Cross-Nationally Comparative Results on Teachers' Qualification, Beliefs, and Practices

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Abstract A growing body of research compares educational processes and outcomes cross-nationally, but up to now there are only few studies on teachers and their expertise involving more than a handful of countries. Drawing on data from the OECD-Teaching and Learning International Survey the present chapter aims at filling this research gap. It compares different aspects of teacher quality – namely mathematics teachers' qualification, beliefs about the nature of teaching and learning and classroom teaching practices – across 23 countries. Results of descriptive and multivariate analyses show the three facets and their subscales to be distinct but interrelated across countries. At the same time significant differences in profiles are observed cross-nationally. The findings suggest both, global and country-specific effects on teacher quality.

Keywords Mathematics teachers · Teacher quality · Teacher beliefs · Conceptions of teaching · Teaching practices · International comparisons · Cross-cultural

Introduction

Comparative research in education has been following different paradigms. Qualitative approaches characterise educational regimes in two or more countries or regions juxtaposing local findings and subsequently drawing conclusions about similarities and country specifics (as an example, see Döbert, Klieme, & Sroka, 2004). In a second paradigm, direct empirical comparisons are made between select countries; for example, there are multiple studies comparing mathematics education in the USA and Japan (Becker, 1992; Stigler & Hiebert, 1999). A third approach – cross-national large scale surveys involving representative samples from larger numbers of countries – additionally facilitates analysis of cross-cultural generalizability and country level effects.

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The latter paradigm has become most influential in student assessment. In research on teacher expertise on the other hand, there are only few attempts to examine a larger sample of countries. Even though mathematics has been a prominent subject in international large scale surveys run both by the IEA (FIMS, SIMS, and TIMSS) and OECD (PISA), they do not provide rich data on mathematics teachers.[1] PISA does not survey teachers at all, and the IEA studies have focused on professional background variables such as a teacher's level of training, the amount and quality of teaching experience, and status as a professional worker.

More recently, the IEA has begun to cover cognitive and affective aspects of teacher expertise as well. TIMSS 2011 will incorporate scales measuring teacher motivation and self efficacy (Mullis, Martin, Ruddock, O'Sullivan, & Preuschoff, 2009, p. 108). In 2007–2009, the Teacher Education and Development Study (TEDS-M) examined knowledge and beliefs of future teachers from 20 countries. In parallel to these IEA initiatives, the OECD launched its Teaching and Learning International Survey (TALIS) in 2008 (see OECD, 2009 for the initial report) which covered – besides other aspects of school quality and teachers' work places – several scales related to teacher quality.

The present chapter builds on the TALIS data base[2] to study three aspects of teacher quality in cross-national comparison: mathematics teachers' qualification, their beliefs about the nature of teaching and learning, and profiles of classroom teaching practices in mathematics lessons. In addition to comparing means and profiles the chapter also examines the generalizability of relations between these three indicators. The next section will introduce the constructs used in our comparative study and relate them to the overarching concepts of teacher quality and teacher expertise.

Theoretical Background

Teacher Expertise and Teacher Quality in Mathematics

Within educational psychology, the constructs of expertise and professionalism, and knowledge and competence can hardly be discriminated when the quality of teachers

[1] IEA is the International Association for the Evaluation of Educational Achievement, which launched the First and the Second International Mathematics Study (FIMS 1964; SIMS 1977) as well as the Third International Mathematics and Science Study (TIMSS 1995) which later became the Trends in Mathematics and Science Study 1999, 2003, and 2007. The Programme for International Student Assessment (PISA) was launched by the Organisation for Economic Co-operation and Development (OECD).

[2] The authors of the present chapter have been affiliated with TALIS as research fellow and members of the international TALIS expert group, respectively. They authored the chapter on *Teacher Beliefs and Teaching Practices* in the initial report edited by OECD (Klieme & Vieluf, 2009). The authors would like to thank Michael Davidson and Ben Jensen (project leaders, OECD), Ralph Carstensen and Steffen Knoll (project managers at IEA-DPC, the international study contractor), as well as David Baker, Aletta Grisay and Jaap Scheerens (members of the TALIS Questionnaire Expert Group) for excellent collaboration.

and/or teaching is discussed. Those who tend to use the notion of *expertise* (like Bromme, 2008) understand teaching to depend on a combination of knowledge structures, including schemata for perception and action, skills, and routines that are developed through extended practice while moving from the status of a novice to the status of an expert. When Bromme (2008; see also Bromme, 1997) equates teacher expertise with teachers' professional knowledge and skills related to teaching and learning in school, however, he refers to the seminal work on *professional teacher knowledge* done by Shulman (e.g., Shulman, 1987). In this tradition, three forms of professional knowledge are frequently discussed: (1) content knowledge, (2) pedagogical content knowledge, and (3) pedagogical knowledge (e.g., Borko & Putnam, 1996; Helmke, 2003; Lipowsky, 2006). There is evidence that pedagogical content knowledge – that is knowing how a specific content area is taught and learned – is most important in predicting the quality of teaching and learning processes, and finally the outcomes of student learning. Ball and Hill (2008) as well as Baumert et al. (2009) developed tests of pedagogical content knowledge in the area of elementary and secondary-level mathematics respectively, and were able to predict student achievement growth from teachers' test scores. However, neither Shulman nor other authors have drawn a clear distinction between knowledge and beliefs. (See section *Teachers' Beliefs About Teaching and Learning* below for a discussion of these notions). Therefore, Baumert and Kunter (2006) came up with a rather comprehensive definition of *professional teacher competence* as the interplay of the three knowledge dimensions with teachers' beliefs, motivation, and self-regulation competencies.

In their recent overview of *teacher quality* in mathematics, Ball and Hill (2008) take an even broader perspective when discussing different approaches to measuring the quality of teachers. They set out defining high-quality teachers as those who "consistently and effectively foster students' learning" (p. 95). However, they do not establish student achievement growth as *the* measure of teacher quality, as econometricians have done (e.g., Hanushek, 2002). Student achievement can hardy be accounted to one teacher. Moreover, the effectiveness approach lacks the pedagogical substance needed to guide teacher education. Therefore, Ball and Hill worry about the "many problems with using direct measures of student learning to gauge teacher quality" (2008, p. 95).

Ball and Hill also discuss teacher qualification – that is teacher education, certification, and experience – as another approach for measuring teacher quality. Advanced academic degrees, a major in the subject being taught, and professional experience have been described as desired qualifications or as indicators of teacher quality. However, results regarding their association with student achievement are inconsistent (for a summary of research see Zuzovsky, 2009; for teacher certification see Libman, 2009). For the case of mathematics, Ball and Hill (2008, p. 85) conclude: "Overall, course taking and certification are relatively imprecise discriminators of teacher quality". This is also in line with results from economics of education (Hanushek & Rivkin, 2007) and from international studies (Mullis & Martin, 2007). Nevertheless, the professional background may have an impact on teacher competence (as defined above) and teaching practices and thus a more indirect effect on student learning.

Instead of effectiveness and qualification measures, Ball and Hill prefer direct measures of instructional practice, identifying "teachers who provide students with error-free, substantial mathematics and who can manage with mathematical adeptness the range of students' mathematical productions. There may also be other dimensions of instructional quality, such as the cognitive challenge of students' classroom work or the pedagogical aspects of classroom practice, that we would want to include" (2008, p. 95).

To sum up, empirical research on teacher quality has been discussing a number of different, though related constructs. Expertise is just one out of many notions used in this context. No single study like the TALIS, which the present chapter is based on, can cover all relevant aspects. Rather, following the broader view expressed by Ball and Hill (2008), teacher qualification, teacher beliefs about the nature of teaching and learning (chosen as a core element of professional competence), and instructional practices are covered here. The TALIS framework for *Teacher beliefs and teaching practices* (Klieme & Vieluf, 2009) assumed (1) teacher qualification, including teacher education and professional development, to impact (2) teacher beliefs about the nature of teaching and learning, which in turn would have an influence on (3) classroom teaching practices. This line of argument will be taken up in the present chapter. Although the present study may well be considered a study on teacher expertise, the more neutral term *teacher quality* will be used. Also, it should be noted that TALIS was a domain-general survey, sampling teachers from all kinds of subject areas, which did not allow subject-specific knowledge or beliefs to be addressed. However, the present chapter exclusively studies the TALIS sub-sample of mathematics teachers.

Teachers' Beliefs About the Nature of Teaching and Learning

Teachers' beliefs can be defined as "psychologically held understanding, premises, or propositions about the world that are felt to be true" (Richardson, 2003, p. 2). Within mathematics education, there has been a long history of research into teachers' as well as students' beliefs (Leder, Pehkonen, & Törner, 2002). In his overview of the state-of-the-art, Pehkonen (2004, p. 2) sees beliefs "situated in the 'twilight zone' between the cognitive and the affective domain". Mathematics educators have focused on beliefs about the nature of mathematics (e.g., Grigutsch, Raatz, & Törner, 1998; Hannula, Kaasila, Laine, & Pehkonen, 2005; Törner & Grigutsch, 1994), but Pehkonen (2004) also mentions beliefs on mathematics learning and teaching, self-related beliefs (such as self efficacy), and beliefs about the social context of mathematics education.

Following the seminal work by Peterson, Fennema, Carpenter, and Loef (1989; see also Fennema, Carpenter, & Loef, 1990), a reception/direct transmission view on teaching and learning is often contrasted with a constructivist view. Although these views were originally introduced as *pedagogical content beliefs* in the area of mathematics, they may be applied to teaching and learning in general.

- As a traditional strand of professional beliefs, the direct transmission approach – according to Staub and Stern (2002) – is rooted in behaviorism, which proposes a teacher directed approach to learning and instruction. Teachers should explicitly communicate concrete knowledge and exemplary approaches to specific assignments in a clear and structured way. Also, attentiveness and discipline in the classroom are considered to be highly important. Teachers who support this approach tend to view their students as recipients of knowledge that is passed on to them from their teachers.
- Constructivist beliefs assign students a more active role in the process of acquiring knowledge. Constructivism – which many scholars regard as the more modern, reform oriented kind of pedagogy – assumes that learning is embedded in its settings and conditions, and that learners actively construct their knowledge based on previous experiences. Many different instructional approaches are based on constructivist theories. Central to these approaches is that teachers are not seen as transmitters of information, but rather as facilitators of students' self-regulated learning processes. Thus, teachers holding this view emphasize facilitating student inquiry, prefer to give students the chance to develop solutions to problems on their own, and allow students to play an active role in instructional activities (Staub & Stern, 2002).

As exemplified by Kirschner, Sweller, and Clark's (2006) critique of constructivist (*minimal guidance*) instruction and the scholarly debate it triggered (Tobias & Duffy, 2009), the discussion about success and failure of constructivist vs. direct instruction is still unsettled from a researchers' perspective (see section *Classroom Teaching Practices* on this issue). In the present context, however, it is important to note that *constructivist* vs. *direct transmission teacher beliefs* still represent two distinct ways of professional thinking which are quite popular among teachers, and which in the case of mathematics may even be predictive of their students' achievement trajectories (Staub & Stern, 2002). Therefore, TALIS attempted to study these beliefs in an international comparison.

Classroom Teaching Practices

Classroom teaching practices have been shown to be related to effective classroom learning and student outcomes (Brophy, 2000; Brophy & Good, 1986; Seidel & Shavelson, 2007; Wang, Haertel, & Walberg, 1993). Existing evidence suggests there is no single best way of optimizing instruction. Well-structured lessons with close monitoring, adequate pacing and classroom management, clarity of presentation, informative and encouraging feedback – which are known as key aspects of *direct instruction* – bear a positive impact on student achievement. However, researchers inspired by reform pedagogy and humanistic psychology, e.g., Deci and Ryan (1985), argue that student motivation and non-cognitive outcomes require additional facets of quality, such as a classroom climate and teacher-student relations which support autonomy, competence and social relatedness. Finally, in order to foster *cognitive activity* (Mayer, 2004) – rather than *activity per se* – and conceptual understanding, instruction has to use *deep*, challenging content (Brown, 1994), which in the case of mathematics means making connections between mathematical facts, procedures, ideas, and representations (Hiebert & Grouws, 2007); argumentation and non-routine problem solving should be promoted. Thus, teachers have to orchestrate learning activities in a way that serves the needs of their specific class.

Klieme, Pauli, and Reusser (2009) condensed this knowledge into a framework of three *basic dimensions of instructional quality*: (a) clear, well-structured classroom management, (b) supportive, student-oriented classroom climate, and (c) cognitive activation with challenging content. Empirical support for the separation of these dimensions and their impact on student learning comes from the German extension to the TIMSS 1995 video study (Klieme, Schümer, & Knoll, 2001), from a German large scale study on mathematics teachers (Baumert et al., 2009), from a Swiss-German video study in math instruction (Lipowsky et al., 2009), but also from international work in educational effectiveness (e.g., Creemers & Kyriakides, 2008). By incorporating both (socio-)constructivist thinking and classical process-product-research, the framework may help to build a bridge between constructivism and direct instruction (Tobias & Duffy, 2009). Lipowsky et al. (2009) consider the basic dimensions as *latent* factors which are related to, but not identical with specific instructional practices.

We assume classroom practice to be influenced by teachers' beliefs. Generally teachers with direct transmission beliefs are expected to focus more on structure and discipline and to use more lecturing, while on the other hand we anticipate a correlation between constructivist beliefs and more student-centred practices as well as a focus on self-regulated learning, collaboration, problem-solving and cognitive challenge. However, the results of studies examining these relationships are inconsistent. While some studies showed beliefs to be related with classroom teaching practices in Western countries (e.g., Dubberke, Kunter, McElvany, Brunner, & Baumert, 2008; Peterson et al., 1989; Staub & Stern, 2002), but also in Asia (Kember & Kwan, 2000), other authors find no such link (e.g., Wilcox-Herzog, 2002). The inconsistency of findings may be partly due to differences in the operationalization of the constructs.

Cross-Cultural Comparison of Teacher Beliefs About the Nature of Teaching and Learning and Classroom Teaching Practices

Cross-cultural studies examining teachers' knowledge and beliefs mainly focus on comparisons of the USA with East Asia and examine two or three countries only (e.g., An, Kulm, & Wu, 2004; An, Kulm, Wu, Ma, & Wang, 2006; Cai, 2006; Correa, Perry, Sims, Miller, & Fang, 2008; Ma, 1999; Zhou, Peverly, & Xin, 2006). These studies highlight specific differences between countries, but they do not inform about differences and similarities of beliefs on an overarching level. Some research comparing teachers or future teachers from a larger variety of countries comes from IEA studies such as TIMSS and MT21. The results are mixed: Incremental vs. entity beliefs about student abilities, epistemological beliefs about mathematics, and instructional goals sometimes are shared and sometimes vary between countries (see LeTendre, Baker, Akiba, Goesling, & Wiseman, 2001; Mullis et al., 2008; Schmidt et al., 2007).

With regard to teaching practices in mathematics, SIMS already identified a surprising level of similarity among systems. Teachers were using whole-class instructional techniques, relying heavily on prescribed textbooks, and rarely giving differentiated instruction or assignments (Burstein, 1992). Later, TIMSS – including the 1995 and 1999 video studies – found global patterns regarding the general repertoire of practices. Thus, a high degree of convergence was found across countries when the presence of certain features of lessons was examined (LeTendre et al., 2001; Mullis & Martin, 2007). However, analysing the sequencing of lessons, Stigler and Hiebert (1999) identified scripts that seemed to be country specific. For example, teachers across most (industrialized) countries employ whole class work, seat work and lecturing, but the sequence of these practices and the frequency of shifts between them significantly vary (Givvin, Hiebert, Jacobs, Hollingsworth, & Gallimore, 2005). When the TIMSS 1995 video study was published, many – including Stigler and Hiebert – believed the instructional script found in Japanese classrooms to be the cause for high level mathematics achievement in Japan. Later, the 1999 TIMSS video study, which included another five high achieving countries (i.e. Hong Kong, the Czech Republic, the Netherlands, Switzerland, and Australia), revealed that those countries had quite different profiles in teaching practices, thus devaluating any attempt at directly linking student achievement to teaching practices on a national level (Hiebert et al., 2003). Some early conclusions drawn from the TIMSS video studies may be flawed due to ecological fallacy.

Aims and Hypotheses

As the previous sections have shown, cross-cultural research is still left with open questions about cross-national differences and similarities of teacher quality. The present chapter will shed light on this question by examining three indicators of teacher quality across a large sample of 23 countries. More specifically, it aims to answer the following research questions: (1) How similar or different are countries with regards to the quality of their teacher population, considering (a) the composition of their mathematics teacher force in terms of their professional qualification and experience, (b) profiles of beliefs about the nature of teaching and learning, and (c) profiles of classroom teaching practices? (2) Are these three aspects of teacher quality related, and are the relations similar across countries?

Based on previous research, especially the TIMSS study, we expect to find characteristic differences between countries regarding the qualification of teachers (Mullis et al., 2008). We further expect both, *direct transmission* and *constructivist* ideas, to be present across countries. However, influences of national cultures and policies suggest differences in the magnitude and pattern of endorsement of the two views. Regarding classroom teaching practices, comparative research, especially the TIMSS video studies, has proven that mathematics teachers possess a similar repertoire, and that more traditional activities dominate in almost all countries (Hiebert et al., 2003). Thus, *structureing* practices would likely be more frequent than *student orientation* and *enhanced activities* in every country. However, according to previous research in comparative education (including TIMSS, PIRLS and PISA), countries have quite different profiles in terms of alternative or enhanced teaching practices, which we also expect for the present study.

Based on theoretical considerations and previous research (e.g., Dubberke et al., 2008; Peterson et al., 1989; Staub & Stern, 2002) we further expect to find direct transmission beliefs to be related to structuring and constructivist beliefs to correlate with student orientation and enhanced activities.

Method

The research questions described are examined with data from the Teaching and Learning International Survey (TALIS). TALIS uses a teacher and a principal questionnaire to gather information on teachers' beliefs, attitudes and practices and their conditions. The data collection for the first cycle took place in fall 2007 in the Southern Hemisphere and in spring 2008 in the Northern Hemisphere. The target population is all teachers who, as part of their regular duties, provide instruction in programs at the lower secondary level (ISCED level 2[3]) in one of the 23 participating countries. A two-stage stratified sample design was used. Firstly a representative sample of schools providing lower secondary education was drawn, and secondly a representative sample of teachers within these schools was selected. Therefore the data has a multilevel structure with teachers nested within schools (for more information see OECD, 2009, 2010).

Sample and Description of Population Characteristics

The analyses for this chapter are based on a subsample of the TALIS participants who were randomly selected to represent the ISCED level 2 teaching force in the 23 participating countries. Within the questionnaire, teachers were asked to identify the first ISCED level 2 class they typically teach after 11 a.m. on Tuesdays. Those teachers who reported to teach a mathematics class at this specific slot in the timetable will be labelled mathematics teachers in the following. Altogether 73,100

[3]For a detailed description of ISCED levels see United Nations Educational, Scientific and Cultural Organization (2006).

teachers completed the TALIS questionnaire in 2008 and 2009. The sizes of the samples drawn vary by country, with Malta having the smallest teacher sample (1,143 teachers), and Brazil the largest (5,843 teachers; for a more detailed description of sampling procedures see OECD, 2010). The subsample used for this article consists of 9,259 mathematics teachers, which equals 13% of the total sample and 10–19% of each of the total country samples. Between 132 mathematics teachers in Malta and 957 mathematics teachers in Brazil are included.

Altogether 62% of the mathematics teachers are female and 38% male. Also within 19 of the 23 participating countries the percentage of female mathematics teachers is higher than that of male mathematics teachers.[4] A majority of the mathematics teachers is between 30 and 50 years old, both in the total sample (58%) and in most of the country-subsamples (44–77%). Only 18% of the mathematics teachers are 30 years or younger, and 24% are 50 years or older.[5]

Measures

Individual background characteristics – gender, experience, level of education, participation in professional development – are measured with single items. To collect data on mathematics teachers' beliefs, attitudes and practices items were summarized to form scales.

Confirmatory factor analysis (CFA) was used to confirm the expected dimensional structure of the scales. In accordance with scientific conventions (Hu & Bentler, 1999; Schermelleh-Engel & Moosbrugger, 2002), the following values for fit indexes were seen as indicative of an acceptable model fit: CFI > 0.90, RMSEA < 0.08 and SRMR < 0.08. In addition to the general model fit across and within each of the countries, the cross-cultural invariance of the factor loadings, intercepts and residual variances was tested using multiple group confirmatory factor analysis (MGCFA) and different restrictions on the parameters. Such analysis of cross-cultural equivalence informs about the generalizability of constructs (Van de Vijver & Poortinga, 1982), but it can also be interpreted as a multi-method approach to construct validation (Marsh, Martin, & Hau, 2006). The analysis was carried out with the software Mplus, version 5.1 (Muthén & Muthén, 1997–2008). Additionally the internal consistence (Cronbach's Alpha) of the scales was also examined, both across countries and for each country separately. (For detailed results see OECD, 2010).

For the assessment of mathematics teachers' beliefs about the nature of teaching and learning TALIS draws on scales developed by Fennema et al. (1990) and adapted by Staub and Stern (2002). The original questionnaires are designed to measure mathematics teachers' agreement with a cognitive

[4]The five countries with a larger percentage of male mathematics teachers are Australia, Denmark, Mexico, Norway, and Turkey.

[5]Noticeable exceptions are Italy where 60% of the teachers are 50 years or older, and Turkey where 56% are 30 years or younger.

constructivist perspective vs. a direct transmission orientation as two poles of one dimension. Many items are worded in a mathematics specific way, for example referring to word arithmetic. Because TALIS examines teachers teaching different subjects the items were revised to measure domain general beliefs. Moreover the scales were shortened to fit in the time frame of the TALIS study. With the eight items used in TALIS two scales were built: direct transmission beliefs and constructivist beliefs. They were assessed on a four-point Likert scale, ranging from 1 = *strongly disagree* to 4 = *strongly agree*. The two indices for teachers' beliefs about the nature of teaching and learning comprise the items shown in Table 1.

The fit of a confirmatory factor analysis (CFA) model is good for the total sample: CFI = 0.94, TLI = 0.91, RMSEA = 0.04 and SRMR = 0.03. Reliabilities for the two scales measuring mathematics teachers' beliefs about the nature of teaching and learning tended to be rather poor ($\alpha = 0.47$ for direct transmission beliefs and $\alpha = 0.61$ for constructivist beliefs for the total sample). Furthermore, the scales are not fully invariant across countries; the general structure and the factor loadings are relatively similar, but intercepts and residual variances differ noticeably between countries.

Classroom teaching practices were examined by teachers' frequency estimations on a 5-point scale, ranging from *never or hardly ever* to *in almost every lesson*. Based on the triarchic model by Klieme, Lipowsky, Rakoczy, and Ratzka (2006) three indices were established: structuring, student-orientation and enhanced activities. The items measuring classroom teaching practices are detailed in Table 2.

The model fit for the whole model including all three scales is acceptable for the total sample (CFI = 0.90, TLI = 0.87, RMSEA = 0.06, and SRMR = 0.04). Reliabilities for the three scales measuring classroom teaching practices are mostly satisfactory, both for the whole sample ($\alpha = 0.73$ for structuring, $\alpha = 0.70$ for student orientation and $\alpha = 0.72$ for enhanced activities) and for single countries. Across countries, the three scales measuring classroom teaching practice have a similar structure and also relatively similar factor loadings, but they are also not completely cross-culturally invariant.

Table 1 Items wording for beliefs about the nature of teaching and learning

Direct transmission beliefs	Constructivist beliefs
Effective/good teachers demonstrate the correct way to solve a problem.	My role as a teacher is to facilitate students' own inquiry.
Instruction should be built around problems with clear, correct answers, and around ideas that most students can grasp quickly.	Students learn best by finding solutions to problems on their own.
How much students learn depends on how much background knowledge they have; that is why teaching facts is so necessary.	Students should be allowed to think of solutions to practical problems themselves before the teacher shows them how they are solved.
A quiet classroom is generally needed for effective learning.	Thinking and reasoning processes are more important than specific curriculum content.

Table 2 Item wording for classroom teaching practices

Structuring	Student orientation	Enhanced activities
I explicitly state learning goals.	Students work in small groups to come up with a joint solution to a problem or task.	Students work on projects that require at least 1 week to complete.
I review with the students the homework they have prepared.	I give different work to the students that have difficulties learning and/or to those who can advance faster.	Students make a product that will be used by someone else.
At the beginning of the lesson I present a short summary of the previous lesson.	I ask my students to suggest or to help plan classroom activities or topics.	I ask my students to write an essay in which they are expected to explain their thinking or reasoning at some length.
I check my students' exercise books.	Students work in groups based upon their abilities.	Students hold a debate and argue for a particular point of view which may not be their own.
I check, by asking questions, whether or not the subject matter has been understood.		

Model fit and reliability are unsatisfactory in some cases, especially for teacher beliefs about the nature of teaching and learning. However, scales have been shown to work well for the total sample in most countries (OECD, 2010). Therefore, we believe that we can trust in the psychometric quality of these scales – as long as we restrict ourselves to correlation and regression models, without comparing country means when scales are not equivalent across countries.

Statistical Modelling

The TALIS data have a hierarchical structure with teachers nested within schools. Since the school samples of mathematics teachers are very small, no multilevel analyses are carried out, but standard errors are corrected for possible cluster effects. For all analyses Mplus factor scores were used as indicators for latent constructs (for details regarding their computation also see OECD, 2010). Descriptive analyses and correlations are computed with population weights and Balanced Repeated Replicates (BRR) methodology with Fay's adjustment for variance estimation. The Software WesVar was used for the former and a special SPSS macro developed for TALIS for the latter kind of analysis (for a more detailed description see OECD, 2010). To deal with missing data listwise deletion was used for all analyses.

To examine associations between the different indicators of teacher quality multiple group regression analysis with the program Mplus was used. Two models were analysed respectively, one in which all beta weights are allowed to vary and one in which all beta weights are fixed to be equal across countries. Fit indexes are used to judge the cross-national invariance of regression coefficients. Comparing the two models ΔCFI > –0.01, ΔRMSEA > 0.01 and ΔSRMR > 0.01 are seen as indicative of differences between countries (Chen, 2007; Cheung & Rensvold, 2002).

Standardized net effects (beta weights) are reported for the model with equal regression weights and controlling for teacher's gender, years of experience as a teacher, and level of education (a Master's degree or higher versus a lower level of qualification). For standardization the standard deviations of the predicted variable and those of continuous predictor variables are used. An effect is considered statistically significant if the p-value is below 0.05.

Results

Teacher Qualification

Across all countries, one third of the mathematics teachers report more than 20 years of professional experience, while 39% have been working in their job less than 10 years. Between 10 and 20 years of work experience are reported by 28% of the mathematics teachers. Country differences are significant (Chi-Square = 1,095.87; $df = 132$; $p < 0.01$). A comparatively large proportion of mathematics teachers with more than 20 years of professional experience can be found in Austria, Italy, and in the Eastern European countries (except Poland). Turkey, Malaysia, and Malta, on the other hand, have comparatively less experienced teaching staff in mathematics. Here more than 50% report less than 10 years of professional experience. All of the other countries lie in between these extremes.

In most of the TALIS countries the initial training of mathematics teachers takes place in colleges and universities and at least a Bachelor's degree is required for employment. Accordingly about 90% of the mathematics teachers across countries report at least this level of educational attainment. Three exceptions are Austria, Belgium and Slovenia, where more than 50% of mathematics teachers report to have completed ISCED level 5B only. Continuing education until a Master's degree is common in Italy, Spain, the Eastern European countries (except Hungary) and, to a lesser extent, Korea and Austria. In all of the other countries less than a third of the mathematics teachers report this level of attainment. Finally a PhD is generally very rare (1%). Differences between countries are significant (Chi-Square = 33563.46; $df = 88$; $p < 0.01$).

The vast majority of mathematics teachers – 89% across countries – have taken mathematics as a field of study during their academic training. Significant differences between countries are found (Chi-Square = 1205.45; $df = 22$; $p < 0.01$). All European countries except Italy (86%) score at or above the average, while Australia (86%), Brazil (84%), Iceland (73%), and Malaysia (85%) score below.

Professional development in TALIS refers to all "activities that develop an individual's skills, knowledge, expertise and other characteristics as a teacher" (OECD, 2009). Therewith TALIS adopts a broad definition, including both, traditional workshops and courses and more modern practices, that is observation visits to other schools, participation in networks for professional development, individual or collaborative research on a topic of professional interest, education conferences or seminars, mentoring and/or peer observation, and coaching as part of a formal school arrangement. Finally, extra occupational qualification programs (e.g., a degree program) are included as well.

Across countries, most of the mathematics teachers report they regularly participate in at least one of these professional development activities. On average teachers report to have spent 19 work days on professional development during the preceding 18 months. However large variation is found regarding the total number of days for the total sample ($SD = 32$) and for all country subsamples ($SD = 6$ to $SD = 67$). Moreover, the average reported days of attendance also vary between countries ($R^2 = 0.09$; $F = 46.92$; $df = 20$, $p < 0.01$). Belgium Fl., Ireland, and Malta have the lowest means (6 days). Mexico has the most active teachers with regards to their professional development (36 days on average) followed by Bulgaria, Poland, Italy, and Spain (more than 20 days on average). The high mean scores can partly be explained by the fact that many of the mathematics teachers in the countries concerned report to attend qualification programs (Mexico, Bulgaria, Poland) and/or individual and collaborative research activities (Mexico, Italy, Poland, Spain), which are significantly more time consuming.

Across all countries workshops and courses are the most common forms of professional development. In most countries, at least three out of four teachers have participated in this kind of professional education, with the Slovak Republic and Turkey as exceptions. Modern forms of professional development which involve more cooperation and reflection are also present across all countries, but less common. For all programs significant differences between countries are found ($p < 0.01$; $df = 22$, and Chi-Square = 409.30, Chi-Square = 365.90, Chi-Square = 656.57, Chi-Square = 515.93, and Chi-Square = 463.12 for each of the variables respectively). A comparatively large percentage (> 60 %) of teachers (a) participates in networks for professional development in Iceland, Slovenia, and Poland, (b) observes other teachers' instruction in Estonia, Korea, and Iceland, (c) participates in mentoring arrangements in Korea, Poland, and the Slovak Republic, and (d) reports research visits in Mexico, respectively. Thus in summary, the highest percentages of teachers involved in these more modern activities are found in Iceland, Korea, and Poland.

Teachers' Beliefs About the Nature of Teaching and Learning

Teachers' beliefs about the nature of teaching and learning form two scales across all participating countries, which are sufficiently invariant to compare correlations across countries (see OECD, 2010 for an in-depth discussion on scale invariance). These scales capture constructivist beliefs and direct transmission beliefs, as expected. Thus, the two aspects can be identified within all countries. However, multiple group confirmatory factor analysis (MGCFA) shows the item intercepts to vary significantly, which questions the validity of mean score comparisons (see section Measures). Therefore, in the following mean score comparisons are reported for single items only.

Figures 1, 2, 3 and 4 show that mathematics teachers' agreement with all items measuring teachers' beliefs about the nature of teaching and learning is generally high: In a majority of countries the mean scores for all items are higher than the theoretical average of the response scale (> 2.50). The items measuring direct transmission beliefs receive slightly less support than those measuring constructivist beliefs, but the differences are small. However, not all teachers agree with the items to a similar extent. The standard deviations equal between 0.60 and 0.80 respectively.

Table 3 shows the variance within countries to be considerably larger than the variance between countries: Country indicators (so called dummy variables) explain 2% to 19% of the total variance in each of the items measuring teachers' beliefs about the nature of teaching and learning. But even though the differences between countries are small as compared to within country differences, they are still significant for all of the items. The largest cross-country-differences can be found for the importance of a quiet classroom for efficient instruction. Teachers in Mexico, Iceland, the Slovak Republic, and Ireland have a low mean score for this item, while teachers in Austria, Bulgaria, Portugal, Brazil, Turkey, and Italy put more emphasis on quietness in the classroom. Comparatively small country effects are found for the statement that teachers' main role is to *facilitate students' own inquiry*, and that *thinking and reasoning processes are more important than specific curriculum content*.

Response patterns further seem to be related to geographical regions. Based on the profiles four groups were built: Group A consists of the Northern European

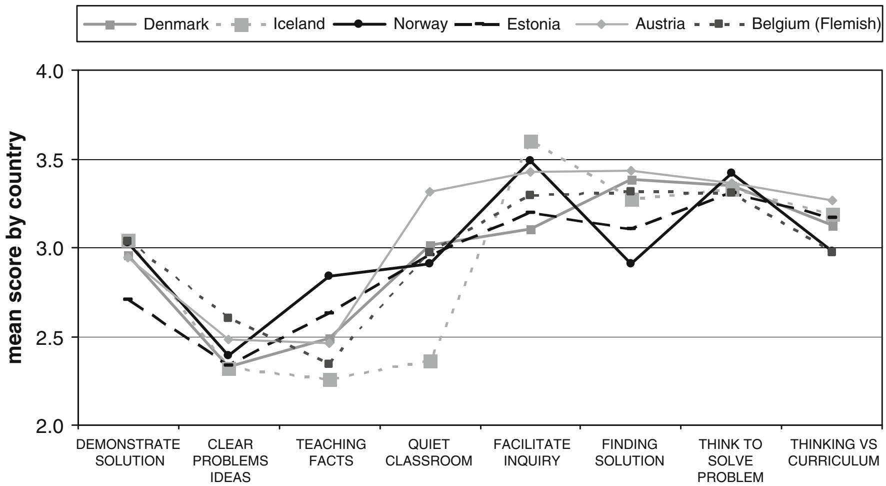

Fig. 1 Mean scores for all items measuring teachers' beliefs about the nature of teaching and learning by country (only Northern and Central European countries)

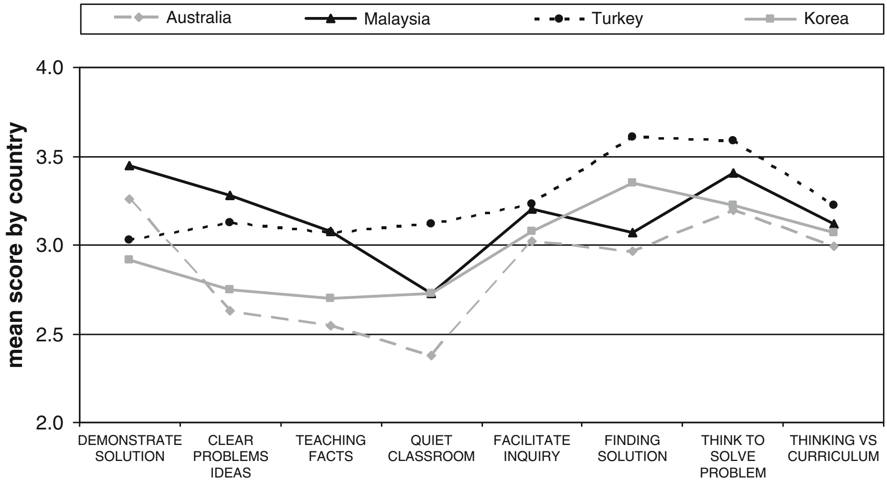

Fig. 2 Mean scores for all items measuring teachers' beliefs about the nature of teaching and learning by country (only Asian countries and Australia)

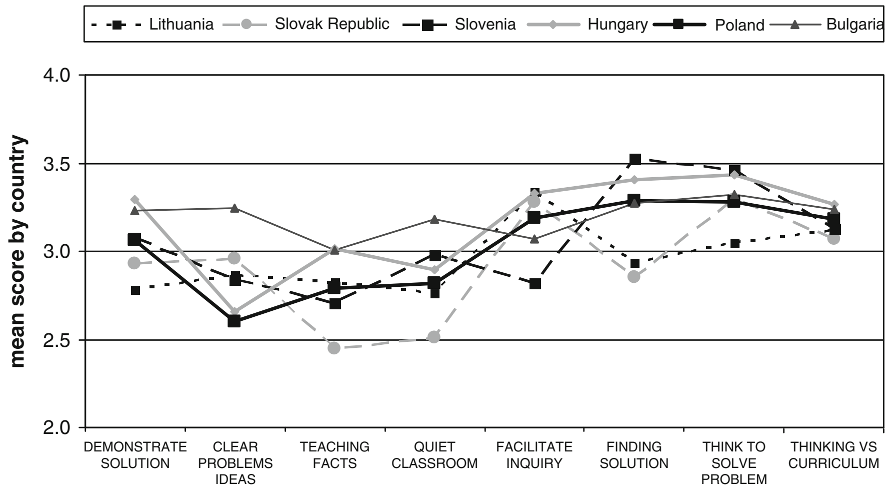

Fig. 3 Mean scores for all items measuring teachers' beliefs about the nature of teaching and learning by country (only Eastern European countries)

countries, but also Estonia, Austria and the Flemish Part of Belgium. Asian countries and Australia form group B, and the former communist European countries (except for Estonia) group C. Group D unites all Southern European and South American countries plus Ireland. In group A teachers agree with items measuring constructivist beliefs more strongly than with those measuring direct transmission beliefs (Fig. 1). This tendency is also apparent, but less clear in group B, except for Malaysia (Fig. 2). By contrast the average agreement with all items is relatively similar in group C (Fig. 3) and especially in group D (Fig. 4).

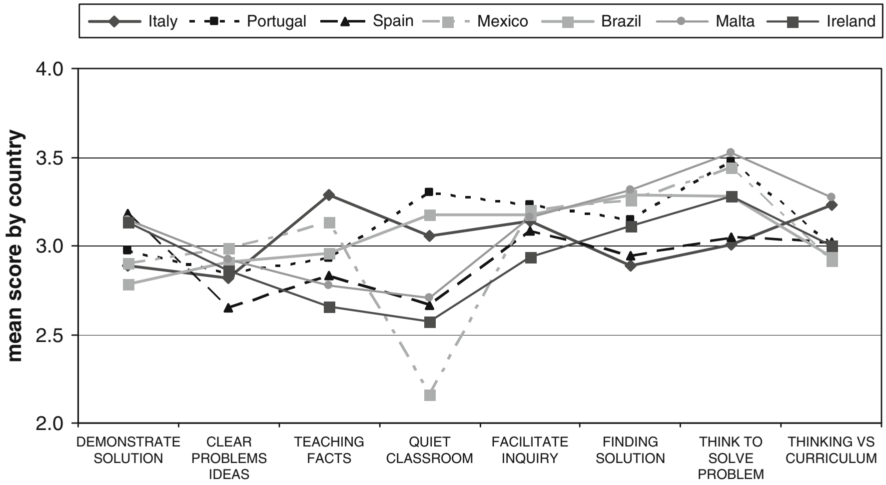

Fig. 4 Mean scores for all items measuring teacher beliefs about the nature of teaching and learning by country (only Southern European and South American Romanic countries and Ireland)

Table 3 Country effects on items measuring teacher's beliefs about the nature of teaching and learning

	Demonstrate solution	Clear problems/ideas	Teaching facts	Quiet classroom	Facilitate inquiry	Finding solution	Think to solve problem	Thinking vs. curriculum
R^2	0.06	0.07	0.09	0.19	0.02	0.08	0.06	0.03
F-value	30.16	44.42	39.64	41.11	23.28	33.69	14.84	11.33
df	22	22	22	22	22	22	22	22
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Classroom Teaching Practices and Their Relationship with Teachers' Beliefs About the Nature of Teaching and Learning

As for teacher beliefs about the nature of teaching and learning, our theoretical expectation about the structure of classroom teaching practices was supported across all countries. Three dimensions of classroom teaching practice – namely, structuring student orientation, and enhanced activities – could be identified within all countries. However, once again, the intercepts vary significantly, so that mean score comparisons are reported for single items only.

The results show that, around the globe, most structuring and student orientation are regularly employed by teachers. The country means are mainly above 2.00, indicating that teachers use these practices at least in one out of four lessons. *Checking understanding* is among the most frequently reported classroom teaching practices in a large majority of countries (mean scores > 3.50). Relatively low mean scores are found on the other hand for *student classroom planning*, *ability grouping*, and *small group work* (mean scores < 2.00 in a majority of countries). In mathematics classrooms teachers across all countries also report an infrequent use of enhanced activities (projects, students making products, debates/arguments, and written reasoning/essay). These practices are more common in science and the humanities (see Klieme & Vieluf, 2009).

Again the within country variance is larger than the variance between countries, which explains 5% to 16% respectively. But for all items country effects are significant (see Table 4). Country dummies explain a comparatively large proportion of variance for working in small groups, checking the exercise books, reasoning/essay writing and student classroom planning. Comparatively small country effects are found for giving different work to the students that have difficulties learning and/or to those who can advance faster, holding debates/arguments and for checking understanding.

Regarding general patterns of classroom teaching practices, one basic difference between countries is illustrated by Figs. 5 and 6. They show that structuring is reported to be considerably more frequent than student orientation in Southern Europe. In contrast, Northern European teachers report lower frequencies for most of the classroom teaching practices covered in TALIS, and especially for those that aim at structuring the lesson. Some of the student oriented teaching practices on the other hand are more common in Northern than in Southern Europe.

Thus, teachers in Northern countries do not only show strong support for constructivist compared to direct transmission beliefs, as discussed in section *Teachers' Beliefs About the Nature of Teaching and Learning*, but they also use student oriented teaching practices quite often as compared to their colleagues in Southern Europe. This observation indicates a parallelism of beliefs and practices. With a case number of 23 and a non-random selection of these countries, correlations between both aspects cannot be statistically tested on the country level but the associations can be examined within countries (see Table 5).

The results of regression analyses of classoom teaching practices on beliefs about the nature of teaching and learning – controlling for gender, experience, and highest level of education – in fact show that structuring rather associated with direct transmission beliefs, while student orientation rather goes along with constructivist beliefs (Table 5). However, significant differences between countries exist: The model fit drops substantially when the beta-weights are fixed to be equal across countries ($\Delta CFI = 0.29–0.60$ and $\Delta RMSEA = 0.04–0.05$). A closer look at within country regressions suggests that these differences mainly concern the strength of associations, not the direction of coefficients. For structuring significant and positive effects of direct transmission beliefs are found in seven countries, and significant effects of constructivist beliefs in six. Constructivist beliefs have a positive effect on student orientation in eight countries and on enhanced activities in nine. Relations between direct transmission beliefs and the latter two practices are significant in only three and five countries respectively. Also within countries the associations are rather weak.

Table 4 Country effects on items measuring classroom teaching practices

	State learning goals	Review home-work	Previous lesson summary	Check exercise	Check under-standing	Small groups	Different work	Student classroom planning	Ability groups	1 week projects	Student make product	Write reasoning/essay	Debate/argument
R^2	0.08	0.13	0.08	0.16	0.06	0.20	0.05	0.15	0.12	0.07	0.09	0.17	0.05
Z-value	48.90	74.51	80.05	76.07	35.67	55.98	45.74	55.61	50.61	38.19	39.44	72.44	82.26
df	22	22	22	22	22	22	22	22	22	22	22	22	22
p	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

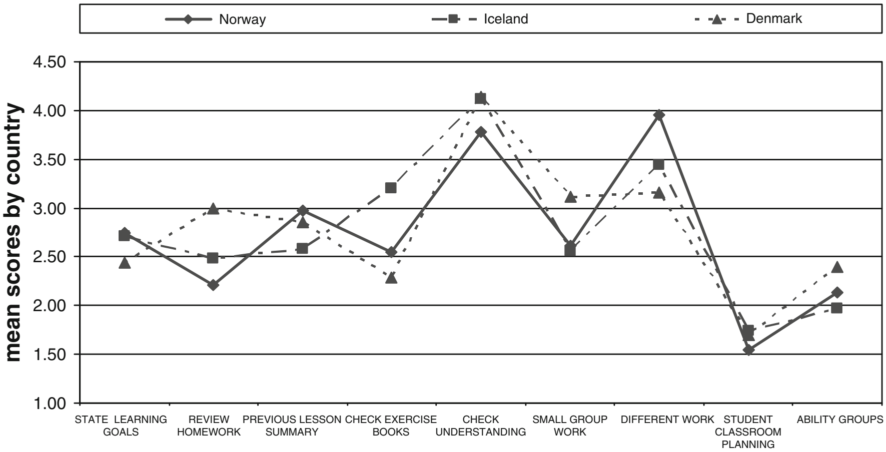

Fig. 5 Mean scores for items measuring classroom teaching practices by country (Northern European countries)

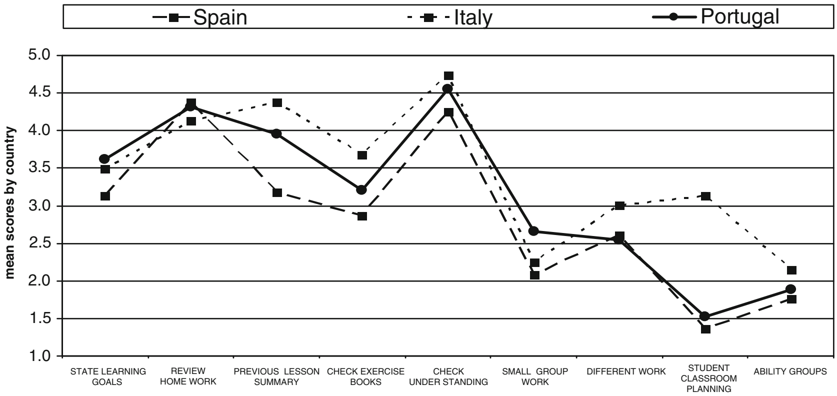

Fig. 6 Mean scores for items measuring classroom teaching practices by country (Southern European countries)

Relationships Between Teachers' Professional Background and Their Beliefs About the Nature of Teaching and Learning and Classroom Teaching Practices

Table 6 shows the results of multiple group regression analyses predicting teachers' beliefs about the nature of teaching and learning with indicators of professional qualification. When all coefficients are restricted to be equal across countries, direct transmission beliefs are positively related with professional experience and negatively with participation in workshops and courses. None of the other effects is significant.

Table 5 Results of multiple group regression analyses explaining classroom teaching practices with beliefs about the nature of teaching and learning. (Three regression analyses are reported, each with two independent variables and teachers' gender, experience, and level of education as control variables)

	Classroom teaching practices		
	Structuring	Student orientation	Enhanced activities
Direct transmission beliefs	0.11**	0.05**	0.05**
Constructivist beliefs	0.06**	0.09**	0.04**

Notes: $^{*}p \leq .05$; $^{**}\ p \leq .01$

Table 6 Results of multiple group regression analyses explaining beliefs about the nature of teaching and learning with teacher qualification (Two regression analyses are reported, each with seven independent variables and teachers' gender as control variable)

	Beliefs about the nature of teaching and learning	
	Direct transmission	Constructivist
Professional experience	0.04**	−0.01
Highest level of education (Bachelor or below vs. Master/PhD)	0.01	0.03
Studied mathematics	0.05	−0.06
Days of professional development	−0.00	0.00
Workshops/courses	−0.10**	0.01
Networks for professional development	−0.01	0.04
Mentoring	0.01	0.03

Notes: $^{*}p \leq .05$; $^{**}\ p \leq .01$

Classroom teaching practices are more closely related with teacher qualification: First of all, the level of education has a negative, but weak effect on student orientation and enhanced activities. Moreover teachers who have studied mathematics report to use more structuring than out-of-field-teachers. Finally, attendance of workshops and courses is positively related with student orientation, and teachers participating in networks or mentoring programs report to use all three practices more often, especially student orientation (Table 7).

Analysis of invariance shows that the correlations of indicators of teacher qualification with beliefs about the nature of teaching and learning as well as correlations with classroom teaching practices are not equivalent across countries. For all regression models the fit drops noticeably when regression coefficients are restricted to be equal (ΔCFI = 0.30–0.44 and ΔRMSEA = 0.03–0.04). However, more detailed analyses of within country effects show that differences between countries mainly concern the strength of the associations, not their direction.

Table 7 Results of multiple group regression analyses explaining classroom teaching practices with teacher qualification (Three regression analyses are reported, each with seven independent variables, and teachers' gender as control variable)

	Classroom teaching practices		
	Structuring	Student orientation	Enhanced activities
Professional experience	0.02	0.02	0.01
Highest level of education (Bachelor or below vs. Master/PhD)	0.00	−0.07*	−0.04*
Studied mathematics	0.12**	−0.00	−0.00
Days of professional development	0.00	0.00	0.00
Workshops/courses	0.05	0.06*	0.03
Networks for professional development	0.07**	0.12**	0.08**
Mentoring	0.14**	0.17**	0.11**

Notes: *$p \leq .05$; ** $p \leq .01$

Discussion

While there are many studies comparing student achievement cross-nationally, most empirical research on teachers focuses on single countries only. In the present contribution we drew on a large international database to explore cross-cultural differences and similarities regarding three aspects of teacher quality. The results show both, similarities and differences across the 23 countries participating in TALIS.

Cross-National Differences and Similarities in Levels and Patterns of Teacher Quality

Similarities Between Countries

First of all, the findings show that basic features of teacher qualification systems are similar across participating countries. Almost all of the secondary mathematics teachers have attained a university degree, and most (> 70%) have studied mathematics. Most common is a Bachelor's degree, but about a third has also attained a Master's degree. A PhD is generally rare. To expand their teaching skills and to stay up-to-date with instructional methods, teachers in all participating countries attend professional development, especially courses and workshops. Arrangements demanding a higher level of cooperation and active reflection – like networks for professional development and mentoring – are also familiar cross-nationally, but less widespread.

These results are consistent with findings from the TIMS-study. However, one difference becomes apparent: In TIMSS only 78% of 8th grade students have teachers with a university degree as compared to 90% of the TALIS teachers. A close look at the data shows that this is mainly due to the fact that more developing countries (e.g., Tunisia, Algeria, Morocco, Ghana, Lebanon) participated in TIMSS with higher rates of teachers who had completed secondary school only (Mullis et al., 2008). Hence, differences in teacher qualification may be larger when less affluent countries are also included in the sample.

Remarkably, TALIS shows that basic dimensions of teachers' beliefs about the nature of teaching and learning (namely constructivist vs. direct transmission views) can be cross-nationally identified. The agreement with all items measuring teachers' beliefs about the nature of teaching and learning is high – a result that was also found in MT21 (Schmidt et al., 2007). Hence, the instruments seem to cover well what teaching and learning means to teachers in different countries. Moreover, it is impressive to see that constructivist views are supported by a majority of mathematics teachers in all countries. This shows constructivist ideas to be present in different philosophical traditions and educational discourses.

Dimensions of classroom teaching practices (namely structuring, student orientation, and enhanced activities) could also be measured cross-nationally. Like TIMSS we found a similar repertoire in different regions of the world (Mullis & Martin, 2007; LeTendre et al., 2001): Across countries most mathematics teachers report to regularly state learning goals, review homework, check exercise books, check student understanding, use group work, and summarize the previous lesson.

Altogether these findings show that at more general levels of abstraction mathematics teachers in different countries are quite similar regarding their qualification, beliefs about the nature of teaching and learning and classroom teaching practices. However, going into more detail, significant differences regarding all three indicators of teacher quality become apparent.

Differences Between Countries in Terms of Teacher Qualification

The most striking difference between countries regarding teachers' level of education is the high percentage of teachers without a Bachelor or Master degree in Austria, Belgium and Slovenia. This can be explained by a peculiarity of the education systems in these countries: the training of mathematics teachers used to take place in special institutions – at least for some tracks or educational levels. However, recently – in the course of the European Bologna process – equalization to other systems is taking place in these European countries.

Aside from the level of education, differences are also found for the proportion of out-of-field-teaching: This is comparatively low in Eastern Europe and higher in many Southern, Northern and non-European countries. Mathematics teachers who have studied mathematics are likely to have more content knowledge and pedagogical content knowledge than out-of-field-teachers, and research suggests a positive (but non-linear) relation of subject specific training with student achievement (Darling-Hammond, 1999; Monk, 1994). Hence, teachers in countries with a large percentage of out-of-field-teaching may be on average less well prepared for their job. Moreover – as out-of-field teaching often concerns schools with a socially disadvantaged student population (Ingersoll, 2003) – the cross-national differences may be relevant for explaining system level variation in equity.

While the attendance rates in workshops and courses for professional development are relatively similar across countries, considerably more variance is found regarding networks for professional development, observation visits, research visits, and mentoring. Research suggests that professional development that involves teachers in professional learning communities may be more effective in changing classroom teaching practices, promoting student-centred approaches and enhancing student achievement than traditional programs (e.g., Bolam et al., 2005; Supovitz, 2002; Supovitz & Turner, 2000; Vescio, Ross, & Adams, 2008). Thus, in countries where this is common (e.g., Iceland, Korea and Poland) teachers are better supported with becoming a *reflective practitioner* (Schön, 1983).

Differences Between Countries in Terms of Teacher Beliefs About the Nature of Teaching and Learning

Significant country effects are further found for the level of endorsement of each of the items measuring teachers' beliefs about the nature of teaching and learning. Such differences were expected, as teachers' professional beliefs are considered to be influenced by *folk pedagogies* (Bruner, 1996) or *personal history-based lay theories* (Holt-Reynolds, 1992), and bearing in mind that previous research found distinct patterns of teacher beliefs and practices even for countries that are very close with regards to their cultural background and their education systems (e.g., Germany and Switzerland; Leuchter, Pauli, Reusser, & Lipowsky, 2006).

In the TALIS sample, the preference for constructivist beliefs is especially pronounced in Northern and Central Europe, reflecting the long-standing tradition of reform pedagogy in this region. However, a comparatively strong relative endorsement of constructivist views was also found in Korea, despite its different philosophical traditions. Similar results have been reported for other Confucian countries (Cheng, Chan, Tang, & Cheng, 2009; Lingbiao & Watkins, 2001; Tang, 2008), and in fact Lee (1996) and Shim (2008) pointed to some intersection of Confucian philosophy with European constructivist ideas. In Southern Europe and South America the pattern is less clear. Here, the relative agreement with a direct transmission view as compared to a constructivist view is higher than in other countries. Interestingly, these regions are also characterized by comparatively traditional general values (Inglehart, Basàñez, Díez-Medrano, Halman, & Luijkx, 2004). This suggests that in addition to country specific pedagogic traditions there may also be an influence of more general values on beliefs about the nature of teaching and learning.

Differences Between Countries in Terms of Classroom Teaching Practices

Finally, just like TIMSS (Givvin et al., 2005), we also found characteristic differences in profiles of classroom teaching practices. Most noticeable is the comparatively frequent self-reported use of student oriented teaching practice in the Northern European countries. It is especially group work and adaptive practices which are more common in this region than in other parts of the world. At the same time structuring teaching practices are reported to be common, but less frequently used than in Southern Europe. This may reflect the concern of the *Nordic Model* for promoting weak and socially disadvantaged students in comprehensive school systems (e.g., Lie, Linnakylä, & Roe, 2003).

Associations Between Different Indicators of Teacher Quality

The present study uses indicators of teacher quality from three different research traditions, namely teacher qualification, teachers' beliefs about the nature of teaching and learning, and classroom teaching practices. Results show that across countries these different aspects are indeed associated with each other, but they still represent quite distinct facets of teacher quality.

No significant correlation is found for teachers' professional experience and their level of initial education with beliefs about the nature of teaching and learning or classroom teaching practices. This reflects the large body of research in economics of education – mostly within countries, especially in the USA – that finally led to the conclusion that teacher experience is a weak indicator for teacher quality (for a more detailed discussion, see Ball & Hill, 2008). The finding is further consistent with the observation that beliefs about the nature of teaching and learning are often acquired prior to professional education and can be quite stable over the life span (e.g., Borko & Putnam, 1996; Pajares, 1992; Wilson, 1990). However, it should be noted that TALIS only asks for the level of educational attainment, while the curricula, the specific content, and the quality of initial education programs may also be relevant for the acquirement and differentiation of beliefs and a repertoire of practices.

In contrast to initial teacher education, professional development is shown to be associated with beliefs and practices in TALIS. The relationships are rather weak, but significant for the total sample as well as the country subsamples. Networks and mentoring have stronger effects than workshops and courses. Furthermore the former kinds of professional development – which regularly go along with an intensive professional exchange and a high level of teacher commitment – are rather related with student orientation and enhanced activities than with structuring. However, as the study is cross-sectional, the causal chain behind this correlational pattern could be twofold: Teachers with more diverse and/or more intensive didactical practices may be more willing to participate in professional development, or professional development may inspire teachers to use classroom teaching practices in a more explicit way. Results of previous research on effects of professional development on teacher behaviour and student achievement are rather inconsistent (for a discussion see e.g., Buczynski & Hansen, 2010). To establish causality experimental settings may be used in the future, comparing the effects of different kinds of professional development programs in a variety of countries.

Correlations between beliefs and practices are in accordance with theoretical expectations and previous research. Teachers who have a rather constructivist view on the nature of teaching and learning also use more student orientation, while structuring is less closely related to teachers' beliefs is about the nature of teaching and learning. The associations are rather weak. This is consistent with previous research (e.g., Levitt, 2001; Seidel, Schwindt, Rimmele, & Prenzel, 2008; Wilcox-Herzog, 2002), and in TALIS it can also be explained with the abstract nature of the beliefs examined, which generally implies less relevance for actual behaviour (see e.g., Alisch, 1981). However, TALIS is the first study to show that the magnitude of these associations also varies between cultures.

More generally, in comparing 23 countries it was found that the associations between all different indicators for teacher quality differ between education systems. It is mainly the strength of the association not the prefix that is different across countries. Nevertheless these results suggest that it may be necessary to define and examine teacher quality in a country-specific way.

Conclusions and Implications for Research and Practice

In summary, the results regarding cross-country differences in teacher qualification, beliefs and practices neither support the theory of national cultures, which assumes education to be largely culture specific (e.g., Bennett, 1987; Bracey, 1997), nor the theory of *institutional isomorphism* which holds the influence of international institutions responsible for a general harmonization of education systems (e.g., Spindler & Spindler, 1987). They are – if anything – consistent with the *global culture dynamics* approach suggested by LeTendre et al. (2001). The authors argue that organizational characteristics of schooling, but also instructional practices, are similar around the world because "the modern institution of school has penetrated most nations" (p. 5). At the same time their approach also assumes effects of national or regional laws as well as "national, regional, or local systems, customs and expectations on schooling" (p. 12). Accordingly, we found similarities, but also significant and characteristic differences between countries.

The finding of differences in profiles and structure of teacher quality emphasizes the importance of a careful analysis of cross-national equivalence in any study aiming at level oriented comparisons, but also whenever results and practices from one country are transferred to another. The same conclusion may hold for related constructs such as teacher expertise, professional knowledge, and teacher competence. Theoretical paradigms like the expert-novice-distinction, Shulman's taxonomy of professional knowledge, or the notion of competence (most often being defined as a mixture of cognitive and attitudinal dispositions) have been used and empirically applied in educational research world wide. However, the present study may induce a more careful approach to these paradigms in cross-cultural contexts. Previous research, being based on these globally accepted theoretical paradigms, seems to have neglected the role of culture in defining, understanding, and measuring teacher expertise and teacher quality. Especially, conceptions of constructivism have been used without reflecting its cultural foundations. More cross-cultural research on teacher expertise and teacher quality, both qualitative and quantitative, is needed.

Putting constructivism into perspective is another important message to mathematics education practitioners. The triarchic model of instruction, which has been supported in the present study, assumes structure, support, and cognitive activation to be basic dimensions of high-quality teaching. Pure constructivists tend to neglect the dimension of structure, which is indispensable for cognitive learning as well as for student motivation.

From a teacher education point of view it should be noted that structuring teaching practices are implemented more often by teachers who had studied mathematics, while all three dimensions seem to be correlated with professional networking and mentoring.

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