Chapter 2
Theoretical Framework of Teacher Practice

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2.1 Introduction

Understanding the factors that contribute to effective and equitable teacher practice is of top priority within educational research. Researchers strive to determine how various aspects of teacher practice can be customized to provide optimal learning opportunities for diverse student populations (Dudek et al., 2019; Wallace, 2009). As the world becomes increasingly interconnected and diverse, it is imperative for educational systems to adapt and respond to the varying needs of students from different cultural, linguistic, and socioeconomic backgrounds. By gaining novel insights into effective and equitable teacher practice, we can establish a solid foundation for evidence-based professional practice and teacher education that aims to enhance student outcomes and narrow the gap in educational disparities.

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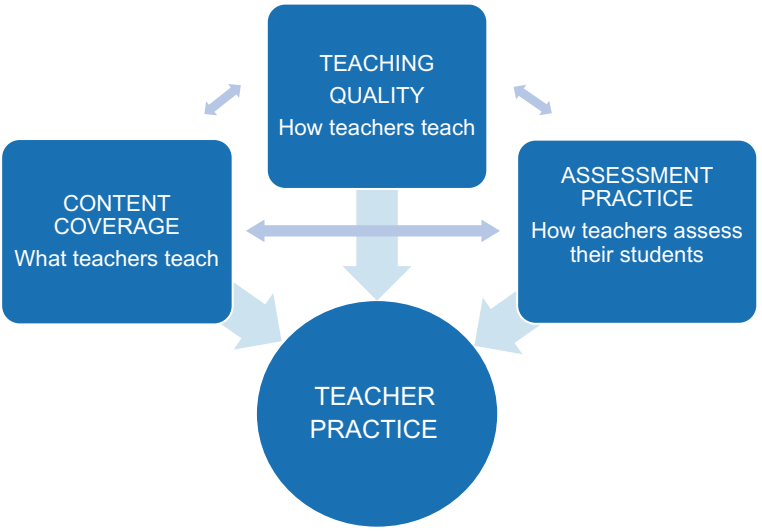

Fig. 2.1 The conceptual framework of teacher practice

But what exactly is teacher practice? The concept of "teacher practice" encompasses a wide range of teachers' work and responsibilities within educational settings (Klein, 2012). Teacher practice may relate to instructional methods and strategies, classroom assessments, lesson planning, or curriculum implementation and can be influenced by teachers' beliefs and attitudes about the nature of teaching and learning (Anderman & Anderman, 2020; Denessen et al., 2022; Wallace, 2009). This book specifically focuses on three aspects of teacher practice that directly impact student learning. As depicted in Fig. 2.1, the *content coverage* reveals what teachers teach, *teaching quality* describes how teachers deliver the content, and *assessment practice* shows how teachers assess their students' learning outcomes.

These three aspects of teacher practice are interconnected and play a significant role in shaping students' learning experiences and their subsequent academic outcomes (Fauth et al., 2014; Panadero et al., 2017; Schmidt et al., 2021). This chapter provides an in-depth exploration of these aspects and discusses their interrelationships, with specific emphasis on mathematics and science learning.

2.2 What Teachers Teach: Content Coverage

Within the context of teacher practice, what teachers teach, or content coverage serves as a foundation for learning, determining the scope and depth of students' learning, influencing their understanding, critical thinking skills, and overall academic growth. Content coverage refers to the amount of material that is covered or taught in a particular subject, making it an essential aspect of education as it ensures students to have a

fundamental understanding of the subject matter (Porter, 2002). Content coverage can vary depending on the educational level, subject matter, and objectives of the course. Sufficient content coverage can provide students exposure to all the necessary topics, concepts, and skills outlined in the curriculum or educational standards. Conversely, inadequate content coverage can limit students' opportunities to learn, potentially leading to knowledge gaps and hindering their overall academic achievement.

Content coverage represents a critical aspect of any curriculum, as it outlines the subject matter students will be exposed to and the knowledge they are expected to acquire. The relationship between content coverage and curriculum is vital, as it ensures the fulfilment of educational goals and objectives stipulated within the curriculum. It is widely observed that students typically perform better on topics they have been taught, compared to those they have not.

Content coverage has also been conceptualized as "opportunity to learn" (OTL) in large-scale studies conducted by the International Association for the Evaluation of Educational Achievement (IEA) including the Trends in International Mathematics and Science Study (TIMSS) (see e.g., Schmidt et al., 1997). Generally, OTL encapsulates more than just content coverage; it refers to the extent to which students have access to quality learning experiences, time, and resources that support the acquisition of knowledge and skills (Floden, 2002; Perry et al., 2023; Schmidt et al., 2021). Content coverage is an essential component of OTL, as it determines what students are exposed to during their time in the classroom. There is a strong relationship between content coverage and OTL. In order for students to comprehend the material being covered, it is imperative that they are provided with sufficient OTL. Inadequate time or resources can impede students' ability to fully grasp the material, ultimately resulting in suboptimal academic performance. Similarly, when the scope of the content coverage is too extensive or intricate, students may not have enough time to fully understand the subject matter, which can also lead to poor academic performance.

In the TIMSS framework, content coverage is distinguished into three key components (Mullis & Martin, 2017). The *intended curriculum*, prescribed at the system level, refers to the officially prescribed learning objectives, standards, and subject matter that students are expected to learn, as outlined by educational authorities. The *implemented curriculum*, manifested at the classroom level, is the actual content delivered by teachers in the classroom, which may differ from the intended curriculum due to factors such as teachers' competence, school or classroom resources, and students' backgrounds. The *attained curriculum* refers to the knowledge, skills, and competencies that students acquired as a result of their educational experiences. Better alignment between educational goals (the intended and implemented curricula) with educational outcomes (the attained curriculum) is an important characteristic of effective teacher practice (Daus et al., 2018).

In general, when compared to other aspects of teacher practice, such as teaching quality and assessment practice, the extent of content coverage largely depends on the intended curriculum at the national level. However, Nordic countries use multi-year curricula, which span across several years or grades and outline the learning objectives, topics, and skills that students are expected to acquire over that period

(see Chap. 4). For instance, in Norway, the curriculum is organized into three-year cycles, with the first cycle covering grades 1–4, the second cycle covering grades 5–7, and the third cycle covering grades 8–10. Unlike annual curricula that provide more specific guidance on what should be covered in a particular grade level, multi-year curricula give teachers a certain degree of autonomy and flexibility to decide when and how to cover specific topics and learning objectives within the curriculum cycle. Consequently, content coverage emerges as a key aspect of teacher practice, as teachers are tasked with selecting suitable topics and adjusting their instruction and assessment strategies to meet their students' needs and interests. At the same time, they are responsible for ensuring the required curriculum is covered and providing a coherent learning experience for students over several years.

This book conceptualizes content coverage as student exposure to TIMSS' mathematics and science topics in grades four and five. Content coverage, in this context, refers to the coverage of topics in the three content domains of mathematics (number, geometry, and data) and of science (life science, physical science, and earth science). Teachers reported whether and when they have covered the topics. This conceptualization is applied in Chaps. 4, 6, and 8. Chapter 4 further examines the alignment between content coverage (implemented curricula) with educational goals (intended curricula) and educational outcomes (attained curricula). Meanwhile, Chaps. 6 and 8 investigate the relations between content coverage and student achievement across the various content domains of mathematics and science.

2.3 How Teachers Teach: Teaching Quality

Teaching quality is a multifaceted construct that has garnered significant attention in the field of education due to its pivotal role in shaping student learning outcomes and experiences. Various definitions of teaching quality have emerged in the literature, reflecting its diverse aspects and the complexity of the teaching process (Senden et al., 2022). Some scholars interpret teaching quality through the lens of generic, domain-specific aspects, or a blend of both (Blömeke et al., 2016). Others approach it through specific instructional practices, such as differentiated instruction, problem-based learning, inquiry-based teaching, and formative assessment (Hattie, 2009; Ko & Sammons, 2013; Muijs & Reynolds, 2017). This perspective underscores the importance of adapting teacher instruction with the diverse learning needs and styles of students in order to maximize their potential for success. Additionally, the concept of teaching quality has been closely linked to teacher effectiveness and the ability to create a supportive and engaging learning environment (Goe et al., 2008). Another perspective emphasizes the necessity of ongoing professional development and the capacity to adapt teaching practices in response to students' needs and the dynamic nature of educational contexts (Darling-Hammond et al., 2017).

Despite the varying perspectives on teaching quality, a consistent feature in the literature is the recognition that teaching quality serves as a crucial determinant of student achievement, motivation, and overall educational success. This book adopted

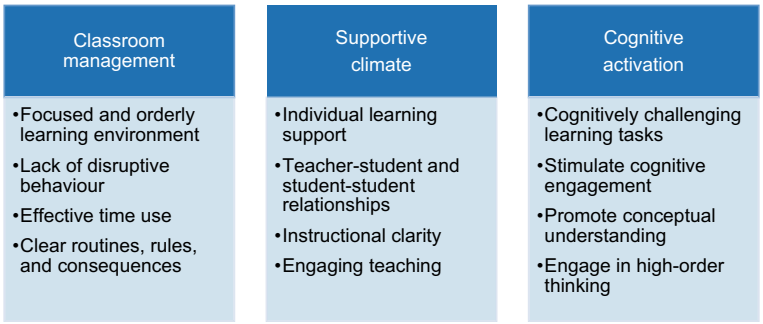

Fig. 2.2 Various aspects of teaching quality. *Note* Figure adopted from Klieme et al. (2009)

the three basic dimensions of teaching quality from Klieme et al. (2009) as a theoretical framework, which encompasses classroom management, supportive climate, and cognitive activation. (Fig. 2.2).

Classroom management is a fundamental and the most generic aspect of teaching quality. It refers to the strategies, techniques, and processes explored by teachers to establish and maintain a well-organized, focused, and orderly learning environment (Praetorius et al., 2018). An orderly classroom environment with minimal disruptions allows students to focus on learning and making the most of their educational experience (Freiberg et al., 2020; Marder et al., 2023). It involves effective time management, task-oriented student behavior, consistent enforcement of rules and consequences, and the establishment of routines.

The positive impact of classroom management on student outcomes across various subjects is more robust than other aspects of instructional quality (Korpershoek et al., 2016; Senden et al., 2023). High-achieving classrooms often exhibit effective classroom management, which fosters a conducive learning atmosphere and encourages student engagement (Dijk et al., 2019; Korpershoek et al., 2016).

Supportive climate refers to the overall classroom environment that facilitates positive student learning experiences, including teacher support, classroom interaction (teacher-student and student–student relationships), and instructional clarity. Creating a supportive climate in a classroom entails the teacher's ability to foster an atmosphere that promotes students' intellectual, social, and emotional development. This involves providing personalized support to address the individual students' unique needs, establishing clear expectations, and utilizing varied instructional approaches to enhance understanding (Senden et al., 2022).

The need for a supportive climate in mathematics and science classrooms is particularly critical due to the complex and abstract nature of the subjects. Students often encounter challenging concepts and problem-solving tasks in these areas. Consequently, establishing a safe and supportive environment, where students feel comfortable to ask questions and seek clarification, is crucial. This nurturing environment not only fosters student engagement and motivation but also nurtures their interest, curiosity, and enthusiasm for these subjects (Teig & Nilsen, 2022).

Cognitive activation represents a domain-specific aspect of teaching quality, involving instructional approaches and learning tasks that stimulate students' cognitive engagement, promote conceptual understanding, and encourage students to engage in higher-order thinking (Baumert et al., 2010; Förtsch et al., 2017; Klieme et al., 2009; Lipowsky et al., 2009). Lipowsky et al. (2009) identified three key elements of cognitive activation: (1) emphasizing conceptual understanding and connections between facts or ideas, and activating students' prior knowledge, (2) employing tasks that demand higher cognitive skills; and (3) encouraging student engagement through argumentation, explanation, critique, or idea exchange. By incorporating these elements into teaching practices, teachers can create a stimulating learning environment that enhances students' critical thinking and problem-solving skills.

The level of cognitive activation largely depends on the selection and implementation of tasks and activities in the classrooms (Baumert et al., 2010; Lipowsky et al., 2009). Cognitive activation is more likely to occur when teachers present challenging tasks that stimulate students' thinking, encourage them to recognize connections between new content and their existing knowledge, and promote discussions about potential problem solutions. Additionally, exploring multiple approaches to solve a problem and emphasizing the importance of self-reflection can further enhance cognitive activation (Baumert et al., 2010; Lipowsky et al., 2009). On the other hand, cognitive activation is less likely to occur if teachers merely view learning as the one-way transmission of subject knowledge (Lipowsky et al., 2009).

Cognitive activation can be distinguished into general and subject-specific forms (Schlesinger et al., 2018; Teig et al., 2019). General cognitive activation represents practices applicable across all classrooms, regardless of the subject domain. In contrast, subject-specific cognitive activation relates to the unique aspects of cognitive activation that typically characterize a particular subject domain. Cognitive activation may involve students independently applying what they have learned to new problem situations, linking content with their everyday lives, and expressing their ideas or explaining their answers to challenging exercises. Typical examples of cognitive activation in mathematics include providing students with the opportunity to deal with mathematical proof and engage in other mathematical processes, including problem-solving, modeling, or reasoning (Schlesinger et al., 2018; Sigurjónsson, 2023). In science classrooms, cognitive activation typically involves students in scientific inquiry practices, such as formulating research questions, designing and conducting investigations, and analyzing and interpreting data (Teig et al., 2019; Teig et al., 2022). Inquiry-based cognitive activation strategies enable students to learn about scientific content and explore the nature of science more deeply through first-hand experience in scientific investigations (Teig et al., 2019). Both general and subject-specific cognitive activation play vital roles in determining the quality of teaching.

The empirical chapters in this book examine various dimensions of teaching quality. Chapter 5 explores the trends in classroom management, supportive climate (specifically on teacher support and instructional clarity), and cognitive activation

as well as their relations to mathematics and science achievement. Chapter 7 investigates whether changes in supportive climate and cognitive activation are related to the changes in achievement in both subjects. Meanwhile, Chapter 9 delves into similar dimensions by focusing on their roles in mitigating socioeconomic and ethnic disparities in mathematics.

2.4 How Teachers Assess Their Students: Assessment Practice

Teacher assessment practice encompasses a range of methods and strategies used by teachers to gather evidence of their students' understanding (Black & Wiliam, 1998; Popham, 1999). This evidence serves as a basis for important educational decisions, including adapting instruction, selecting assignments, providing feedback, assigning grades, and planning lessons (Black & Wiliam, 1998; Gardner et al., 2010; Herppich et al., 2018; Popham, 1999).

In general, three main types of assessment can be identified: assessment *for* learning, assessment *of* learning, and assessment *as* learning, each serving distinctive objectives and functions in educational settings. *Assessment for learning*, also known as formative assessment, is used to inform and improve the teaching and learning process (Black & Wiliam, 1998; Schildkamp et al., 2020). It takes place during the learning process and provides teachers with valuable information about students' understanding, progress, and misconceptions (Schildkamp et al., 2020). Teachers can then use this information to adjust their instruction, provide feedback, and address any learning gaps. *Assessment of learning* or summative assessment is typically conducted at the end of a unit, course, or academic year (Gao et al., 2020; Harlen, 2007). Its primary purpose is to evaluate students' overall achievement and mastery of specific learning objectives (Harlen, 2007), for example, through standardized tests, final exams, and end-of-term projects. *Assessment as learning* emphasizes the students' active involvement in their own learning process (Panadero et al., 2017; Popham, 1999). It promotes metacognition, self-assessment, and reflection, enabling students to become more independent and self-regulated learners (Panadero et al., 2017).

To accommodate these various assessment types, educators utilize a wide range of assessment practices, from traditional exams and quizzes to more innovative approaches like project-based assessments, peer evaluations, and learning journals or reflection logs. One common example of assessment practice is the assignment of homework, which among other things allows teachers to gauge students' understanding of the material, helps students practice and reinforce skills learned in the classroom, and can also serve as a way for students to learn new content (Fernández-Alonso & Muñiz, 2022). Effective assessment practice enables teachers to identify strengths and weaknesses and efficacy of their teaching methods and allows them to adjust their instruction to better meet the needs of their students (Black &

Wiliam, 1998; Popham, 1999). Furthermore, effective assessment practice provides valuable feedback to students and offers guidance for improvement, helping them understand their progress (Gardner et al., 2010). Assessment practices can foster a positive collaboration between teachers and students, ultimately contributing to the development of student outcomes (Black & Wiliam, 1998; Muijs & Reynolds, 2017).

Assessment practices can also be used to establish high standards and expectations for all students, including those from socioeconomically disadvantaged backgrounds (Andrade & Brookhart, 2020; Panadero et al., 2017). The practices enable teachers to identify learning gaps among disadvantaged students, thus allowing them to tailor instruction, resources, and support accordingly. By upholding rigorous standards for every student, teachers can promote a culture of achievement and ensure equal opportunity to succeed.

In mathematics and science classrooms, assessment practices hold a significant place due to the complex and abstract nature of these subjects (Gao et al., 2020). Mathematics and science often require higher-order thinking, problem-solving, and critical analysis, making it essential for teachers to employ adequate assessment strategies to ensure positive learning outcomes and experiences for students. Additionally, assessment practices in mathematics and science may promote metacognition, persistence, and resilience, as students are encouraged to reflect on their learning processes and work through challenges (Gao et al., 2020). By using assessment data to inform instruction, teachers can ensure that their students are developing a deep understanding of the material and are able to apply their knowledge to real-world situations (Black & Wiliam, 1998; Muijs & Reynolds, 2017).

Subsequent chapters in this book delve into various aspects of assessment practice in mathematics and science. Chapter 5 explores the trends in homework frequency, homework time, how teachers use homework in the classroom (referred to as in-class homework discussion), and the emphasis teachers place on assessment strategies. Chapter 7 further investigates whether changes in homework frequency, time spent on homework, and in-class homework discussion correspond to the changes in achievement in both subjects. Meanwhile, Chapter 9 scrutinizes teachers' emphasis on assessment strategies in mitigating disparities in mathematics achievement. Together, these chapters provide a comprehensive examination of assessment practices and their implications for student learning outcomes.

2.5 An Integrated Framework

To emphasize the importance of aligning curriculum objectives with assessment measures and understand the interconnection between content coverage, teaching quality, assessment practice, and students' learning outcomes, the book adopts the theoretical model of Potential Educational Experiences (Schmidt et al., 1997). This model describes the dynamic mechanism between content coverage, teaching quality, and assessment practices in facilitating effective learning experiences for all students (Floden, 2002; Perry et al., 2023; Schmidt et al., 2021).

In the Potential Educational Experiences model, the implemented curriculum functions as a mediator between the intended curriculum and the curriculum carried out. It serves as a representation of the desired learning experiences outlined in the intended curriculum, and at the classroom level, it can be referred to as the "opportunity" provided to students. The choices made by schools and teachers, such as student grouping, timetable structuring, and resource selection, all have implications for the educational opportunities available. The model also highlights direct and indirect effects on the attained curriculum, considering various antecedents and contexts at the system level, school and classroom levels, and student level. These antecedents may include, for example, teacher characteristics, teaching practice, learning conditions, and student attributes (see Fig. 2.3).

The model identifies three main channels through which the implemented curriculum impacts the attained curriculum. These channels involve the influence of student characteristics and peers on teaching quality, the effects of teacher practice-related factors (e.g., content coverage, instructional activities, and supportive functions) on student achievement, and the impact of organizational differentiation on teacher resources and teaching support. In this book, our primary examination focuses on the second channel of teacher practice and its impact on students' learning outcomes. Specifically, we delve into content coverage, teaching quality, and assessment practice, either independently to analyze changes over time, or in an integrated manner to explore the interrelationship between these constructs.

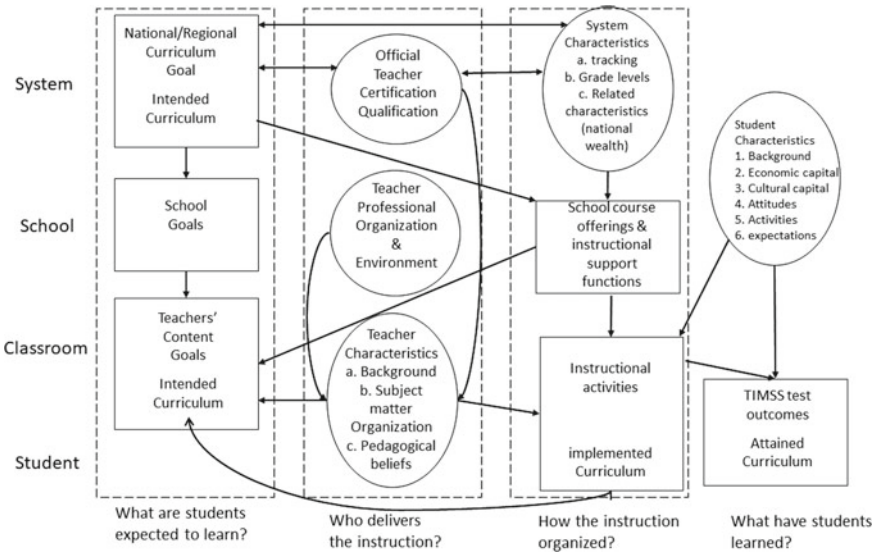

Fig. 2.3 The TIMSS model of potential educational experiences. *Source* Schmidt et al. (1997, p. 188)

2.6 Closing Remarks

One of the primary challenges in investigating effective and equitable teacher practice involves acknowledging that different aspects of teaching practice—what teachers teach (content coverage), how teachers teach (teaching quality), and how teachers assess their students (assessment practice)—are not static or isolated factors. Instead, they are dynamic and interconnected factors that exert their influence on student outcomes, as depicted in Fig. 2.3. Adequate content coverage ensures students' opportunity to learn essential concepts and competencies. High-quality teaching fosters a positive learning environment, encourages student engagement with the subject matter, and promotes deep understanding. Effective assessment practices help teachers to identify student strengths and weaknesses, allowing for tailored instruction and support, which in turn contribute to improved student outcomes. When these three aspects of teacher practice are well-aligned and consistently applied, they collectively create a cohesive and effective learning experience for students, ultimately leading to better outcomes.

Understanding the impact of any single aspect of teacher practice requires considering its relationship with other aspects. For instance, content coverage and teaching quality are inextricably linked. A solid understanding of the curriculum empowers teachers to determine, integrate, and present mathematics and science content in a coherent and meaningful way, making it more accessible and engaging for students. Similarly, teacher assessment practices play a crucial role in shaping both content coverage and teaching quality, as they provide valuable feedback on student learning and progress that can inform instructional decisions and adaptations. These interconnected aspects of teacher practice work together to create a conducive environment that fosters academic growth and success for all students. By recognizing the interdependence of these aspects, researchers and practitioners can develop a more comprehensive understanding of effective and equitable teacher practice, essential for improving educational outcomes for all students.

References

Anderman, E. M., & Anderman, L. H. (2020). *Classroom motivation: Linking research to teacher practice*. Routledge.

Andrade, H. L., & Brookhart, S. M. (2020). Classroom assessment as the co-regulation of learning. *Assessment in Education: Principles, Policy & Practice*, *27*(4), 350–372. https://doi.org/10.1080/0969594x.2019.1571992

Baumert, J., Kunter, M., Blum, W., Brunner, M., Voss, T., Jordan, A., Klusmann, U., Krauss, S., Neubrand, M., & Tsai, Y.-M. (2010). Teachers' mathematical knowledge, cognitive activation in the classroom, and student progress. *American Educational Research Journal, 47*(1), 133–180. https://doi.org/10.3102/0002831209345157

Black, P., & Wiliam, D. (1998). *Inside the black box: Raising standards through classroom assessment*. Granada Learning.

Blömeke, S., Olsen, R. V., & Suhl, U. (2016). Relation of student achievement to the quality of their teachers and instructional quality. In: T. Nilsen & J. E. Gustafsson (Eds.), Teacher quality, instructional quality and student outcomes. IEA Research for Education, vol 2. Springer. https://doi.org/10.1007/978-3-319-41252-8_2

Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). *Effective teacher professional development*. Learning Policy Institute.

Daus, S., Nilsen, T., & Braeken, J. (2018). Exploring content knowledge: Country profile of science strengths and weaknesses in TIMSS. Possible implications for educational professionals and science research. *Scandinavian Journal of Educational Research*, *63*(7), 1102–1120. https://doi.org/10.1080/00313831.2018.1478882

Denessen, E., Hornstra, L., van den Bergh, L., & Bijlstra, G. (2022). Implicit measures of teachers' attitudes and stereotypes, and their effects on teacher practice and student outcomes: A review. *Learning and Instruction, 78*, 101437. https://doi.org/10.1016/j.learninstruc.2020.101437

Dijk, W., Gage, N. A., & Grasley-Boy, N. (2019). The relation between classroom management and mathematics achievement: A multilevel structural equation model. *Psychology in the Schools, 56*(7), 1173–1186. https://doi.org/10.1002/pits.22254

Dudek, C. M., Reddy, L. A., & Lekwa, A. (2019). Measuring teacher practices to inform student achievement in high poverty schools: A predictive validity study. *Contemporary School Psychology, 23*, 290–303. https://doi.org/10.1007/s40688-018-0196-8

Fauth, B., Decristan, J., Rieser, S., Klieme, E., & Büttner, G. (2014). Student ratings of teaching quality in primary school: Dimensions and prediction of student outcomes. *Learning and Instruction, 29*, 1–9. https://doi.org/10.1016/j.learninstruc.2013.07.001

Fernández-Alonso, R., & Muñiz, J. (2022). Homework: Facts and fiction. In: T. Nilsen, A. Stancel-Piątak, & J. E. Gustafsson (Eds.), *International handbook of comparative large-scale studies in education.* Springer https://doi.org/10.1007/978-3-030-88178-8_40

Floden, R.E. 2002. The measurement of opportunity to learn. In National Research Council (Ed.), *Methodological advances in cross-national surveys of education achievement* (pp. 231–266). National Academies Press.

Förtsch, C., Werner, S., Dorfner, T., von Kotzebue, L., & Neuhaus, B. J. (2017). Effects of cognitive activation in biology lessons on students' situational interest and achievement. *Research in Science Education, 47*(3), 559–578. https://doi.org/10.1007/s11165-016-9517-y

Freiberg, H. J., Oviatt, D., & Naveira, E. (2020). Classroom management meta-review continuation of research-based programs for preventing and solving discipline problems. *Journal of Education for Students Placed at Risk (JESPAR), 25*(4), 319–337. https://doi.org/10.1080/10824669.2020.1757454

Gao, X., Li, P., Shen, J., & Sun, H. (2020). Reviewing assessment of student learning in interdisciplinary STEM education. *International Journal of STEM Education*, *7*(1). https://doi.org/10.1186/s40594-020-00225-4

Gardner, J., Harlen, W., Hayward, L., Stobart, G., & Montgomery, M. (2010). *Developing teacher assessment*. McGraw-Hill Education (UK).

Goe, L., Bell, C., & Little, O. (2008). *Approaches to evaluating teacher effectiveness: A research synthesis NCCTQ*. National Comprehensive Center For Teacher Quality.

Harlen, W. (2007). *Assessment of learning.* Sage.

Hattie, J. (2009). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. Taylor & Francis.

Herppich, S., Praetorius, A. -K., Förster, N., Glogger-Frey, I., Karst, K., Leutner, D., Behrmann, L., Böhmer, M., Ufer, S., Klug, J., Hetmanek, A., Ohle, A., Böhmer, I., Karing, C., Kaiser, J., & Südkamp, A. (2018). Teachers' assessment competence: Integrating knowledge-, process-, and product-oriented approaches into a competence-oriented conceptual model. *Teaching and Teacher Education*, *76*, 181–193. https://doi.org/10.1016/j.tate.2017.12.001

Klein, P. (2012). *Predictive relationships of teacher efficacy, geometry knowledge for teaching, and the cognitive levels of teacher practice on student achievement*. University of Louisville. https://doi.org/10.18297/etd/763

Klieme, E., Pauli, C., & Reusser, K. (2009). The Pythagoras study: Investigating effects of teaching and learning in Swiss and German mathematics classrooms. In T. Janik & T. Seidel (Eds.), *The power of video studies in investigating teaching and learning in the classroom* (pp. 137–160). Waxmann.

Ko, J., & Sammons, P. (2013). *Effective teaching: A review of research and evidence.* CfBT Education Trust.

Korpershoek, H., Harms, T., de Boer, H., van Kuijk, M., & Doolaard, S. (2016). A meta-analysis of the effects of classroom management strategies and classroom management programs on students' academic, behavioral, emotional, and motivational outcomes. *Review of Educational Research, 86*(3), 643–680. https://doi.org/10.3102/0034654315626799

Lipowsky, F., Rakoczy, K., Pauli, C., Drollinger-Vetter, B., Klieme, E., & Reusser, K. (2009). Quality of geometry instruction and its short-term impact on students' understanding of the pythagorean theorem. *Learning and Instruction, 19*(6), 527–537. https://doi.org/10.1016/j.learninstruc.2008.11.001

Marder, J., Thiel, F., & Göllner, R. (2023). Classroom management and students' mathematics achievement: The role of students' disruptive behavior and teacher classroom management. *Learning and Instruction, 86*, 101746. https://doi.org/10.1016/j.learninstruc.2023.101746

Muijs, D., & Reynolds, D. (2017). *Effective teaching: Evidence and practice*. Sage.

Mullis, I. V. S., & Martin, M. O. (Eds.). (2017). *TIMSS 2019 Context questionnaire framework*. TIMSS & PIRLS International Study Center. http://timssandpirls.bc.edu/timss2019/frameworks/framework-chapters/science-framework/

Panadero, E., Jonsson, A., & Botella, J. (2017). Effects of self-assessment on self-regulated learning and self-efficacy: Four meta-analyses. *Educational Research Review, 22*, 74–98. https://doi.org/10.1016/j.edurev.2017.08.004

Perry, L.B., Thier, M., Beach, P. (2023). Opportunities and conditions to learn (OCL): A conceptual framework. *Prospects*. https://doi.org/10.1007/s11125-023-09637-w

Popham, W. J. (1999). *Classroom assessment: What teachers need to know*. Allyn and Bacon.

Porter, A. C. (2002). Measuring the content of instruction: Uses in research and practice. *Educational Researcher, 31*(7), 3–14. https://doi.org/10.3102/0013189X031007003

Praetorius, A.-K., Klieme, E., Herbert, B., & Pinger, P. (2018). Generic dimensions of teaching quality: The German framework of three basic dimensions. *ZDM Mathematics Education, 50*(3), 407–426. https://doi.org/10.1007/s11858-018-0918-4

Schildkamp, K., van der Kleij, F. M., Heitink, M. C., Kippers, W. B., & Veldkamp, B. P. (2020). Formative assessment: A systematic review of critical teacher prerequisites for classroom practice. *International Journal of Educational Research*, *103*, 101602. https://doi.org/10.1016/j.ijer.2020.101602

Schlesinger, L., Jentsch, A., Kaiser, G., König, J., & Blömeke, S. (2018). Subject-specific characteristics of instructional quality in mathematics education. *ZDM Mathematics Education, 50*, 475–490. https://doi.org/10.1007/s11858-018-0917-5

Schmidt, W. H., McKnight, C. C., Valverde, G., Houang, R. T., & Wiley, D. E. (Eds.). (1997). *Many visions, many aims: A cross-national investigation of curricular intentions in school mathematics* (Vol. 1). Springer Science & Business Media.

Schmidt, W. H., Guo, S. W., & Houang, R. T. (2021). The role of opportunity to learn in ethnic inequality in mathematics. *Journal of Curriculum Studies, 53*(5), 579–600. https://doi.org/10.1080/00220272.2020.1863475

Senden, B., Nilsen, T., & Blömeke, S. (2022). Instructional quality: A review of conceptualizations, measurement approaches, and research findings. *Ways of Analyzing Teaching Quality: Potentials and Pitfalls*, 140–172.

Senden, B., Nilsen, T., & Teig, N. (2023). The validity of student ratings of teaching quality: Factorial structure, comparability, and the relation to achievement. *Studies in Educational Evaluation, 78*. https://doi.org/10.1016/j.stueduc.2023.101274.

Sigurjónsson, J. Ö. (2023). Quality in Icelandic mathematics teaching: Cognitive activation in mathematics lessons in a Nordic context. [Doctoral dissertation, University of Iceland]. Opinvisindi. https://hdl.handle.net/20.500.11815/3843

Teig, N., Scherer, R., & Nilsen, T. (2019). I know I can, but do I have the time? The role of teachers' self-efficacy and perceived time constraints in implementing cognitive-activation strategies in science. *Frontiers in Psychology*, *10*(1697). https://doi.org/10.3389/fpsyg.2019.01697

Teig, N., & Nilsen, T. (2022). Profiles of instructional quality in primary and secondary education: Patterns, predictors, and relations to student achievement and motivation in science. *Studies in Educational Evaluation, 74*, 101170. https://doi.org/10.1016/j.stueduc.2022.101170

Teig, N., Scherer, R., & Olsen, R. V. (2022). A systematic review of studies investigating science teaching and learning: over two decades of TIMSS and PISA. *International Journal of Science Education, 44*(12), 2035–2058. https://doi.org/10.1080/09500693.2022.2109075

Wallace, M. R. (2009). Making sense of the links: Professional development, teacher practices, and student achievement. *Teachers College Record, 111*(2), 573–596. https://doi.org/10.1177/016146810911100205

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