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## Moving forward: Advancing the research and policy agendas on teacher knowledge

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Studying teaching as a knowledge profession, especially in an international survey, is as important as it is challenging. This publication summarised the research on key topics relating to teacher knowledge and provided many suggestions for making such a challenging endeavour a success. This closing chapter first outlines main takeaways from these discussions, embedding them into a broader discussion around researching teacher knowledge in education systems around the globe. In the end, the success of any research endeavour is also determined by the contributions made to improving policy and practice. The chapter, therefore, also discusses how research on teacher knowledge can be used for informing teacher policy and strengthening professional exchange and knowledge-based practice in schools. Tackling these issues requires enormous efforts from everyone: researchers, policy makers and practitioners. Given the importance of a strong knowledge base of teachers for the thriving of students and societies, the effort is worth it.

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## Introduction

Teaching provides the foundation for future professional careers and, thus, is in fact the mother of all professions. This publication explored teaching as a knowledge profession, with a focus on teachers' general pedagogical knowledge. It collated convincing arguments for considering teaching a full profession with teacher knowledge as a main pillar. Whereas content knowledge (e.g. knowledge about mathematics, science) is partly shared with other professions, pedagogical knowledge (e.g. knowledge of how to teach and how students learn) is unique to the teaching profession. General pedagogical knowledge, which is independent of the subject taught, provides teachers with a common language and understanding for reflecting jointly on improving teaching and learning across subjects. Hence, strengthening general pedagogical knowledge among the teaching profession has a great potential for enhancing the learning experience of students across different subjects as well as the collaboration in and among schools.

A better understanding of teacher knowledge, in particular general pedagogical knowledge, and effective means of promoting it is of value for both education systems aiming at improving teacher quality and learning outcomes, and for practitioners striving continuously to improve their teaching and the support they receive for their work. An international study of teacher knowledge can play a key role in sparking greater attention to the topic and making education systems, schools and teachers part of a global education community determined to strengthen knowledge-based and evidence-informed practices in schools. To do so, an international study of teacher knowledge must represent the state-of-art of scientific knowledge and use cutting-edge methodologies. Certainly, such a study needs to address the major challenges education systems face with regard to teacher knowledge and its results need to be informative and useful for policy makers, practitioners and researchers alike.

These are the ambitions for the new optional Teacher Knowledge Survey (TKS) assessment module in the 2024 cycle of the OECD Teaching and Learning International Survey (TALIS). The module will explore teacher knowledge across education systems, drawing on the extensive work conducted in the Centre for Education Research in Innovation (CERI), where the module was originally developed as a stand-alone survey (see Chapters 1 and 2). The module has now been integrated into TALIS and will be further developed to fulfil the great ambition for the 2024 cycle.

This publication aimed to contribute to this challenging endeavour and to the broader discussion on teacher knowledge and professionalism. Its chapters summarised what is known from research about major challenges relating to teacher knowledge across countries and economies, such as managing diversity and technology in teaching. They also shared ideas for studying these issues across education systems using innovative testing designs.

This closing chapter reflects first on the experts' insights and ideas and outlines the main takeaways. It then summarises the implications of using research on teacher knowledge for improving both policy and practice as well as implications for future research. The chapter ends with a concluding note.

## Main takeaways for an international study of teacher knowledge

This publication brought together experts' insights on the state-of-art of scientific knowledge about teacher knowledge. It also presented viable approaches to studying teacher knowledge across education systems and strengthening the relevance of this research for guiding teacher policies. Each chapter addressed a particular key topic relating to the study of teacher knowledge:

- **Chapter 1** set the scene for an in-depth exploration of teaching as a knowledge profession and presented arguments for considering teaching a profession with teachers' pedagogical knowledge as its main pillar and for studying teacher knowledge across countries.

- **Chapter 2** provided an overview of the new TALIS Teacher Knowledge Survey (TKS) assessment module and described its design, aims as well as its conceptual underpinning and instruments.
- **Chapter 3** focused on the knowledge and skills teachers need to master a major challenge in today's classrooms: the effective use of technology to facilitate student learning.
- **Chapter 4** was dedicated to the pressing issue of preparing and supporting the teaching workforce for high quality teaching in increasingly diverse classrooms.
- **Chapter 5** centred on the knowledge and skills teachers need for making adequate use of their knowledge in the context of specific classroom situations.
- **Chapter 6** discussed the importance of offering teachers practical opportunities to learn about pedagogy to foster knowledge-based and evidence-informed practice in schools.
- **Chapter 7** is dedicated to innovative testing designs for exploring teacher knowledge across education systems (i.e. multidimensional adaptive testing designs).

Each chapter also made suggestions for the challenging endeavour for the 2024 TALIS cycle: exploring teacher knowledge across education systems through a new module. The aim for the TALIS Teacher Knowledge Survey (TKS) assessment module is the design of a survey that provides meaningful information on key areas of teacher knowledge, while limiting the response time and burden for participating teachers. The work on the Teacher Knowledge Survey (TKS) and its integration into the Teaching and Learning International Survey (TALIS) was guided by the CERI and TALIS Governing Boards, which were also invited to a meeting to discuss the topics covered in this publication. An expert group in collaboration with participating countries and economies, the TALIS Governing Board (TGB) and important stakeholders will be involved in the further development of the module. The suggestions made by experts in this publication are meant to provide a stimulus for future joint discussions and collaborative efforts. Table 8.1 provides a brief summary of the main takeaways from the chapters for the development of the TKS assessment module.

**Table 8.1. Takeaways from the expert chapters for the Teacher Knowledge Survey (TKS) assessment module**

Chapter number and focus	Main takeaways
<i>Chapter 1: Teachers as knowledge professionals</i>	<ul style="list-style-type: none"> <li>• Chapter 1 provided convincing arguments for considering teaching a profession with teachers' pedagogical knowledge as its main pillar.</li> <li>• Education systems have enacted policies and reforms to ensure a solid knowledge base and a continuous update of knowledge and skills among the teaching workforce. An international study of teacher knowledge such as the TKS assessment module provides guidance for policy and practice and helps foster learning and dialogue among policy makers, practitioners and researchers.</li> <li>• Thus far, TALIS has relied on indirect measures of teacher knowledge through self-reports. Yet, research suggests that assessed and self-reported knowledge are distinct teacher characteristics. The TKS assessment module will, therefore, use an objective assessment of teacher knowledge, building on prior international and national work in that area, most notably the substantive prior work conducted in CERI.</li> <li>• General pedagogical knowledge is crucial for mastering emerging challenges in today's classroom such as digital teaching as well as learning and the increasing diversity. Teachers need to be not only owners of deep professional knowledge but also able to apply knowledge adequately in different pedagogical contexts and situations. Thus, an international knowledge assessment needs to cover pedagogical knowledge in the area of technology and diversity and measure practice-based knowledge, professional judgement and knowledge-based skills in addition to theoretical-scientific knowledge.</li> </ul>
<i>Chapter 2: Studying teaching as a knowledge profession across education systems</i>	<ul style="list-style-type: none"> <li>• Drawing on the CERI Teacher Knowledge Survey (TKS), the new TALIS TKS assessment module will study teaching as a knowledge profession across education systems. It will collect international comparative data on the strengths and weaknesses of teachers' knowledge base, in particular teachers' general pedagogical knowledge.</li> <li>• The assessment covers teachers' general pedagogical knowledge in the areas of instruction, learning and assessment. Knowledge for fostering 21st century skills, teaching diverse classrooms and using digital technology for teaching are considered transversal knowledge areas across these three main areas. Chapter 2 provided an overview of the existing objective teacher assessments of technology- and diversity-related pedagogical knowledge, which can be used to strengthen these areas in the TKS assessment.</li> </ul>

Chapter number and focus	Main takeaways
<i>Chapter 3: The use of technology in teaching</i>	<ul style="list-style-type: none"> <li>The assessment will include contextualised items and text vignettes that confront teachers with written descriptions of typical classroom situations and different options for teaching. In line with the CERI TKS approach, the module will use indicators measured via questionnaires to provide the context for the assessment results.</li> <li>Technological knowledge is not sufficient to ensure an effective use of technology in teaching. Teachers need specialised pedagogical knowledge. Accordingly, the CERI TKS included this knowledge in its framework and assessment. Teachers' preparedness and their use of technology was also considered with single items in the TALIS 2018 questionnaire.</li> <li>Teachers can use technology to support their <i>instruction</i> and their <i>assessment</i> practices. Technology can also help foster 21st century skills and facilitate individual and group <i>learning</i>. Consequently, technology is considered a transversal area across the three main knowledge areas of instruction, assessment and learning in the module's assessment framework. The TKS assessment already includes technology-related items but the item bank should be carefully reviewed to ensure a sufficient coverage of items across all areas.</li> <li>The Technological Pedagogical and Content Knowledge (TPACK) framework described in Chapter 3 provides a nuanced description of the technology-related knowledge of teachers. The framework has also produced several useful self-report instruments. Some items can be used to strengthen the technology topic in the next round of TALIS and the new TKS assessment module.</li> <li>Chapter 3 points out that exploring teachers' self-rated Technological Pedagogical Knowledge and practice enables a deeper understanding of the relevance of this knowledge for an effective use of technologies as educational tools. Studying the purpose and frequency of teachers' technology usage as well as the overall conditions for technology use at schools could further improve the interpretation of assessment results. Several items are proposed for the measurement of such context information, which is in line with the approach of TALIS and the TKS assessment module.</li> </ul>
<i>Chapter 4: Teaching in diverse classrooms</i>	<ul style="list-style-type: none"> <li>Tailoring teaching to diverse backgrounds and needs of students is a major challenge growing in importance. Consequently, TALIS puts an emphasis on the diversity topic and explored self-efficacy in multicultural classrooms and diversity-related practices. The TKS assessment module complements TALIS with an assessment of teachers' knowledge about teaching in diverse classrooms. Chapter 4 provides an impulse for a more nuanced consideration of this topic in the next cycle by including the critical component of inclusive and multicultural education, mainly with a focus on self-report measures.</li> <li>A review of TALIS 2018 items shows that <i>conservative</i> and <i>liberal</i> approaches to multicultural education are well represented, whereas <i>critical approaches</i> are missing. The chapter includes first ideas for new items and scales that would allow exploring critical approaches and diversity-related competences for teaching more holistically (e.g. self-report items on content and pedagogical knowledge, attitude, multicultural pedagogy and practice).</li> </ul>
<i>Chapter 5: Drawing on knowledge in the context of specific classroom situations</i>	<ul style="list-style-type: none"> <li>Measuring practice-based knowledge and situation-specific skills is key for understanding why many teachers, especially novice teachers, struggle to apply knowledge acquired in teacher education in the classroom. Chapter 5 provides a model illustrating their role for transforming knowledge into effective practice.</li> <li>Chapter 5 also highlights the advantages of using text vignettes with Likert scales to assess these knowledge and skills while using of an expert rating system for scoring. This reflects the directions taken for the TKS assessment (further increasing the amount of vignette-based items, including Likert scales as a response format and discussing an expert rating system for scoring).</li> </ul>
<i>Chapter 6: Opportunities to learn about general pedagogy</i>	<ul style="list-style-type: none"> <li>Chapter 6 outlines strategies and concepts for exploring teachers' opportunities to learn about general pedagogy, drawing on experiences from national and international studies on general pedagogical knowledge. It outlines promising approaches, and suggests items for profiling teachers' learning opportunities across education systems in initial teacher education, induction and professional development.</li> <li>TALIS has a well-established item battery measuring subject-specific and subject-independent learning opportunities along the teaching career. The original TKS questionnaire developed in CERI complements the TALIS questionnaire, providing a more nuanced picture on subject-independent learning opportunities. With every cycle, TALIS revises a certain share of items from the teacher questionnaire and includes new items. The items presented here, especially those from cross-country studies, can be used as a starting point for the revision.</li> </ul>
<i>Chapter 7: Multidimensional adaptive testing</i>	<ul style="list-style-type: none"> <li>Chapter 7 explains the importance of using multidimensional item-response-theory for the scaling of data from international assessments such as the TKS assessment module. A two-parameter logistic (M2PL) model is suggested for the module, which provides allows for a more precise measurement of teacher knowledge while allowing for stable parameter estimates. This is already envisioned for 2024.</li> <li>The benefits of an adaptive testing design is highlighted, including improved test efficiency and precision as well as reduced test burden and increased motivation of respondents. These benefits apply in general for using such a design for international assessments.</li> <li>The chapter also makes concrete suggestions for the TKS assessment module (including pilot study, field trial and main study) and shows efficiency and precision gains for the module in a simulation study. Though an adaptive design is currently not envisioned for 2024, Chapter 7 points out the direction for the future of the TKS and international assessments in general.</li> </ul>

## Using cross-country insights on teacher knowledge for education policy and practice

Though each of the chapters includes specific suggestions for exploring teacher knowledge across education systems, these suggestions are embedded into a broader discussion on major challenges relating to teacher knowledge across education systems and, thus, have implications for research, policy and practice that are more general in nature. In the following, implications for strengthening teacher knowledge and improving knowledge-based and evidence-informed practices in schools emerging from the topics discussed and further scientific literature will be discussed.

### ***Using knowledge assessments to drive policies and initiatives***

Within education systems, policy reforms and local initiatives should be informed by sound evidence, indicating strengths as well as weaknesses and actual need for improvement. These needs should be met with programmes and initiatives of proven effectiveness and the progress made in implementing reforms and scaling up promising initiatives must be evaluated regularly. Results from surveys such as TALIS have been widely used to identify needs and evaluate progress through trend analysis (OECD, 2019<sup>[1]</sup>; OECD, 2020<sup>[2]</sup>). Yet, these analysis were based on teachers' self-reports (e.g. self-reports of teachers' feeling of preparedness, their participation and need for professional development). The discrepancies observed for self-rated vs. assessed knowledge discussed in Chapter 1 underline the importance of additionally using an objective assessment of the strength and weaknesses of teacher knowledge for informing policies and practice. Naturally, results need interpreting in light of national priorities and contexts.

As discussed in Chapter 1, TALIS and other international studies have proven to be powerful tools for inspiring learning and dialogue among education systems. Similarly, an international study focused on teacher knowledge may help foster learning and dialogue about effective policies and practices for strengthening the knowledge base of the teaching profession and knowledge-based practices in schools. However, such a study is only a first step, additional studies are necessary for guiding policy and practice, as discussed further below.

### ***Building a global professional community that jointly reflects on pedagogy and co-constructs knowledge***

Apart from fostering learning about effective policies among education systems, results from an international study on teacher knowledge can be used as an impulse for a joint reflection on pedagogical knowledge and improving teaching and pedagogies among the teachers around the globe. They can also promote peer learning about effective means of knowledge exchange and constructions in and across schools. Being part of a community that shares knowledge and experiences at a global scale allows teachers to find authentic examples of practices drawn from a rich range of contexts that can inspire their own practice. Such a platform can thus enrich national and regional pedagogical debates and help explore new approaches to pedagogical situations.

To promote peer learning among teachers on a global level, the OECD developed a global video library of teaching practices. The library showcases and disseminates videos of effective teaching practices around the world, using results from the OECD Global Teaching InSights (GTI) study (OECD, 2020<sup>[3]</sup>). The digital platform allows creating and sharing expertise about teaching, including video-enhanced examples of teaching practices that the GTI study finds to be most associated with student outcomes. Drawing on that experience, a digital platform could collect and distribute scientific knowledge and state-of the art research on teaching and learning. Best practice examples could demonstrate how teachers engage in reflecting on their practice and embedding research into their everyday teaching and how knowledge in schools is successfully shared and co-constructed in schools. Through such a platform, teachers can not only share

pedagogical success stories, research and personal experiences, they can also provide mutual support and feedback.

### ***Promoting knowledge exchange and co-construction in schools***

Schools should work out further means to promote knowledge exchange and co-construction in and among schools. Regular meetings can be held, where research and innovative pedagogical approaches are discussed and teachers work jointly on potential solutions for challenges they face in their daily work (Ulferts, 2019<sup>[4]</sup>; OECD, 2019<sup>[5]</sup>). School networks enable teachers to be continuously in contact with a large community of practice and other resources that are essential support for innovating and improving pedagogies (Paniagua and Istance, 2018<sup>[6]</sup>; Révai, 2020<sup>[7]</sup>).

TALIS 2018 results indicate that lower secondary teachers are generally open towards change and willing to develop new ideas and solutions for teaching and learning and provide each other practical support for innovating teaching (OECD, 2020<sup>[8]</sup>; OECD, 2019<sup>[11]</sup>). Nonetheless, professional exchange stays commonly limited to discussing the learning of students, exchanging teaching materials and attending team conferences. Deeper forms of collaboration are rare (e.g. joint teaching, collaborative professional learning). Initiatives such as team teaching, research groups or peer learning through observations and feedback are, however, important for establishing a culture where teachers regular share their knowledge and grow together. Such initiatives build on a strong school leadership that goes beyond management and administration. This requires pedagogical leadership in schools, which includes the facilitation of a constant knowledge exchange and co-construction among teachers and schools through various means.

### ***Preparing teachers with a good start and ensuring a career-long updating of knowledge***

Education systems need to support teachers in acquiring and updating their pedagogical knowledge. Teachers also need support in developing and refining their ability to apply knowledge in various pedagogical situations and contexts. The content areas of general pedagogy and approaches identified as promising in this publication can serve as first reference points for a reflection on the learning opportunities offered in education systems. As detailed in Chapter 1, it is important that systems:

- ensure a sufficient coverage of topics across all important areas of general pedagogy in initial teacher education (ITE) and continuous professional learning (CPL) (see Chapter 2 for an overview on important knowledge areas)
- incorporate new findings and insights into effective teaching and learning evolving from research (OECD, 2019<sup>[5]</sup>; Boeskens, Nusche and Yurita, 2020<sup>[9]</sup>; Tatto and Menter, 2019<sup>[10]</sup>; Tatto et al., 2018<sup>[11]</sup>; OECD, 2019<sup>[11]</sup>)
- increase teachers' opportunities to experiment and probe knowledge in practice during initial teacher education (e.g. during teaching practicum, modelling of pedagogical approach, video- and computer-based learning)
- provide expert guidance and mentoring when novice teachers enter school to help them learn about the context-adequate use of knowledge (OECD, 2019<sup>[5]</sup>; OECD, 2020<sup>[2]</sup>)
- differentiate and tailor learning opportunities to the needs and varying knowledge and skills levels of participating teachers (Collinson et al., 2009<sup>[12]</sup>)
- offer digital courses, platforms and other digital resources of high quality as flexible and cost-efficient opportunities for learning about general pedagogy, which are available even during potential closures of schools and institutions offering ITE and CPL (Donitsa-Schmidt and Topaz, 2018<sup>[13]</sup>; Shin et al., 2009<sup>[14]</sup>)
- enhance (pre-service) teachers' reflective practice, systematic inquiry and their continuous engagement with research (e.g. promote knowledge and skills for identifying and interpreting



relevant research and data and adapting it to their own classroom contexts) (OECD, 2019<sup>[5]</sup>; Tatto and Menter, 2019<sup>[10]</sup>; Boeskens, Nusche and Yurita, 2020<sup>[9]</sup>)

- establish partnerships between research institutions and schools, translate and package knowledge in ways that are user-centred as well as promote “knowledge brokering” in schools (Wollscheid and Opheim, 2016<sup>[15]</sup>; Malin and Brown, 2019<sup>[16]</sup>; OECD, 2019<sup>[5]</sup>).
- ensure the professionalism of all those involved in educating teachers (e.g. higher education staff, supervisors of practice in schools linked to initial teacher education institutions and trained and experienced teachers supervising practice in other schools, professional development staff of private providers) (European Commission, 2013<sup>[17]</sup>)
- safeguard the pedagogical preparedness of teachers entering into the profession through “alternative” routes (e.g. second career fast-track training, Teach for All). This means, for example, the provision of high quality trained mentors as well as a strong practicum and continuous contact with schools that partner with the programme (Drake et al., 2018<sup>[18]</sup>; OECD, 2019<sup>[5]</sup>).

Certainly, a successful restructuring of teacher support requires a needs analysis, including a profiling of the strength and weaknesses of the knowledge base of the teaching profession prior to implementation as well as an evaluation of the effectiveness of measures post implementation.

### ***Basing career entry and progression on competences and knowledge***

The structures and processes in place need to ensure a solid pedagogical knowledge base among teachers entering the profession as well as a system of career progression that ensures a continuous updating of in-service teachers’ knowledge in the various areas relevant for 21st century teaching.

Existing licensing procedures must be up to date with the recent research on high quality teaching as well as the knowledge it requires and reflect the latest methodological standards (Ulferts, 2019<sup>[4]</sup>; OECD, 2013<sup>[19]</sup>). Qualification frameworks and standards need to emphasise that a strong pedagogical knowledge base is a key requirement for career entry and progression (Guerriero, 2017<sup>[20]</sup>; Révai, 2018<sup>[21]</sup>).

Optimally, education systems reward efforts of teachers to strengthen their knowledge, for example through salary advancements, promotions and non-financial rewards. Systems and schools can promote not only individual knowledge progression but also reward and promote the engagement of teachers in facilitating knowledge exchange and improving pedagogies. Schools could create, for instance, positions for “knowledge broker teacher” that are responsible for facilitating knowledge exchanges and updating the knowledge of colleagues (Jusinski, 2021<sup>[22]</sup>).

### ***Updating teacher knowledge for the 21st century***

Teachers are also more than ever expected to foster 21st century skills (e.g. critical thinking and collaboration) and to meet diverse needs and backgrounds in classrooms and to embrace diversity as an enriching element of school education (König et al., 2017<sup>[23]</sup>; Wasonga, 2005<sup>[24]</sup>; Valanidou and Jones, 2012<sup>[25]</sup>; Schleicher, 2014<sup>[26]</sup>). Diversity in the classroom and schools can be used to enable young people to see the world from different perspectives, engage with different ways of thinking and appreciate different cultures (OECD, 2020<sup>[27]</sup>). In doing so, teachers prepare their students for a globalised world and citizenship in diverse and open societies.

These educational missions require specialised knowledge and skills. TALIS results, however, indicate that the share of teachers who feel “well” or “very well” prepared for such 21st century teaching tasks (i.e. teaching cross-curricular skills, teaching in a mixed ability and multicultural setting) is the lowest while the need for professional development is the highest for these tasks. Thus, stronger investments into learning opportunities are needed that help teachers update their knowledge to 21st century teaching.

### ***...including digital and hybrid teaching***

Stronger investments into teachers' learning opportunities for digital and hybrid teaching are also needed. Results from the Programme for International Student Assessment (PISA) 2018 showed a consistent negative association between the intensity of students' technology use in classrooms and the digital reading skills of 15-year olds (OECD, 2021<sup>[28]</sup>). This means that the use of digital technology does not automatically translate into better learning outcomes. Of course, there are many potential reasons for this (OECD, 2021<sup>[29]</sup>), inter alia a use of technology lacking pedagogical purpose and depth.

Teachers have an important role in guiding and shaping students' use of such tools and optimising the educational benefits of their digital experiences. This requires specialised knowledge from teachers. As explained in Chapter 3, Technological Knowledge (TK; knowledge of how to work with and apply technologies) is not sufficient. Teachers need Technological Pedagogical Knowledge (TPK; knowledge for using technology effectively for teaching and learning. International evidence on this is missing but TALIS 2018 results showed, for example, that the majority of lower secondary teachers do not feel well prepared for the use ICT for teaching and the reported need for professional development in that area was among the highest (OECD, 2019<sup>[11]</sup>).

Technologies are constantly evolving, providing new educational opportunities through learning analytics as well as social robots and smart technologies powered by AI (artificial intelligence) (OECD, 2021<sup>[29]</sup>). Thus, systems need to adjust constantly offered learning opportunities to allow teachers to update their technology-related knowledge. For instance, to make efficient use of Teaching and Learning Analytics (TLA) teachers now need data literacy and data inquiry skills (Ndukwe and Daniel, 2020<sup>[30]</sup>). Apart from that, a broader technology planning in schools needs to guide teachers and schools in the integration of technology in teaching and learning (Vanderlinde and Braak, 2013<sup>[31]</sup>). Such planning needs to ensure, for example, the selection of digital tools that meets the intended pedagogical purposes and provide support activities and menus that help teachers differing in knowledge and skills to use them adequately.

### ***Acknowledging teachers as experts of learning and teaching***

Education systems today have high expectations of their teachers in terms of pedagogical knowledge and expertise. This publication has provided many good arguments for this. Such high expectations need to be rewarded with an adequate status, autonomy, salary and societal value to keep teaching an attractive job as many systems are challenged with teacher shortage and high attrition (OECD, 2019<sup>[11]</sup>; OECD, 2020<sup>[21]</sup>). Teachers also need a stronger acknowledgement as experts of teaching and learning.

Expert teachers should be involved in debates and consulted in decisions made about education policies, technology and research. A study by Joram and colleagues (2020<sup>[32]</sup>) found that a reason for teachers not to engage in research was that they felt as though they were mainly passive recipients of research, and that they – as experts of teaching and learning in practical contexts - themselves had little influence on the kind of questions addressed by research and proposed solutions. There was also a sense among teachers that research is drawn upon to make decisions (e.g. changes in curricula or initiatives) by administrators who do not involve teachers in this process.

In the area of technology, partnerships between schools and education technology (EdTech) companies are important building blocks for a successful digital transformation of education (Burns and Gottschalk, 2020<sup>[33]</sup>). This also means that EdTech companies should not only conduct usability studies, teachers also need to be involved in the design of education tools and software, to ensure tools serve pedagogical purposes and are adapted to teachers' and learners with different needs and levels of knowledge and skills (OECD, 2021<sup>[29]</sup>).



## Pushing forward the research agenda and broadening the understanding of teacher knowledge

To push further the research agenda on teacher knowledge, the following sections outline the broader implications for research emerging from discussed issues. The sections signal important gaps in the knowledge about teacher knowledge that future research needs to fill. Some of the gaps identified will be addressed by the next cycle of TALIS and the TKS assessment module; others require further international and national research, using a variety of designs and methods.

### ***Researching teacher knowledge and skill required for digital and hybrid education***

Technological knowledge is not sufficient to ensure an effective use of technology in teaching. Teachers need specialised pedagogical knowledge. This publication supported a view on teachers' general pedagogical knowledge with knowledge about the effective use of technology as an integral element (see Chapters 2 and 3). This contrasts with most research on this topic, which has often drawn on the Technological Pedagogical Content Knowledge (TPCK) framework described in Chapter 3 (Mishra and Koehler, 2006<sup>[34]</sup>). This research emerged – though with reference to Shulman (1986<sup>[35]</sup>) – as a line of research somewhat separate from the work on teachers' pedagogical knowledge (Ulferts, 2019<sup>[4]</sup>; Harris et al., 2017<sup>[36]</sup>). More recent work has investigated the relationship between general pedagogical knowledge and Technological Pedagogical Knowledge but still treated them as separate knowledge entities (Baier and Kunter, 2020<sup>[37]</sup>; Drummond and Sweeney, 2017<sup>[38]</sup>; Maderick et al., 2016<sup>[39]</sup>).

Within this publication, technology-related pedagogical knowledge is seen as a transversal domain of general pedagogical knowledge, since technologies can serve a wide range of pedagogical purposes, spanning tasks in all broad knowledge areas (i.e. assessment, instruction and learning). Technology can also be used to enhance inclusion and equity and to foster 21st century skills (OECD, 2021<sup>[29]</sup>). This and the discussions in chapter 2 and 3 provide some good arguments for treating technology-related knowledge as an integral part of teachers' general pedagogical knowledge instead of separate entities.

Apart from such conceptual refinements, more work is needed to understand the knowledge and skills teachers need for modern technology. While most research in this area still focuses on more traditional, digital tools, modern tools such as social robots, Teaching and Learning Analytics (TLA) and other smart technologies powered by AI technologies are entering classrooms and schools (Ndukwe and Daniel, 2020<sup>[30]</sup>; OECD, 2021<sup>[29]</sup>). In addition, researchers should investigate the knowledge and skills that help teachers successfully combine offline and online teaching and learning, thus create holistic hybrid and blended learning experiences. Generally more research is also required on the type of learning opportunities that bring the most value for teachers' Technological Pedagogical Knowledge and skills and the kind of support (e.g. help menus, defaults) that optimise the use of digital tools for education purposes of teachers of varying backgrounds and knowledge.

### ***Investigating diversity-related pedagogical knowledge of teachers***

Despite substantive variations in policies and practices to tackle diversities in schools among education systems, there is an overall trend towards a more inclusive, equitable education. Systems also increasingly aim at embracing diversity and unique experiences and backgrounds of students as an enriching element of school education. Thus far, however, it is unclear if teachers have sufficient knowledge and skills to fulfil these educational missions. Though in TALIS lower secondary teachers across OECD countries reported high needs for professional development for managing diversity in classrooms (e.g. teaching special needs students and teaching in multicultural or multilingual settings) (OECD, 2019<sup>[1]</sup>), there is no evidence showing that reported needs reflects an actual lack of diversity-related pedagogical knowledge among the teaching workforce. An international assessment of teachers' diversity-related knowledge promises, therefore, to fill important research gaps unanswered by the current TALIS measures.

Chapter 4 of this publication includes suggestions for measuring teachers' knowledge, beliefs and practices for managing diversity in classrooms using self-ratings in questionnaires. Given the low correlations between self-rated and assessed knowledge (Baier and Kunter, 2020<sup>[37]</sup>; Drummond and Sweeney, 2017<sup>[38]</sup>; Maderick et al., 2016<sup>[39]</sup>; König, Kaiser and Felbrich, 2012<sup>[40]</sup>), it seems necessary to assess diversity-related pedagogical knowledge additionally.

However, actual assessments of teachers' diversity-related pedagogical knowledge are still rare. Existing assessments also often focus on diversity-related pedagogical knowledge in certain areas or cover knowledge about specific student characteristics such as attention-deficit/hyperactivity disorder (ADHD) and external behaviour problems (see Chapter 2 for a discussion). However, managing diversity requires pedagogical knowledge across all knowledge areas (instruction, learning processes, as well as assessment). An important aspect insufficiently covered by existing instruments is teachers' knowledge about using technologies for improving inclusion and equity. Technologies provide unique opportunities for inclusive education (e.g. highly individualised learning and accurate learning analytics) but also come with risks (e.g. bias and discrimination reinforced through certain algorithms) (OECD, 2021<sup>[29]</sup>). In addition, more research is needed on teachers' knowledge for embracing diversity, including the development of assessments to measure the knowledge and skills that teachers need to use diversity in the classroom to enrich the education experiences of students.

### ***Studying how teachers apply their knowledge in classroom contexts***

Chapters 1 and 5 highlighted that teachers need to be not only owners of deep professional knowledge but also able to apply their knowledge in context. A major barrier for knowledge-based practice in schools is, however, the “theory-practice gap” (OECD, 2019<sup>[5]</sup>; Paniagua and Sánchez-Martí, 2018<sup>[41]</sup>): Teachers struggle to integrate the knowledge, theories and research learnt in training into the reality of classrooms. This is especially visible for novice teachers transitioning from teacher education to schools [the so-called “practice shock”; (OECD, 2020<sup>[2]</sup>; Paniagua and Sánchez-Martí, 2018<sup>[41]</sup>)]. However, even more experienced teachers struggle to act in accordance with their own beliefs and attitudes. Results from TALIS 2018, for instance, show that 80.3% of lower secondary teachers feel confident about using a variety of assessment strategies but the majority of teachers across OECD countries report relying on a few strategies in their practice (mainly using own assessments as well as observing students and providing immediate feedback) (OECD, 2019<sup>[1]</sup>).

There are various possible explanations for this, among them a lack of knowledge, in particular actionable knowledge (i.e. practice-based knowledge and the skills needed to apply knowledge in the context of specific classroom situations). The TKS assessment module will explore to which extent teachers from different education systems are able to apply their knowledge, addressing an important research gap. The module will use a contextualised assessment that uses text vignettes that confront teachers with a written description of typical classroom situations and different options for teaching (see Chapters 2 and 5). Further development into innovative approaches such as simulations is needed to make them viable for large-scale international studies in the future.

### ***Investigating the evolution of teacher knowledge and the effectiveness of learning opportunities***

Typical ways to alleviate the “theory-practice gap” include providing more opportunities to experiment and probe knowledge in practice during initial teacher education (e.g. teaching practicum, modelling of pedagogical approach, video-based learning) as well as practical guidance and mentoring when novice teachers enter school (OECD, 2019<sup>[5]</sup>; OECD, 2020<sup>[2]</sup>). International reviews and TALIS 2018 showed how the structure, content and quality of initial teacher education, induction and professional learning differ within and across countries and economies (OECD, 2019<sup>[5]</sup>; Boeskens, Nusche and Yurita, 2020<sup>[9]</sup>; Tatto and Menter, 2019<sup>[10]</sup>). As discussed in Chapter 6 and in the pilot TKS report (Sonmark et al., 2017<sup>[42]</sup>),

a more fine-grained international data with a stronger focus on the opportunities to learn general pedagogical knowledge is needed to better understand how this special knowledge can be developed and shaped over a teacher's professional career. This includes a more fine-grained measurement of the pedagogical content covered but also the type and quality of practical experiences and guidance offered to teachers, especially in the initial career phase. This is crucial for researching how type, duration and quality of initial teacher education (ITE) and continuous professional learning (CPL) relate to the acquisition and consolidation of a strong knowledge base among teachers.

As experts of teaching and learning teachers also need to shape increasingly their own professional learning and actively engage in an autonomous career-long updating of their knowledge. Thus, research should focus more on the non-formal and informal learning activities teachers involve in. TALIS explores professional exchange and collaboration as key pillars of teacher professionalism and includes certain informal activities (e.g. networking, reading professional literature) (OECD, 2019<sup>[1]</sup>; OECD, 2020<sup>[2]</sup>). This promising starting point for an exploration of non-formal and informal learning opportunities of teachers needs expanding in the future. Additionally, further research, using a variety of designs and methods, is needed for a more complete understanding of teaching as a knowledge profession. It would be worthwhile, for example, to have more in-depth insights into the role expertise plays in professional networks and collaborations and to explore how knowledge is exchanged and co-constructed in schools as well as in virtual environments (Révai, 2020<sup>[7]</sup>).

Additionally, the evolution of teacher knowledge requires further attention. A comparison of pedagogical knowledge among different teacher populations can also provide some insights into the evolution of teacher knowledge (e.g. comparing the knowledge of pre-service, novice and experienced teachers). Such a comparison has been made in the TKS pilot study. Longitudinal data would be of particular value for understanding how general pedagogical knowledge evolves over time. This has been done previously for German teachers in a follow-up study of TEDS-M (König et al., 2014<sup>[43]</sup>).

### ***Exploring the role of teacher knowledge for teaching quality and student outcomes***

A systematic review and meta-analysis showed that teachers' general pedagogical knowledge is linked to teaching quality as well as student outcomes (Ulferts, 2019<sup>[4]</sup>). The study found overall positive associations of teacher knowledge to more "traditional" indicators of teaching quality (e.g. cognitive activation, emotional support) and student outcomes, particularly in maths and science (e.g. achievement, self-regulation and interest). Yet, more research is required that explores the role of teachers' general pedagogical knowledge for implementing innovative pedagogies as well as digital and inclusive lessons. Research should also focus on a broader range of subject areas and more studies should look at the importance of teacher knowledge for fostering so-called "21st century learning outcomes" (e.g. critical thinking, metacognition). The review also points to a lack of empirical evidence on how teachers' general pedagogical knowledge interacts with other parts of the teacher's knowledge base (content knowledge, pedagogical content knowledge) and further competences such as beliefs, motivation and attitudes.

Drawing on established and new self-report measures in TALIS, the TKS assessment module will be able to address some of these gaps, for instance, how general pedagogical knowledge relates to the well-being, beliefs, motivation and attitudes as well as teaching practices of teachers across different national contexts. If the measures of self-reported feeling of preparedness and need for professional development are kept in the next cycle, it would also be interesting to compare the self-ratings to assessed knowledge to get a sense for how aware teachers are of the strengths and weaknesses of their knowledge base.

Although the TKS assessment module will fill important gaps in the knowledge base about teaching as a knowledge profession, further research should address remaining gaps. Studies that link teacher knowledge to observations and student ratings of teaching practices and artefacts (e.g. lesson plans) as well as student outcomes, for example, can counterbalance the common criticism of teacher self-reports of teaching practices used in TALIS. Some of this has been done in national add-on studies of the

international study Teacher Education and Development Study in Mathematics (TEDS-M) (Ulferts, 2019<sub>[41]</sub>). Some studies used longitudinal or experimental designs, allowing an investigation of the directions of relationships.

An international comparative study that links teacher knowledge to observed or student-rated instructional practice and student outcomes would be a completely new and promising undertaking. This allows studying the variations of associations across education systems, schools and student populations in the future (e.g. students varying in socio-economic and migration background, education systems varying in teacher policies). Such an undertaking can draw on existing experiences from international studies that linked data gathered from teachers to observations of teaching practices and student outcomes, such as the Global Teaching InSights (GTI) study (OECD, 2020<sub>[31]</sub>) and the TALIS-PISA link (OECD, 2021<sub>[44]</sub>).

### ***Researching teacher educators as gatekeepers of teachers' pedagogical knowledge***

Of particular value is research on those educating teachers, as planned for the original TKS stand-alone study in CERI (Sonmark et al., 2017<sub>[42]</sub>). Yet, researching the knowledge and professional competences of teacher educators requires additional efforts. First, they have received far less attention of the international research community, and, thus, there is less existing work to draw from (e.g. conceptual work, instruments and study designs). Second, the organisation of teacher education and support varies substantially between education systems, especially for the phases beyond initial teacher education. As teacher educators comprise all those who actively facilitate the (formal) learning of (pre-service) teachers, it includes a wide range of actors and providers (e.g. higher education staff, supervisors of practice in schools linked to initial teacher education institutions and trained and experienced teachers supervising practice in other schools, professional development staff of private providers) (European Commission, 2013<sub>[17]</sub>). Thirdly, studying competences, including general pedagogical knowledge, means measuring competences on two levels: first-order and second-order knowledge, skills and attitudes (European Commission, 2013<sub>[17]</sub>):

- *First-order competences* refer, for instance, to the knowledge base about schooling and teaching that teacher educators teach to the teachers in training.
- *Second-order competences* refer to the knowledge base of how teachers learn and grow in competence. The focus is on teachers as adult learners and the pedagogy associated with teaching teachers as well as the organisational knowledge about the workplaces of teachers.

Studies on teacher educators, especially large-scale international surveys, are scarce. TEDS-M (Tatto et al., 2018<sub>[11]</sub>), the pilot TKS (Sonmark et al., 2017<sub>[42]</sub>) and the International Forum for Teacher Educator Development (InFo-TED) survey (Czerniawski, Guberman and MacPhail, 2016<sub>[45]</sub>) exemplified how the background, needs and competences of teacher educators from higher education can be measured across countries and economies. The CERI TKS pilot additionally studied the general pedagogical knowledge of higher education teacher educators across countries, using the same assessment as for teachers. Future research should include the second-order knowledge base of teacher educators as well as other teacher educator populations, who have increased in importance over the last decades.

### ***Increasing motivation and reducing barriers to participation in research***

Lower secondary teachers (including full-time and part-time teachers) spend on average 38.8 hours per week on all the tasks related to their job across OECD countries (OECD, 2019<sub>[11]</sub>). Hence, the numbers of available hours for additional tasks, such as participating in research, are limited and stress levels are high. Almost half of all lower secondary teachers (48.7%) across the OECD reported that they experience stress in their work “a lot” or “quite a bit” (OECD, 2020<sub>[2]</sub>). At the same time, teachers are being asked to participate in a growing number of studies. Consequently, survey fatigue is a common phenomenon among teachers and a huge challenge for researchers: Among the potential consequences are problems to recruit a

sufficient number of teachers and thus to suffice sample size requirements, biased results and low power due to non-response and high drop out rates.

Key for maximising participation and response rates is a transparent communication that highlights that:

- Through participation teachers contribute to research, that informs policies and decision making.
- Results will be used to give teachers voice, in particular, on how to design teacher education programmes and schools that empower knowledge sharing and construction, and to optimise the support and working conditions of teachers, rather than to blame them.
- Participation is anonymous and the reporting will use aggregated (e.g. regional or country-level) results with no possibility to identify individual results.

Apart from a transparent communication, effective incentives need to be offered. More research is needed to determine which incentives are effective without leading to bias as done for the PISA assessments and the United States National Assessment of Educational Progress (NAEP) (OECD, 2019<sup>[46]</sup>). It is likely that the effectiveness varies across regions, countries and economies and probably also between different teacher populations. An open question is, for example, if instant feedback about the strength and weaknesses of the knowledge base at the end of the assessment completion has a positive effect on completion rates. A similar question relates to the type of information that should be provided with the results from an individual assessment (e.g. about the limitations of obtained results and useful online resources and courses on the topics identified as weaker areas).

Additionally, potential barriers to survey participation need to be minimised by reducing, for instance, survey length, increasing the flexibility of participation and avoiding boredom or the feeling of being overwhelmed among participating teachers. As explained in Chapter 1, the aim for the TKS assessment module is the design of a survey that provides meaningful information on key areas of teacher knowledge, while limiting the response time and burden for participating teachers. The online format will further allow for a flexible participation, e.g. allowing teachers to choose the time and take breaks. Similarly, drop out analysis and non-response analysis are planned to estimate potential bias.

Technological and methodological advances such as the multidimensional adaptive testing (MCAT) design in Chapter 7 help further optimise the efficiency of testing (i.e. covering a variety of knowledge topics in a limited amount of time) and the accuracy of obtained results. Such designs can also facilitate participants' motivation through selecting optimal difficulty levels and thus neither risk bore teachers with too easy items, nor overwhelm and discourage them with questions that are too difficult for them. Though not being considered for this cycle, the discussion of such cutting-edge technology may pave way for a modernised assessment in a future round of the of the TKS assessment module. More generally, the discussed design and methodologies can also inspire other studies to innovate their assessment approach.

## Concluding remark

Teaching is, in fact, the mother of all professions. It is the starting point for successful professionals, engaged citizens and influential leaders. Yet, the status of teaching as a profession has long been under scrutiny. Critics have commonly argued that teaching lacks a common body of knowledge that informs practice. This publication has collated many good arguments rebutting such criticism.

Teaching is indeed a complex task that can only be mastered by skilful and highly knowledgeable teachers. Creating effective learning environments and promoting a healthy, prosperous development of students requires a strong and highly specialised body of knowledge. It also requires teachers to update constantly their knowledge and skills as societies and technologies evolve, and new insights into effective teaching and learning emerge from research as well as practice. The COVID-19 pandemic has shown yet again how vital a strong and updated knowledge base is for tackling the enormous challenges of teaching,

especially in times of uncertainty that ask for autonomous decisions and flexible, adaptive solutions to unforeseen new challenges.

Together with its companion publication *Pedagogical Knowledge and the Changing Nature of the Teaching Profession* (Guerriero, 2017<sup>[20]</sup>), this publication makes a strong case for acknowledging teaching as a knowledge profession. Though a significant body of research exists, the overview presented in this publication has also revealed a great need to better understand the professional knowledge required for teaching and a great need in many education systems for effective means to strengthen the knowledge base among the teaching profession.

An international study on teacher knowledge, especially on general pedagogical knowledge, has a particular potential for providing new insights into the nature of teacher knowledge and its role and evolution in various education contexts. It can provide a powerful tool for facilitating peer learning and joint reflections among education systems, schools and practitioners around the world on how to improve the knowledge base of teachers and the learning experiences of students. With the optional Teacher Knowledge Survey (TKS) assessment module the next cycle of the OECD Teaching and Learning International Survey (TALIS) puts teacher knowledge, more particularly teachers' general pedagogical knowledge, in the centre of its evidence-based reflections on teacher professionalism across countries and economies.

Exploring teaching as a knowledge profession across education systems is, however, as challenging as it is important. To be successful, such a study has to provide internationally comparable evidence on the knowledge and learning opportunities needed for creating effective learning environments and fostering the well-being and socio-emotional development of all students. Sufficient attention should be paid to the most pressing challenges in today's classrooms, such as diversity and technology and a use of knowledge that considers the pedagogical context. We also owe it to the participating teachers to invest in designs and cutting-edge methodologies that deliver precise, efficient measures, reduce the response burden and make participation a motivating experience.

The TKS assessment module can build on the substantial work previously conducted in CERI, outlined in Chapters 1 and 2. This publication provided additional ideas to make this challenging endeavour a success. It has also outlined areas for further research that go beyond the scope of this module and for using research on teacher knowledge to improve teacher policy and practice. In the end, the success of any research endeavour is also determined by the contribution made to informed decision making and learning, in this case in terms of its impact on strengthening knowledge-based practice in schools. Tackling this issue requires enormous efforts from everyone: research, policy and practice. Given the importance of a strong knowledge base of teachers for the well-being and thriving of students and societies, the effort is worth it.

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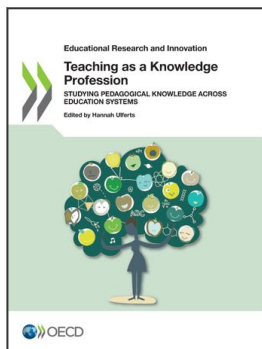
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