variation in student achievement (Chingos & Peterson, 2011; Coenen et al., 2018; Goe, 2007).

Regardless of method, some research indicate that teaching experience does not have a significant relationship with student mathematics achievement (Gustafsson & Nilsen, 2016), other studies indicate that teaching experience up to about five years is beneficial for student achievement (Chingos & Peterson, 2011; Clotfelter et al., 2010; Goe, 2007; Rivkin et al., 2005). Yet, more recent findings suggest that teachers continue to contribute to student learning and achievement throughout a teacher's career (Coenen et al., 2018; Harris & Sass, 2011; Hill et al., 2019; Johansson et al., 2023; Podolsky et al., 2019).

The Processes

Teaching quality

This aspect of teachers' professional competence takes into account what teachers do in classrooms, and links them to students' achievement. Students' knowledge construction is often influenced by the processes in the classrooms, the teaching quality (Goe, 2007), and involve core instructional practices which often include explicit and cognitively challenging instruction (cognitive activation), how classroom and time is managed, socio-emotional and learning support offered, and formative assessment to name a few (Alp Christ et al., 2022; Baumert et al., 2010; Cohen, 2018; Fauth et al., 2019; Leino et al., 2022; Nissen, 2023; Praetorius et al., 2018; Rieser et al., 2016).

While some empirical studies demonstrate a positive relationship between teaching quality and student achievement (e.g., Muijs et al., 2014), others report non-significant effects (Alp Christ et al., 2022; Blömeke et al., 2016; Praetorius et al., 2018). This inconsistency may stem from the various frameworks and instruments used to conceptualize and investigate teaching quality and its influence on student outcomes (Blömeke et al., 2016; Klieme et al., 2022; Pianta & Hamre, 2009; Praetorius et al., 2018; Schlesinger et al., 2018). These frameworks differ considerably in the specific aspects of teaching quality they address, as well as how they conceptualize, operationalize, and measure these dimensions.

Additionally, what is considered "high-quality" teaching in one context may not be applicable in another, as teacher instruction and student needs can differ

across different educational settings. Moreover, findings on the influence of teaching quality vary across countries, subjects, and types of student outcomes, making it challenging to reach consensus on which instructional practices most effectively support student learning (Blömeke & Olsen, 2019; Senden et al., 2021). Blömeke et al. (2016), for example, explored the relationships between teaching quality and fourth-grade students' mathematics achievement across 47 countries utilizing TIMSS 2011 assessment data. Teaching quality was examined as a mediator between teacher quality indicators and student achievement and was based on the teacher questionnaire, which asked teachers how frequently they engaged in various classroom activities. Key dimensions examined included cognitive activation, instructional clarity, and a supportive climate. The findings revealed substantial cross-country variation between teaching quality and student achievement, likely influenced by cultural differences in teaching practices.

In a Nordic context, where school systems share similarities, Nilsen et al. (2018) investigated the relationships between teaching quality and students' science achievement in grade 4 and 8 utilizing TIMSS 2015 assessment data. Employing two-level structural equation modeling, they investigated whether teaching quality – cognitive activation and teacher support – mediated the link between teacher quality and student outcomes. Interestingly, the results varied across the Nordic countries at the class level. While Denmark showed no significant relationship, Finland and Sweden demonstrated weak but significant associations, whereas Norway exhibited a moderate relationship. These differences suggest that even within a relatively homogeneous region, the influence of teaching quality can vary.

Continuing with the Nordic context (Denmark, Norway, Sweden, and Finland) but now in the reading domain, Leino et al. (2022) employed instead path analysis to examine the relationships between teacher quality, teaching quality, and student achievement in the PIRLS 2016 assessment. This study measured teaching quality across three dimensions: classroom management, cognitive activation, and teacher support. Notably, the conceptualization of cognitive activation in this study differs from that in the previously mentioned TIMSS studies. Here, it focuses on reading-related classroom activities, such as how often teachers read aloud to students or ask students to read aloud. In contrast, in the Nilsen et al. (2018) study cognitive activation pertains into more general questions; such as how often the teacher asks students to complete challenging exercises that require them to go beyond the instruction. Overall, Leino et al. (2022) found that the associations between teaching quality and student achievement were not particularly strong in any of the Nordic countries. Furthermore, all variables measuring cognitive activation were

excluded from the final analysis due to their lack of statistical significance. Only the dimensions of classroom management and teacher support demonstrated statistically significant associations.

While the studies mentioned above offer valuable insights, they are primarily cross-sectional, which limits the inferences that can be drawn about causal relationships over time. In contrast, longitudinal approaches provide a more robust understanding of how teaching and learning interact. However, such studies are rare due to the substantial resources they require (Senden et al., 2021). One notable exception is the previously mentioned COACTIV project, which was a one-year longitudinal extension of PISA in Germany designed to study teachers' mathematical knowledge, teaching quality, and student achievement (Baumert et al., 2010). The sample comprised 4353 grade 10 mathematics students and 181 teachers, with teaching quality measured through the three basic dimensions: cognitive activation, classroom management, and learning support. The multilevel structural equation models revealed that the relationship between teachers' pedagogical content knowledge and students' learning gains was mediated by cognitive activation and individual learning support. The findings emphasize that teachers' PCK influences instructional quality in terms of cognitive activation level and individual learning support offered.

Similarly, a more recent longitudinal study conducted by Blömeke et al. (2022a) also in the German context, investigated how teachers' mathematical content knowledge (MCK), pedagogical content knowledge (MPCK), and pedagogical-instructional decision-making (PID) skills influence student learning progress, with instructional quality as a potential mediator. Instructional quality was measured as a single latent construct encompassing the three basic dimensions along with indicators of mathematics educational structuring. The study followed 3495 eight-grade students from 154 classrooms over 1.5 to 2 years, utilizing standardized tests, video-assessments, classroom observations, and national achievement tests. Data were drawn from the German TEDS-Instruct and TEDS-Validate studies, part of the international Teacher Education and Development Study in Mathematics (TEDS-M). The findings revealed that MCK predicted MPCK, which, in turn, influenced teachers' PID skills. However, neither MCK nor MPCK directly influenced student learning progress. Instead, student achievement was significantly affected by teachers' PID skills and instructional quality. Notably, when controlling for school type, the indirect effects lost their significance. Additionally, compared to the Baumert et al. (2010) study, Blömeke et al. (2022a) used a different operationalization, modeling instructional quality as a single latent

construct. This methodological difference may have influenced the study's outcomes. Nonetheless, both studies, suggest that, when prior achievement is controlled for, instructional (teaching) quality positively influences student achievement in mathematics.

Furthermore, given that many primary school teachers teach multiple subjects, a set of cross-subject instructional practices may be particularly beneficial in primary school teacher preparation. A key assumption is that teachers who are effective in one subject area also tend to be effective in other areas (Goldhaber et al., 2013). However, there is limited research supporting this assumption of cross-subject consistency in teaching quality (Cohen et al., 2018; Graeber et al., 2012). For instance, mathematics teachers may not demonstrate the same teaching quality in reading lessons due to differences in content knowledge across subjects, available curricular materials, and students' prior experiences in mathematics versus reading instruction (Goldhaber et al., 2013). Nonetheless, some studies suggest consistency in cross-subject practices such as explicit or direct instruction (Cohen, 2018), where teachers demonstrate step-by step routines, provide students with structured practice opportunities, and offer consistent feedback. Conversely, teachers who offer cognitively demanding activities in mathematics are not always the same ones who create similarly challenging activities in reading class (Graeber et al., 2012). These findings underscore the need for further research in this area.

The affective-motivational aspects and beliefs of teachers

Johnson's well-cited research (Johnson, 1990, 2006; Johnson et al., 2012) within the field teachers' workings conditions has contributed to understandings of the workplace conditions that support teachers' effectiveness and retention. Her work identifies a wide range of critical components, from the physical environment (such as safety and comfort) to economic factors (including pay and job security), to organizational structures (workload, autonomy), and cultural and social elements (such as values, norms, and the characteristics of colleagues and students). These factors are suggested to influence teachers' affective-motivational aspects, effectiveness, and retention.

Johnson (2006) further argues that a successful teaching environment is shaped by these interconnected factors, which collectively empower teachers to support their students effectively. To support teachers in performing at their best, schools must provide working conditions that not only address practical resources but also offer organizational support that actively promotes and sustains teachers' teaching

efforts in multiple ways (Johnson, 2006). With supportive environments, better teaching practices are enabled (Hanushek & Rivkin, 2007; Johnson, 2006; Ye & Singh, 2017).

Manageable workload is particularly critical, along with teaching assignments that align with the teachers' area of expertise, safe and well-equipped facilities, sufficient resources to meet the diverse needs of the students, and administrative support and supportive leadership. In addition, collaboration with colleagues in matters related to teaching, sense of autonomy, and ability to influence school decisions, and school climate are further aspects of working conditions that teachers identify as critical to their work and well-being (Admiraal & Kittelsen Røberg, 2023; Bascia & Rottmann, 2011; Collie et al., 2012; Jentsch et al., 2023; Johnson, 2006; Johnson et al., 2012; Wang & Degol, 2016).

Workload, in particular, has been highlighted as a crucial factor influencing teacher well-being and effectiveness. Toropova et al. (2021) examined the relationships between school working conditions – particularly workload – and job satisfaction among eight-grade mathematics teachers in Sweden. Using data from TIMSS 2015, which included 4090 students and 200 teachers, the study employed structural equation modeling to analyze latent constructs related to working conditions and workload. The findings highlighted teacher workload as a key determinant of job satisfaction.

Similarly, the Swedish study by Nilsson et al. (2019) involving 338 teachers found that most participants reported that being unable to complete their work on time and the experience of time pressure had the strongest association with work-life balance. The feeling which comes from accomplishing and completing work curbs stress and is necessary for teachers' psychological resilience (Nilsson et al., 2019). Increasing stress as a result of high workload and feeling of time pressure has been reported in several studies in Sweden (Ahlgren & Gillander Gådin, 2011; Boström et al., 2020; Nilsson et al., 2017) and internationally (Borg et al., 1991; Burrow et al., 2020; Carroll et al., 2022; Creagh et al., 2023) as a major contributor to reduced job satisfaction, and diminished well-being. Teachers' workload, job satisfaction, and well-being are important determinants of teaching effectiveness and a teacher's decision to stay in the profession (Gray et al., 2017; Madigan & Kim, 2021a; Thapa et al., 2013).

The quality of the workplace plays an important role in either enabling or limiting effective teaching (Johnson, 2006), however, the link to student outcomes is much less explored (Gray et al., 2017; Hakanen et al., 2006). While research suggests that teachers facing high demands, such as extensive workload, are more

likely to experience stress and burnout, teachers with strong job resources, such as positive school environments and professional support, are likely to remain motivated, committed and perform better (Collie, 2021; Collie & Mansfield, 2022; Collie et al., 2012; Salinas et al., 2022; Skaalvik & Skaalvik, 2017, 2021).

Summary

Despite methodological challenges in conceptualizing and operationalizing teacher and teaching quality, recent research provides some evidence on the importance of teaching experience on student achievement (Coenen et al., 2019; Johansson et al., 2023) and highlights the influence of subject-specific specializations and certification/licensure on student outcomes, particularly in mathematics (Baumert et al., 2010; Hill et al., 2019; Johansson & Myrberg, 2019). Due to considerable variations in teacher education programs across educational systems and over time (Darling-Hammond, 2017), it is important to account for teachers' subject-specific specializations, as demonstrated in studies by Baumert et al. (2010) and Johansson and Myrberg (2019). Moreover, research suggests that aligning teacher qualifications with both grade level and subject content could benefit teaching (Cohen et al., 2018; Ost, 2014). However, capturing the precise effects of these qualifications remains challenging.

Conceptualizing elements of teaching quality differs across studies; however, several influential frameworks provide guidance. For example, the German TBD framework suggests at least three dimensions of teaching quality to consider (Klieme et al., 2009), though findings remain mixed. Additionally, teaching quality may mediate the relationship between teacher qualifications and student achievement, and its impact may vary depending on student characteristics, subject domains, and working conditions (Blömeke & Olsen, 2019; Collie, 2021; Collie & Mansfield, 2022; Senden et al., 2021). Given these complexities, there is a growing demand for more refined measures of both teacher and teaching quality.

Chapter 4 Teacher Education in Sweden: Shaping and Reshaping a Profession

The following section provides the contextual background for this thesis. To begin, it addresses the historical changes in Swedish teacher education and offers an overview of key changes. It then outlines the variations in teachers' subject and grade level specializations in Swedish compulsory schools, as well as the development of primary education stage divisions over time. A distinctive feature of the Swedish education system is its stage divisions, where teachers typically remain with the same group of students from grades 1 to 3 and grades 4 to 6. This contrasts with many international education systems, where teacher transitions occur more frequently across grades. These structural characteristics are central to the thesis, as they facilitate more in-depth analyses of teacher and teaching quality, as well as the long-term impact of teachers on student outcomes.

Changes in Swedish teacher education

To understand the variation among teachers in Swedish compulsory school, it is valuable to consider the changes in teacher education over the past decades. In this section, context for the diverse formal teacher competencies in Swedish primary schools is provided. The intention is to offer a concise overview of the historical changes in Swedish teacher education, particularly during the past six decades (see Table 3 for an overview). These changes have resulted in a teaching workforce with varying expertise and specializations for different grade levels and subjects in Sweden's compulsory education system.

Compulsory school and the teaching profession

Swedish teacher education has undergone numerous changes over the years. The introduction of a compulsory comprehensive school in 1962 meant new conditions for the teaching profession. Until the 1960s, the most common school

types were the Folkskola (elementary school, also referred to as folk-school), followed by the voluntary secondary school Realskolan (referred to as real-school), and Läroverk (grammar school) (Furuhagen et al., 2019; Marklund, 1984). However, other forms of schooling, such as private elementary schools, also existed (Persson, 2008; Ringarp & Parding, 2018).

The folk-school teacher education seminaries and grammar-school teacher education created a divided profession that recruited students from different social classes and later also different genders. Furthermore, the seminar teacher tradition was primarily grounded on a practice-based curriculum designed for teaching younger students and those from lower socio-economic backgrounds in folk-schools. In contrast, grammar-school teachers focused on academic subject instruction for older, middle- and upper-middle class students in grammar schools and academies. Unlike folk-school teachers, grammar school (and real-school) teachers received their education at universities (Furuhagen & Holmén, 2017; Persson, 2008).

Until 1962, the folk-school was also divided into the lower primary school (in Swedish Småskolan) where mostly female teachers taught students in grades 1-3, and into the upper grades of folk-school where teachers taught students in grades 4-6. Initially, a primary school teacher did not need to be seminary-educated, which was a requirement for the folk-school teacher. Eventually, the primary- and folk-school seminaries were merged into one unified folk-school seminary (Marklund, 1984; Persson, 2008).

Already in the 1948 school commission's report (SOU 1948:27) there was a vision of a unified teaching staff and a coherent teacher education at joint teacher training colleges. But the decision to establish such teacher training colleges was delayed until 1967, and a year later folk-school seminaries were converted into teacher training colleges (Persson, 2008). However, the characteristics of the previous school forms and teacher categories (i.e., folk-school teachers and real-school teachers) remained in the compulsory school system, as it was divided into three three-year stages: primary school (grades 1-3), upper primary/middle school (grades 4-6), and lower secondary school (grades 7-9) (Marklund, 1984; Persson, 2008).

Teacher education reforms in the 1970s and 1980s

Extensive changes to higher education occurred during the 1970s, including the integration of teacher education into the higher academic tradition in 1977.

Around the same time, a proposal was made to establish a unified teacher education program spanning seven semesters. However, these discussions would end in a compromise: a unified compulsory school teacher education but with two orientations, which was first realized in 1988. One orientation aimed at primary teachers, i.e. teachers who taught in grades 1-7, the other towards teachers who taught in grades 4-9 (Ringarp & Parding, 2018). For the earlier grades the compromise suggested that the grade 1-7 teachers would receive more depth of subject matter (either in mathematics and science subjects or Swedish and social science subjects) than previous primary and upper primary/middle school teachers. For the later grades the compromise meant that the grade 4-9 teachers studied more subjects than before, which reduced the specialization/s in subject/s (Furuhagen et al., 2019; Hallsén, 2013). The compromise also meant that students in grades 4-7 could have teachers with quite different focus in their teacher education (1-7 vs 4-9).

The main purpose of this reform was that teacher training would have a structure and a content which focused on the needs of the compulsory school. Central to this reform was also the changed role of the teacher. Pre-service teachers were to be prepared to promote students' personal development and take greater responsibility for the school's social mission. Students' knowledge seeking was in the forefront, as opposed to previous traditional knowledge transmission in teaching. Further, the reform aimed for the teacher role to move from being authoritarian to rather being supportive and stimulating. The 1988 reform was also influenced by a vocational orientation in teacher training, where studies in pedagogy and methodological training were included, but were extended and intertwined with a social agenda. Subjects such as internationalism, gender equality, and immigration and diversity were included in this agenda (Furuhagen et al., 2019).

Teacher education reforms of the 1990s and the millennium

After a political shift in power in 1991 a partial change of the 1988 teacher education programme was initiated. This new reform emphasized the importance of subject specific knowledge in teacher education. The primary role of school was proposed to be the transmission of knowledge and skills. Students' personal development was considered to be subordinate and seen primarily a responsibility

of the parents. The teacher as a subject specialist became the official ideal (Furuhagen et al., 2019).

In 1994, a new curriculum was introduced along with new changes in teachers work. The three-year stages were increasingly phased out of policy documents and attempts were made with so-called earlier and later teachers and a planning of a new teacher education program began. It ended up in a teacher education reform which was launched in 2001 (Furuhagen et al., 2019; Ringarp & Parding, 2018). The reform was motivated by the decentralization of Swedish schools and the rapid fundamental social transformations that had affected schools and society (such as globalisation, information technology, and multiculturalism) (Furuhagen et al., 2019). The major changes in the school system required a new teacher education and a teaching staff with a common professional knowledge base, from primary to upper secondary school. Several teacher education degrees were proposed to be merged into a single *Teacher degree* giving pre-service teachers common competence and in addition a specialization and/or several specializations. This meant that a common teacher's degree was introduced for the teachers in preschool, compulsory school, and upper secondary school, while for example the special education teachers kept their own degree. However, within this degree student teachers were offered options to focus on specific subjects and age categories, but the subject-specific orientation was weak. Subject knowledge specializations were proposed but not emphasized in the policy texts behind the 2001 reform (Furuhagen et al., 2019). This meant that a student could get a degree towards the earlier years of compulsory school without a specialization in either Swedish or mathematics. In more concrete terms, a more generalized orientation towards compulsory school, but towards earlier years, towards grades 1-5/6, with several subject options to choose from during education, however with the intention to be prepared to teach most of the subjects covered in the curriculum in primary school (SOU 2008:109). Further, it was stressed that teacher education needed to be better rooted in practical experience (Furuhagen et al., 2019; Hallsén, 2013; SOU 1999/2000:135).

Again, in 2006 extensive reforms were implemented across all levels of the educational system. These included a new school law, a new curriculum, the introduction of a new upper secondary school system, a planning of a restructured teacher education, and the establishment of a new school authority. Together, these changes affected teachers' education and work. The government proposed four professional degrees: pre-school teacher degree, primary school degree, subject teacher degree, and vocational teacher degree which were implemented in

2011 (SOU 2009/10:89). The changes implied a return to the stages of the teacher education before 1988. The primary school degree consists of three specializations: work in pre-school class and grades 1-3, work in grades 4-6, and work in leisure centres. These changes meant that teachers for younger students would teach all or most of school subjects. The education was also extended by one semester to four years and the primary school pre-service teachers were suggested to study several subjects, but without deeper specialization in any of them. However, Swedish language/reading and mathematics became compulsory for all primary school teachers. The subject teacher degree is now offered in two orientations: one for grades 7-9 and another for upper secondary school. Subject knowledge gained more emphasis, even in grades 4-6, while the common courses were reduced across all teacher degrees. However, educational science was introduced as a new subject in all the professional degrees, incorporating areas such as special education, assessment, and grading. The ideal teacher was now envisioned as more of a specialist than a generalist (Furuhagen et al., 2019; Hallsén, 2013; Prop. 2009/10:89; SOU 2008:109).

As new grading criteria (called knowledge requirements) and national tests were introduced in grades 3 and 6 in 2011 along with the new eligibility requirements for e.g., primary school teachers, the old stage classification levels were proposed to be introduced for lower primary, upper primary/middle school and lower secondary in 2016 (Prop. 2016/17:143). These were implemented in 2018.

Table 3 Teacher education categories in primary school 1972- today

Years	Teacher category
1972–1988	Lower primary teacher grades 1–3
	Upper primary teacher grades 4–6
1988–2001	Mathematics and sciences grades 1–7
	Swedish and social sciences grades 1-7
	Mathematics and sciences grades 4–9
	Swedish and another language grades 4-9
	Social sciences grades 4–9
2001–2011	Teacher degree Earlier grades 1–5/6
	Teacher degree Later grades 6/7–9
2011-	Lower primary teacher Preschool class- grade 3
	Upper primary teacher grades 4–6

What did the changes in education mean for mathematics and Swedish teachers?

In terms of mathematics and Swedish teachers' education today, prospective teachers at the primary school level (pre-school class to grade 3) are typically educated to become generalists. They are expected to teach not only mathematics and Swedish, but also a variety of other subjects. However, their education now places a stronger emphasis in basic reading, writing, and mathematics learning compared to the teacher training at the turn of the millennium. Teachers at grades 4-6 also receive a compulsory theoretical foundation in basic reading, writing, and mathematics learning. Additionally, they are now required to deepen their knowledge in at least one additional subject or subject area (e.g., music or science). Consequently, their subject-specific education differs from that of teachers trained for grades 1-7 and 7-9, as well as the primary teachers educated around the millennium. Furthermore, the division of primary school into lower primary and upper primary (or middle school) was mainly due to previous teacher education neglecting the specific subject content regarded as important for teaching students aged 10 to 12 (Ebbelind, 2020; Furuhagen et al., 2019; SOU 2009/10:89). Due to reforms implemented in recent decades, the current teaching staff in Swedish compulsory school possess a diverse range of educational backgrounds and specializations shaped by these past reforms.

Chapter 5 Method

In this chapter the methodological choices of the empirical studies are presented. It begins with an overview of the data, samples, constructs, and items, followed by a presentation of the analytical methods. The chapter concludes with a discussion of validity issues and ethical considerations.

Data

The empirical work in this thesis is based on Swedish Trends in International Mathematics and Science Study (TIMSS) and the Progress in International Reading Literacy Study (PIRLS). The data was retrieved from the official website of TIMSS and PIRLS (http://timssandpirls.bc.edu). TIMSS is an international large-scale assessment conducted by the International Association for the Evaluation of Educational Achievement (IEA), focusing on mathematics and science achievement for fourth and eighth grade students. The study is conducted on a four-year cycle. PIRLS, also conducted by IEA, assesses reading literacy achievement for fourth-grade students, and is administered every five years. In addition to academic achievement, both TIMSS and PIRLS collects data through questionnaires from school principals, teachers, students, and parents/caregivers about the contextual factors influencing student learning and achievement (Mullis & Martin, 2015).

Samples and variables

Student achievement is used as the outcome variable in all three studies. Both achievement test designs, TIMSS and PIRLS, make use of a matrix-sampling technique to divide the assessment item pool so that each sampled student responds to a limited number of assessment items (Martin et al., 2017; Martin et al., 2020). These are however too few to produce accurate individual content-related scale scores for each student. TIMSS and PIRLS relies on Item Response Theory (IRT) scaling to combine student responses in a way that provides accurate estimates of achievement. The multiple imputation known as "plausible values"

method is used to obtain the achievement scores, even though each student responded to only a limited number of assessment items. They represent the performance an individual might have had if the student participated in the entire assessment (see https://timssandpirls.bc.edu).

Additional student outcomes in Study II come from Swedish register data; students' subject grades in mathematics and Swedish in grade 6, as well as their total grade point average score (GPA) for 16 subjects.

The independent variables used in this thesis are operationalized in different ways across the constituent studies. In TIMSS and PIRLS, a set of questions address teachers' educational backgrounds, teaching experience, and participation in professional development activities, collectively referred to as teachers' formal competence and teacher qualifications in this thesis. More detailed information regarding how each of the questionnaires are constructed can be found in the technical reports from the IEA website for the studies (https://timssandpirls.bc.edu).

Study I is conducted as a secondary analysis and utilized TIMSS 2019 data. The sample comprised 194 teachers and 3965 students in grade 4 (The Swedish National Agency for Education, 2020). Mathematics assessment scores and survey questionnaires for students and teachers were used to explore the relationship between teachers' formal competence and student outcome. In Study I, teacher qualifications are represented by five items, including teachers' Highest level of education completed, Major or main area of study/specialization, Teaching experience, Participation in professional development activities, and Hours participating in professional development activities (for a complete overview of the items and response categories, see Lindström et al. (2024)).

In Study I, control variables are used to account for student background factors. Research has long emphasized the relationship between students' socio-economic status (SES) and academic achievement, with students from higher SES backgrounds outperforming those from lower SES backgrounds (Erberber et al., 2015; Gustafsson & Yang Hansen, 2018; Sirin, 2005). Sirin (2005) identified three key SES indicators: parental education, occupation, and income. However, in Study I, parental income is missing in the TIMSS data, and both parental occupation and education, which are self-reported by parents, contain a large number of missing values (> 20%) in the Swedish sample. Therefore, the student reported number of books at home is used as a proxy for SES. In the Swedish context, this measure is commonly regarded as a reliable SES indicator (e.g., Eriksson et al., 2018; Wiberg & Rolfsman, 2023), strongly correlating with home

resources reported in the student questionnaires (Bellens et al., 2019) and potentially reflecting parental economic capacity. Despite concerns about its validity, such as underreporting by low-achieving students and issues related to endogeneity (Engzell, 2021), this indicator has been rigorously tested in research (Chmielewski, 2019; Harju-Luukkainen et al., 2020; Wiberg & Rolfsman, 2023). In the TIMSS 2019, students' responses on the number of books at home are distinguished by five categories, ranging from 0 to more than 200 books, with approximately one-third of the grade 4 students reporting fewer than 25 books at home. This suggests that "Books" may reflect students' SES background. To further control for student background differences, the item "Language spoken at home" in the student questionnaire is used to distinguish language, as well as immigration, background.

Study II utilized PIRLS 2016 data for students in fourth grade and their teachers. The Swedish sample comprised 4525 students and 214 teachers. Since PIRLS alone does not provide sufficient data to account for student background variables and prior academic performance, additional variables were incorporated into the Swedish dataset. Specifically, the 2016 Swedish PIRLS database was enhanced by integrating register data into the national dataset. Following ethical vetting, the Swedish National Agency for Education collected social security numbers for the participating students, enabling the inclusion of detailed information on both earlier and later academic performance for these students. Additionally, background characteristics, such as parents' or guardians' educational levels and migration status, were added to the dataset (The Swedish National Agency for Education, 2017).

These enhancements enabled Study II to incorporate several control variables. Specifically, data on students' prior achievement in grade 3 and their parents' or guardians' educational levels were obtained from the Swedish national registers, while student gender information was drawn from the PIRLS assessment. Prior achievement is considered predictive of later performance in both mathematics and reading (Hemmings et al., 2011; Sparks et al., 2014), while parental education level is seen as a key factor influencing student outcomes (Holmlund et al., 2011; Lundborg et al., 2014). Gender also appears to influence student outcomes, with girls generally outperforming boys in reading and boys showing stronger performance in mathematics (Encinas-Martín & Cherian, 2023; Reilly et al., 2015, 2019). These variables were utilized at the within-level to ensure that the observed effects on outcomes, student performance, are not confounded by differences in students' starting abilities (and by this also excluding the influence of prior

teachers) and gender. Control variables at the within-level account for individual-level variability that might influence the outcome variable.

In Study II, teacher qualifications are represented by four items: Highest level of education completed, Major or main area of study, Specializations (in reading), and Teaching experience, with additional data from the Swedish national extension on teachers' Subject-specific license. The study also focused on teachers' reading related cognitive activation and reading comprehension activities. The included reading comprehension items focused on text analysis, such as how often the teacher asks the students to locate information within the text, identify main ideas of what they have read, and explain or support their understanding of what they have read. The Swedish national extension further included items assessing the frequency of cognitively challenging classroom activities, such as asking students to complete challenging tasks that require more than what the teaching was about, asking students explain their answers, and encouraging classroom discussions (for an overview of the items and response categories, see Study II).

Study III relied on both PIRLS and TIMSS data. Two cycles of PIRLS (2016 and 2021) and two cycles of TIMSS (2019 and 2023) were utilized. The Swedish sample for PIRLS 2021 comprised 5175 students and 261 teachers. The Swedish sample for TIMSS 2023 comprised 5139 students and 261 teachers.

Many of the items in the assessments are trend items. These are repeated in subsequent questionnaires enabling the linking of assessments from one cycle to another. Trend items concerning teachers' workload, sense of safe and orderly schools, and job satisfaction were used in the analyses together with student performance. In PIRLS 2016 and 2021 items concerning workload were however a national extension. These items were retrieved from the Swedish National Agency for Education. These teacher-related items are identical across both cycles and assessments (PIRLS and TIMSS), enabling the trend analysis and comparisons across subjects. This makes it possible to study teachers' working conditions and job satisfaction under different circumstances over time, but also across subjects.

In Study III, the available items related to teachers' perceptions of workload and safe and orderly schools were used to measure working conditions and school climate. Teachers' workload includes items addressing, for example, time needed to prepare lessons, administrative tasks, and amount of material teachers must cover. Furthermore, teachers' perceptions of safe and orderly school climate include items such as feeling safe at school, student behavior in class, and students' respecting teachers and school property. In the TIMSS and PIRLS teacher questionnaire, the questions framed as "How often do you feel the following of

being a teacher?" capture to some extent the teachers' perceived social working climate, which reflects their job satisfaction. These items address teachers' sense of meaning and purpose in their work, as well as their overall contentment. In Study III, Job satisfaction is used both as an outcome and as a predictor (for an overview of the items and response categories, see Study III).

In Study III, Time is used as a predictor to capture changes across cycles of the included assessments. Dummy variables were created for the PIRLS and TIMSS data, with Time in PIRLS coded as 0 for the 2016 cycle and 1 for the 2021 cycle. For TIMSS, Time was coded as 0 for the 2019 cycle and 1 for the 2023 cycle.

Methods of analysis

Structural equation modeling (SEM), a widely used approach in educational sciences, serves as the primary analytic method in this thesis. SEM encompasses a family of statistical techniques that examine the relationships between variables, enabling the researcher to establish measurement models, explore connections between non-observable latent constructs and observed variables through regression, and specify complex paths between dependent and independent variables. An advantage of SEM is that it can treat more than one dependent variable at a time but also variables that are both dependent and independent in the same model. In addition, it is possible to investigate the mutual influence of variables on each other. Furthermore, SEM can incorporate multilevel modeling, allowing for the analysis of data with hierarchical structures and the investigation of the mutual influence of variables across levels (Hox, 2002; Kline, 2016). In this thesis, multilevel modeling is employed in the first two studies, whereas mediation with aggregated data serves as the primary analytic method in the third study.

The analyses in this thesis were performed using Mplus version 8 software (Muthén & Muthén, 1998-2017), a robust software designed for multivariate and multilevel statistical modeling with or without latent variables within a single model. Data cleaning and preparation were conducted using IBM Statistics 28 and 29 (SPSS) (IBM Corp. Released 2021).

Analytical approaches

Many of the concepts investigated in this thesis are not directly observable, necessitating the use of multiple indicators (manifest variables) to measure different constructs (latent variables). This approach reflects the inherently complex and multidimensional nature of the studied phenomena. Across the three

studies in this thesis, latent constructs were designed to capture multifaceted concepts such as teacher competence, cognitive activation, and job satisfaction.

The first step in the modeling process is the construction of a measurement model. In the measurement model, each latent variable is associated with multiple indicators (at least two, but typically several) selected to reflect the construct. The validity of these constructs is evaluated through confirmatory factor analysis (CFA) which identifies the latent structure and examines how well the latent variable explains the observed variables. By capturing the covariation between several indicators/variables, we get an idea of which ones measure similar phenomena. Basically, there is common variance that is shared by the indicators, which is then a basis for observed covariances among them and can be interpreted as a measure of a correlation between the variables in question (these can assume a value between 0 and ±1). The common variance is assumed to be due to the latent factor (latent variable). However, there is a unique variance (a residual or error variance) in addition to the common variance for each indicator. It consists of specific variance and random measurement error. The specific variance is systematic variance which is not explained by any factor in the model. This error variance lies outside the latent variable and is thus considered error-free (Kline, 2016).

Fit indices play a crucial role in CFA by providing an assessment of how well the hypothesized measurement model aligns with observed data. In this thesis, CFA was employed to validate the measurement structures of the latent constructs, ensuring the construct validity of measurements. Key measures included were Chi-square (χ^2), Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Residual (SRMR), Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI) (Hu & Bentler, 1999; Schreiber et al., 2006). A non-significant χ^2 value indicates good fit. The relationship between χ^2 and the number of degrees of freedom can also signal model fit (the ratio of χ^2 to degrees of freedom should be $\leq$ 2 or 3). Though χ^2 is sensitive to large sample sizes, and in such cases, despite an otherwise acceptable model fit, tends to assume high values (Hu & Bentler, 1999; Schreiber et al., 2006). The limitations of χ^2 necessitate the use of additional fit indices. RMSEA evaluates the deviation between the model and observed data, with values $\leq$0.06 indicating good fit and >0.10 suggesting poor fit, often reported with confidence intervals. SRMR measures the deviations between the observed and predicted covariance matrices, with values $\leq$0.08 considered acceptable. CFI and TLI compare hypothesized model to a baseline model, with values > 0.95 indicating strong fit. The CFI assesses the relative improvement in fit of the researchers' model and over that of a baseline model, while TLI controls for

degrees of freedom from the researcher's model and for degrees of freedom from the baseline model. While highly correlated, typically only one of these indices is reported (Kline, 2016). Collectively, these measures provide a comprehensive assessment of model fit.

The next step in the modeling process is to build a model with more complex relationships between the variables. A structural part, a structural regression, is added to the model, and it represents hypotheses about direct or indirect effects among observed or latent variables (Kline, 2016). Similar to CFA, the model fit of the SEM can be evaluated by CFI, TLI, RMSEA, and SRMR.

This thesis also employs multilevel models to investigate the relationships between latent constructs at the teacher/classroom level while accounting for factors at the student level. The studies utilize data collected from entire classes of students, aiming to investigate class-level factors, such as the teacher's formal educational level and reading comprehension activities, that influence student achievement. Hierarchical data, such as TIMSS and PIRLS, are well-suited for analysis using SEM, as it accommodates the dependencies created by cluster effects and enables analyses at more than one level. This approach allows for simultaneous calculation of variation between students within a class and variation across different classes. Specifically, a two-level analysis partitions the total variation into two components: within-class variation, which captures differences among individual students in the same class, and between-class variation, which reflects differences across entire classes. This distinction provides an understanding of how individual and group-level factors influence outcomes (Hox, 2002). In addition, multilevel analysis can be carried out with both manifest and latent variables using, for example, the program Mplus (Muthén & Muthén, 1998-2017) as is done in this thesis.

Missing data

Missing data is a common challenge in large-scale assessments, arising from individuals missing out of on part of a survey, entire survey, or specific questions. Missing data in the three studies follow a Missing at Random (MAR) pattern, where the likelihood of missingness is related to observed variables. For instance, an individual might not answer specific questions, but the responses can be predicted from other information about the individual. Contemporary approaches to handle this issue is by either deleting incomplete cases (e.g., listwise deletion) or by replacing a missing score with a single calculated (imputed) score.

In this thesis, Mplus was used to handle missing data through Full Information Maximum Likelihood (FIML) estimation approach (Muthén & Muthén, 1998-2017). FIML is a robust method for dealing with missing data, estimating model parameters directly from all available data without requiring explicit imputation. This approach utilizes all available data simultaneously during estimation process, producing efficient and unbiased parameter estimates under the assumption of data missing at random (MAR). Unlike methods such as Multiple Imputation (MI), which creates multiple completed datasets to handle missing data, FIML partitions cases into subsets based on patterns of missing observations, including complete cases, and extracts statistical information (e.g., means, variances, and covariances) from each subset to retain all available information for the analysis. FIML combines the parameter estimates and their standard errors, without the need to delete or impute missing values (Kline, 2016). Missing data for students did not exceed 4% in Study I. For teachers, missingness varied across datasets: TIMSS 2019 teachers had missing data ranging from 10% to 21%, while TIMSS 2023 teachers ranged between 14% and 16%. PIRLS 2016 teachers exhibited lower levels of missing data, between 3% and 10%, compared to PIRLS 2021 teachers, whose missing data ranged from 14% to 19%.

Validity and reliability

An essential discussion in this thesis concerns whether the survey questions in the TIMSS and PIRLS assessments accurately capture the concepts being studied, the alignment between the research designs and the intended analyses, and the validity of the inferences drawn from the findings. Large-scale testing bodies, such as the IEA, which develop the TIMSS and PIRLS surveys, base their work on robust theoretical frameworks. To ensure validity and reliability at the country level, various assurance methods are employed, such as field tests before the large-scale tests are administered (Martin et al., 2017; Martin et al., 2020).

Shadish et al. (2002) provide a useful typology for distinguishing between construct-, external, internal, and statistical validity. Validity is defined as the evaluation of concepts, research designs, measurements, and conclusions to determine if they are well-founded and accurately reflect the intended constructs and relationships (Shadish et al., 2002).

Construct validity, a long-discussed concept (Newton & Shaw, 2014), evaluates the relationship between sampling data and theoretical constructs. For instance, omitting key indicators of students' socio-economic background, such as parental

education and income levels, can distort the model estimates, leading to inaccurate measures of the impact of SES on student achievement. This, in turn, may influence the perceived relationship between teachers' professional competence and student performance. Furthermore, the use of the number of books at home as an SES indicator in Study I has been critiqued for its limited reliability and validity (e.g., Engzell, 2021). To address this concern, Study II utilized parental education levels obtained from the register data as a more robust SES indicator.

The central concepts and constructs in this thesis, such as teachers' formal competence, teaching quality, teachers' working conditions, as well as teachers' job satisfaction are theory driven (Goe, 2007; Guerriero & Révai, 2017; Shulman, 1987). However, the extent to which these concepts are adequately captured by the questions in the questionnaires remains open to discussion. To counter these threats in this thesis, confirmatory factor analysis is used in the measurement construction to judge if the construct measures the concept it purports to measure and is evaluated with recommended Model fit indices (Brown, 2015; Kline, 2016; Shadish et al., 2002).

External validity refers to the extent to which inferences and causal relationships can be generalized across variations in populations, settings, treatment, measurement variables, and outcomes (Shadish et al., 2002). This concept encompasses generalizations not only from specific samples of individuals but also across broader populations, where questions of applicability arise. Shadish et al. (2002) list threats to external validity in terms of interactions of causal relationships. For example, in terms of population – in which units and settings does a cause-effect relationship hold? As the thesis utilizes secondary data analysis, the present research relies on the assumption that the sampling procedures and methodologies undertaken by the IEA allow the results to be generalizable. TIMSS and PIRLS include large samples of students and teachers. They employ a so-called two-stage stratified random sample design. In the first stage, a sample of schools is drawn and in the second stage, one or more intact classes of students are selected from each of the sampled schools. To ensure that the sample reflects the population, adjustments are made using sample weights (see e.g., LaRoche et al., 2020). However, the exclusion of certain students or schools from the sample could become a threat to external validity (Borger et al., 2024). Exclusion rates for the used studies are however within the accepted limits (The Swedish National Agency for Education, 2017, 2020), meaning that the samples should still be representative of the broader population and allow for generalization.

Internal validity concerns inferences about whether covariation between two variables reflects a causal relationship, ensuring extraneous variables are controlled for and confounds have been eliminated. It addresses potential errors in causal-reasoning (Shadish et al., 2002). In the context of this thesis, internal validity pertains to the extent to which it can be claimed that teacher competence, for example, influences student performance in a certain direction, assuming that all potential threats are accounted for. Threats to internal validity include not only confounding variables but also factors such as non-response of respondent, and maturation effects (Shadish et al., 2002). In the three studies, missing data in the teacher questionnaires end up in most variables at about 15%, whereas student non-response missingness was significantly lower. These issues were addressed statistically with full information maximum likelihood approach.

Statistical conclusion validity (SCV), closely related to internal validity, concerns errors in assessing statistical covariation (Shadish et al., 2002). It evaluates whether cause and effect covary and the strength of this relationship. Null hypothesis significance testing (NHST) is commonly used for this purpose, typically accompanied by a probability statement indicating the likelihood that an observed difference of the given magnitude could occur by chance in a population where no difference exits between groups. The probability is measured with a significance test, with results generally interpreted as significant if $p < 0.05$, or as non-significant if above this value (Shadish et al., 2002).

Reliability refers to the extent to which measures or results can be consistently reproduced across different contexts and populations (Field, 2018). In educational research, particularly if utilizing international large-scale assessment, reliability is closely tied to external validity (Shadish et al., 2002). In the context of this thesis, reliability concerns whether the findings can be generalized across the Swedish educational system or assessment cycles. One major reliability concern is the sampling procedures. Assessments such as TIMSS and PIRLS are designed to produce country-representative data using carefully structured sampling methods (Martin et al., 2020; Mullis & Martin, 2015). Inconsistencies in, for example, the exclusion criteria for students may pose a significant threat to reliability, resulting in that the conclusions made of results become biased. Another issue affecting reliability is the accuracy of proxy measures, such as student-reported 'Books' (SES-measure). It may not reflect the actual SES background of students (Engzell, 2021). Similarly, the studies rely on teachers' self-reported questionnaire responses. These responses may be influenced by different interpretations of questions across teacher groups and cycles (Hooper, 2022). In addition, although TIMSS and

PIRLS sample multiple teachers, typically only one classroom per school is included, which may not fully represent the diversity of teaching practices and outcomes within schools.

Ethical considerations

TIMSS 2019, TIMSS 2023, PIRLS 2016 and PIRLS 2021 data for all European countries have been collected in accordance with the General Data Protection Regulation (GDPR) of Europe and country-specific amendments of the law (see e.g., https://www.iea.nl/studies/iea/timss/2019), and by this, the directives of ethical principles by the Swedish Research Council (SOU 2017:72) are followed. However, register data that is connected to the PIRLS 2016 assessment does include sensitive data. The key between individuals and the used register information is not held by the researcher. The participants are further considered as minors (ten to eleven-year-olds), and some of them are socio-economically disadvantaged, special attention needs to be paid to their protection. Since only openly available secondary data from large-scale international assessments are used, these will not contain any identifying information about the research participants. Approval from the ethical board is not required for openly accessed data. An ethical vetting was, however, undergone when the Swedish National Agency for Education collected the social security numbers for the participating students in the PIRLS 2016 study. Information about prior and later achievement levels were added to the dataset, as well as background characteristics of students such as their immigration status (The Swedish National Agency, 2017).

Further, the data management is in line with the FAIR principles stated in the European Code of Conduct for Research Integrity. It will be Findable, Accessible, Interoperable, and Re-usable (ALLEA, 2017).

Chapter 6 Results and Discussion

Three studies were conducted to explore different aspects of teachers' professional competence and the relationships to student achievement in middle school context in Sweden. In the following chapter, objectives of each of the studies are presented and the main findings of each study are summarized and discussed. The findings of the empirical studies aim to answer the research questions provided in Chapter 1:

1. How does teachers' professional competence relate to student achievement?
2. What long-term effects of teachers' professional competence can be found?
3. What are the interrelationships between teachers' working conditions, job satisfaction, and student achievement?
4. Are potential changes in teachers' working conditions and job satisfaction related to changes in student achievement over time?

Studies I and II aim to answer the first question about teacher qualifications and instructional practices, Study II also answers the second, and Study III aims to answer the third and fourth question. An integrated discussion follows where emergent themes and implications for policy from the studies are raised.

Study I

The main purpose of the first study was to investigate the importance of different teacher competence indicators on mathematics achievement in grade 4 using TIMSS 2019 data. In this study a latent variable representing teachers' formal competence was formulated. It represented a wider spectrum of fourth grade teachers' formal qualifications for teaching mathematics. The research questions guiding the analyses were:

1. What measures of teachers' formal competence, in terms of formal level of education, subject-specific specialization, teaching experience, and professional development are related to students' mathematics achievement in grade 4?
2. How is teachers' formal competence, formulated as a latent construct, related to students' mathematics achievement in grade 4?
3. How is teachers' formal competence distributed with respect to classroom composition in terms of students' socio-economic and language background?

To explore these questions data from TIMSS 2019 was utilized. The study used information from student, teacher, and parent/home questionnaires. A set of indicators of teacher competence (formal education level, specializations during teacher training, teaching experience, and professional development activities) were selected and related to fourth grade students' mathematics achievement. The results show that the teacher competence indicators that had significant positive relationships with student mathematics achievement were teachers' formal education level, subject-specific specialization towards primary school, and years of teaching experience. Teachers' undertaken professional development, on the other hand, was a non-significant predictor of student mathematics achievement. These indicators of teacher competence were used in separate regression analyses initially. To encapsulate a more comprehensive range of formal competence with these indicators, a latent variable (*TCH_COMP*) was formulated. The results revealed a strong effect of .51 ($p < .001$) for this latent construct of teacher formal competence. To control for classroom composition, proxies for students' socio-economic background (Books) and immigrant background (Language) were introduced in the analyses. After controlling for SES and immigration background, the relationship between teacher competence and students' mathematics achievement weakened ($\beta = .21$, $p < .05$). However, teacher competence remains moderately associated with student achievement when school composition is held constant.

Other findings were that the more advantaged schools, in terms of students' SES background, have a higher proportion of teachers with relevant competence for teaching mathematics in primary school ($r = .33$, $p < .001$). The relationship between SES and student mathematics achievement on the classroom level of .74 ($p < .001$) further indicates that there are large achievement differences between classrooms of high and low socio-economic composition. The results also indicate

that students with different language background than Swedish perform lower in mathematics (β= -.11, p< .001). This relationship becomes even more pronounced in classrooms with greater linguistic diversity (β= -.59, p< .001). In these settings, teacher competence is particularly important, as suggested by the significant and positive relationship between the latent teacher competence variable and student achievement. More competent mathematics teachers can play a key role in mitigating the effects of students' diverse background characteristics upon entering school. However, the distribution of competent mathematics teachers should be carefully reviewed to ensure equitable access for all students.

Study II

The main purpose of Study II was to identify teacher qualifications and instructional practices that contribute to student progress in Swedish, mathematics, and overall performance by grade 6. In Sweden, students typically transition to a new teacher in grade 4, who then remains with the same class through grades 4 to 6. This allowed the study to isolate the effects of teacher qualifications and reading instruction in grade 4 on student achievement in both the PIRLS reading assessment and in sixth-grade outcomes. The study addressed limitations from previous cross-sectional studies, particularly the ability to control for students' prior achievement and parental education levels. Utilizing data from PIRLS 2016, complemented by extensions from the Swedish national registers, the study incorporated information on student prior national test results from grade 3, their subject grades and overall GPA score from grade 6, and parents'/guardians' highest education levels. By linking PIRLS students and register data enabled an analysis of the extent to which various teacher-related factors are associated to student performance while accounting for different student background factors. This approach also enabled the examination of both short- and long-term effects of teacher qualifications and teaching practices on a broader academic performance. The following three research questions were addressed:

1. To what extent are teachers' formal qualifications related to student PIRLS achievement in grade 4 and to achievement in grade 6?
2. To what extent is teachers' specialization in reading pedagogy related to student PIRLS achievement in grade 4 and to achievement in grade 6?

3. To what extent is teachers' teaching quality, in terms of reading instruction activities and cognitive activation in class, related to student PIRLS achievement in grade 4 and to achievement in grade 6?

The results from the second study suggest that teachers' formal level of education in grade 4 matters for students' mathematics achievement (mathematics grade) in sixth grade. This relationship even strengthens slightly when prior achievement is taken into account (from β= .15 to β= .19). No relationship was however found with PIRLS achievement, nor the Swedish grade or the overall grade point average score in sixth grade. This finding for mathematics supports previous research, which also indicates that teachers' formal education (attained degree level) has a more favorable relationship with students' mathematics achievement (e.g. Coenen et al., 2018; Harris & Sass, 2011). The result for mathematics is perhaps not unexpected given that mathematics is largely taught and learned in school. In contrast, reading is a skill that students are exposed to and practice in various contexts outside of school.

The results from Study II further suggest a positive relationship between teachers holding a license in Swedish and Swedish as a second language in grade 4 and student performance in PIRLS, as well as in Swedish and mathematics in grade 6. However, this relationship disappears when covariates are included, suggesting that simply having a teaching license may not fully mitigate initial performance differences among students. In contrast, teachers with subject-specific specializations in reading pedagogy show a significant positive relationship with students' mathematics and Swedish grade in grade 6. Teachers having specializations is particularly beneficial for students with lower initial achievement and socio-economic background (β= .19 , p< .05 for mathematics and β= .31 , p< .01 for Swedish). This finding aligns with prior research in reading (Myrberg et al., 2019) and mathematics (Coenen et al., 2018; Goe, 2007; Harris & Sass, 2011).

In Study II, items concerning teachers' reading comprehension instruction and cognitively challenging instruction were also investigated. It was assumed that, given that many middle school teachers teach most of the subjects in grades 4 to 6, there may be some variations in their teacher preparation, and differences in student achievement might emerge. Additionally, teachers' reading instruction practices in grade 4 might influence student performance in other subjects, such as mathematics (Hübner et al., 2022; Purpura et al., 2011; Purpura et al., 2019).

Teachers' reading comprehension activities within the reading and language domain in fourth grade appear to have a spillover effect on students' overall

performance (total grade point average score) in sixth grade when prior achievement, gender, and guardian's education level are taken into account. This finding suggests that these activities enhance skills beyond just the language domain, as some subjects demand higher levels of reading, likely because they involve text analysis and comprehension strategies that benefit performance across multiple subjects regardless of initial performance level. However, since no linear relationship was found with neither PIRLS nor Swedish performance in sixth grade, nonlinearity was tested between teachers' reading comprehension activities and the four outcome measures. Non-linear relationships emerged only for PIRLS achievement and Swedish grade. These findings suggest that teacher-related variables may not always have linear effects, and that dedicating time to reading comprehension activities once or twice a week in grade 4 may be sufficient to develop students' reading comprehension skills, with some spillover effects evident in sixth grade. It is possible that teachers continue these activities in grades five and six, which could explain the observed results in sixth grade, although no data is available to confirm this.

The cognitive activation strategies employed by the fourth-grade teachers, which challenge students' thinking and understanding in the reading and language domain, are positively associated with all four student outcomes. However, after controlling for student background factors, only the relationship with students' Swedish grade remained significant. These findings still indicate that certain pedagogical practices are crucial across subjects, particularly in the Swedish subject for students with lower initial achievement and SES. Additionally, the type and impact of cognitive activation on student learning and achievement may vary by subject, highlighting the need for further subject-specific analyses.

In line with the results of the first study, which highlighted the positive relationship between teachers' specialization in primary mathematics and students' mathematics performance, the second study suggests that investing in teachers' grade- and subject-specific specializations (in mathematics and reading pedagogy) as well as enabling higher formal education level for primary school teachers in mathematics is of importance. In addition, teachers with specializations, and higher qualifications in mathematics, may mitigate initial disparities in student performance. In other words, such investments have a significant impact on students' learning and performance regardless of student background factors.

Study III

Teachers' working conditions, perceptions of workload and safe and orderly schools, are considered to be aspects that influence teachers' job satisfaction and performance in this thesis. The main purpose of the third study was to investigate the effects of teacher workload, job satisfaction, and sense of safe and orderly schools (school climate) on student achievement across two cycles of PIRLS and TIMSS. During the second cycle of PIRLS, teachers experienced new challenges of work life since they experienced the strains of the COVID-19 pandemic. Teachers were confronted with demands to adapt teaching and classroom interaction to the Swedish Public Health Agency's requirements, while following the restrictions themselves. When the second cycle of TIMSS (TIMSS 2023) was administered the pandemic was over. These different working conditions across cycles may have affected teachers' sense of workload, safe and orderly schools, and job satisfaction differently.

The study further investigates whether there have been changes over time in teachers' perceptions of workload, safe and orderly schools, and job satisfaction. Moreover, the study aims to explore whether changes in teachers' workload, sense of safe and orderly schools, and job satisfaction are related to changes in student achievement, particularly focusing on reading achievement scores across two PIRLS cycles and mathematics achievement scores across two TIMSS cycles. The following research questions were addressed:

1. How have teacher workload, job satisfaction, and sense of safe and orderly schools changed over the time period?
2. How are teacher workload and sense of safe and orderly schools related to job satisfaction, and are they all related to achievement?
3. Are potential changes in teachers' workload, sense of safe and orderly schools, and/or job satisfaction related to changes in achievement?

The findings suggest a slight decline in reading achievement in Sweden between the 2016 and 2021 PIRLS cycles. During this period, teachers reported a small decline in perceptions of school climate, alongside small improvements in teachers' job satisfaction and workload. However, these changes did not appear to translate into gains in student achievement. Notably, a safe and orderly school climate emerged as the factor most strongly associated with the observed decline in student achievement, accounting for approximately half of the decrease. While

teachers' job satisfaction improved, it may have helped mitigate the extent of the decline in achievement.

The trends differ between the PIRLS and TIMSS studies. Findings for TIMSS cycles suggest slight increase in mathematics achievement, and that while teachers' perceptions of their workload improved, it had no significant relationship to student achievement in mathematics. Teachers' job satisfaction and sense of safe and orderly schools had not significantly changed between the two cycles. However, both were significantly associated with mathematics achievement, with safe and orderly schools demonstrating the strongest relationship. Still, neither of these factors separately explain the overall increase in achievement across the two cycles. However, the total indirect effect of workload, job satisfaction, and safe and orderly school climate suggests that the increase may have been greater if it had not been the negative combined indirect effect of these three variables.

The third study also investigated how the factors related to teachers' working conditions influence their perceptions of job satisfaction. In the PIRLS assessments, a safe and orderly school climate demonstrated a moderate and significant relationship with job satisfaction, whereas no significant relationship was found between workload and job satisfaction. In contrast, findings from TIMSS revealed that workload in the 2019 cycle and a safe and orderly school climate in the 2023 cycle both had significant and moderate associations with teachers' job satisfaction.

Discussion of the results

The empirical studies explored various aspects of teachers' professional competence and its relationship with student achievement in Swedish middle school context (grades 4-6). In addition to the results answering the research questions, the following section discusses the results in relation to theory and previous research.

Teachers' professional competence and student achievement in Grades 4 and 6

Guerriero and Révai (2017) stress that the initial teacher education equips teachers with the initial qualifications that build their content knowledge. The first two studies suggest that content knowledge attained through formal education matters for middle school students' achievement in mathematics and reading. These

findings align with previous research demonstrating that teachers' subject-specific specializations in mathematics (Coenen et al., 2018; Hill, 2007; Johansson et al., 2023; Toropova et al., 2019) and reading (Johansson & Myrberg, 2019; Myrberg et al., 2019) are critical for student achievement. Additionally, the studies reaffirm that teachers' formal level of education is of importance for students' mathematics achievement (e.g., Coenen et al., 2018; Harris & Sass, 2011; Wayne & Youngs, 2003). As Shulman (1986, 1987) pointed out, strong subject matter preparation is essential for developing effective teaching skills. Subject-specific specializations are likely to improve teachers' ability to identify topics, problems, and questions that are critical for developing students' understanding of the subject (Ball et al., 2008; Baumert et al., 2010; Clark et al., 2017; Deng, 2018; Guerriero & Révai, 2017; Shulman, 1987). The decision making and professional judgement involved when teachers' select topics to teach or addressing students' misconceptions influence the (skilful) teachers' teaching approaches and the instruction provided (Guerriero & Révai, 2017). This means that teachers must recognize potential challenges and misconceptions students may have, as well as provide support for struggling students, highlighting the importance of integrating theoretical knowledge with situational awareness (Blömeke & Kaiser, 2017). The capacity, and ability, to apply and adapt knowledge in a given context, and choosing the pedagogical practices that influence student learning the most are essential aspects of teachers' professional competence (Guerriero & Révai, 2017; Stoof et al., 2002; Tigelaar & van der Vleuten, 2014).

In Sweden, teacher preparation programs have varied in their emphasis on subject specializations over time (Furuhagen et al., 2019). Further changes in teacher training are currently underway. The recent report on the reformed teacher and preschool teacher education, put forward by the Swedish government (SOU 2024:81), emphasizes the need to strengthen teacher education by placing greater focus on subject-matter knowledge and practical methodology. Based on the results of Studies I and II, the recommendations are appropriate. Equipping pre-service teachers with a stronger foundation in content knowledge and pedagogical knowledge is likely to strengthen their ability to integrate these into effective teaching strategies, such as cognitive activation, reading comprehension activities, and other teaching methods that engage students in higher-order thinking (Baumert et al., 2010; Rieser et al., 2016; Voss et al., 2022).

Moreover, the unique Swedish context, where middle school teachers typically teach the same students from grades 4 to 6, provided an opportunity to explore teacher and teaching effects over time. Study II suggests not only that cognitive

activation may be influential across subjects but also that there are spill-over and long-term effects of teachers' reading comprehension activities in grade 4, which is a significant contribution of this thesis. These findings emphasize that teaching reading comprehension has long-term implications for student outcomes, and that certain cognitively activating activities, such as asking students to explain their answers and complete challenging tasks, stimulate student learning more than others (Baumert et al., 2010; Duke et al., 2021; Nilsen et al., 2018). These teaching strategies may also play a role in narrowing the achievement gap, particularly for at-risk students (Gore et al., 2022; Ryder et al., 2006). Therefore, ensuring equitable access to competent teachers, especially in schools with higher proportion of at-risk students, is essential for mitigating the effects of socio-economic and linguistic disparities on student achievement.

Studies I and II highlight the need for a careful review of teacher distribution. To reduce achievement gaps and promote educational equity, it is important to ensure that competent teachers are distributed equitably across schools, particularly in schools serving lower SES and linguistically diverse populations. This approach could help to level the playing field, providing all students the opportunity to succeed, regardless of their home background. This is a policy issue to be addressed by policymakers at the national level.

Teachers' working conditions and relations to student achievement

Notably, the PIRLS 2021 assessment was administered during the COVID-19 pandemic, a period that affected both work and daily life for most people, providing unique insights into teachers' experiences when exposed to high strain. During the pandemic, Sweden took a unique approach compared to many other countries, by keeping schools open and emphasizing students' social well-being and their right to education (The Public Health Agency of Sweden, 2024). Interestingly, across the PIRLS cycles, teachers reported slight improvements in workload and job satisfaction over time. This was a surprising finding, as international research suggests that the increase in job demands during the pandemic decreased teachers' sense of well-being (Lee, 2020; Marti-Gonzalez et al., 2023; Pressley, 2021; Sigursteinsdottir & Rafnsdottir, 2022). The study speculates that the slight improvement in workload could be due to fewer students per class and less time required on classroom management, despite increased demands in other areas during the pandemic. Additionally, the emphasis on

students' social well-being and their right to education during this period may have enhanced teachers' feelings of purpose and motivation, which likely contributed to increased job satisfaction (Admiraal & Kittelsen Røberg, 2023; Arthur & Bradley, 2023; Dreer, 2021). However, these improvements were insufficient to prevent the decline in reading achievement. Approximately half of the decline in reading achievement is associated to teachers' perceptions of safe and orderly school climate. This measure includes both teachers' sense of safety at school and their perceptions of student behavior. Nonetheless, teachers' overall perception of the school climate also declined across the cycles.

By TIMSS 2023, pre-pandemic working conditions had largely returned, as reflected by the results of school climate and job satisfaction since 2019. Swedish teachers continued to experience similar levels of strain, with school climate being associated to both job satisfaction and student outcomes. Unlike PIRLS, TIMSS results showed improved student performance, although this improvement cannot be fully explained by teachers' perceptions of school climate or job satisfaction. While this study focuses on distal measures linked to student achievement, it leaves room for the possibility of an alternative chain of associations. For instance, teachers' working conditions could impact their job satisfaction, which may influence teaching quality and, ultimately, student achievement – an important pathway not investigated here.

According to the Job Demands-Resources model (Bakker & Demerouti, 2017), balancing job demands and resources is critical in maintaining teacher well-being and enhancing teaching quality. Job satisfaction itself can function as a key resource. When teachers feel satisfied with their job, they are more likely to be motivated, engaged, and creative in their work, ultimately enhancing their performance in the classroom. (Admiraal & Kittelsen Røberg, 2023; Hakanen et al., 2006). However, a negative school climate can exacerbate negative feelings at work ultimately influencing teachers' effectiveness (Collie et al., 2012; Dicke et al., 2020).

In summary, from a JD-R (Demerouti et al., 2001) perspective, enhancing the resources available to teachers, such as improving school climate and reducing workload, can mitigate negative effects of job demands. This balance is essential for improving teacher well-being, sustaining job satisfaction, and ultimately promoting teaching quality, which benefits students.

Chapter 7 Concluding Remarks

The purpose of this thesis has been to investigate how different aspects of teachers' professional competence and working conditions are related to student achievement in middle school education. The substantial proportion of unqualified teachers in Swedish compulsory schooling highlights the urgency of exploring how various aspects of teacher quality relate to student achievement. This is particularly pressing in grades 4-6, where nearly one-third of teachers lack formal qualifications. It has further been important to highlight the Swedish context as the country's educational system has become increasingly unequal over recent decades, evident in student performance, learning opportunities offered, and the distribution of competent teachers (Hansson & Gustafsson, 2016; Yang Hansen & Gustafsson, 2016, 2019). To ensure high-quality education for all students, it was essential to investigate some of the key factors driving student learning and achievement from a teacher professional competence perspective. This need has been reinforced by the extensive reforms implemented over the past 30 years, impacting not only students but also teacher training programs and teachers' working conditions (Ringarp & Parding, 2018; Yang Hansen & Gustafsson, 2019). Additionally, in recent years, the challenge of recruiting pre-service teachers and retaining skilled teachers, especially in schools with the greatest needs, has intensified (Håkansson Lindqvist et al., 2022; Lindqvist & Nordänger, 2016).

Understanding the effects of teachers' professional competence, as well as teacher and teaching quality, are central to this thesis. However, measuring quality solely through formal qualifications and standardized assessments may neglect other critical aspects essential for student learning (Fenstermacher & Richardson, 2005). While teacher quality can often be assessed through attributes, knowledge, and qualifications, teaching quality is inherently more complex to evaluate. This complexity arises not only because teaching quality is context-dependent, shaped by factors such as school culture, classroom composition, and student interaction, but also due to the diverse methods used to assess it. Operationalizing teaching quality measures through, for example, self-reports or classroom observations may yield different insights and conclusions about what teachers' express they do and what actually occurs in the classrooms (Klette, 2022; Senden et al., 2021).

Furthermore, focusing exclusively on either teacher quality or teaching quality risks overlooking their interdependent relationship and the potential mediating role of teaching quality between teacher quality and student outcomes. With this in mind, the following discussion outlines the strengths and limitations of relying on ILSA data, as well as the contributions of this thesis.

Strengths and limitations of the thesis

International large-scale assessments have been conducted for several decades, providing a wealth of educational data that would otherwise be inaccessible. These assessments enable researchers to address a wide range of educational questions, with cross-country – and, to some extent, longitudinal – comparisons offering valuable insights. By analyzing trends over time, policymakers and other stakeholders can make informed decisions based on changes in educational outcomes and contextual factors. Some countries have further expanded ILSAs by incorporating longitudinal designs, allowing for deeper exploration of the mechanisms underlying student learning within national contexts. Additionally, the large sample sizes and the extensive range of variables in ILSAs enable complex modeling of educational phenomena, enhancing our understanding of various factors influencing student achievement (Blömeke et al., 2022b; Rutkowski et al., 2010; Strietholt & Scherer, 2018).

Despite these strengths, ILSAs face methodological challenges, particularly regarding causal inferences due to their cross-sectional design. The potential presence of confounding variables, reverse causality, and reciprocal relationships limits the ability to draw clear causal conclusions (Blömeke et al., 2022b; Rutkowski et al., 2010). Furthermore, ILSAs are typically not connected to prior achievement measures from previous grades. Without baseline performance measures, isolating the impact of teachers and instructional practices on student outcomes becomes difficult (Hemmings et al., 2011). As a result, drawing causal inferences about educational effectiveness are weakened, and the role of prior knowledge in shaping current performance remains unclear (Blömeke et al., 2022b).

In addition, the effectiveness of teachers is often context-dependent, influenced by the specific student population they teach (Gustafsson et al., 2013). In ILSAs, home background information has traditionally been collected through student and parent questionnaires. However, the low response rates for the socio-economic indicators in the TIMSS 2019 parent questionnaire were substantial. As

a result, the first study relied on student-reported "Books" as a proxy for socio-economic status and immigration background to explain differences in student achievement. Some researchers, such as Hanushek and Woessmann (2010), consider the number of books at home as a strong proxy for students' socio-economic background, suggesting it reflects their families' education, social, and economic status. However, others, such as Engzell (2021), question its validity due to concerns about endogeneity and risks of measurement error, noting that girls tend to report a higher number of books in ILSAs. In addition, younger students may have limited knowledge of various aspects measured in the socio-economic background indicators. For instance, discrepancies may arise between students from well-educated and less-educated families in accurately reporting their parents' education and occupation, which can affect the validity of their responses (Engzell, 2021).

To address these challenges, the second study in the thesis utilized register data linked to PIRLS 2016, an initiative undertaken by the Swedish National Agency for Education. This integration allowed for a more comprehensive analysis by controlling not only for students' home backgrounds but also for their prior achievement. This approach accounted for initial student differences and the influence of previous teachers, enabling the identification of key teacher qualifications and instructional practices that contribute to student success. Combining registry data with ILSA data could enhance the reliability of findings and strengthen the conclusions.

Measuring teachers' professional competence also presents some challenges, when relying on questionnaire data from ILSAs (Hooper, 2022; Senden et al., 2021). While the collected indicators provide a reflection of teacher quality, they could offer a more comprehensive view of teachers' educational backgrounds, qualifications, and instructional effectiveness. First, variations in teacher training programs, both over time and across institutions, complicate the conclusions of which qualifications matter most for student performance (Darling-Hammond, 2017). Additionally, teachers' self-reported practices may be influenced by social desirability effects rather than reflecting actual instructional methods (Senden et al., 2021). This discrepancy can lead to an over- or underestimation of certain teaching practices, reducing the validity of conclusions drawn from the data. While video-based assessments of classroom instruction could provide richer understandings of teachers' knowledge and practical approaches, this method is both costly and methodologically complex (Klette, 2022; Klette et al., 2017). Moreover, teachers may adapt their own behavior when they know they are being

observed, leading to artificial representations of their teaching practices. In addition, the limited observation time may fail to capture the full complexity of teaching strategies or long-term teaching effectiveness, potentially compromising the validity of the conclusions (Senden et al., 2021).

Despite the above challenges, the use of multiple items to measure teacher-related constructs, such as job satisfaction, offers important strengths and valuable insights. By incorporating multiple items to assess a construct, the influence of item-specific measurement error is minimized, leading to more reliable results. Furthermore, the questionnaire development in ILSAs undergo rigorous expert review to ensure the selection of relevant items across participating countries. This process allows for the inclusion of national item extensions, enabling countries to address context-specific research questions while also maintaining international comparability (Hooper, 2022). In Sweden, this approach was implemented in PIRLS 2016 and 2021, adding variables such as teacher licensure and items capturing cognitive activation, which contributed to a more comprehensive understanding of teacher and teaching quality in this thesis.

Many items in TIMSS and PIRLS are also repeated across assessment cycles, allowing for the linking of assessments from one cycle to the next (Hooper, 2022). The third study took advantage of this. However, including more cycles in the trend analysis or using data from true longitudinal cohort studies would further enhance the reliability and the validity of findings (Blömeke et al, 2022b; Greger et al., 2022; Kaplan & Jude, 2022). Ideally, future advancements in measuring teaching quality in ILSAs could integrate both questionnaire-based assessments and video-based observations. Combining these approaches could provide richer theoretical and methodological insights, offering a more comprehensive understanding of teaching practices and their impact on student learning (Klette, 2022).

Contributions

Having discussed the strengths and limitations of utilizing ILSA data, I now turn to the contributions of this thesis. What, then, are its key contributions?

This thesis contributes to the existing body of literature in several ways. First, it reinforces the importance of teachers' professional competence in student performance. Factors such as formal level of education, subject- and grade-specific specialization, and teaching experience are positively related to student

achievement, aligning with previous research (Coenen et al., 2018; Cohen et al., 2018; Hill et al., 2019; Johansson et al., 2023). Notably, the thesis emphasizes the importance of teachers' formal level of education in enhancing students' mathematics achievement. It also highlights the importance of subject-specific specializations, especially for students with lower prior knowledge and those from lower socioeconomic backgrounds. Moreover, when teacher competence is conceptualized as a latent construct encompassing various aspects of teacher quality, its relationship with student achievement becomes even more pronounced.

The thesis also underscores that teaching quality – specifically reading comprehension and cognitive activation – affects student performance both in the short term and over time, consistent with previous research in the field (Coenen et al., 2018; Duke et al., 2021; Johansson et al., 2023; Myrberg et al., 2019; Nilsen et al., 2018; Toropova et al., 2019). These findings highlight not only the complexity of teachers' professional competence but also its vital role in shaping long-term educational outcomes.

Second, school climate matters. A positive school climate, characterized by, among other things, safety, orderliness, and supportive relationships, serves as a valuable resource that enhances teachers' well-being and job satisfaction while mitigating the strain of the job demands, such as heavy workload (Admiraal & Kittelsen Røberg, 2023; Dicke et al., 2018; Skaalvik & Skaalvik, 2021). Conversely, a decline in safety and orderliness can act as a stressor, depleting teachers' resources and potentially reducing their motivation and job satisfaction, ultimately affecting their classroom performance (Collie et al., 2012; Lopes & Oliveira, 2020).

Third, the thesis makes important methodological contributions. The use of a latent factor to represent teacher competence offers a more comprehensive measure than traditional reliance on individual indicators in effectiveness studies. The incorporation of register data – including both prior and later achievement measures – facilitate more robust and comprehensive analyses. By studying grades 4-6, where teachers often follow their students across three grades, further strengthens the validity of the findings by capturing sustained educational effects. Finally, the third study focuses on trend analyses using both PIRLS and TIMSS data, utilizing identical variables to enable comparisons of trends over time and across subjects.

Implications for teacher education and policy

Given the importance of teacher and teaching quality for student outcomes, what are the implications of the findings of this thesis?

The recommendations based on these conclusions are as follows; teacher training programs should (continue to) emphasize subject- and grade-specific specializations, ensuring that prospective teachers develop the qualities that are essential for effective teaching. Teacher training plays an important role in preparing teachers for the subject- and grade-specific content, particularly in mathematics. Teacher training plays a critical role in enhancing teachers' pedagogical skills by providing the education needed to gain knowledge of effective teaching strategies and activities that best support student learning. The initial teacher education is only the first step in teachers' life-long learning and equips teachers with the initial knowledge needed in the teaching profession (Guerriero & Révai, 2017; Shulman, 1987). Education policies and teacher educators should emphasize the importance of rigorous teacher training that integrates both theoretical knowledge and practical experience. Ensuring that pre-service teachers are equipped with subject-matter knowledge and an evidence based repertoire of pedagogical skills prepares them for a long teaching career (Ingvarson & Rowe, 2008) where a continuous professional development occurs (Guerriero & Révai, 2017). Sustained investments in teacher training are critical to educate high quality teaching staff. By prioritizing these recommendations, both teacher educators and policymakers can contribute to the development of highly qualified teachers who are well-prepared to meet the diverse needs of students.

Moreover, Study I raises an important policy issue concerning the equitable distribution of teacher competence across schools in Sweden. The most pressing challenge lies in ensuring that schools in greatest need have access to highly competent teachers. The allocation of teachers has implication for educational equity and necessitates policy reform.

Study III highlights the critical need for school-level interventions and policy reform to address school climate issues. Teachers need working conditions that not only support but also enable them to fully utilize their professional expertise. The impact of school climate extends beyond mere workplace satisfaction and well-being. Sense of safety, mutual respect, and clear behavioural expectations create an environment that allows teachers to focus on effective teaching rather than managing disruptions or addressing safety concerns. Moreover, a positive

school climate has a direct effect on student achievement (Collie et al., 2012; Dicke et al., 2020).

Future research

In light of the findings and limitations, several suggestions for future research can be made. First, there is a need to investigate how teacher quality and different aspects of teaching quality affect specific student groups, such as special education students, which were not distinguished in the thesis. In addition, exploring the relationships between teacher quality and student achievement across various social groups is another important area for future research if we are to reduce inequality in Swedish primary school education. To better support students with the greatest needs, it is essential to identify the teacher qualities that have the greatest impact on their learning. Future research should also investigate the impact of specific teaching practices across different subjects and student outcomes. If teacher education is to change, research should direct attention to the pedagogical activities that most effectively impact student learning, which could, in turn, shape teacher training programs.

However, to identify the key qualities of effective teachers and teaching with ILSA data, it is essential for research to link ILSAs with national register data. While ILSAs provide a lot of valuable insights, they lack prior achievement measures. By accounting for prior achievement and students' home backgrounds, researchers can more accurately assess the true impact of teachers on student outcomes. Additionally, longitudinal research approaches would offer valuable insights into how these qualities influence student outcomes over time. In this regard, TIMSS 2023 Longitudinal Study represents a significant contribution and a promising direction for future studies (Mullis et al., 2021). Furthermore, comparing teachers' self-reporting of teaching quality and video assessments of actual teaching behavior would also offer valuable insights into potential discrepancies between perceived and observed teaching quality. If teachers' self-reports would be consistent with video-assessed teaching behaviors, the teaching quality measures in ILSAs would gain greater validity.

Finally, investigating the mediating role of teaching quality, particularly classroom management, in the relationship between teacher competence and student achievement is essential, especially in mitigating the effects of disorderly or unsafe school environment. Equally important is understanding how school climate impacts teaching quality and teachers' well-being. Exploring how positive

student-teacher relationships and classroom dynamics can curb stress and improve both teacher and student outcomes could inform more effective strategies for teaching and managing challenging working conditions. Future research could also focus on evaluating specific school climate interventions, such as promoting safety, respectful relationships, and orderliness. Again, longitudinal studies would be especially valuable in tracking the long-term impact of these interventions on teacher well-being and student performance.

Chapter 8 Swedish Summary

Bakgrund

Under de senaste åren har en växande oro för lärarutbildningarna och lärarkvaliteten vuxit fram både nationellt och internationellt (Alatalo et al., 2021; Darling-Hammond, 2017). Många länder har ställts inför reformer av lärarutbildningen, förändringar i rekryteringen till lärarutbildningen, utmaningar för skolor att behålla lärare samt en sjunkande status för läraryrket, och Sverige är inget undantag. Sverige har genomfört flera reformer som syftar till att förbättra lärarutbildningen samt infört lärarlegitimation för att förbättra läraryrkets kvalitet och status (Lindström & Beach, 2015; Persson, 2008; Prop. 1984/85:122; Ringarp & Parding, 2018; SOU 1999/2000:135; SOU 2010/11:UbU5). Dessa reformer har drivits av genomgripande samhällsförändringar, såsom framsteg inom informationsteknologi och en växande mångkulturalism, vilka krävt anpassningar av yrkesverksamma lärare såväl som av lärarutbildningen (Furuhagen et al., 2019). Vidare har lärarlegitimation införts för att säkerställa att lärare uppfyller höga krav på både lämplighet och kompetens. Syftet med legitimationssystemet var att garantera elevernas rätt till kvalitativ utbildning samt erkänna deras beroendeställning i skolsammanhang (Prop. 2010/11:20).

Trots dessa ansträngningar är fortsatt en betydande andel av lärarna i svensk skola obehöriga och saknar legitimation (The Swedish National Agency for Education, 2021, 2024a). I dagsläget är endast cirka 72 procent av de svenska lärarna behöriga att undervisa i grundskolan, med den högsta behörighetsandelen på lågstadiet (ca 77 % i årskurs 1–3) och en lägre andel på mellan- och högstadiet (ca 68 % i årskurs 4–6 och ca 70 % i årskurs 7–9) (The Swedish National Agency for Education, 2024b). Att förbättra lärarkompetensen är och har varit ett av de prioriterade områdena för Skolverket (The Swedish National Agency for Education, 2021). Myndigheten rapporterade nyligen att bland de olegitimerade lärare som för närvarande arbetar inom grundskolan saknar 63 procent eftergymnasial pedagogisk utbildning. Nästan hälften av dessa har andra former av eftergymnasiala examina, som emellertid ofta har begränsad relevans för de ämnen

de undervisar i. En stor andel av de obehöriga lärarna är koncentrerade till mellan- och högstadiet.

En annan stor utmaning för att säkerställa lärarkvaliteten är rekryteringen av nya lärare. Skolverket (2021) beräknar att det totala rekryteringsbehovet uppgår till cirka 131 000 heltidstjänster fram till 2035, vilket motsvarar ett årligt rekryteringsbehov på 8 700 heltidsanställda. Efterfrågan förväntas dock nå en topp de kommande åren för att sedan minska i takt med att antalet elever minskar i grundskolan. Samtidigt beräknas cirka 153 000 lärare och förskollärare behöva slutföra sin utbildning fram till 2035 för att ersätta lärare som lämnar professionen, hantera pensionsavgångar samt ersätta obehöriga lärare med behöriga. Baserat på antagnings- och examenstrenderna förväntas ett underskott på minst 12 000 behöriga lärare och förskollärare år 2035. Denna brist tyder på att skolor kommer att fortsätta att rekrytera obehöriga lärare.

En annan utmaning för att säkerställa lärarkvalitet är den ojämna fördelningen av kvalificerade och välutbildade lärare mellan olika skolor (Beach et al., 2019; Hansson & Gustafsson, 2016). Denna obalans i allokering har bidragit till ökande prestationsskillnader mellan skolor och elevgrupper (Hansson & Gustafsson, 2016; Yang Hansen & Gustafsson, 2019). Den svenska skollagen betonar inkluderande utbildning, och kräver att skolor gör anpassningar till elevers individuella behov, förhindrar social utslagning och ger lika tillgång till utbildning. Skolan ska inte bara erbjuda likvärdiga utbildningsmöjligheter utan också se till att alla elever har nödvändiga förutsättningar att uppfylla nationella kunskapskriterier, oavsett familje- eller språkbakgrund (SFS 2010:800, 2010). Trots skollagens intentioner fortsätter ojämlikheten inom och mellan skolor att växa, och hembakgrundens inflytande på elevprestationer blir alltmer uttalade (Gustafsson & Yang Hansen, 2018; Gustafsson et al., 2013; Yang Hansen & Gustafsson, 2019). För att möta dessa utmaningar är det viktigt för det svenska utbildningssystemet och beslutsfattare att inte bara öka antalet kvalificerade, legitimerade lärare, men även förbättra lärarnas professionella kompetens och minska skillnaderna i tillgång till skickliga lärare. För att förbättra lärarnas professionella kompetens är det viktigt att identifiera effektiva läraregenskaper som både utjämnar och förbättrar elevernas lärandemöjligheter. Detta fokus är avgörande både ur ett policy- och lärarutbildningsperspektiv.

Med tanke på det betydande antalet obehöriga lärare i grundskolan är det väsentligt att undersöka om och hur olika aspekter av lärarkvalitet relaterar till elevernas lärande och prestationer, särskilt på mellanstadiet där antalet obehöriga lärare uppgår till nästan en tredjedel av lärarna. Medan ett ökande antal studier har

tagit upp implementeringar och konsekvenser av de senaste årens skolreformer (Börjesson et al., 2017; Hallsén, 2013; Håkansson Lindqvist et al., 2022) såväl som frågor om ökande prestationsklyftor och utbildningsjämlikhet (t.ex Yang-Hansen & Gustafsson, 2019) finns det fortfarande begränsad forskning om hur variationer i lärarkvalitet och specialiseringar påverkar elevernas prestationer i grundskolan, särskilt i spåren av de senaste lärarutbildningsreformerna. Med detta sagt avser denna avhandling att bidra med insikter om de specifika egenskaper i lärares professionella kompetens som kan påverka mellanstadieelevers lärande och prestationer positivt. Det är viktigt att förstå hur olika aspekter av lärares yrkeskompetens kan minska inverkan av elevers bakgrundsegenskaper på prestation. Ur ett lärarutbildningsperspektiv är det dessutom viktigt att identifiera de egenskaper som har störst inverkan på elevernas lärande, särskilt med tanke på svenska lärares varierande utbildningsbakgrunder.

Med tanke på de utmaningar Sverige står inför när det gäller att rekrytera och behålla lärare, kommer denna avhandling även att undersöka hur arbetsförhållanden och mer affektiva aspekter av läraryrket påverkar lärareffektiviteten. Även om lärare har goda formella kvalifikationer kommer lärares upplevda arbetsförhållanden och arbetstillfredsställelse påverka hur de utövar sin yrkeskompetens i klassrummen (Collie & Mansfield, 2022; Collie et al., 2012; Malinen & Savolainen, 2016).

Syfte

Av ovan nämnda skäl avser avhandlingen att undersöka hur olika aspekter av lärares professionella kompetens, såsom utbildningsbakgrund, ämnesspecialiseringar, undervisningskvalitet och arbetsförhållanden, påverkar elevernas prestationer i matematik och svenska i årskurs 4 och 6, samt meritvärdet i årskurs 6 med hjälp av flera storskaliga datainsamlingar (TIMSS, PIRLS och svensk registerdata).

Teoretiskt ramverk

Eftersom avhandlingen behandlar lärares professionella kompetens som en nyckelfaktor i högkvalitativ undervisning och framhåller dess inverkan på elevernas resultat redogörs det för flera ramverk som berör lärares professionella kompetens. I den här avhandlingen används benämningen professionell kompetens för att beskriva den kapacitet som lärare har när de möter komplexa

krav i ett specifikt undervisningssammanhang genom att utnyttja olika psykosociala resurser, inklusive kognitiva, funktionella, personliga samt etiska kunskaper och färdigheter. Kompetensen omfattar såväl lärares professionella kunskaper som affektiva och motivationsrelaterade egenskaper och förmåga att tillämpa och anpassa kunskap effektivt (Goe, 2007; Guerriero & Revaí, 2017; Shulman, 1987).

I avhandlingen uppfattas dessutom lärares yrkeskompetens som ett mångfacetterat koncept som involverar förmågan att integrera kunskaper, färdigheter och attityder för att utföra komplexa uppgifter i specifika undervisningssammanhang (Guerriero & Révai, 2017). Traditionella sätt att se på lärarkvalitet fokuserar ofta på lärares kvalifikationer och personliga karakteristika, i relation till elevers resultat i standardiserade test (se till exempel Goe, 2007). Detta tillvägagångssätt kritiseras ofta för att vara alltför förenklat (Fenstermacher & Richardson, 2005; Goe et al., 2008). Andra perspektiv betonar inflytandet av undervisningsmetoder, klassrumsledning, kamrateffekter och skolmiljö på elevernas resultat (till exempel Admiraal & Kittelsen Røberg, 2023; Goe et al., 2008; Johnson et al., 2012). Guerriero och Revaís (2017) ramverk används för att beskriva hur lärares professionella kompetens även inkluderar affektiva aspekter och aspekter som berör lärares motivation jämte kognitiva kompetenser (ämneskunskaper och pedagogiska kunskaper). Ramverkets syn på lärares kognitiva kompetenser överensstämmer med Shulmans (1987, 1987) begrepp om innehållskunskap och pedagogisk innehållskunskap, och betonar det dynamiska samspelet mellan teoretiska, praktiska, affektiva och motivations relaterade dimensioner i ramverket. Detta holistiska synsätt menar att lärare utifrån sina kunskaper och erfarenheter anpassar undervisningsmetoder till olika kontexter. Ramverkets betoning av elevers kognitiva och socioemotionella utveckling som en följd av lärarkompetensen lyfter fram det ömsesidiga beroendet samt den dynamiska karaktären i undervisnings- och lärprocesserna.

Metod

Analyserna i avhandlingen baseras på data från International Association for the Evaluation of Educational Achievement (IEA). Den första empiriska studien genomfördes som en sekundär analys av svensk data för elever i fjärde klass i Trends in International Mathematics and Science Study (TIMSS) 2019. Uppgifter hämtades från den officiella webbplatsen för TIMSS (https://timssandpirls.bc.edu). TIMSS är en av de storskaliga

kunskapsmätningarna som genomförs av IEA vart fjärde år. TIMSS bedömer matematik- och naturvetenskapliga prestationer för elever i fjärde och åttonde klass. Den första mätningen genomfördes 1995 och den senaste 2023. Förutom att mäta elevers kunskaper i matematik- och naturvetenskap, samlar TIMSS även in detaljerad information från rektorer, lärare, elever och vårdnadshavare om kontextuella faktorer som påverkar elevers lärarande och prestationer. Det svenska urvalet till TIMSS 2019 omfattade 194 lärare och 3965 elever i årskurs 4 (The Swedish National Agency for Education, 2020). Elevers matematikpoäng samt enkäter för elever och lärare användes för att utforska sambanden mellan lärares formella kompetens och elevprestationer.

Den andra studien är en kohortstudie som bygger på svensk data från Progress in International Reading Literacy Study (PIRLS) 2016 över elever i fjärde klass och deras lärare. Uppgifter hämtades från den officiella webbplatsen för PIRLS (https://timssandpirls.bc.edu). PIRLS är en annan storskalig mätning som genomförs av IEA och mäter elevernas läskunnighet och attityder till läsning under deras fjärde skolår i grundskolan. Den har genomförts vart femte år sedan 2001 och den senaste mätningen genomfördes 2021. Utöver elevernas läsprestationer samlas bakgrundsinformation om elevernas hem- och skolmiljö samt läsundervisning in genom frågeformulär till elevernas vårdnadshavare, lärare och rektorer. Sverige har deltagit i mätningarna sedan introduktionen 2001 (Mullis & Martin, 2015). Det svenska urvalet omfattade 4525 elever och 214 lärare. Svensk data för PIRLS 2016 innehåller, till skillnad från den internationella designen, även tillagda frågor till lärare (om lärarlegitimation exempelvis) samt registerinformation för de deltagande eleverna. Efter etisk granskning samlade Skolverket in personnummer för de deltagande eleverna och kunde därmed lägga till information om senare och tidigare prestationer för dessa elever, men också bakgrundkarakteristika såsom vårdnadshavares utbildningsnivå och migrationsstatus (The Swedish National Agency for Education, 2017). PIRLS-lärarnas formella kompetens och undervisningsaktiviteter relaterades till elevprestationer i läsning i årskurs 4 samt betyg i årskurs 6.

Den tredje studien bygger på svensk data från två cykler av PIRLS (2016 och 2021) samt två cykler av TIMSS (2019 och 2023) och är därmed en trend-analys. Det svenska urvalet för PIRLS 2021 omfattade 5175 elever och 261 lärare och urvalet för TIMSS 2023 omfattade 5139 elever och 250 lärare. Elevers läsförståelse- och matematikpoäng samt enkäter för lärare användes för att utforska relationerna mellan lärares arbetsbelastning, arbetsklimat, arbetstillfredsställelse och elevprestationer.

Variabler

I den första studien användes variabler från TIMSS 2019. Den beroende variabeln bestod av de fem plausibla värdena för årskurs 4 elevernas matematikprestationer. Dessutom användes två elevbakgrundsvariabler som kontrollvariabler, nämligen ”Antalet böcker hemma”, som representerar ett socio-ekonomiskt mått för elevens hembakgrund, samt ”Språk som talas hemma” för att särskilja elever med en migrationsbakgrund. Kontrollvariabler används för att undersöka om den beroende variabeln möjligen kan påverkas av till exempel elevens migrationsbakgrund, och genom att introducera denna variabel i modellen kan denna korreleras med den oberoende variabeln (till exempel lärares undervisningserfarenhet) för att se hur denna påverkar relationerna mellan den undersökta oberoende variabeln och beroende variabeln. De oberoende variablerna i den första studien bestod av ”Högsta formella utbildning slutförd” (mätt på ISCED:s sjugradiga skala, som sträcker sig från ej slutfört gymnasieutbildning till forskarutbildning), ”Huvudområde(n) för studier samt ämnesspecialisering”, ”Undervisningserfarenhet”, ”Deltagande i kompetensutveckling,” samt antal timmar som läraren deltagit i kompetensutveckling under de senaste två åren.

I den andra studien användes variabler från PIRLS 2016. De beroende variablerna bestod av de fem plausibla värdena för årskurs 4 elevernas läsprestationer i PIRLS, elevernas betyg i svenska och matematik samt meritvärdet från årskurs 6. Som kontrollvariabler i den här studien användes elevernas tidigare prestationer på nationella proven i svenska och matematik i årskurs 3, kön samt vårdnadshavarnas högsta utbildningsnivå. De nationella proven består av flera prov i svenska och matematik. Av svenskaproven användes endast de två läsförståelseproven. Matematikproven består vidare av sex delprov som mäter olika aspekter av tidiga matematikfärdigheter, såsom taluppfattning, aritmetiska beräkningar, tabeller och mätning. Eftersom alla prov har olika antal uppgifter och därmed skiljer sig i poäng, standardiserades och summerades poängen från varje prov utan att viktas (i svenska respektive i matematik). De oberoende variablerna i den här studien bestod precis som i den första studien av ”Högsta formella utbildning slutförd”, ”Huvudämne eller huvudområde(n) för studier”, ”Specialisering i läspedagogik och svenska” samt ”Undervisningserfarenhet”. De svenska nationella tilläggen i PIRLS-enkäterna innehöll vidare information om lärares ämnesspecifika legitimation som förvandlades till en binär variabel (0 = ingen legitimation och 1 = ämnesspecifik legitimation). De svenska tilläggen

innehöll även frågor som berörde hur ofta vissa kognitivt aktiverande klassrumsaktiviteter vid läsundervisning förekom. Dessa frågor berörde till exempel hur ofta lärare ber elever att utföra utmanande uppgifter som kräver mer än vad undervisningen handlar om, och om lärare använder frågor för att få fram resonemang och förklaringar. Dessutom användes lärarnas uttryckta läsförståelseaktiviteter i analyserna. Dessa bestod av frågor som berörde läsförståelsestrategier, till exempel hur ofta läraren ber eleverna hitta information i texten samt identifiera huvudidéer i vad de har läst.

Slutligen berörde den tredje studien lärarnas arbetsförhållanden, skolklimat samt elevers prestationer i läsning och matematik. Studien omfattade två cykler av PIRLS och TIMSS vardera. Det vill säga PIRLS 2016 och 2021 samt TIMSS 2019 och 2023. Här användes också de fem plausibla värdena för läs- och matematikprestationerna som beroende variabler. Dessutom användes identiska lärarvariabler från både PIRLS- och TIMSS-studierna. Lärarnas uttryckta arbetstillfredsställelse användes som både beroende och oberoende variabel i undersökningen. Studien använde vidare lärares arbetsbelastning, bestående av variabler som bland annat berör om lärarna anser sig ha tillräckligt med tid att förbereda lektioner och mängden administrativa uppgifter. Lärares upplevda skolklimat, som berör elevernas uppförande i klassrummet och elevernas respekt för läraren och varandra, användes också som oberoende variabel. Eftersom studien genomfördes som en trendanalys inkluderades Tid som en prediktor i analyserna för att möjliggöra mätning av förändringar över de olika mätcyklerna. Dummyvariabler skapades för PIRLS- och TIMSS-cyklerna. Tiden i PIRLS kodades 0 för cykeln 2016 och 1 för cykeln 2021. Likadant gjordes för TIMSS.

Analysmetod

Sammanslagning av datafiler, omkodning av variabler och aggregering av data har genomförts med IBM Statistics 28 och 29 (SPSS) (IBM Corp. 2021). Den primära analysmetoden i avhandlingen är strukturell ekvationsmodellering (SEM), som tillämpas med hjälp av programvaran Mplus (Muthén & Muthén, 1998–2017). SEM tillåter undersökningar av relationer mellan både manifesta (observerbara) och latenta (icke-observerbara) variabler. SEM kan också hantera flera beroende variabler och komplexa ömsesidiga beroenden mellan variabler.

SEM består av två delar: en mätmodell, som länkar manifesta variabler till latenta variabler, och en strukturell modell som specificerar samband mellan variabler och testar hypoteser om direkta eller indirekta effekter. Mätmodellerna

valideras med hjälp av konfirmatorisk faktoranalys (CFA), medan de strukturella modellerna konstrueras steg för steg för att avslöja invecklade samband. I avhandlingen tillämpas även flernivåmodellering både i Studie I och Studie II (där kontrollvariablerna Tidigare prestationer, Kön och Vårdnadshavares högsta utbildningsnivå används på elevnivå, medan övriga variabler används på lärarnivån). Flernivåmodeller tillåter forskaren att hantera nästlade strukturer av data. Det vill säga att analysera hierarkiska data, med hänsyn tagen till beroendeförhållanden inom kluster, såsom elever i en klass. Analyserna på två nivåer delar upp den totala variationen i två delar: variationen inom klasserna och variationen mellan klasserna, vilket ger insikter i hur individuella och gruppnivå faktorer påverkar elevers prestationer.

För att utvärdera modellanpassningen användes flera index, inklusive Chi-square, Root Mean Square Error of Approximation (RMSEA), Stadardized Root Mean Residual (SRMR), Comparative Fit Index (CFI) och Tucker-Lewis Index (TLI). Var och en bedömer hur väl den hypotiserade modellen överensstämmer med observerade data. Till exempel indikerar RMSEA-värden under 0,06 en god anpassning, och SRMR-värden under 0,08 en acceptabel anpassning. Anpassningsmåtten hjälper till att förfina modellerna för att säkerställa teoretisk validitet och anpassning till data.

Resultat

Studie I

Lindström, M., Johansson, S., & Borger, L. (2024). Does formal teacher competence matter for students' mathematics achievement? Results from Swedish TIMSS 2019. *Educational Research and Evaluation*, 1–30. https://doi.org/10.1080/13803611.2024.2367486

Studien fokuserade på relationen mellan grundskollärarnas formella kompetens och elevernas matematikprestationer i årskurs 4. Studien utforskade indikatorer på lärares formella kompetens och inflytandet av lärares utbildningsnivå, ämnes- och årskursspecifik specialisering, undervisningserfarenhet och professionell vidareutveckling på elevernas matematikprestationer i årskurs 4 i Sverige. Med hjälp av data från TIMSS 2019 använde studien konfirmatorisk faktoranalys och strukturell ekvationsmodellering på två nivåer för att testa en latent modell av formell lärarkompetens (*TCH_COMP*). Resultaten lyfter fram flera

nyckelindikatorer på lärarkompetens som alla påverkar elevernas prestationer positivt, inklusive formell utbildning, ämnesspecifik specialisering och antal år av undervisningserfarenhet. Den latenta konstruktionen av lärarkompetensen (*TCH_COMP*) visade dessutom ett starkt samband med elevernas prestationer, även när man kontrollerade för socioekonomisk status och migrationsbakgrund. Vidare visade resultaten att skolor eller klasser med högre socioekonomisk sammansättning hade fler kompetenta lärare, men även att klassernas språkliga mångfald hade negativ relation med elevernas matematikprestationer. Resultaten antyder att lärares kompetens skulle kunna vara avgörande för att mildra utmaningarna på skolorna med störst behov. Studien understryker behovet av en rättvis fördelning av kvalificerade lärare över skolor.

Studie II

Lindström, M., Johansson, S., & Borger, L. Teachers' Qualifications and Their Reading Instruction in Grade 4: Short-Term and Long-Term Effects. (inskickad till *European Journal of Teacher Education*/under granskning)

Forskning om hur lärares utbildning och ämnesspecifika inriktningar påverkar elevernas prestationer har resulterat i inkonsekventa resultat. Till viss del kan denna inkonsekvens förklaras av variationer i forskningsmetoder. I den andra studien hanterades vissa av dessa tidigare metodologiska begränsningar genom att använda registerdata från elevernas tidigare och senare prestationer som kopplats till PIRLS 2016-mätningen. Studien undersökte sambanden mellan lärarutbildning, lässpecialiseringar, undervisningskvalitet och elevernas läsförståelseprestationer i årskurs 4, elevernas betyg i svenska och matematik samt det totala meritvärdet i årskurs 6. Nationella prov i årskurs 3 användes som kontrollvariabler för att kontrollera för tidigare prestationer och på så vis kunde tidigare lärareffekter särskiljas från nuvarande lärares påverkan. Dessutom användes kön och vårdnadshavares högsta utbildningsnivå som kontrollvariabler. Med hjälp av strukturell ekvationsmodellering fann studien att lärares formella kvalifikationer har mindre inverkan på elevernas prestationer jämfört med undervisningsfaktorer såsom lärares kognitiva aktivering och läsförståelseaktiviteter på lektionerna i svenska. Studien påvisade att lärarens formella utbildningsnivå har betydelse för matematikbetyget i årskurs 6. Vidare påverkade lärares lässpecialisering elevernas betyg i matematik och svenska i årskurs 6 positivt. Lärares specialisering är särskilt

betydelsefull för lågpresterande elever samt elever med låg socioekonomisk bakgrund. Lärares läsförståelseundervisning visade sig ha en kurvlinjär relation till såväl PIRLS-prestationer i årskurs 4 som elevernas betyg i svenska i årskurs 6. Resultaten antyder att läsförståelseundervisning en till två tillfällen i veckan i årskurs 4 kan vara tillräckligt för att förbättra elevernas läsförståelse och även ha senare effekter på prestation. Vidare påverkade lärares kognitiva aktiveringsstrategier i årskurs 4 elevernas prestationer inom flera ämnen några år senare, i årskurs 6. Efter att ha kontrollerat för elevernas bakgrundsvariabler kvarstod endast effekterna på betyget i svenska i årskurs 6. Sammantaget betonar studien vikten av lärares formella utbildning och ämnesspecifika specialisering för att förbättra elevernas resultat, särskilt i matematik och läsning, men även betydelsen av lärares läsförståelseaktiviteter såväl som kognitiva aktivering för elevernas senare prestationer.

Studie III

Lindström, M. Teachers' working conditions and student achievement pre- and post-COVID-19: synthesizing evidence from PIRLS and TIMSS in Sweden (inskickad till *Educational Assessment, Evaluation, and Accountability*/ under granskning).

Den tredje studien undersökte hur lärares arbetsförhållanden, särskilt arbetsbelastning och uppfattningen om skolklimatet, påverkade lärares arbetstillfredsställelse och elevernas prestationer under en period som omfattade covid-19-pandemin. Sveriges unika inställning till att i stort sett hålla skolorna öppna under pandemin står i kontrast till andra länder, vilket gör det till ett intressant fall att studera. Studien använder data från PIRLS (cyklerna 2016 och 2021) samt TIMSS (cyklerna 2019 och 2023) för att analysera dessa relationer över tid. Job Demands-Resources modellen ligger till grund för analyserna. Den kategoriserar arbetskrav och resurser för att bedöma deras effekter på elevernas prestationer. Studien fann att även om lärares arbetsbelastning och arbetstillfredsställelsen förbättrades något mellan PIRLS-cyklerna, försämrades uppfattningen om skolklimatet, vilket korrelerade med en minskning av elevernas läsprestationer (den förklarade ungefär hälften av nedgången i läsförståelsepoängen). Hade inte lärarnas uppfattning och arbetstillfredsställelse förbättrats kunde möjligen elevernas resultat ha sjunkit ännu mer. Dessa resultat

understryker det kritiska inflytandet av ett säkert skolklimat på utbildningsresultat, och betydelsen av arbetstillfredsställelse. Behovet av stödjande arbetsförhållanden för lärare för att förbättra elevernas prestationer belyses också.

Trenderna i PIRLS och TIMSS skiljer sig något åt. När TIMSS 2023 genomfördes hade pandemin gått över. Resultaten för TIMSS-cyklerna tyder på en ökning i elevernas matematikprestationer. Lärarnas uppfattning om arbetstillfredsställelsen och skolklimatet hade inte nämnvärt förändrats mellan de två cyklerna; dock hade de betydande samband med matematikprestationerna, med skolklimatet som den mest inflytelserika faktorn. Ändå bidrar ingen av dessa faktorer enskilt till att förklara den totala ökningen i prestation över de två cyklerna. Den totala indirekta effekten av arbetsbelastning, arbetstillfredsställelse och skolklimat indikerar dock att ökningen kunde ha varit större om det inte vore för den negativa kombinerade indirekta effekten av dessa tre variabler.

Den tredje studien undersökte också faktorer, det vill säga arbetsförhållanden, som påverkar lärares uppfattning om arbetstillfredsställelse. Lärares uppfattning om ett säkert och ordnat skolklimat visade på signifikant samband med deras arbetstillfredsställelse. Bättre skolklimat tydde på högre arbetstillfredsställelse. Däremot var relationen mellan lärares arbetsbelastning och lärares arbetstillfredsställelse signifikant endast för TIMSS 2019-studien.

Ett av huvudresultaten i den tredje studien är vikten av att upprätthålla och/eller sträva mot ett positivt skolklimat för elevernas prestationers skull. Ett positivt skolklimat omfattar säkerhet, ordning och reda samt goda relationer mellan lärare och elever såväl som elever emellan. Ett annat nyckelresultat är att lärares arbetstillfredsställelse har betydelse för elevernas prestationer. Även om uppfattningen om arbetstillfredsställelse visade en liten förbättring över PIRLS-cyklerna var relationen till elevernas läsprestationer negativ. Resultaten från båda bedömningarna tyder på att lärares arbetstillfredsställelse påverkas av känslan av säkra och ordnade skolor.

Diskussion och slutsatser

Resultaten pekar på flera viktiga slutsatser. För det första finns det belägg för att lärares formella utbildningsnivå samt ämnesspecifika specialiseringar är betydelsefulla för elevernas ämnesprestationer. Detta bekräftas av tidigare forskning inom fältet (till exempel Coenen et al., 2018; Harris & Sass, 2011). Dessutom visar resultaten att undervisningskvalitet, lärares

läsförståelseundervisning samt kognitiv aktivering, är betydelsefulla för elevernas lärande på mellanstadiet (Rieser et al., 2016). Att gå från lågstadiets läsinlärningsträning till att på mellanstadiet diskutera och reflektera över budskapet i texter är värdefull kunskap inte bara i svenska utan även i andra ämnen. Dessutom tyder resultaten på att det finns ett kurvlinjärt samband mellan lärares läsförståelseaktiviteter och elevers läsförståelse, vilket innebär att arbete med läsförståelse en till två gånger i veckan kan ha långsiktiga effekter.

För det andra är lärares uppfattning om skolklimatet en avgörande faktor som påverkar lärarnas arbetstillfredsställelse och elevernas prestationer, särskilt inom läsning.

För det tredje ligger denna avhandlings metodologiska bidrag i de distinkta tillvägagångsätt som har använts i de enskilda studierna. Användningen av en sammansatt latent faktor för att representera lärarkompetens erbjuder ett mer omfattande mått än traditionell användning av enskilda indikatorer i effektivitetsstudier. Skolverkets tillägg av registerdata över både tidigare och senare elevprestationsmått i PIRLS 2016 möjliggör longitudinella kohortstudier och därmed mer robusta och heltäckande analyser. Den svenska utbildningskontexten där lärare ofta följer sina elever över tre årskurser stärker validiteten ytterligare eftersom detta gör det möjligt att fånga upp långsiktiga pedagogiska effekter. Slutligen fokuserar den tredje studien på trendanalyser med användning av både PIRLS- och TIMSS-data och utnyttjar identiska variabler för att möjliggöra jämförelser av trender över tid och mellan ämnen.

Baserat på avhandlingens slutsatser angående betydelsen av lärar- och undervisningskvalitet för elevernas prestationer är rekommendationerna följande: lärarutbildningarna bör (fortsätta med) att betona ämnes- och årskursspecifika fördjupningar och säkerställa att blivande lärare utvecklar de kvaliteter som är väsentliga för effektiv undervisning. Lärarutbildningen spelar en viktig roll i att förbereda lärarna för det ämnes- och årskursspecifika innehållet, särskilt i matematik. Lärarutbildningen spelar också en avgörande roll i att förbättra lärares pedagogiska färdigheter genom att tillhandahålla den utbildning som behövs för att få kunskap om effektiva undervisningsstrategier och aktiviteter som bäst stöder elevernas lärande. Den initiala lärarutbildningen är det första steget i lärarnas livslånga lärande och utrustar dem med de initiala kunskaperna som behövs i läraryrket (Guerriero & Revaí, 2017; Shulman, 1987). Att säkerställa att lärarstudenter är utrustade med ämneskunskaper och en evidensbaserad repertoar av pedagogiska färdigheter förbereder dem för en lång lärarkarriär (Ingvarson &

Rowe, 2008) under vilken en kontinuerlig professionell kunskapsutveckling även sker (Guerriero & Revaí, 2017).

Studie I belyser dessutom en viktig policyfråga, nämligen den orättvisa fördelningen av lärarkompetensen mellan skolorna i Sverige. En stor utmaning är att se till att de skolor som är i störst behov av det får tillgång till kvalificerade och kompetenta lärare. Fördelningen av kvalificerade och kompetenta lärare har betydande konsekvenser ur ett rättviseperspektiv, och politiska reformer är nödvändiga för att komma till rätta med denna fråga.

Studie III belyser det kritiska behovet av åtgärder på skolnivå och av politiska reformer för att förbättra skolornas arbetsklimat. Lärare behöver arbetsvillkor som inte bara stödjer utan också möjliggör för dem att fullt ut utnyttja sin yrkeskompetens. Konsekvenserna av skolklimatet sträcker sig längre än till lärarnas arbetstillfredsställelse och välbefinnande på arbetsplatsen. Ett tryggt arbetsklimat, ömsesidig respekt mellan elever och lärare, samt tydliga förväntningar på elevers uppföranden i skolan skapar en atmosfär som gör det möjligt för lärare att fokusera på effektiv undervisning snarare än att hantera störningar eller säkerhetsproblem. Ett positivt skolklimat har dessutom en direkt inverkan på elevernas lärande och prestationer.

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Teacher competence is a widely-debated topic in the educational research. While it is acknowledged that the quality of teachers matters for student learning and performance, there is ongoing discussion about which aspects of quality matter most. This thesis explores how various aspects of teachers' professional competence and working conditions relate to student achievement in the Swedish middle school context (grades 4-6). The thesis comprises three empirical studies and utilizes International large-scale assessment data (TIMSS and PIRLS) as well as register data to explore these relationships. Studies I and II investigate how different teacher qualifications, teachers' reading specializations, reading comprehension activities, and cognitive activation strategies in grade 4 are associated with student performance in mathematics and reading in grade 4 and across multiple subjects in grade 6. Study III explores the influence of teachers' working conditions and school climate on teacher job satisfaction and student achievement in grade 4.

The findings lend support to the importance of formal education level and teachers' subject-specific specializations for student performance. The findings further suggest that teachers' reading comprehension activities and their cognitive activation strategies in grade 4 may have positive long-term cross-subject influences. In addition, the thesis highlights the importance of a positive school climate for both teacher job satisfaction and student performance.

Mari Paloniemi Lindström holds a M.Sc. in Educational work and has her background in mathematics and science teaching. Her research interests include teacher and teaching quality, and International Large-scale Assessments.

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