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Conditions and Practices Associated with Teacher Professional Development and Its Impact on Instruction in TALIS 2013

Darleen Opfer

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CONDITIONS AND PRACTICES ASSOCIATED WITH TEACHER PROFESSIONAL DEVELOPMENT AND ITS IMPACT ON INSTRUCTION IN TALIS 2013

By Darleen Opfer, RAND Corporation

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This working paper has been authorised by Andreas Schleicher, Director of the Directorate for Education and Skills, OECD.

Contact:
Darleen Opfer, RAND Corporation, dopfer@rand.org

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ABSTRACT

A key lever for improving teaching is provision of effective professional development. This paper uses TALIS 2013 data to consider personal and school-level factors associated with teacher participation in effective professional development and reports of impact on instruction. Results of the analyses indicate that levels of teacher co-operation and instructionally-focused leadership in schools are associated with higher levels of effective professional development participation and reported instructional impact. Systems also vary significantly on the percentage of teachers in schools with supportive conditions and this is associated with differences in teacher participation in professional development types and reported instructional impact.

RÉSUMÉ

Offrir des possibilités de formation continue constitue assurément un levier efficace pour améliorer la qualité de l'enseignement. Ce document utilise les données issues de l'enquête TALIS 2013 pour étudier les facteurs, tant au niveau des individus qu'au niveau des établissements scolaires, qui interviennent dans la participation des enseignants à des programmes de formation continue. Il rend compte également de l'effet de ces programmes sur l'enseignement. Les résultats de cette étude indiquent que la coopération entre enseignants et un leadership des chefs d'établissement centré sur l'instruction sont associés à une plus grande participation des enseignants à des programmes de formation continue et à de plus grandes retombées pour l'enseignement. Le pourcentage d'enseignants qui bénéficient de conditions favorables dans leur environnement de travail varie de manière significative d'un système d'éducation à l'autre. Cette réalité est associée à des niveaux différents de participation à des programmes de formation continue et à des effets différents sur l'enseignement.

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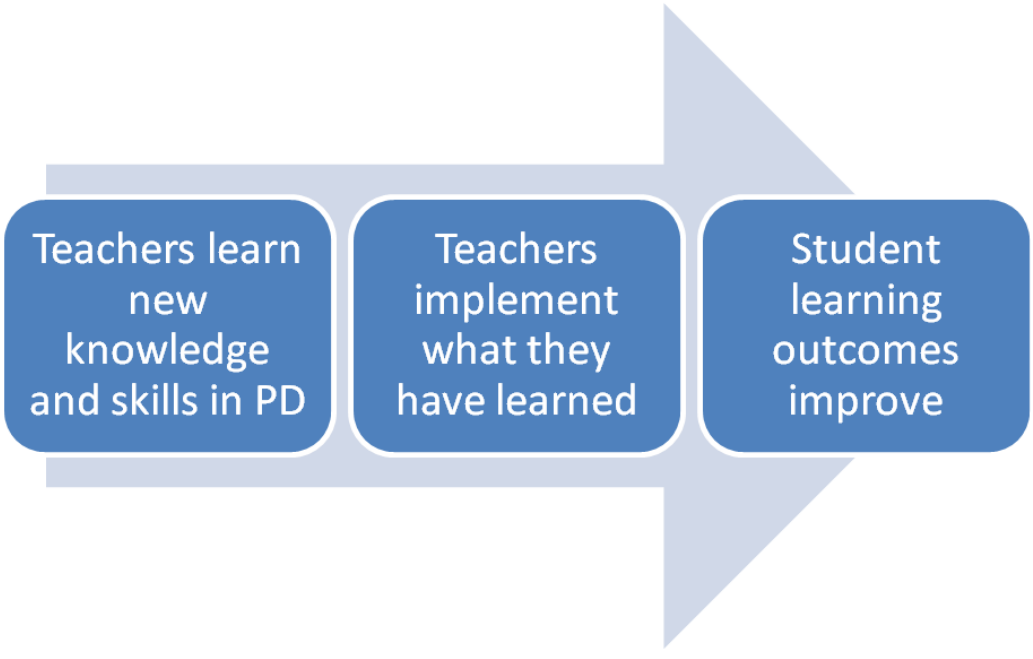
Introduction

Beyond initial teacher preparation, professional development is often considered the primary mechanism for improving teaching in many countries (Cohen and Hill, 2000; Darling-Hammond et al., 2009; Day and Sachs, 2005; European Commission, 2005; Fernandez, 2002; Guskey, 2003; Hassel, 1999; Hawley and Valli, 1998; Loucks-Horsley et al., 2003; National Commission on Teaching and America's Future, 1996; Timperley et al., 2007; Weiss and Pasley, 2009). Yet, despite its perceived importance, research on effective teacher professional development is scant (Weiss, 2009; Yoon et al., 2007) and much of the existing evidence criticises teacher professional development for failing to impact teachers' classroom practices and improve student achievement. This criticism is due, in part, because of the prevalence of single-shot learning opportunities that Hill (2009) has described as uninspired and of poor quality. Teacher professional development has also been criticised as "…intellectually superficial, disconnected from deep issues of curriculum and learning, fragmented, and noncumulative…" (Ball and Cohen, 1999: 3-4) and a "…patchwork of opportunities – formal and informal, mandatory and voluntary, serendipitous and planned…" (Wilson and Berne, 1999: 174) that lack coherence and a clear focus on classroom practices. Ingvarson (1998) describes this "traditional system of professional development" as in-service training where teachers have little control over learning and which is often disconnected from practical issues in the classroom.

Underlying this traditional notion of professional development is a very basic conceptualisation of how changes in teaching practice occur. Professional development opportunities that are disconnected from the school context assume that if teachers learn new knowledge and skills in these activities, they will go back to their classrooms, implement what they have learned, and students will be positively impacted (see Figure 1).

Figure 1. Basic conceptualisation of professional development impact



It should not be surprising that professional development with this simplistic understanding of the teacher change process has had disappointing results. As Yoon et al. (2007) have pointed out, improved student achievement will not result if one of these elements is weak or missing. Students cannot benefit from the teacher's professional learning if the teacher fails to learn new knowledge and skills or then fails to apply new learning in the classroom.

The majority of research on professional development has focused on understanding the elements of professional learning activities that ensure teachers gain knowledge and skills from the experience (Step 1 in the figure above). Often referred to as "effective professional development" or "high quality professional development", studies have focused on the characteristics of learning opportunities that lead to teachers implementing what they have learned.

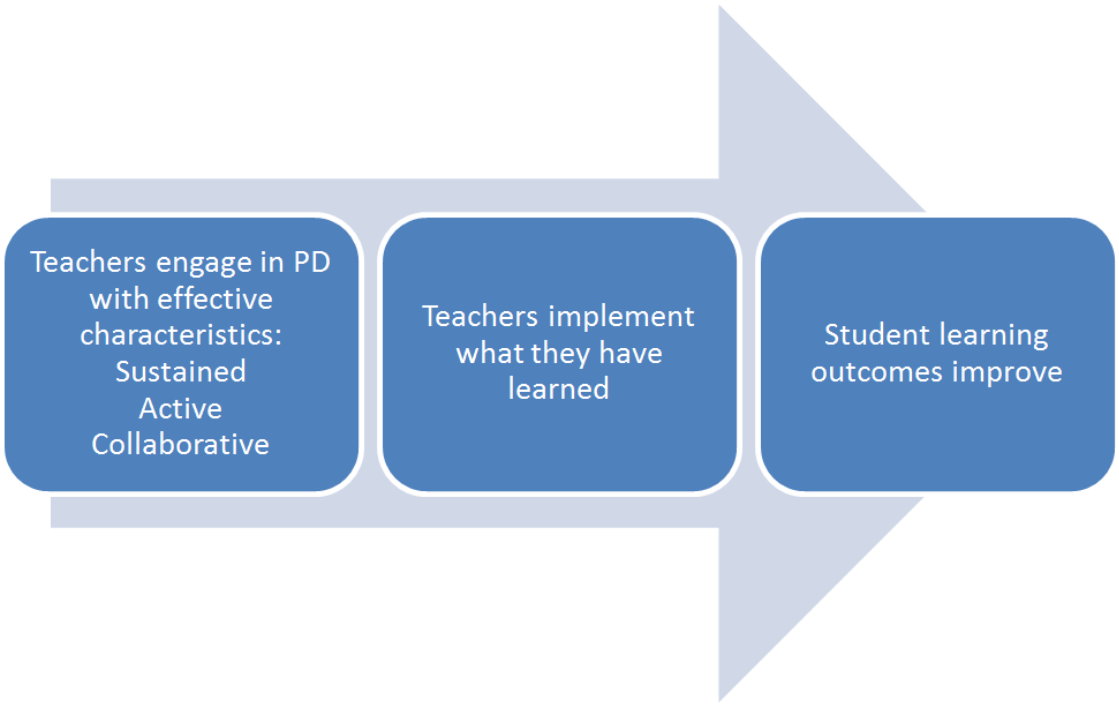
Research has developed a consensus around characteristics of activities that make professional development more effective. One of the most researched characteristics is the relationship between duration of the activities and implementation of new teaching techniques. Teachers need time to learn, reflect, and accumulate new knowledge. Thus, professional development activities that are sustained over a period of time have been associated with improved teaching and student learning (Cohen and Hill, 2001; Desimone et al., 2002; Garet et al., 2001; McGill-Franzen et al., 1999; Supovitz, Mayer and Kahle, 2000, Weiss and Pasley, 2006). In a review of 1 300 professional development studies, Yoon et al. (2007) found that those activities which had 14 or more hours of learning had a positive effect on student learning. Unfortunately, few professional development opportunities meet the 14 hour standard for impact; Yoon and his colleagues (2007) found that only 9 out of 1 300 studies had activities of that duration.

In addition to the duration of the activities, form has also been shown to matter. Professional development that is active has been associated with teaching improvement (Snow-Renner & Lauer, 2005). These types of activities allow teachers to practice new techniques and reflect on them (Carpenter et al., 1989; Cohen & Hill, 2001; Desimone et al., 2002; Garet et al., 2001; Penuel et al., 2007; Saxe, Gearhart and Nasir, 2001; Supovitz, Mayer and Kahle, 2000). Relatedly, studies of professional development content have shown that it is most effective when focused on "…concrete tasks of teaching, assessment, observation and reflection…" (Darling-Hammond and McLaughlin, 1995: 598).

The importance of collaborative and collegial learning activities has also been identified as a characteristic of effective professional development (Darling-Hammond and McLaughlin, 1995; Knapp, 2003). Teachers who engage in professional learning with colleagues from their school site become "…engaged in a powerful form of staff development that allows them to grapple with 'real' issues related to the new content and instructional processes…" (Killion, 1999: 180). School change that extends beyond classroom improvement has also been shown to follow from collaborative approaches to professional development (Hord, 1997; Joyce and Calhoun, 1996; Louis, Marks and Kruse, 1996; McLaughlin and Talbert, 2001; Newman and Wehlage, 1997). This results from collaborative professional development often being a part of a coherent school reform effort (Elmore and Burney, 1997; Cohen and Hill, 2001; Garet et al., 2001; Penuel et al., 2007; Supovitz, Mayer and Kahle, 2000).

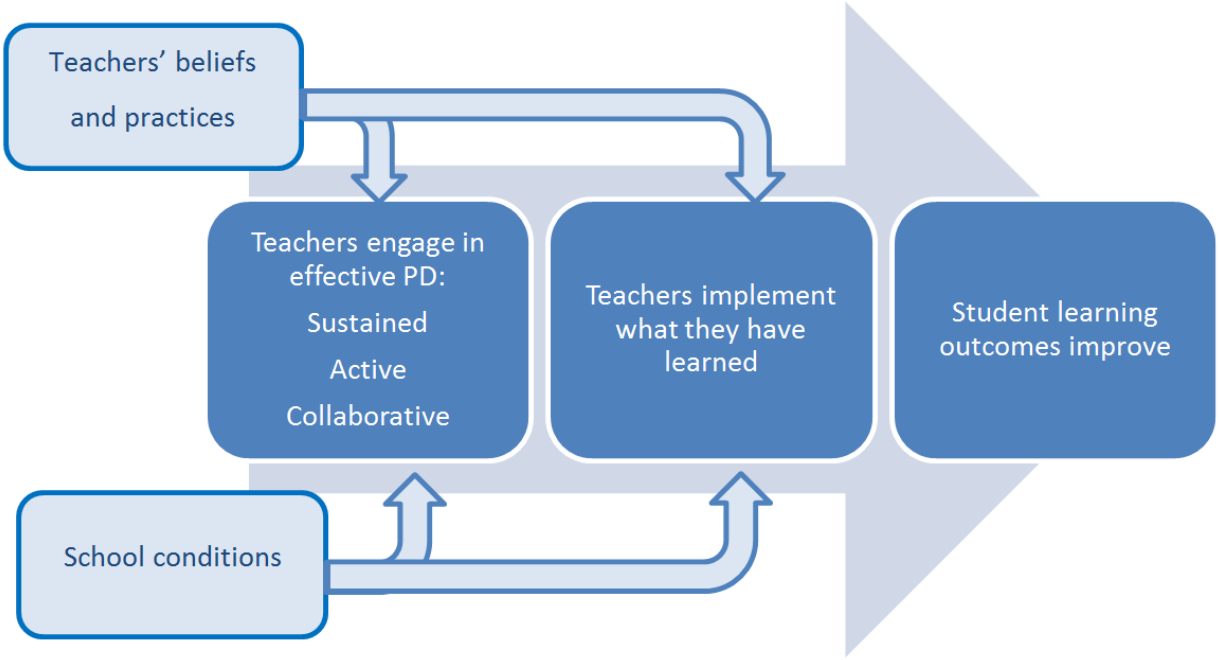
Thus, much of the research on effective teacher professional development has identified activities that are intensive, sustained, collaborative, and focused on materials and problems of practice as having more impact on teachers' knowledge, classroom practices and student achievement (See Figure 2 for revised conceptual model) (Ball and Cohen, 1999; Day and Sachs, 2005; European Commission, 2005; Garet et al., 2001; Joyce and Showers, 1995; Loucks-Horsley, Stiles and Hewson, 1996; Timperley et al., 2007; Wilson and Berne, 1999; Yoon et al., 2007). As Elmore (2004) asserts, "…improvement above all entails 'learning to do the right things in the setting where you work'…" (2004: 73).

Figure 2. Revised conceptualisation of professional development impact



However, these effects have also been found to be mediated by prior teacher knowledge and practice in the classroom, a supportive school context and teacher beliefs that are conducive to learning and improvement (Cohen and Hill, 2000; Fishman et al., 2003; Garet et al., 2001; Guskey and Sparks, 2004; Hargreaves, 1998; Ingvarson et al., 2005; Kennedy, 1998; Loucks-Horsley and Matsumoto, 1999; Richardson, 2003a). Outside of the professional development literature, researchers have shown teaching and learning to be influenced by the context in which they occur (e.g. Anderson et al., 2000; Ball, 1997; Borko et al., 1997; Cobb and Bowers, 1999; Greeno, Collins and Resnick, 1996; Lave and Wenger, 1991; Leinhardt, 1988). Given this situational understanding, one must consider how both professional development activities and the implementation of the knowledge and skills gained are shaped by individual beliefs and practices, as well as school-level contexts (see Figure 3).

Figure 3. Situational conceptualisation of professional development impact



Richardson's (2003a) work has shown that the beliefs teachers bring to their work are shaped by three sources: personal experience, experience with school and instruction, and experience with formal knowledge (both subject and pedagogical). Likewise, Powell and Birrell (1992) and Novak and Knowles (1992) demonstrate that beliefs are heavily grounded in past and present experiences. These beliefs, in turn, impact teacher practices. In a survey of 1 212 primary and secondary teachers in 32 schools in England, United Kingdom, teachers were asked how often certain learning practices occurred and how important teachers believed these practices were for creating opportunities for students to learn. The analysis showed that differences in the gaps between teachers' own assessment of their beliefs and practices were indicative of varying levels of inquiry, collaboration, valuing of learning, and critical and responsive learning (James et al., 2007; Pedder, 2006; Pedder, James and MacBeath, 2005; Pedder and MacBeath, 2008). Thus the intersection of experience and belief creates a powerful combination that determines not only the instructional decisions that teachers make (Raths, 2001; Richardson, 1996), but also what they themselves are willing to learn (Opfer and Pedder, 2011).

Specific teacher beliefs, including self-efficacy, feelings of preparedness, beliefs about classroom pedagogy, and satisfaction with their performance, have all been shown to impact whether teachers participate in professional development and also whether that participation leads to changes in classroom practice (Gamage and Hansson, 2006; Gregoire, 2003; Grider, 2008; Grove, Dixon and Pop, 2009; Hardre and Sullivan, 2008; Hargreaves, 1998; Harrison et al., 2008; Ingvarson et al., 2005; Jurow, 2009; Kuskovski, 2008; Meirinka et al., 2009; Moore, 2008; Mueller et al., 2008; Richardson, 2003b; Richardson and Placier, 2001; Zambo and Zambo, 2008). The relationship between these teacher beliefs and participation in professional development is often shown in the literature to be curvilinear. That is, we might expect that teachers with less self-assurance in their teaching ability would be more likely to undertake activities to improve their teaching. However, the extant research has shown that just the opposite occurs. For example, teachers with low self-efficacy are less likely than teachers with average self-efficacy to engage in professional learning and improvement (Grove, Dixon and Pop, 2009; Jurow, 2009; Kuskovski, 2008; Zambo and Zambo, 2008). Teachers with extremely high levels of self-efficacy, feelings of preparedness, etc. are also less likely to engage in professional development.

Taken together, the literature on teacher beliefs about pedagogy, self-efficacy, preparedness, and satisfaction suggests that some teachers may have individual characteristics that lead them to be more amenable to professional learning and subsequent changes in their teaching practice than others. Teachers who hold constructivist pedagogical beliefs and who have typical levels of self-efficacy, feelings of preparedness for their teaching assignment and satisfaction with their teaching may participate in more learning activities and be more willing to try out new practices because they see teaching efficacy as incremental and changeable.[1] Teachers who hold transmissive pedagogical beliefs,[2] who suffer from low self-efficacy and feel unprepared or dissatisfied with their teaching, may be less interested in participating in professional development and also less willing to try new practices. Teachers with extremely high levels of belief in their teaching may also be less likely to participate in professional development because they hold static notions of teaching efficacy (Rodriguez et al., 2014).

In addition to individual teacher beliefs, the norms of the school, its structures and practices, influence teachers' professional learning (Galloway et al., 1982; Mortimore et al., 1990; Pollard, 1985; Rutter et al., 1979; Woods, Jeffery and Troman, 1997). School-level beliefs influence both individual and collective behaviour by creating norms of action (Sampson, Morenoff and Earls, 1999). Coleman's (1990, 1987, 1985) research on normative control confirmed that a group of teachers will sanction an individual teacher's practice when that practice violates group pedagogical beliefs. New or inexperienced teachers are especially vulnerable to constraining their practice to fit with collective pedagogical beliefs (Chester and Beaudin, 1996; Woolfolk Hoy and Burke-Spero, 2005).

In addition to school-level beliefs about teaching and learning, Hollingsworth's (1999) longitudinal study of primary mathematics teachers' professional development demonstrated that teachers encountered difficulties in implementing new practices in their classrooms because of unsupportive conditions in their schools: a lack of co-ordination and leadership, little collegial activity, and no obvious commitment to professional development in mathematics. Additionally, research literature on school conditions has shown both the type of leadership and the degree of co-operation among teachers to be important in supporting teachers to undertake more effective forms of professional development (Keith, 2008; Leithwood, Steinbach and Jantzi, 2002; Loucks-Horsely et al., 2003; Loucks-Horsely et al., 1996; Loxley et al., 2007; Nir and Bogler, 2008; Scribner, 1999; Timperley et al., 2007). This research indicates that leadership that is instructionally focused[3] is often associated with teacher participation in professional development (Keith, 2008; Leithwood, Steinbach and Jantzi, 2002). Likewise, it is not surprising that in schools where teacher collaboration is more prevalent, teacher participation in professional development that involves collaboration also occurs (Loucks-Horsley et al., 2003; Loucks-Horsley, 1996; Loxley et al., 2007).

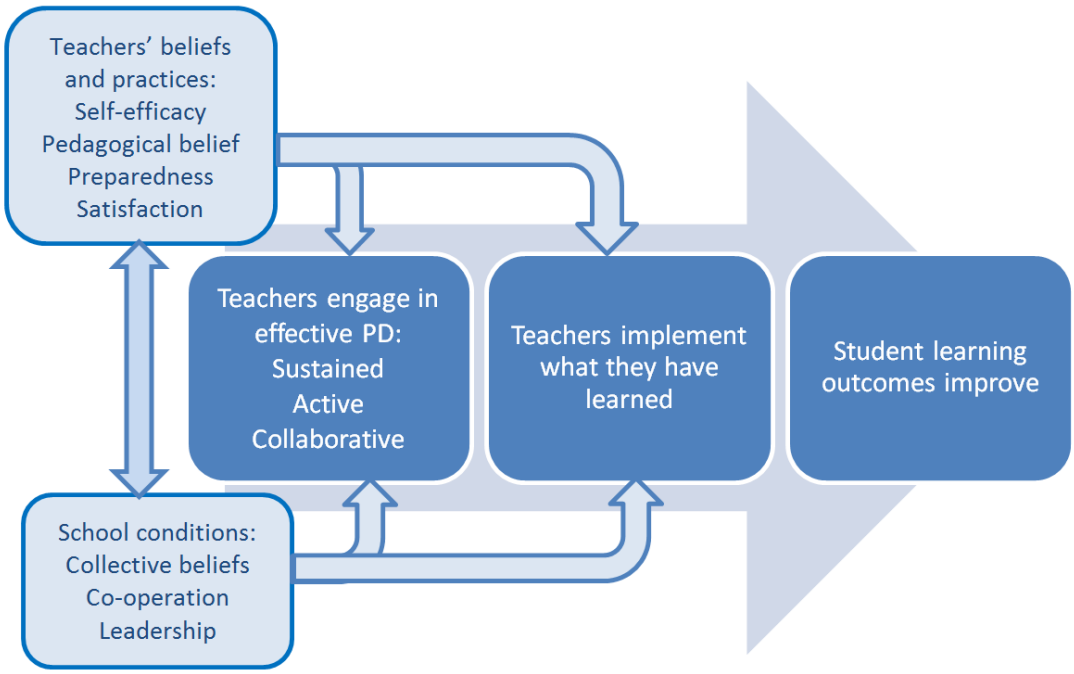
1. Constructivist beliefs are those held by teachers who feel that learning occurs as learners are actively involved in a process of meaning and knowledge construction as opposed to passively receiving information.

2. Transmissive pedagogical beliefs are those held by teachers who feel it is their duty to transmit their knowledge to their students. The primary teaching method for those who hold these beliefs tends to be lecture and learning is passive.

3. Instructional leadership focuses on learning for both students and adults and measures the effectiveness of learning by improvement in instruction and in the quality of student learning (Center for Educational Leadership, University of Washington, http://info.k-12leadership.org/4-dimensions-of-instructional-leadership).

Although individual teachers' decisions about professional learning may result from a confluence of instructional practices, pedagogical beliefs, prior knowledge, and past experiences, school-level norms and decisions about professional learning may similarly play a role. To understand and explain why and how teachers learn, research suggests that in addition to focusing on the characteristics of the professional learning activities, we must also consider how a teacher's individual beliefs and practices interact with school-level beliefs and practices, and how both together may affect the activities and impacts of activities on teacher practices and student learning (see Figure 4 below).

Figure 4. Full conceptual model of teach professional development impact



This paper uses Teaching and Learning International Survey (TALIS) 2013 data to explore the types of professional development activities in which teachers report engaging and the teacher beliefs and school norms and practices that influence whether this participation is associated with reported improved teaching practices. TALIS is an international, large-scale survey that focuses on the working conditions of teachers and the learning environment in schools. The analyses presented in this paper rely on data from the second cycle, TALIS 2013, which surveyed teachers and school leaders of lower secondary education in 34 countries and economies (OECD, 2014). The target sample size for TALIS is 200 randomly selected lower secondary schools per system, with 20 randomly selected teachers and 1 school leader per school resulting in a total sample size of 107 655 for TALIS 2013.

The paper is structured around answering a series of questions:

- In what types of professional development activities do teachers report participating?
- Does participation in these different types of professional development matter?
- Are there school contexts that support engagement in more effective forms of professional development?

- Do teachers report participating in different types of professional development in different types of schools?

- How can policy makers support engagement in teacher professional development that improves teaching?

In answering each question, data from TALIS are presented to consider patterns in response from teachers in general and teachers by system in order to understand how teacher professional development and its mediators vary internationally.

In what types of professional development activities do teachers report participating?

There are a wide variety of questions in TALIS that ask teachers about their prior participation in activities that could be considered professional development. As described in the technical appendix, these questions were factor analysed and two types of activities were identified. One type of activity includes the kinds of traditional professional development activities in which teachers have long participated: conferences, workshops, in-service training and qualification programmes. These activities often pull teachers out of their schools and classrooms in order for them to learn a new technique or skill. For the purposes of this paper, these kinds of activities will be referred to as "non-school embedded" professional development (see the technical appendix for factor fit statistics for the entire sample and for each system). Table 1 below shows the percentage of teachers who indicated they had participated in these activities in the 12 months prior to TALIS 2013 survey administration. Overall, teachers report having participated in these kinds of activities more than other kinds of professional development.

Table 1. Percentage of teachers indicating participation in non-school embedded professional development activities in the 12 months prior to TALIS 2013 administration

Professional development activity	Teachers indicating they participated in activity in previous 12 months
Courses and workshops	70.5%
Education conferences or seminars	43.6%
In-service training courses in business premises	15.5%
Qualification programme (e.g. a degree programme)	19.2%

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

The second type of professional development activities identified through factor analysis are those that more closely align with professional development literature indicating that ongoing, intensive, and collaborative activities, referred to here as "school embedded" professional development, have greater impacts on teaching practice (see the technical appendix for factor fit statistics for the entire sample and for each system). These kinds of activities include participating in professional development networks, undertaking collaborative research on problems of practice, peer observation and coaching, etc. Table 2 below shows the percentage of teachers who indicated they had participated in these activities in the 12 months prior to the TALIS 2013 survey administration.

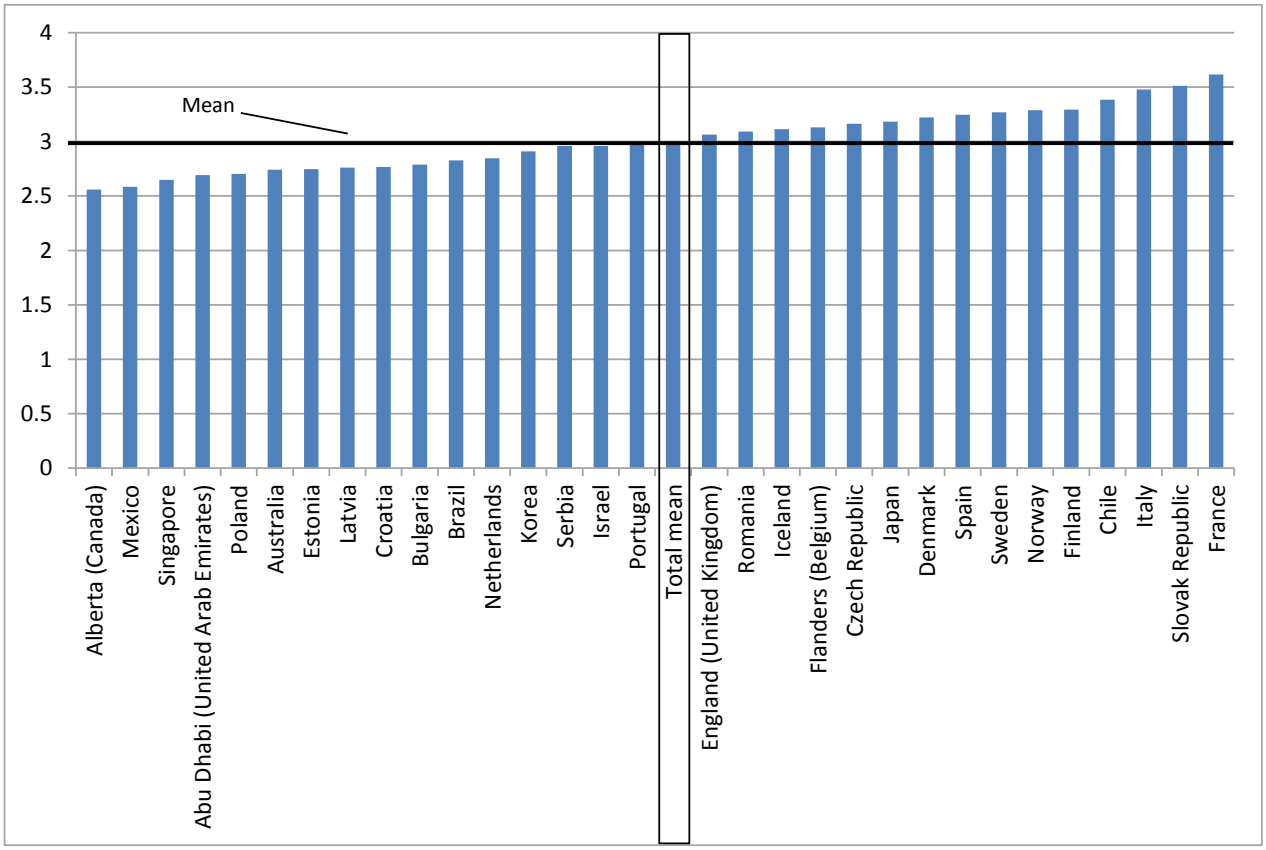
Table 2. Percentage of teachers indicating participation in school embedded professional development activities in the 12 months prior to TALIS 2013 administration

Professional development activity	Teachers indicating they participated in activity in previous 12 months
Participation in a network of teachers	36.7%
Individual or collaborative research	32.3%
Mentoring and coaching	30.5%
Observe other teachers' classes and provide feedback	33.1%
Work with teachers to ensure common standards for assessing student progress	79.7%
Take part in collaborative professional learning	61.0%

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Using the standardised factor scores for these two different types of professional development, we can compare the amount of each type of professional development participation as reported by teachers in TALIS 2013 participating countries and economies. Consistent with the item responses presented above, there is high participation in non-school embedded professional development activities in most countries and economies (mean = 3.0 on a scale of 0 to 4). However, the differences between the systems with the highest level of teachers participating in these activities (France) and the lowest (Alberta, Canada) is more than a standard deviation; indicating the existence of significant differences in participation between countries and economies. Figure 5 below demonstrates this variation across participating systems. In addition to France, teachers in Chile, Italy and the Slovak Republic indicate participating in non-school embedded professional development activities at much higher than average levels. Conversely, teachers in Abu Dhabi, United Arab Emirates; Mexico; and Singapore and indicate participating in these types of activities at lower than average levels.

Figure 5. Differences between systems in standardised amount of teachers reporting participation in non-school embedded professional development

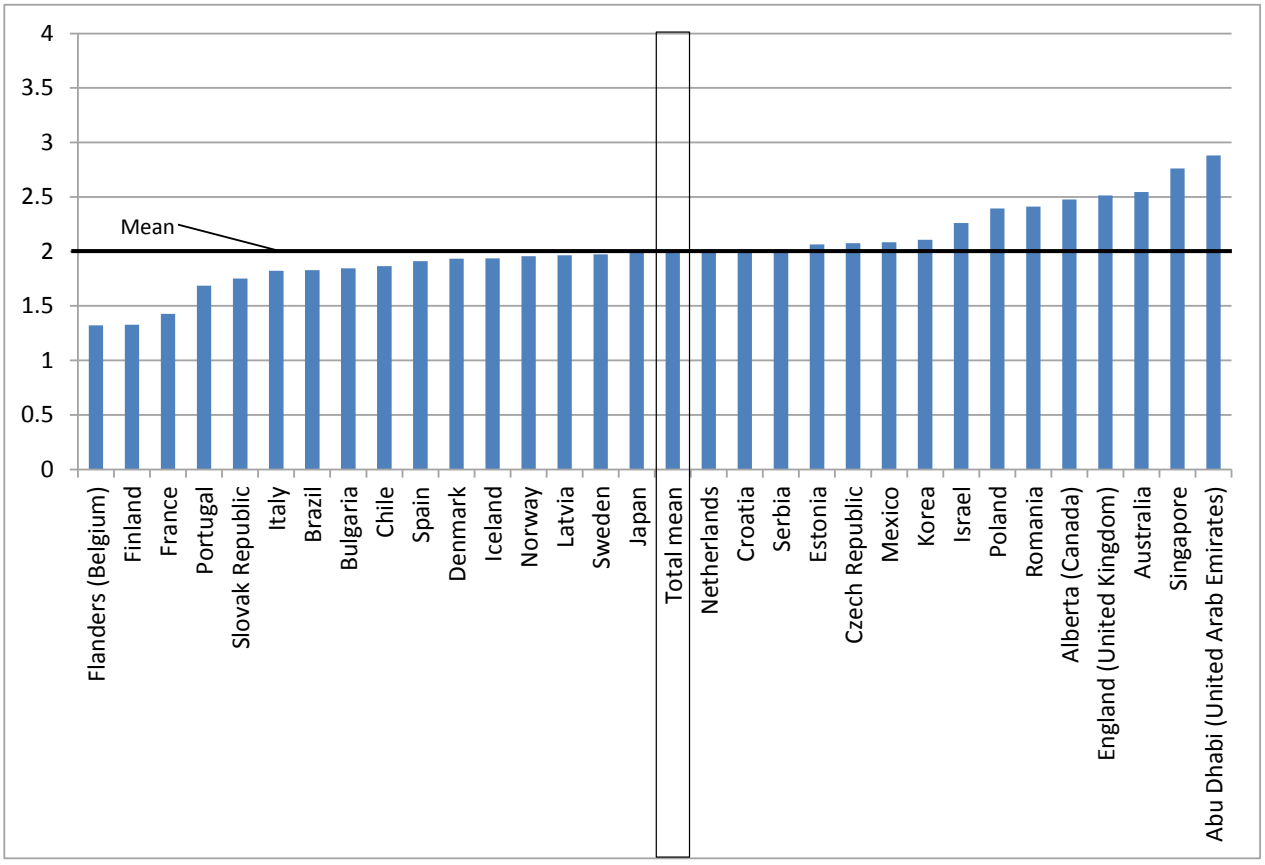


Countries and economies are ranked in ascending order, based on the mean reported participation in non-school embedded professional development.

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

While there is a lower overall level of participation reported by teachers in school embedded professional development (mean = 2.0 on a scale of 0 to 4), as with non-school embedded professional development, there are significant differences between systems in levels of teachers' reported participation. Figure 6 below demonstrates this variation between systems. Teachers in systems such as Finland; Flanders, Belgium; France; and Portugal indicate significantly below average participation in these types of activities whereas teachers in Abu Dhabi, United Arab Emirates; Australia; England, United Kingdom; and Singapore all indicated significantly higher than average levels of participation in school embedded professional development activities.

Figure 6. Differences between systems in standardised amount of teachers reporting participation in school embedded professional development

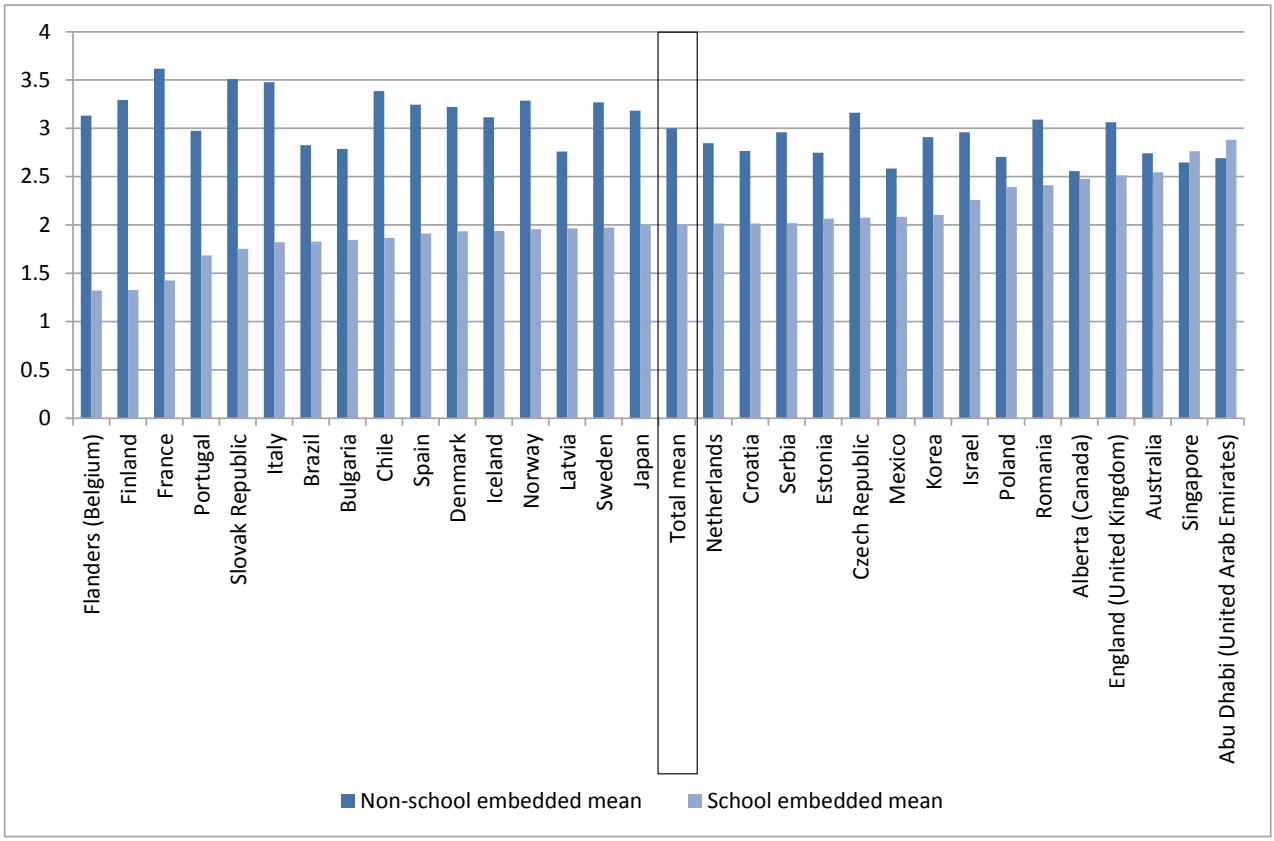


Countries and economies are ranked in ascending order, based on the mean reported participation in school embedded professional development.

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

While it is the case that in most systems teachers report participating in non-school embedded professional development more often, the general trend is that there is an inverse releationship in participation between the two types. That is, if levels of participation in both types of professional development are overlayed (see Figure 7 below), systems where teachers report high levels of participation in school embedded professional development also tend to be the systems where teachers report lower levels of participation in non-school embedded professional development. In systems where teachers report high levels of participation in non-school embedded professional development, teachers also tend to report lower levels of participation in school embedded professional development.

Figure 7. Comparison of mean reported participation in both types of professional development, by system



Systems are ranked in ascending order, based on the mean reported participation in school embedded professional development.

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Does participation in these different types of professional development matter?

As indicated previously, the research literature on professional development has shown that participation in school embedded professional development activities is more likely to have a positive impact on teaching than participation in non-school embedded activities. Results from TALIS 2013 further support these findings. Teachers were asked whether the professional development activities in which they participated during the prior 12 months had a positive impact on 14 aspects of their work. In addition to impacts related to teachers' knowledge and practice, teachers were asked about impacts on student behaviour, school management, and use of technology. Again using factor analysis techniques described in the technical appendix, a factor was identified that summarises the teachers' reported impact on areas related to teacher knowledge and practice (see the technical appendix for factor fit statistics for the entire sample and for each system). As with previous studies of professional development impact, teachers in TALIS 2013 report low levels of impact on instruction from their participation. Table 3 below provides the means and standard errors for each of the items included in the factor.

Table 3. Means and standard deviations for impacts on teaching knowledge and practice

Estimate the positive impact where 1 = no impact and 4 = large impact	Mean	Std. error
Knowledge and understanding of my subject field(s)	1.70	0.001
Pedagogical competences in teaching my subject fields(s)	1.67	0.001
Knowledge of the curriculum	1.66	0.001
Student evaluation and assessment practices	1.64	0.001
ICT (information and communication technology) skills	1.62	0.001
Student behaviour and classroom management	1.62	0.001
Teaching cross-curricular skills	1.61	0.001
Student career guidance and counselling	1.60	0.001

Note: The data in this table are based on 102 746 responses in each question.

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Using this professional development impact factor, we can consider the association between the two types of professional development identified (school embedded and non-school embedded) and the perceived impacts on teacher knowledge and practice as indicated by teachers in TALIS 2013. Using a Pearson correlation (two-tailed), we find that school embedded professional development has a positive, significant association with teacher reports of impact (0.336, p. = 0.000) whereas non-school embedded professional development activities have a significant, negative association with reported professional development impact (-0.413, p. = 0.000). This same pattern holds at the system-level with all correlations significant where $p < 0.01$ (see the technical appendix for individual system correlations between professional development type and impact). Thus, while higher levels of participation in school embedded professional development are associated with higher levels of reported impacts on teaching knowledge and practice, just the opposite is the case with non-school embedded professional development. The more teachers participate in non-school embedded professional development, the lower the impact on teaching knowledge and practice that is reported.

Are there school contexts that support more effective forms of professional development?

Existing literature has identified both individual teacher beliefs and school conditions that mediate participation in more effective professional development, such as the school embedded types.

TALIS 2013 asked teachers about their feelings of preparedness, their beliefs about teaching and their satisfaction with their performance. For the most part, teachers reported high levels of preparedness, self-efficacy, constructivist beliefs and satisfaction with performance. On a scale of one to four, where one indicates strong disagreement or no belief and four indicates strong agreement or a lot of belief, teachers on TALIS 2013 had beliefs with means all above three (see Table 4 below), indicating agreement and quite a bit of belief in the statements.

Table 4. Teachers' beliefs about preparedness, self-efficacy, constructivist teaching and satisfaction with performance

Teacher belief items	Mean	Std. error
Feelings of preparedness		
Prepared for teaching content of the subject(s) I teach	3.53	0.000
Prepared for teaching pedagogy of the subject(s) I teach	3.30	0.000
Prepared for teaching classroom practice in the subject(s) I teach	3.36	0.000
Self-efficacy		
Extent to which you can craft good questions for students	3.22	0.000
Extent to which you can control disruptive behaviour in the classroom	3.25	0.000
Extent to which you can make expectations about student behaviour clear	3.37	0.000
Extent to which you can get students to follow classroom rules	3.29	0.000
Extent to which you can calm a student who is disruptive or noisy	3.21	0.000
Extent to which you can use a variety of assessment strategies	3.14	0.000
Extent to which you can provide an alternative explanation	3.38	0.000
Extent to which you can implement alternative instructional strategies	3.08	0.000
Constructivist beliefs		
Believe role as a teacher is to facilitate students' own inquiry	3.29	0.000
Believe students learn best by finding solutions to problems on their own	3.10	0.000
Believe students should be allowed to think of solutions themselves	3.23	0.000
Believe thinking and reasoning processes are more important	3.08	0.000
Satisfaction with performance		
Am satisfied with my performance in this school	3.16	0.000

Note: The data in this table are based on 102 746 responses for each item.

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Not unexpectedly, when we look at the relationship between these beliefs and participation in the two types of professional development – school embedded and non-school embedded – we see statistically significant relationships. Table 5 below demonstrates that, while small, the relationship between beliefs and school embedded professional development participation is positive, whereas the correlations between beliefs and non-school embedded professional development are all negative. This indicates that teachers with positive beliefs in their preparedness, self-efficacy, constructivist role and satisfaction with their performance are more likely to engage in more school embedded professional development. In contrast, teachers with these positive beliefs are less likely to engage in non-school embedded professional development less often. These results are mirrored at the system-level with all correlations for each system significant, $p < 0.01$ (see the technical appendix for individual system correlations between professional development type and teacher beliefs). Consistent with the research literature then, teachers who have the most need for effective professional development – those that have low feelings of preparedness, low self-

efficacy, low constructivist teaching beliefs and low levels of satisfaction with their performance – are less likely to participate in the intensive, collaborative and school embedded type of professional learning.

Table 5. Pearson correlations (two-tailed) between teacher beliefs and school embedded and non-school embedded types of professional development (PD)

Teacher belief items	School embedded PD correlation	Non-school embedded PD correlation
Feelings of preparedness		
Prepared for teaching content of the subject(s) I teach	0.072	-0.041
Prepared for teaching pedagogy of the subject(s) I teach	0.149	-0.086
Prepared for teaching classroom practice in the subject(s) I teach	0.137	-0.083
Self-efficacy		
Extent to which you can craft good questions for students	0.107	-0.070
Extent to which you can control disruptive behaviour in the classroom	0.106	-0.043
Extent to which you can make expectations about student behaviour clear	0.099	-0.070
Extent to which you can get students to follow classroom rules	0.102	-0.041
Extent to which you can calm a student who is disruptive or noisy	0.101	-0.032
Extent to which you can use a variety of assessment strategies	0.178	-0.095
Extent to which you can provide an alternative explanation	0.113	-0.076
Extent to which you can implement alternative instructional strategies	0.195	-0.106
Constructivist beliefs		
Believe role as a teacher is to facilitate students' own inquiry	0.075	-0.070
Believe students learn best by finding solutions to problems on their own	0.060	-0.067
Believe students should be allowed to think of solutions themselves	0.073	-0.074
Believe thinking and reasoning processes are more important	0.069	-0.032
Satisfaction with performance		
Am satisfied with my performance in this school	0.124	-0.055

Note: All correlations are significant at the $p < 0.000$ level.

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

TALIS 2013 asked teachers how often they engaged in co-operative activities with other teachers in their school. On a scale from one to four where one would be never and four would be very often, teachers responded with medium levels of co-operation (see Table 6 below). TALIS 2013 also asked school leaders how often they took instructionally focused action in their schools. Again on a scale of one to four (where one = never, four = very often), principals tended to rate their level of action higher than teachers rated their level of co-operation (see Table 6 below).

Table 6. Means and standard deviations for school condition items from TALIS 2013

School conditions items	Mean	Std. error
Teacher co-operation		
How often do you [teacher] exchange teaching materials with colleagues?	2.24	0.000
How often do you [teacher] engage in discussions about the learning development of specific students?	2.49	0.000
How often do you [teacher] attend team conferences?	2.20	0.000
Instructionally focused leadership		
How frequently did you [school leader] take action in supporting co-operation among teachers?	2.78	0.000
How frequently did you [school leader] take action to ensure teachers feel responsibility for improving teaching skills?	2.84	0.000
How frequently did you [school leader] take action to ensure teachers feel responsibility for learning outcomes	2.96	0.000

Note: Each of the means and standard errors reported in the table were calculated on 102 746 teacher observations.

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

When we consider the correlations between these school conditions – teacher co-operation and instructionally focused leadership – and the two types of professional development, we see results consistent with previous research literature. The correlation between teacher co-operation and participation in school embedded professional development is moderately strong in the positive direction (0.326 - 0.343, Pearson, two-tailed correlation, p = 0.01). When higher levels of co-operation exist between teachers in a school, teachers are more likely to report participation in school embedded professional development (see Table 7 below). This is unsurprising given that school embedded professional development requires co-operation and co-ordination amongst teachers in a school.

The converse relationship is also present; when teachers report low levels of co-operation they also report higher levels of participation in non-school embedded PD. While not as strong, the relationship between instructionally focused leadership and participation in school embedded and non-school embedded professional development follows the same pattern (see also Table 7 below). Higher levels of instructionally focused leadership are associated with higher levels of teacher reported participation in school embedded professional development. Higher levels of instructionally focused leadership activity are also negatively correlated with teacher participation in non-school embedded professional development; indicating that teachers in schools with more instructionally focused leadership are less likely to participate in non-school embedded professional development.

This is the pattern for the international sample and within 21 of the systems and economies. In Australia, Chile, the Czech Republic, Italy, the Slovak Republic and Sweden, teacher co-operation and instructionally focused leadership had a positive association with both school and non-school embedded professional development. In Abu Dhabi, United Arab Emirates, these school conditions had a negative association with both school and non-school embedded professional development. In Serbia, these school conditions had a negative association with school embedded professional development and a positive relationship with non-school embedded. Neither Estonia nor Singapore had statistically significant associations between school conditions and either type of professional development.

Table 7. Correlations between school conditions and school embedded and non-school embedded professional development

School conditions items	School embedded PD	Non-school embedded PD
Teacher co-operation		
How often do you [teacher] exchange teaching materials with colleagues?	0.343	-0.090
How often do you [teacher] engage in discussions about the learning development of specific students?	0.326	-0.082
How often do you [teacher] attend team conferences?	0.332	-0.075
Instructionally focused leadership		
How frequently did you [school leader] take action in supporting co-operation among teachers	0.061	-0.033
How frequently did you [school leader] take action to ensure teachers feel responsibility for improving teaching skills	0.089	-0.059
How frequently did you [school leader] take action to ensure teachers feel responsibility for learning outcomes	0.091	-0.057

Note: Pearson, two-tailed correlations, all significant at the $p < 0.01$ level.

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Results from TALIS 2013 are thus consistent with the available literature on conditions that support teacher participation in more effective types of professional development. When teachers have high levels of co-operation in a school, they tend to participate more often in professional development that is co-operative, sustained and focused on problems of their practice. Likewise, when there is more instructionally focused leadership action taking place in the school, teachers are more likely to participate in more effective types of professional development. When teachers lack these conditions, they are more likely to participate in less effective professional development that takes place outside of their school environment. The consistency of the relationships across these conditions suggests that there could be types of schools where engagement in different types of professional development activities takes place.

Do teachers participate in different types of professional development in different types of schools?

Cluster analysis allows us to group teachers by their responses on the school conditions and teacher beliefs items from TALIS 2013. These clusters of teacher responses give us profiles of the kind of schools in which teachers work (see the technical appendix for a more detailed discussion of the cluster analysis techniques used). Based on the grouping of teacher responses on the items about school conditions and those about instructional beliefs held by teachers, four school types can be identified. Teachers responding to TALIS 2013 are not evenly distributed across these clusters (see Table 8 below); approximately 60% of teachers are in Clusters 1 (teacher-led schools) or 2 (school leader-led schools) while 40% are in either Clusters 3 (balanced, collaborative schools) or 4 (leader-dominant schools).

Table 8. Distribution of teachers responding to TALIS 2013, by cluster membership

Cluster	Percent of teachers in cluster	Number of teachers in cluster
1	24.5%	24 582
2	34.3%	34 458
3	27.7%	27 797
4	13%	13 681

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Teachers in each cluster differ in how they responded to questions about their school conditions (see Table 9 below). Teachers in Cluster 1 reported higher than average levels of teacher co-operation, but their school leaders reported lower than average levels of instructionally focused leadership – what we might call a teacher-led school environment. In Cluster 2, teachers reported lower than average teacher co-operation and their school leaders reported above average instructionally focused leadership – a school leader-led school environment. Teachers and school leaders in Cluster 3 reported higher than average levels of both teacher co-operation and instructionally focused school leadership – a balanced, highly collaborative school environment. Finally, teachers in Cluster 4 reported lower than average teacher co-operation and the school leaders for these teachers reported very high levels of instructionally focused leadership – a leader-dominant environment.

Table 9. Item means for school conditions items, by cluster membership

School conditions items	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Total average
Teacher co-operation					
How often do you [teacher] exchange teaching materials with colleagues?	2.25	2.17	2.35	2.12	2.24
How often do you [teacher] engage in discussions about the learning development of specific students?	2.54	2.42	2.61	2.31	2.49
How often do you [teacher] attend team conferences?	2.32	2.12	2.28	2.00	2.20
Instructionally focused leadership					
How frequently did you [school leader] take action in supporting co-operation among teachers?	2.12	2.86	2.83	3.66	2.78
How frequently did you [school leader] take action to ensure teachers feel responsibility for improving teaching skills?	2.03	2.96	2.92	3.84	2.84
How frequently did you [school leader] take action to ensure teachers feel responsibility for learning outcomes?	2.22	3.05	3.05	2.86	2.96

Note: All differences are significant at the p <.05 level except between Cluster 2 and 3 on the leadership question concerning teacher responsibility for learning outcomes.

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Teachers in each cluster also significantly differ in their perceptions of their preparedness, self-efficacy, constructivist beliefs and satisfaction with performance (see Table 10 below). However, these ratings are fairly consistent across these different types of beliefs. Teachers in Cluster 1 report, across all items, low levels of feelings of preparedness, self-efficacy, constructivist beliefs and satisfaction with performance. Teachers in Cluster 2 report the lowest levels of belief on all items. Teachers in Cluster 3

report very high levels of teacher belief. And teachers in Cluster 4 report moderate levels of belief across all items (while significant, only slightly above or below the average response for all teachers).

Table 10. Item means for teacher belief items, by cluster membership

Teacher beliefs	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Total average
Feelings of preparedness					
Prepared for teaching content of the subject(s) I teach	3.42	3.4	3.78	3.5	3.53
Prepared for teaching pedagogy of the subject(s) I teach	3.16	3.11	3.64	3.26	3.3
Prepared for teaching classroom practice in the subject(s) I teach	3.21	3.15	3.71	3.33	3.36
Self-efficacy					
Extent to which you can craft good questions for students	3.05	2.88	3.72	3.14	3.21
Extent to which you can control disruptive behaviour in the classroom	2.93	2.83	3.65	3.11	3.14
Extent to which you can make expectations about student behaviour clear	3.23	3.09	3.85	3.34	3.38
Extent to which you can get students to follow classroom rules	2.9	2.75	3.59	3.04	3.08
Extent to which you can calm a student who is disruptive or noisy	3.22	3.18	3.45	3.25	3.29
Extent to which you can use a variety of assessment strategies	3.02	3.02	3.22	3.11	3.1
Extent to which you can provide an alternative explanation	3.16	3.14	3.37	3.22	3.23
Extent to which you can implement alternative instructional strategies	3.03	3.01	3.2	3.05	3.08
Constructivist beliefs					
Believe role as a teacher is to facilitate students' own inquiry	3.07	2.95	3.65	3.19	3.22
Believe students learn best by finding solutions to problems on their own	3.11	2.94	3.74	3.2	3.25
Believe students should be allowed to think of solutions themselves	3.23	3.09	3.83	3.32	3.37
Believe thinking and reasoning processes are more important	3.13	2.98	3.78	3.24	3.29
Satisfaction with performance					
Am satisfied with my performance in this school	3.05	3	3.39	3.13	3.16

Note: All differences are significant at the $p < .05$ level.

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Table 11 below summarises for each cluster how teachers and school leaders perceive the school conditions and how teachers rate their own beliefs. Teachers in teacher-led schools (Cluster 1) with high teacher co-operation and low levels of instructionally focused leadership report low levels of teacher beliefs. Teachers in leader-led schools (Cluster 2) report low teacher co-operation, moderate instructionally focused leadership and very low levels of teacher belief. Teachers in balanced, collaborative schools (Cluster 3) report high levels of both teacher co-operation and instructionally focused leadership and very high levels of teacher belief. Teachers in leader dominated schools report low levels of teacher co-operation, very high levels of instructionally focused leadership and moderate levels of teacher belief. It is quite interesting that in teacher-led schools, teachers would report low levels of preparedness,

self-efficacy, constructivist beliefs and satisfaction with performance. It is only in the balanced, highly collaborative schools that teachers report high levels of these beliefs although teachers in leader dominated schools tend to have higher levels of belief than either the teacher-led or the leader-led schools.

These findings suggest that teacher beliefs are sensitive to teacher co-operation in a curvilinear way. Too much co-operation amongst teachers, where teacher co-operation dominates the environment, may cause teachers to be less assured as individuals. Too little teacher co-operation, as in the leader-led schools, may also lead to less assured teachers. Just the right amount of teacher co-operation – balanced by strong leadership (as in the balanced, collaborative schools) – results in high teacher instructional beliefs. The amount of leadership also appears to matter. Very high leadership (as in the leader dominated schools) may compensate for low levels of teacher co-operation to lead to moderate teacher beliefs. Otherwise, the relationship between teacher belief and instructionally focused leadership appears to be fairly linear with teacher beliefs rising as instructionally focused leadership raises.

Table 11. Summary of cluster descriptions

	Teacher co-operation	Instructionally focused leadership	Teacher beliefs
Cluster 1 - teacher-led	High	Low	Low
Cluster 2 - school leader-led	Low	Moderate	Very low
Cluster 3 - balanced, highly collaborative	High	High	High
Cluster 4 - leader dominant	Low	Very high	Moderate

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Given these differences in conditions, which have been shown to support professional development of teachers, we would expect to see differences between the clusters in participation of teachers in school embedded and non-school embedded professional development. Table 12 below shows the percentage of teachers in each cluster at different levels of participation in non-school embedded professional development. With one being a low level of participation and four being a high level of participation, we see that teachers in the teacher-led and leader-led school clusters have the highest levels of participation in non-school embedded professional development. The teacher-led cluster had 62% of its teachers' participation in non-school embedded professional development at levels three and four. Teachers in the school leader-led schools had 62.4% of their teachers participating at these levels. Teachers in the balanced, collaborative school cluster (Cluster 3) have more teachers reporting the lowest level of participation in non-school embedded professional development (10.1%), with teachers in the leader-dominant (Cluster 4) schools reporting slightly less participation at the lowest level (9.4%) than those is the balanced, collaborative cluster, but still at higher levels than the teacher- (Cluster 1) (5.8%) and school leader-led (Cluster 2) clusters (6.5%).

Table 12. Percentage of teachers in each cluster participation in non-school embedded professional development, by level of participation

Level of teacher participation	Non-school embedded professional development by cluster			
	1 – teacher led	2 – leader led	3 – balanced, collaborative	4 – leader dominant
1 = low	5.8%	6.5%	10.1%	9.4%
2	31.9%	31.0%	34.3%	31.8%
3	37.7%	36.3%	34.6%	35.3%
4 = high	24.6%	26.1%	21.0%	23.4%

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Table 13 below shows the percentage of teachers in each Cluster at different levels of participation in school embedded professional development. Again, with one being a low level of participation and four being a high level of participation, we see that teachers in the teacher-led (23.8%) and leader-led (23.3%) clusters have the lowest levels of participation in school embedded professional development. Teachers in the balanced, collaborative cluster (Cluster 3) report the highest levels of participation in school embedded professional development (37.1%). Teachers in the leader-dominant cluster (Cluster 4) also report higher levels of participation in school embedded professional development (29%) than teachers in either the teacher- (Cluster 1) or leader-led (Cluster 2) clusters, but lower than teachers in the balanced, collaborative cluster (Cluster 3).

Table 13. Percentage of teachers in each cluster participating in school embedded professional development, by level of participation

Level of teacher participation	School embedded professional development by cluster			
	1 – teacher led	2 – leader led	3 – balanced, collaborative	4 – leader dominant
1 = low	38.6%	37.5%	27.9%	35.1%
2	37.7%	39.2%	35.0%	35.9%
3	18.1%	17.7%	24.9%	20.0%
4 = high	5.7%	5.6%	12.2%	9.0%

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

The same pattern across the cluster types emerges when we consider teacher reports of instructional impact from professional development participation. Table 14 below demonstrates that teachers in the balanced, collaborative cluster (Cluster 3) report the highest levels of instructional impact from professional development participation (58.6%). Fewer teachers in the teacher- (Cluster 1, 50.6%) and leader-led (Cluster 2, 50.6%) clusters report high levels of professional development impact and greater numbers of them report low levels of instructional impact from professional development participation.

Table 14. Percentage of teachers reporting instructional impact from professional development participation, by level within each cluster

Level of reported instructional impact	Percentage of teachers reporting professional development impact by cluster			
	1 – teacher led	2 – leader led	3 – balanced, collaborative	4 – leader dominant
1 = low	32.2%	32.3%	27.0%	30.2%
2	17.1%	17.1%	14.4%	16.0%
3 = high	50.6%	50.6%	58.6%	53.8%

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Table 15. Percentage of teachers in cluster, by system from TALIS 2013

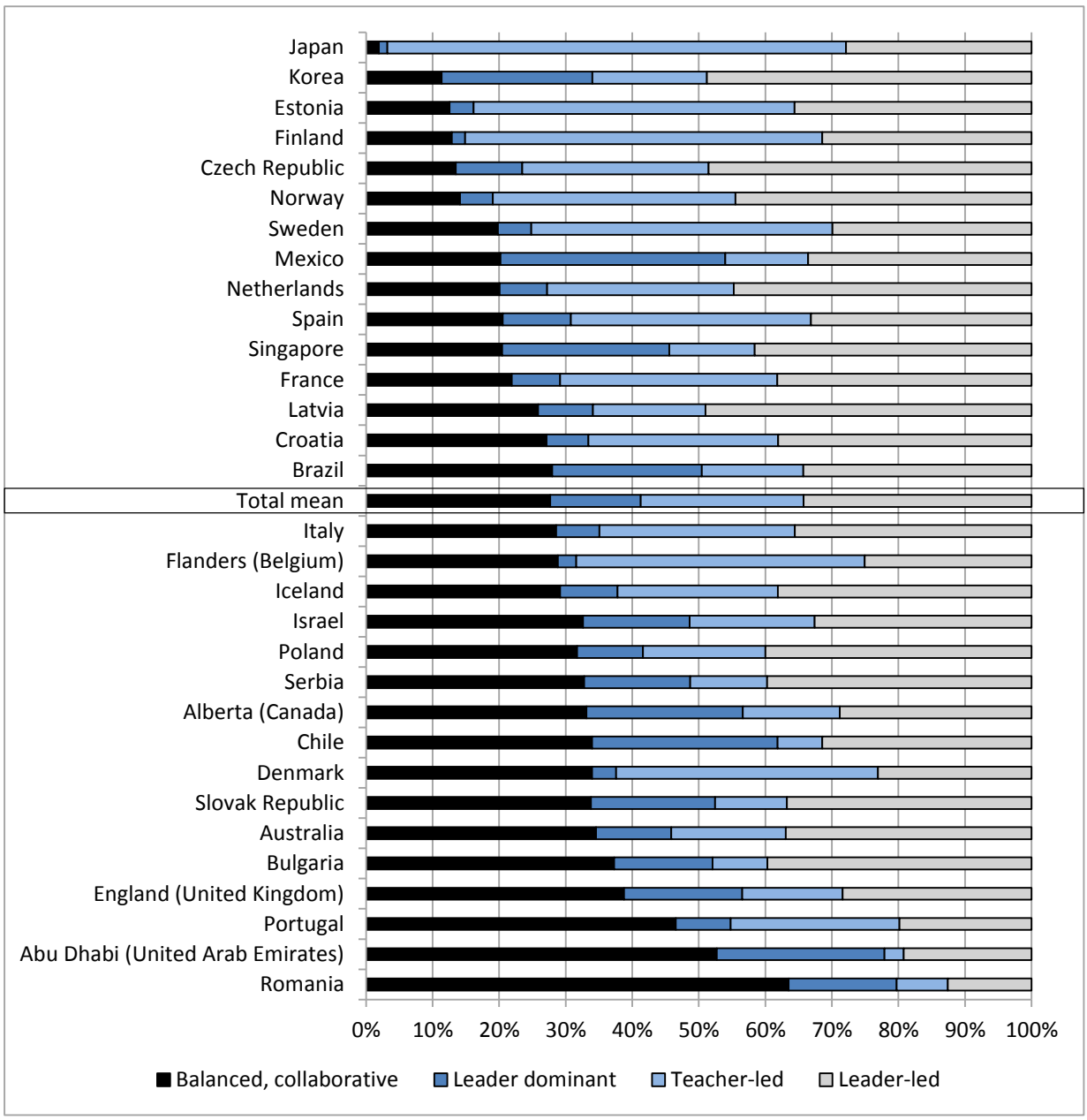
	Percentage of Teachers in Each Cluster			
System	3 – balanced, collaborative	4 – leader dominant	1 – teacher-led	2 – leader led
Romania	59.5	15.2	7.2	11.8
Abu Dhabi (United Arab Emirates)	45.6	21.8	2.5	16.6
Portugal	44.6	7.9	24.3	19
England (United Kingdom)	37.7	17.3	14.7	27.6
Bulgaria	36.7	14.6	8.1	39.1
Australia	33.7	11	16.8	36
Slovak Republic	33.2	18.3	10.6	36.1
Denmark	33	3.5	38.2	22.4
Chile	32.5	26.7	6.4	30.1
Alberta (Canada)	32.3	22.9	14.2	28.1
Serbia	32.1	15.6	11.3	38.9
Poland	31.4	9.8	18.2	39.6
Israel	30.7	15.1	17.7	30.7
Iceland	28.8	8.5	23.8	37.6
Flanders (Belgium)	28.3	2.7	42.6	24.6
Italy	28.2	6.4	29	35.1
Total mean	**27.7**	**13.6**	**24.5**	**34.3**
Brazil	27.5	22.1	15	33.7
Croatia	26.8	6.2	28.2	37.6
Latvia	25.7	8.2	16.8	48.7
France	21.8	7.2	32.5	38
Singapore	20.2	24.8	12.7	41.1
Spain	20.2	10.1	35.5	32.6
Netherlands	19.9	7.1	27.8	44.4
Mexico	19.8	33.1	12.2	32.9
Sweden	19.6	5	44.8	29.6
Norway	14.1	4.9	36.4	44.4
Czech Republic	13.4	9.9	27.8	48.2
Finland	12.8	2	53.4	31.3
Estonia	12.4	3.6	47.7	35.2
Korea	11.2	22.4	17	48.2
Japan	1.9	1.3	68.8	27.8

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

There are statistically significant differences between systems in the percentage of their teachers in each of these school clusters. Table 15, above, provides this information and is sorted to highlight the systems with the largest percentage of teachers in Cluster 3, the balanced, collaborative schools. The percentages of teachers in the leader-dominant schools are shown second with percentages of teachers in teacher-led and leader-led schools appearing last.

Figure 8, below, shows these results graphically. It illustrates that some systems such as Abu Dhabi (United Arab Emirates), Portugal and Romania, have a statistically significant, greater proportion of teachers in Cluster 3 – balanced, co-operative schools – than other systems. While overall there tend to be fewer teachers in leader dominated (Cluster 4) schools in most systems; Abu Dhabi, United Arab Emirates; Alberta, Canada; Brazil; Chile; Korea; and Mexico are exceptions to this trend and all have higher than average numbers of teachers in Cluster 4 schools. As shown previously, the majority of teachers work in Cluster 2 – leader-led – schools; however, the Czech Republic, Korea, Netherlands, Norway, and Singapore have significantly more teachers in these schools than many other systems. Flanders, Belgium; Finland; Japan; and Sweden have a significantly larger percentage of teachers in Cluster 1 – teacher-led – schools than in other systems. Thus, some systems have higher percentages of teachers in schools with conditions that support both teacher participation in school embedded professional development and the higher level of impact on classroom practice that is associated with these activities, while other systems have a higher percentage of teachers in less supportive schools.

Figure 8. Illustration of the distribution of teachers across the clusters in each system graphically



Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

How can policy makers support teacher professional development that improves teaching?

The patterns in the TALIS 2013 data are consistent with the available literature on effective professional development. As shown in other studies, teachers in TALIS reported lower participation rates in the kinds of professional development that has shown to be effective. Teachers participate most often in non-school embedded professional development activities, such as workshops and qualification courses. They participate less often in school embedded professional development that involves teacher collaboration on activities within their school.

These differences in participation of teachers in these two types of professional development matters. Participation in school embedded professional development is positively associated with teacher reports of professional development impact; whereas participation in non-school embedded professional development is negatively associated with teacher reported impact of professional development. This would indicate that the more teachers participate in these non-school embedded forms of professional development the less likely it is that they will be positively impacted.

In addition to the type of professional development making a difference for teachers' professional learning, their instructional beliefs and school conditions also influence whether they will be impacted by professional learning activities. While teachers may learn new knowledge and skills by participating in professional development, whether or not they implement what they learn is dependent upon their own beliefs and the school environment. The analyses in this paper showed that teacher beliefs, such as feelings of preparedness, self-efficacy, constructivist pedagogical beliefs, and satisfaction with performance is associated with the reported impact of professional development. However, the relationship between these beliefs and reported impact of professional development is not always linear. When teachers have too little (for example, not being confident enough) or too much (being overly confident) of these beliefs, they can be less likely to implement new knowledge and skills in their classrooms. Teachers with moderate levels of these beliefs are the most likely to implement new knowledge and skills acquired through professional development.

Additionally, school conditions, such as teacher co-operation and the presence of instructionally focused leadership, can influence the impact of professional development for teachers. Taken together, these school conditions create four different profiles of schools:

1. teacher-led schools with high levels of co-operation and low levels of instructional leadership

2. leader-led schools with low levels of co-operation and moderate levels of instructional leadership

3. balanced, collaborative schools that are characterised by high levels of both co-operation and instructional leadership

4. leader-dominant schools with very high levels of instructional leadership, but low levels of co-operation among teachers.

These school types are associated with teachers' beliefs about themselves, with those in teacher- and leader-led schools reporting low levels of preparedness, self-efficacy, constructivist pedagogical beliefs and satisfaction. Those in leader-dominant schools reported moderate levels of these beliefs, while those in balanced, collaborative schools reported high levels of these beliefs. These types of schools also matter for both the type of professional development in which teachers engage and the impacts these activities have. Teachers in teacher-led schools and leader-led schools report low levels of participation in school embedded professional development and low levels of impact from the activities. Teachers in leader-dominant schools report higher levels of participation in school embedded professional development and higher impact than either teacher- or leader-led schools. Teachers in balanced, collaborative schools report both the highest participation in school embedded professional development and the highest impact levels.

Thus, "effective" teacher professional development that has an impact on teachers' instructional practices are activities that take place in schools and allow teachers to work over time, in collaborative groups, on problems of practice. These types of activities are most likely to occur in schools that are characterised by co-operation amongst teachers and strong instructional leadership. Policy makers can encourage participation in more effective professional development by first attending to the culture of schools. Structures and processes are needed that encourage teachers to co-operate. This often means

providing time and opportunity for teachers to do so. Policy makers should also emphasise and support leaders in ways that allow them to focus on instruction. This support may mean reducing the focus on the managerial aspects of the position and incentivising school leaders to work more closely with teachers. With the right school conditions in place, policy makers should also increase the amount and variation of school embedded professional development offerings. These activities may include teacher initiated research projects, teacher networks, observation of colleagues, and mentoring and coaching. Teacher participation in non-school embedded professional development should be limited and not make up the primary professional development offerings. By supporting the conditions and activities most associated with effective professional development, we can increase the likelihood that students are impacted positively.

Summary of recommendations

- Develop structures and processes that encourage teachers to co-operate.
- Emphasise and support the instructional focus of school leaders.
- Increase the amount and variation of school embedded professional development offerings.
- Non-school embedded professional development should be limited to situations where teachers need to develop new knowledge and used infrequently when teachers are expected to engage in new teaching techniques.

REFERENCES

Anderson, J.R. et al. (2000), "Perspectives on learning, thinking and activity", *Educational Researcher*, Vol. 29(4), pp. 11-13.

Ball, D.L. (1988), "Knowledge and reasoning in mathematical pedagogy: Examining what prospective teachers bring to teacher education", unpublished doctoral dissertation, Michigan State University, East Lansing, Michigan.

Ball, D. L. (1997), "From the general to the particular: Knowing our students as learners of mathematics", *Mathematics Teacher*, Vol. 90(9), pp. 732-737.

Ball, D.L and D.K. Cohen (1999), "Developing practices, developing practitioners: Toward a practice-based theory of professional development", in G. Sykes and L. Darling-Hammond (eds.), *Teaching as the Learning Profession: Handbook of Policy and Practice*, Jossey-Bass, San Francisco, CA, pp. 30-32.

Birman, B. et al. (2007), "State and local implementation of the No Child Left Behind Act, volume II—Teacher quality under NCLB: Interim report",U.S. Department of Education, Office of Planning, Evaluation and Policy Development, Policy and Program Studies Service, Washington, D.C., www.rand.org/content/dam/rand/pubs/reprints/2007/RAND_RP1283.pdf.

Borko, H. (2004), "Professional development and teacher learning: Mapping the terrain", *Educational Researcher*, Vol. 33(8), pp. 3-15.

Borko, H., et al. (1997), "Teachers' developing ideas and practices about mathematics performance assessment: Successes, stumbling blocks, and implications for professional development", *Teaching and Teacher Education*, Vol. 13(3), pp. 259-278.

Campoy, R.W, and A. Hoewisch (1998), "Moral and instructional influences of teachers in professional development schools", Professional Educator, Vol. 20(3), pp. 7-23.

Carpenter, T.P. et al. (1989), "Using knowledge of children's mathematical thinking in classroom teaching: An experimental study", *American Educational Research Journal*, Vol. 26, pp. 499-532.

Center for Educational Leadership, University of Washington (2015), "4 Dimensions of Instructional Leadership", http://info.k-12leadership.org/4-dimensions-of-instructional-leadership (accessed 24 January 2015).

Chester, M. and B.Q. Beaudin (1996), "Efficacy beliefs of newly hired teachers in urban schools", *American Educational Research Journal*, Vol. 33, pp. 233-257.

Cobb, P. and J. Bowers (1999), "Cognitive and situated learning perspectives in theory and practice", *Educational Researcher*, Vol. 28(2), pp. 4-15.

Cohen, D. K., and H. C. Hill (2001), *Learning Policy: When State Education Reform Works*, Yale University Press, New Haven, CT.

Cohen, D.K. and H.C. Hill (2000), "Instructional policy and classroom performance: The mathematics reform in California", *Teachers College Record*, Vol. 102(2), pp. 294-343.

Coleman, J.S. (1985), "Schools and the communities they serve", *Phi Delta Kappan*, Vol. 66, pp. 527-532.

Coleman, J.S. (1987), "Norms as social capital", in G. Radnitzky and P. Bernholz (eds.), *Economic Imperialism: The Economic Approach Applied Outside the Field of Economics*, Paragon, New York, NY, pp. 133-155.

Coleman, J.S. (1990), *Foundations of Social Theory*, Harvard University Press, Cambridge, MA.

Darling-Hammond, L. and M.W. McLaughlin (1995), "Policies that support professional development in an era of reform", *Phi Delta Kappan*, Vol. 76(8), pp. 597-604.

Darling-Hammond, L. et al. (2009), "Professional Learning in the learning profession: A status report on teacher development in the United States and abroad", National Staff Development Council and the School Redesign Network at Stanford University, https://edpolicy.stanford.edu/sites/default/files/publications/professional-learning-learning-profession-status-report-teacher-development-us-and-abroad.pdf.

Day, C. and J. Sachs (2005), International handbook on the continuing professional development of teachers, Open University Press, McGraw-Hill, Maidenhead, Berkshire.

Desimone, L.M. et al. (2002), "Effects of professional development on teachers' instruction: Results from a three-year longitudinal study", *Educational Evaluation and Policy Analysis*, Vol. 24, No. 2, Summer 2002, pp. 81-112.

Elmore, R.F. and D. Burney (1997), "Investing in teacher learning: Staff development and instructional improvement: Community School District 2, New York City", National Commission on Teaching and America's Future and Consortium for Policy Research in Education, New York, N.Y.

Elmore, R.F. (2004), *School Reform from the Inside Out*,Harvard University Press, Cambridge, MA.

European Commission, Directorate-General for Education and Culture, (2005), "CPD for teachers and trainers", report of a Peer Learning Activity, held in Dublin, 26-29 September, 2005.

Fernandez, C. (2002), "Learning from Japanese approaches to professional development: The case of lesson study", *Journal of Teacher Education*, Vol. 53(5), p. 393.

Fishman, B.J. et al. (2003), "Linking teacher and student learning to improve professional development in systemic reform" *Teaching and Teacher Education*, Vol. 19, pp. 643-658.

Galloway, D. et al. (1982), "Sources of stress for classroom teachers", *National Education*, Vol. 64, pp. 166-169.

Gamage, D. and P. Hansson (2006), "A comparative study of profiles and perspectives on professional development of school leaders in Australia and Sweden", *Education and Society*, Vol. 24(3), pp. 61-81.

Garet, M.S. et al. (2001), "What makes professional development effective? Results from a national sample of teachers", *American Educational Research Journal*, Vol. 38(4), pp. 915-945.

Greeno, J.G., A.M. Collins and L. Resnick (1996), "Cognition and learning", in D. C. Berliner and R.C. Calfree (Eds.), *Handbook of educational psychology* (pp. 15–46), Simon & Schuster Macmillan, New York, NY.

Gregoire, M. (2003), "Is it a challenge or a threat? A dual-process model of teachers' cognition and appraisal processes during conceptual change", *Educational Psychology Review*, Vol. 15(2), pp. 147-179.

Grider, A.T. (2008), "Elementary, middle, and high school teachers' perceptions of professional learning community and sense of efficacy", *Dissertation Abstracts International Section A: Humanities and Social Sciences*, Vol. 69(4-A).

Grove, C.M., P.J. Dixon and M.M. Pop (2009), "Research experiences for teachers: Influences related to expectancy and value of changes to practice in the American classroom", *Professional Development in Education*, Vol. 35(2), pp. 247-260.

Guskey, T.R. (2003). What makes professional development effective? Phi Delta Kappan, 84(10).

Guskey, T.R. (2002), "Professional development and teacher change", *Teachers and Teaching: Theory and Practice*, Vol. 8(3/4), pp. 381-391.

Guskey, T. and D. Sparks (2004), "Linking professional development to improvements in student learning", in E.M. Guyton and J.R. Dangel (eds.), *Research Linking Teacher Preparation and Student Performance: Teacher Education Yearbook XII*, Kendall/Hunt, Dubuque, IA, pp. 233-247.

Hardré, P. L. and D. Sullivan (2008), "Classroom environments and student differences: How they contribute to student motivation in rural high schools", *Learning and Individual Differences*, Vol. 18, p. 471.

Hargreaves, A. (1998), "The emotional practice of teaching", *Teaching and Teacher Education*, Vol. 14, pp. 835-854.

Harrison, C. et al. (2008), "Evidence-based professional development of science teachers in two countries", *International Journal of Science Education*, Vol. 30(5), pp. 577-591.

Hassel, E. (1999), *Professional Development: Learning From the Best*, North Central Regional Educational Laboratory (NCREL), Oak Brook, IL.

Hawley, W.D, and L. Valli (1998), "The essentials of effective professional development: A new Consensus", in L.S. Darling-Hammond and G. Sykes (eds.), *The Heart of the Matter: Teaching as a Learning Profession*, Jossey-Bass, San Francisco, pp. 86-124.

Hill, H.C. (2009), "Fixing teacher professional development", *Phi Delta Kappan*, Vol. 90, No. 7, March, pp. 470-477.

Higgins, J. and R. Parsons (2009), "A successful professional development model in mathematics: A system-wide New Zealand case", *Journal of Teacher Education*, Vol. 60(3), pp. 231-242.

Hollingsworth, H. (1999), "Teacher professional growth: a study of primary teachers involved in mathematics professional development", thesis, http://works.bepress.com/hilary_hollingsworth/15/.

Hord, S. (1997), "Professional learning communities: Communities of continuous inquiry and improvement", Southwest Educational Development Laboratory, Austin, TX, www.sedl.org/pubs/change34/plc-cha34.pdf.

Ingvarson, L. M. Meiers and A. Beavis (2005), "Factors affecting the impact of professional development programs on teachers' knowledge, practice, student outcomes and efficacy", *Education Policy Analysis Archives*, Vol. 13(10), pp. 1-28.

Ingvarson, L. (1998), "Professional development as the pursuit of professional standards: The standards-based professional development system", *Teaching and Teacher Education*, Vol. 14(1), pp. 127-140.

James, M. et al. (2007), *Improving Learning How to Learn: Classrooms, Schools and Networks*, Routledge, London, UK.

Joyce, B., and E. Calhoun (1996), "School renewal: An inquiry, Not a prescription", in B. Joyce and E. Calhoun (eds.), *Learning Experiences in School Renewal: An Exploration of Five Successful Programs*, ERIC Clearinghouse on Educational Management, Eugene, OR, pp. 175-190

Joyce, B. and B. Showers (1995), *Student Achievement through Staff Development: Fundamentals of School Renewal*, 2nd edition, Longman, New York.

Jurow, S. (2009), "Cultivating self in the context of transformative professional development", *Journal of Teacher Education*, Vol. 60(3), pp. 277-290.

Keith, D. L. (2008), "Principal desirability for professional development", *Dissertation Abstracts International Section A: Humanities and Social Sciences*, Vol. 69(4-A).

Kennedy, M. (1998), "Form and substance of inservice teacher education", Research Monograph No. 13, National Institute for Science Education, University of Wisconsin-Madison, Madison, WI.

Killion, J. (1999), "What works in the middle: Results-based staff development" National Staff Development Council, Oxford, OH.

Knapp, M.S. (2003), "Professional development as policy pathway", *Review of Research in Education*, Vol. 27(1), pp. 109-157.

Kuskovski, V.D. (2008), "Relationship between professional development and teacher efficacy in teachers of international schools in Switzerland", *Dissertation Abstracts International Section A: Humanities and Social Sciences*, Vol. 69(2-A).

Lave, J. and E. Wenger (1991), *Situated Learning: Legitimate Peripheral Participation*, Cambridge University Press, Cambridge, UK.

Leinhardt, G. (1998), "On the messiness of overlapping goals and real settings", *Issues in Education*, Vol. 4(1), pp. 125-132.

Leithwood, K., R. Steinbach and D. Jantzi (2002), "School leadership and teachers' motivation to implement accountability policies", *Educational Administration Quarterly*, Vol. 38(1), pp. 94-119.

Loucks-Horsely, S. et al. (2003), *Designing Professional Development for Teachers Of Science And Mathematics*, Sage, Thousand Oaks, CA.

Loucks-Horsley, S. and C. Matsumoto (1999), "Research on professional development for teachers of mathematics and science: The state of the scene", *School Science and Mathematics*, Vol. 99(5), pp. 258-271.

Loucks-Horsley, S., K. Stiles and P. Hewson (1996), "Principles of effective professional development for mathematics and science education: A synthesis of standards", NISE Brief, Vol. 1, No. 1, May, University of Wisconsin at Madison, National Institute for Science Education, Madison, WI, pp. 1-5.

Louis, K.S., H.M. Marks and S. Kruse (1996), "Professional community in restructuring schools", *American Educational Research Journal*, Vol. 33(4), pp. 757-798.

Loxley, A. et al. (2007), "The role of whole-school contexts in shaping the experiences and outcomes associated with professional development", *Journal of In-service Education*, Vol. 33(3), p. 21.

Lydon, S. and C. King (2009), "Can a single, short continuing professional development workshop cause change in the classroom?", *Professional Development in Education*, Vol. 35(1), pp. 63-82.

McGill-Franzen, A. et al. (1999), "Putting books in the classroom seems necessary but not sufficient", *The Journal of Educational Research*, Vol. 93(2), pp. 67-74.

McLaughlin, M.W. and J.E. Talbert (2001), *Professional Communities and the Work of High School Teaching*, University Of Chicago Press, Chicago.

Meirinka, J.A. et al. (2009), "Understanding teacher learning in secondary education: The relations of teacher activities to changed beliefs about teaching and learning", *Teaching and Teacher Education*, Vol. 25(1), pp. 89-100.

Moore, F.M. (2008), "Positional identity and science teacher professional development", *Journal of Research in Science Teaching*, Vol. 45(6), pp. 684-710.

Mortimore, P. et al. (1990), *School Matters: The Junior Years*, Open Books, Wells, UK.

Mueller, J. et al. (2008), "Identifying discriminating variables between teachers who fully integrate computers and teachers with limited integration", *Computers and Education*, Vol. 51(4), pp. 1523-1537.

National Commission on Teaching & America's Future (1996), *What matters most: Teaching for America's future*, National Commission on Teaching & America's Future, New York, NY, http://nctaf.org/wp-content/uploads/WhatMattersMost.pdf.

Newman, F. and G. Wehlage (1997), "Successful school restructuring: A report to the public and educators by the Center on Organization and Restructuring of Schools", Wisconsin Center for Education Research, Madison, WI.

Nir, A.E. and R. Bogler (2008), "The antecedents of teacher satisfaction with professional development programs", *Teaching and Teacher Education*, Vol. 24(2), pp. 377-386.

Novak, D. and J.G. Knowles (1992), "Life histories and the transition to teaching as a second career", paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA, 20-24 April 1992.

OECD (2014), *TALIS 2013 Results: An International Perspective on Teaching and Learning*, TALIS, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264196261-en.

OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Opfer, V.D. and D. Pedder (2011), "Conceptualizing teacher professional learning", *Review of Educational Research*, Vol. 81(3), pp. 376-407.

Pedder, D. (2006), "Organizational conditions that foster successful classroom promotion of learning how to learn", *Research Papers in Education*, Vol. 21, pp. 171-200.

Pedder, D., M. James J. MacBeath (2005), "How teachers value and practice professional learning", *Research Papers in Education*, Vol. 20, pp. 209-243.

Pedder, D. and J. MacBeath (2008), "Organisational learning approaches to school leadership and management: Teachers' values and perceptions of practice", *School Effectiveness and School Improvement*, Vol. 19, pp. 207-224.

Penuel, W. et al. (2007), "What makes professional development effective? Strategies that foster curriculum implementation", *American Educational Research Journal*, Vol. 44(4), pp. 921-958.

Pollard, A. (1985), *The Social World of the Primary School*, Holt, Reinhart & Winston, London, UK.

Powell, R. and J. Birrell (1992), "The influence of prior experiences on pedagogical constructs of traditional and nontraditional preservice teachers", paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA, 20-24 April 1992.

Raths, J. (2001), "Teachers' beliefs and teaching beliefs", *Early Childhood Research & Practice*, Vol. 3(1),

Richardson, V. (2003a), "Preservice teachers' beliefs", in J. Raths and A.C. McAninch (eds.), *Teacher Beliefs and Classroom Performance: The Impact of Teacher Education, Volume 6: Advances in Teacher Education*, Information Age, Greenwich, CT, pp. 1-22.

Richardson, V. (2003b), "The dilemmas of professional development", *Phi Delta Kappan*, Vol. 84(5), pp. 401-406.

Richardson, V. (1996), "The role of attitudes and beliefs in learning to teach", in J. Sikula (ed.), *Handbook of Research on Teacher Education, Second Edition*, Macmillan, New York, pp. 102-119.

Richardson, V. and P. Placier (2001), "Teacher change", in V. Richardson (ed.), *Handbook of Research on Teaching*, 4th edition, American Educational Research Association, Washington, DC, pp. 905-947.

Rodríguez, S. et al. (2014), "Teacher self-efficacy and its relationship with students' affective and motivational variables in higher education", *European Journal of Education and Psychology*, Vol. 7(2), July-December, pp. 107-120.

Rutter, M. et al. (1979), *Fifteen Thousand Hours*, Open Books, London, UK.

Sampson, R. J., J.D. Morenoff and F. Earls (1999), "Beyond social capital: Spatial dynamics of collective efficacy for children", *American Sociology Review*, Vol. 64, pp. 633-660.

Saxe, G., M. Gearhart and N.S. Nasir (2001), "Enhancing students' understanding of Mathematics: A study of three contrasting approaches to professional support", *Journal of Mathematics Teacher Education*, Vol. 4, pp. 55-79.

Scribner, J.P. (1999), "Professional development: Untangling the influence of work context on teacher learning", *Educational Administration Quarterly*, Vol. 35(2), pp. 238-266.

Snow-Renner, R. and P. Lauer (2005), "Professional development analysis", MCREL Insights, Mid-Content Research for Education and Learning, Denver, CO.

Supovitz, J.A., D.P. Mayer and J.B. Kahle (2000), "Promoting inquiry based instructional practice: The longitudinal impact of professional development in the context of systemic reform", *Educational Policy*, Vol. 14(3), pp. 331-356.

Timperley, H. et al. (2007), "Teacher professional development: Best evidence synthesis iteration", Ministry of Education, Wellington, New Zealand, http://educationcounts.edcentre.govt.nz/goto/BES.

Weiss, I.R. and B. Miller (2009), "Determining what we know and how well we know it: The promises and perils of knowledge management", presentation at Math and Science Partnership (MSP) Learning Network Conference: Research Findings in Teacher Education: New Approaches >Transformative Possibilities?, Washington, DC, January 25-27, 2009, http://hub.mspnet.org/index.cfm/msp_conf_2009.

Weiss, I.R. and J.D. Pasley (2009), *Mathematics and Science for a Change: How to Design, Implement, and Sustain High-Quality Professional Development*, Heinemann, Portsmouth, NH.

Weiss, I.R. and J.D. Pasley (2006), "Scaling up instructional improvement through teacher professional development: Insights from the local systemic change initiative", *CPRE Policy Briefs*, March, 2006, http://repository.upenn.edu/cpre_policybriefs/32.

Wilson, S.M. and J. Berne (1999), "Teacher learning and the acquisition of professional knowledge: An examination of research on contemporary professional development", *Review of Research in Education*, Vol. 24, pp. 173-209.

Woods, P., B. Jeffery and G. Troman (1997), *Restructuring Schools, Reconstructing Teachers*, Open University Press, Buckingham, UK.

Woolfolk Hoy, A. and R. Burke-Spero (2005), "Changes in teacher efficacy during the early years if teaching: A comparison of four measures", *Teaching and Teacher Education*, Vol. 21, pp. 343-356.

Yoon, K. S. et al. (2007), "Reviewing the evidence on how teacher professional development affects student achievement", *Issues & Answers Report*, REL 2007-No. 033,U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Southwest, Washington, DC, http://ies.ed.gov/ncee/edlabs/regions/southwest/pdf/rel_2007033.pdf.

Zambo, R. and D. Zambo (2008), "The impact of professional development in mathematics on teachers' individual and collective efficacy: The stigma of underperforming", *Teacher Education Quarterly*, Vol. 35(1), pp. 159-168.

ANNEX: TECHNICAL APPENDIX

The first step in conducting analyses presented in this paper was preparing the data. After removing teachers who had not participated in any professional development in the 12 months prior to the survey (approximately 3%) the final sample for analysis was 102 746 teachers (from 34 systems and economies). An analysis of missing data was then conducted and data were found to be missing at random. Fully conditioned specification (MCMC) was used with 10 iterations to create 5 imputed data files.

Identifying factors related to professional development for use in analysis

One of the five imputed data files was used for exploratory factor analysis in Amos V20. With a large sample size the X^2 goodness-of-fit measure becomes problematic; as a result, RMSEA (Root Mean Square Error of Approximation) was relied on to determine best model fit for factors. Factors with theoretical coherence and the lowest RMSEA identified in Amos were then confirmed with the other four data sets using confirmatory factor analysis with SPSS V20. Barlett scores were saved as new variables and used in subsequent analyses.

Using these procedures, five new factors were created:

- School conditions that support professional development
- Teacher beliefs that support professional development
- School embedded professional development
- Non-school embedded professional development
- Professional development impact on instruction.

The school conditions factor includes six items. Means and standard deviations for the items are in Table A.1 below. Factor loadings for each item and the factor fit statistics are shown in Table A.2.

Table A.1 Means and standard deviations for items in school conditions factor

School conditions factor items	Mean	Std. deviation
How often do you [teacher] exchange teaching materials with colleagues?	2.24	0.733
How often do you [teacher] engage in discussions about the learning development of specific students?	2.49	0.643
How often do you [teacher] attend team conferences?	2.20	0.749
How frequently did you [school leader] take action in supporting co-operation among teachers?	2.78	0.701
How frequently did you [school leader] take action to ensure teachers feel responsibility for improving teaching skills?	2.84	0.693
How frequently did you [school leader] take action to ensure teachers feel responsibility for learning outcomes?	2.96	0.699

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Table A.2 Factor item loadings and fit statistics for school conditions factor

Item	Factor loadings
Exchange teaching materials with colleagues	-0.086
Engage in discussions about the learning development of specific students	-0.15
Attend team conferences	-0.179
Support co-operation among teachers	0.776
Ensuring teacher responsibility for improving teaching skills	0.874
Ensuring teacher responsibility for improving learning outcomes	0.82
Fit statistics	
Eigenvalue	2.099
% Variance	34.985
α	0.535
CFI	0.995
RMSEA	0.031
Chi Sq	624.87
DF	6
sig.	0.000

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

The teacher beliefs factor includes 16 items. Means and standard deviations for the items are in Table A.3 below. Factor loadings for each item and the factor fit statistics are shown in Table A.4.

Table A.3 Means and standard deviations for teacher belief items

Items	Mean	Std. deviation
Prepared for teaching content of the subject(s) I teach	3.53	0.652
Prepared for teaching pedagogy of the subject(s) I teach	3.30	0.702
Prepared for teaching classroom practice in the subject(s) I teach	3.36	0.726
Extent to which you can craft good questions for students	3.22	0.663
Extent to which you can control disruptive behaviour in the classroom	3.25	0.692
Extent to which you can make expectations about student behaviour clear	3.37	0.650
Extent to which you can get students to follow classroom rules	3.29	0.661
Extent to which you can calm a student who is disruptive or noisy	3.21	0.704
Extent to which you can use a variety of assessment strategies	3.14	0.710
Extent to which you can provide an alternative explanation	3.38	0.639
Extent to which you can implement alternative instructional strategies	3.08	0.739
Believe role as a teacher is to facilitate students' own inquiry	3.29	0.617
Believe students learn best by finding solutions to problems on their own	3.10	0.695
Believe students should be allowed to think of solutions themselves	3.23	0.624
Believe thinking and reasoning processes are more important	3.08	0.697
Am satisfied with my performance in this school	3.16	0.578

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Table A.4 Item loadings and fit statistics for teacher beliefs factor

Item	Factor loadings
Prepared to teach content of subjects I teach	0.421
Prepared to teach pedagogy of subjects I teach	0.486
Prepared to teach classroom practices in subjects I teach	0.493
Role as a teacher is to facilitate students' inquiry	0.276
Students learn best by finding solutions to problems on their own	0.184
Students should be allowed to think of solutions themselves	0.236
Thinking and reasoning processes are more important	0.196
Craft good questions for students	0.645
Control disruptive behaviour	0.696
Make my expectations about student behaviour clear	0.694
Get students to follow classroom rules	0.716
Calm a student who is disruptive or noisy	0.703
Use a variety of assessments	0.693
Provide alternative explanations	0.705
Implement alternative instructional strategies	0.66
Satisfied with performance in this school	0.44
Fit statistics	
Eigenvalue	4.857
% Variance	30.354
α	0.83
CFI	0.997
RMSEA	0.016
Chi Sq	2158.967
DF	72
sig.	0.000

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

The resulting teacher belief factor had negative skewness. A log10 transformation was conducted after which skewness was within acceptable estimates.

The school embedded professional development factor contains six items. Means and standard deviations for the items are in Table A.5 below. Factor loadings for each item and the factor fit statistics are shown in Table A.6.

Table A.5 Means and standard deviations for items in school embedded professional development factor

Items	Mean	Std. deviation
Participation in a network of teachers	1.34	0.473
Individual or collaborative research	1.32	0.467
Mentoring and coaching	1.29	0.453
Observe other teachers' classes and provide feedback	1.42	0.635
Work with teachers to ensure common standards for assessing student progress	2.19	0.738
Take part in collaborative professional learning	1.79	0.702

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Table A.6 Factor loadings and fit statistics for school embedded professional development

Item	Factor loadings
Participation in a network of teachers	0.52
Individual or collaborative research	0.46
Mentoring and coaching	0.59
Observe other teachers' classes and provide feedback	0.54
Work with other teachers to ensure common standards for assessing progress	0.55
Take part in collaborative professional learning	0.67
Fit Statistics	
Eigenvalue	1.871
% Variance	31.18
α	0.554
CFI	0.994
RMSEA	0.023
Chi Sq	285.902
DF	5
sig.	0.000

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

The non-school embedded professional development factor contains four items. Means and standard deviations for the items are in Table A.7 below. Factor loadings for each item and the factor fit statistics are shown in Table A.8.

Table A.7 Means and standard deviations for non-school embedded factor items

Items	Mean	Std. Deviation
Courses and workshops	1.33	0.471
Education conferences or seminars	1.58	0.493
In-service training courses in business premises	1.84	0.363
Qualification programme (e.g. a degree programme)	1.80	0.402

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Table A.8 Factor loadings and fit statistics for non-school embedded factor

Item	Factor loadings
Courses and workshops	0.69
Conferences and seminars	0.66
In-service training at businesses	0.55
Qualification programme	0.50
Fit Statistics	
Eigenvalue	1.467
% Variance	36.680
α	0.422
CFI	0.992
RMSEA	0.033
Chi Sq	117.479
DF	1
sig.	0.000

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

The factor for impact of professional development on instruction contains eight items. Means and standard deviations for the items are in Table A.9 below. Factor loadings for each item and the factor fit statistics are shown in Table A.10.

Table A.9 Means and standard deviations for items in the professional development impact factor

Items	Mean	Std. deviation
Knowledge and understanding of my subject field(s)	1.70	0.459
Pedagogical competences in teaching my subject fields(s)	1.67	0.469
Professional development/Topic of activities/Knowledge of the curriculum/Impact	1.66	0.475
Student evaluation and assessment practices	1.64	0.479
ICT (information and communication technology) skills	1.62	0.486
Student behaviour and classroom management	1.62	0.486
Teaching cross-curricular skills	1.61	0.488
Student career guidance and counselling	1.60	0.490

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Table A.10 Factor loadings and fit statistics for professional development impact factor

Item	Factor loadings
Professional development had a positive impact on knowledge and understanding of my subject field(s)	0.885
Professional development had a positive impact on pedagogical competencies in teaching my subject field(s)	0.883
Professional development had a positive impact on knowledge of the curriculum	0.863
Professional development had a positive impact on student evaluation and assessment practices	0.857
Professional development had a positive impact on ICT skills for teaching	0.816
Professional development had a positive impact on student behaviour and classroom management	0.846
Professional development had a positive impact on teaching cross-curricular skills (e.g. problem solving, learning-to-learn)	0.844
Professional development had a positive impact on student career guidance and counselling	0.828
Fit statistics	
Eigenvalue	5.820
% Variance	72.744
α	0.946
CFI	0.999
RMSEA	0.020
Chi Sq	503.912
DF	11
sig.	0.000

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Eigenvalues and percent variance explained for each of the reported factors by system can be found in Table A.11 below.

Table A.11 Fit statistics for each factor by system

	School conditions		Teacher beliefs		Non-job embedded PD		Job embedded PD		PD impact	
System	Eigen	%	Eigen	%	Eigen	%	Eigen	%	Eigen	%
Abu Dhabi (United Arab Emirates)	2.328	38.80	4.858	32.38	1.770	44.24	2.436	40.60	6.080	76.00
Alberta (Canada)	2.290	38.17	4.242	28.28	1.281	32.01	1.845	30.75	4.272	53.40
Australia	2.325	38.75	4.529	30.20	1.358	33.95	1.832	30.53	4.442	55.52
Brazil	2.145	35.75	4.163	27.75	1.704	42.61	1.933	32.22	6.020	75.26
Bulgaria	1.840	30.67	3.720	24.80	1.746	43.67	1.827	30.46	6.363	79.54
Chile	2.076	34.60	4.738	31.59	1.686	42.16	2.190	36.50	6.889	86.12
Croatia	1.934	32.24	4.056	27.05	1.249	31.23	1.646	27.43	5.054	63.18
Czech Republic	2.078	34.63	3.850	25.67	1.479	36.97	1.753	29.22	5.735	71.68
Denmark	2.033	33.89	4.085	27.23	1.377	34.43	1.716	28.60	5.551	69.39
England (United Kingdom)	2.078	35.63	4.452	26.68	1.346	33.66	1.961	32.68	4.971	62.14
Estonia	1.893	31.54	3.705	24.70	1.444	36.09	1.903	37.72	4.925	61.56
Finland	1.922	32.04	3.941	26.27	1.314	32.84	1.746	29.10	5.471	68.39
Flanders (Belgium)	2.213	36.89	3.827	25.51	1.260	31.50	1.653	27.54	5.497	68.71
France	1.908	31.80	3.218	21.45	1.219	30.47	1.661	27.68	6.072	75.90
Iceland	2.009	33.48	4.346	28.97	1.532	38.29	1.777	29.61	5.929	74.11
Israel	2.140	35.67	4.340	28.93	1.335	33.37	1.887	31.45	5.771	72.14
Italy	1.963	32.72	4.033	26.89	1.440	36.01	1.698	28.30	6.276	78.45
Japan	2.044	34.06	4.731	31.54	1.463	36.57	1.946	32.43	6.107	76.33
Korea	2.012	33.53	5.000	33.33	1.589	39.72	2.123	35.38	6.238	77.97
Latvia	1.797	29.96	3.774	24.96	1.318	32.96	1.897	31.62	4.845	60.57
Mexico	2.037	33.94	3.489	23.26	1.497	37.41	1.963	32.72	5.822	72.78
Netherlands	1.993	33.22	3.681	34.54	1.369	34.23	1.748	29.14	4.965	62.06
Norway	2.246	37.43	4.152	27.68	1.293	32.32	1.620	26.99	5.715	71.43
Poland	1.806	30.11	4.145	27.63	1.421	35.52	1.805	30.08	5.168	64.61
Portugal	2.123	35.38	3.971	26.47	1.512	37.81	1.505	25.08	6.293	78.66
Romania	2.061	34.53	4.159	27.73	1.344	33.61	1.717	28.61	6.437	80.47
Serbia	1.908	31.80	3.971	26.74	1.238	30.96	1.811	30.18	6.062	75.78
Singapore	2.130	35.40	4.889	32.59	1.278	31.94	1.871	31.18	4.520	56.50
Slovak Republic	1.830	30.50	4.038	26.92	1.444	36.11	1.841	30.68	6.624	82.80
Spain	2.074	34.60	3.897	25.98	1.360	34.01	1.632	27.21	5.924	75.05
Sweden	2.080	34.66	3.846	25.64	1.342	33.55	1.630	27.17	5.387	67.33

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Pearson, two-tailed correlation was used to understand the association between professional development type and teacher reported impact. These relationships reported by system appear in Table A.12 below. All correlations were significant for all systems at $p < 0.01$.

Table A.12 Relationship between type of professional development and teacher reported impact, by system

	Professional development impact	
System	School embedded PD	Non-school embedded PD
Abu Dhabi (United Arab Emirates)	0.384	-0.397
Alberta (Canada)	0.172	-0.152
Australia	0.187	-0.152
Brazil	0.338	-0.317
Bulgaria	0.342	-0.526
Chile	0.273	-0.519
Croatia	0.304	-0.292
Czech Republic	0.297	-0.515
Denmark	0.293	-0.457
England (United Kingdom)	0.290	-0.328
Estonia	0.299	-0.347
Finland	0.264	-0.476
Flanders (Belgium)	0.188	-0.447
France	0.354	-0.511
Iceland	0.286	-0.286
Israel	0.309	-0.326
Italy	0.327	-0.522
Japan	0.464	-0.469
Korea	0.349	-0.407
Latvia	0.181	-0.335
Mexico	0.363	-0.400
Netherlands	0.276	-0.326
Norway	0.300	-0.443
Poland	0.288	-0.378
Portugal	0.314	-0.478
Romania	0.347	-0.369
Serbia	0.369	-0.371
Singapore	0.216	-0.204
Slovak Republic	0.407	-0.566
Spain	0.363	-0.482
Sweden	0.297	-0.435

Note: Pearson, two-tailed correlation. All results significant at p <0.01.

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Pearson, two-tailed correlation was used to understand the association between professional development type and teacher beliefs. These relationships reported by system appear in Table A.13 below. All correlations were significant for all systems at $p < 0.01$.

Table A.13 Correlation between type of PD and teacher belief, by system

	Teacher belief	
System	School embedded PD	Non-school embedded PD
Abu Dhabi (United Arab Emirates)	0.368	-0.303
Alberta (Canada)	0.215	-0.083
Australia	0.221	-0.117
Brazil	0.210	-0.175
Bulgaria	0.220	-0.077
Chile	0.153	-0.126
Croatia	0.257	-0.106
Czech Republic	0.232	-0.099
Denmark	0.136	-0.103
England (United Kingdom)	0.246	-0.143
Estonia	0.222	-0.085
Finland	0.206	-0.115
Flanders (Belgium)	0.167	-0.080
France	0.106	-0.077
Iceland	0.251	-0.197
Israel	0.283	-0.122
Italy	0.176	-0.012
Japan	0.192	-0.091
Korea	0.302	-0.183
Latvia	0.221	-0.138
Mexico	0.202	-0.109
Netherlands	0.190	-0.091
Norway	0.199	-0.123
Poland	0.179	-0.056
Portugal	0.208	-0.139
Romania	0.254	-0.098
Serbia	0.246	-0.098
Singapore	0.197	-0.113
Slovak Republic	0.217	-0.089
Spain	0.215	-0.103
Sweden	0.172	-0.074

Note: Pearson, two-tailed correlation. All results significant at $p < .01$.

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Pearson, two-tailed correlation was used to understand the association between professional development type and school conditions. These relationships reported by system appear in Table A.14 below. Significant correlations are all $p < 0.01$.

Table A.14 Correlation between type of PD and school conditions, by system

	School conditions	
System	School embedded PD	Non-school embedded PD
Abu Dhabi (United Arab Emirates)	-0.038	-0.027
Alberta (Canada)	0.218	-0.043
Australia	0.080	0.086
Brazil	0.115	-0.051
Bulgaria	0.267	-0.129
Chile	0.145	0.041
Croatia	0.155	-0.076
Czech Republic	0.020	0.017
Denmark	0.114	-0.075
England (United Kingdom)	0.111	-0.036
Estonia	0.012[x]	-0.002[x]
Finland	0.055	-0.009[x]
Flanders (Belgium)	0.000[x]	0.028
France	0.067	-0.008
Iceland	0.088	-0.030[x]
Israel	0.245	-0.093
Italy	0.042	0.030
Japan	0.067	-0.032
Korea	0.198	-0.047
Latvia	0.100	-0.025
Mexico	0.075	-0.014
Netherlands	0.200	-0.003[x]
Norway	0.085	-0.102
Poland	0.165	-0.039
Portugal	0.082	-0.034
Romania	0.153	-0.107
Serbia	-0.064	0.038
Singapore	-0.015[x]	0.000[x]
Slovak Republic	0.055	0.010[x]
Spain	0.144	-0.073
Sweden	0.059	0.001[x]

Note: Pearson, two-tailed correlation. [x] indicates non-significant results.

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Identifying school types and their relationship to professional development type and impact

Both the teacher beliefs factor and the school conditions factor were used in a two-step cluster analysis to identify school types. The two-step procedure in SPSS was used because of the large sample size, a lack of clarity about the number of clusters present in the data, and the use of continuous variables in the analysis. Four clusters emerged with good model fit (silhouette measure of cohesion = 0.5). The clusters had a ratio of 2.52 largest to smallest. Cluster one had 24.5% of teachers, cluster two 34.3%, cluster three 27.7%, and cluster four 13.6%. Both the school embedded professional development and non-school embedded professional development factors were used as evaluation factors in the model in order to see how each of the clusters identified varied for these two outcomes. All predictors in the model performed well: school conditions, teacher beliefs and school embedded professional development at 1.00 and non-school embedded professional development at 0.58.

Analysis of variance was then used to compare item level responses by teachers between each of the identified clusters. Levene's test of homogeneity was significant for items related to both teacher co-operation and instructionally focused leadership. Welch test for equality of means is, therefore, reported below and is significant.

Table A.15 Welch test for equality of means for school conditions

Welch robust tests of equality of means				
	Statistic*	df1	df2	Sig.
How often do teachers exchange teaching materials with colleagues?	390.244	4	14819.086	0.000
How often do teachers engage in discussions about the learning development of specific students?	662.534	4	14900.825	0.000
How often do teachers attend team conferences?	643.053	4	14809.423	0.000
How frequently did the school leader engage in supporting co-operation among teachers?	20918.604	4	14497.403	0.000
How frequently did the school leader engage teachers in responsibility for improving teaching skills?	46967.253	4	14412.296	0.000
How frequently did the school leader engage teachers in responsibility for learning outcomes?	30988.862	4	14588.916	0.000

Note: * Asymptotically F distributed.

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Tukey's HSD (honest significant difference) test indicates significant differences between clusters on most of the school conditions related items at the 0.05 level (see Table A.16 below). No difference in means was found between teachers in Clusters 2 and 3 on the item asking school leaders how often they engaged teachers in responsibility for learning outcomes.

Table A.16 Tukey's HSD test for differences between clusters for school conditions

Tukey HSD multiple comparisons							
Dependent variable			Mean difference (I-J)	Std. error	Sig.	95% confidence interval	
						Lower bound	Upper bound
How often do teachers exchange teaching materials with colleagues?	1	2	0.080*	0.006	0.000	0.06	0.10
		3	-0.099*	0.006	0.000	-0.12	-0.08
		4	0.137*	0.008	0.000	0.12	0.16
	2	1	-0.080*	0.006	0.000	-0.10	-0.06
		3	-0.179*	0.006	0.000	-0.20	-0.16
		4	0.057*	0.007	0.000	0.04	0.08
	3	1	0.099*	0.006	0.000	0.08	0.12
		2	0.179*	0.006	0.000	0.16	0.20
		4	0.236*	0.008	0.000	0.22	0.26
	4	1	-0.137*	0.008	0.000	-0.16	-0.12
		2	-0.057*	0.007	0.000	-0.08	-0.04
		3	-0.236*	0.008	0.000	-0.26	-0.22
How often do teachers engage in discussions about the learning development of specific students?	1	2	0.118*	0.005	0.000	0.10	0.13
		3	-0.065*	0.006	0.000	-0.08	-0.05
		4	0.227*	0.007	0.000	0.21	0.25
	2	1	-0.118*	0.005	0.000	-0.13	-0.10
		3	-0.183*	0.005	0.000	-0.20	-0.17
		4	0.109*	0.006	0.000	0.09	0.13
	3	1	0.065*	0.006	0.000	0.05	0.08
		2	0.183*	0.005	0.000	0.17	0.20
		4	0.292*	0.007	0.000	0.27	0.31
	4	1	-0.227*	0.007	0.000	-0.25	-0.21
		2	-0.109*	0.006	0.000	-0.13	-0.09
		3	-0.292*	0.007	0.000	-0.31	-0.27
How often do teachers attend team conferences?	1	2	0.197*	0.006	0.000	0.18	0.21
		3	0.042*	0.006	0.000	0.02	0.06
		4	0.324*	0.008	0.000	0.30	0.35
	2	1	-0.197*	0.006	0.000	-0.21	-0.18
		3	-0.155*	0.006	0.000	-0.17	-0.14
		4	0.127*	0.007	0.000	0.11	0.15
	3	1	-0.042*	0.006	0.000	-0.06	-0.02
		2	0.155*	0.006	0.000	0.14	0.17
		4	0.282*	0.008	0.000	0.26	0.30
	4	1	-0.324*	0.008	0.000	-0.35	-0.30
		2	-0.127*	0.007	0.000	-0.15	-0.11
		3	-0.282*	0.008	0.000	-0.30	-0.26

Table A.16 Tukey's HSD test for differences between clusters for school conditions – continued

Tukey HSD multiple comparisons							
Dependent variable			Mean difference (I-J)	Std. error	Sig.	95% confidence interval	
						Lower bound	Upper bound
How frequently did the school leader engage in supporting co-operation among teachers?	1	2	-0.741*	0.004	0.000	-0.75	-0.73
		3	-0.711*	0.005	0.000	-0.72	-0.70
		4	-1.538*	0.006	0.000	-1.55	-1.52
	2	1	0.741*	0.004	0.000	0.73	0.75
		3	0.031*	0.004	0.000	0.02	0.04
		4	-0.797*	0.005	0.000	-0.81	-0.78
	3	1	0.711*	0.005	0.000	0.70	0.72
		2	-0.031*	0.004	0.000	-0.04	-0.02
		4	-0.827*	0.006	0.000	-0.84	-0.81
	4	1	1.538*	0.006	0.000	1.52	1.55
		2	0.797*	0.005	0.000	0.78	0.81
		3	0.827*	0.006	0.000	0.81	0.84
How frequently did the school leader engage teachers in responsibility for improving teaching skills?	1	2	-0.920*	0.004	0.000	-0.93	-0.91
		3	-0.883*	0.004	0.000	-0.89	-0.87
		4	-1.806*	0.005	0.000	-1.82	-1.79
	2	1	0.920*	0.004	0.000	0.91	0.93
		3	0.038*	0.003	0.000	0.03	0.05
		4	-0.886*	0.004	0.000	-0.90	-0.87
	3	1	0.883*	0.004	0.000	0.87	0.89
		2	-0.038*	0.003	0.000	-0.05	-0.03
		4	-0.923*	0.004	0.000	-0.94	-0.91
	4	1	1.806*	0.005	0.000	1.79	1.82
		2	0.886*	0.004	0.000	0.87	0.90
		3	0.923*	0.004	0.000	0.91	0.94
How frequently did the school leader engage teachers in responsibility for learning outcomes?	1	2	-0.834*	0.004	0.000	-0.85	-0.82
		3	-0.831*	0.004	0.000	-0.84	-0.82
		4	-1.641*	0.005	0.000	-1.66	-1.63
	2	1	0.834*	0.004	0.000	0.82	0.85
		3	0.003	0.004	0.939	-0.01	0.01
		4	-0.807*	0.005	0.000	-0.82	-0.79
	3	1	0.831*	0.004	0.000	0.82	0.84
		2	-0.003	0.004	0.939	-0.01	0.01
		4	-0.810*	0.005	0.000	-0.82	-0.80
	4	1	1.641*	0.005	0.000	1.63	1.66
		2	0.807*	0.005	0.000	0.79	0.82
		3	0.810*	0.005	0.000	0.80	0.82

Note: * The mean difference is significant at the 0.05 level.

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Analyses of variance were also run to consider differences in means between clusters for items related to teacher beliefs. The Levene Test was also significant for these items, therefore, Welch Robust Tests of Equality of Means are reported (see Table A.17 below) and all were significant.

Table A.17 Welch test of equality of means for teacher beliefs

Welch robust tests of equality of means				
	Statistic*	**df1**	**df2**	**Sig.**
Prepared for teaching content of the subject(s) I teach	5425.439	4	22070.857	0.000
Prepared for teaching pedagogy of the subject(s) I teach	8497.760	4	20062.112	0.000
Prepared for teaching classroom practice in the subject(s) I teach	8127.535	4	20978.875	0.000
To what extent can you craft good questions for my students?	13305.614	4	18309.833	0.000
To what extent can you control disruptive behaviour in the classroom?	16413.279	4	20096.078	0.000
To what extent can you make my expectations about student behaviour clear?	14258.068	4	19269.422	0.000
To what extent can you get students to follow classroom rules?	18034.117	4	20244.640	0.000
To what extent can you calm a student who is disruptive or noisy?	16778.269	4	19124.377	0.000
To what extent can you use a variety of assessment strategies?	16609.686	4	18527.127	0.000
To what extent can you provide an alternative explanation?	16258.257	4	19826.432	0.000
To what extent can you implement alternative instructional strategies?	16393.555	4	18843.544	0.000
My role as a teacher is to facilitate students' own inquiry	2987.335	4	16064.231	0.000
Students learn best by finding solutions to problems on their own	1359.935	4	15208.130	0.000
Students should be allowed to think of solutions themselves	2025.471	4	15487.767	0.000
Thinking and reasoning processes are more important	1087.514	4	15106.391	0.000
I am satisfied with my performance in this school	4978.975	4	15645.030	0.000

Note: * Asymptotically F distributed.

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.

Tukey's HSD test indicates significant differences between clusters on all of the teacher belief related items at the 0.05 level (see Table A.18 below).

Table A.18 Tukey's HSD test for differences between clusters for teacher beliefs

Multiple comparisons							
Tukey HSD							
Dependent variable			Mean difference (I-J)	Std. error	Sig.	95% confidence interval	
						Lower bound	Upper bound
Prepared for teaching content of the subject(s) I teach	1	2	0.023*	0.005	0.000	0.01	0.04
		3	-0.362*	0.005	0.000	-0.38	-0.35
		4	-0.077*	0.007	0.000	-0.09	-0.06
	2	1	-0.023*	0.005	0.000	-0.04	-0.01
		3	-0.385*	0.005	0.000	-0.40	-0.37
		4	-0.100*	0.006	0.000	-0.12	-0.08
	3	1	0.362*	0.005	0.000	0.35	0.38
		2	0.385*	0.005	0.000	0.37	0.40
		4	0.285*	0.007	0.000	0.27	0.30
	4	1	0.077*	0.007	0.000	0.06	0.09
		2	0.100*	0.006	0.000	0.08	0.12
		3	-0.285*	0.007	0.000	-0.30	-0.27
Prepared for teaching pedagogy of the subject(s) I teach	1	2	0.053*	0.006	0.000	0.04	0.07
		3	-0.472*	0.006	0.000	-0.49	-0.46
		4	-0.097*	0.007	0.000	-0.12	-0.08
	2	1	-0.053*	0.006	0.000	-0.07	-0.04
		3	-0.525*	0.005	0.000	-0.54	-0.51
		4	-0.149*	0.007	0.000	-0.17	-0.13
	3	1	0.472*	0.006	0.000	0.46	0.49
		2	0.525*	0.005	0.000	0.51	0.54
		4	0.376*	0.007	0.000	0.36	0.39
	4	1	0.097*	0.007	0.000	0.08	0.12
		2	0.149*	0.007	0.000	0.13	0.17
		3	-0.376*	0.007	0.000	-0.39	-0.36
Prepared for teaching classroom practice in the subject(s) I teach	1	2	0.055*	0.006	0.000	0.04	0.07
		3	-0.496*	0.006	0.000	-0.51	-0.48
		4	-0.123*	0.007	0.000	-0.14	-0.10
	2	1	-0.055*	0.006	0.000	-0.07	-0.04
		3	-0.552*	0.006	0.000	-0.57	-0.54
		4	-0.178*	0.007	0.000	-0.20	-0.16
	3	1	.0496*	0.006	0.000	0.48	0.51
		2	0.552*	0.006	0.000	0.54	0.57
		4	0.373*	0.007	0.000	0.35	0.39
	4	1	0.123*	0.007	0.000	0.10	0.14
		2	0.178*	0.007	0.000	0.16	.20
		3	-0.373*	0.007	0.000	-0.39	-0.35

Table A.18 Tukey's HSD test for differences between clusters for teacher beliefs – continued

Multiple comparisons							
Tukey HSD							
Dependent variable			Mean difference (I-J)	Std. error	Sig.	95% confidence interval	
						Lower bound	Upper bound
To what extent can you craft good questions for my students?	1	2	0.117*	0.005	0.000	0.10	0.13
		3	-0.589*	0.005	0.000	-0.60	-0.57
		4	-0.125*	0.006	0.000	-0.14	-0.11
	2	1	-0.117*	0.005	0.000	-0.13	-0.10
		3	-0.706*	0.005	0.000	-0.72	-0.69
		4	-0.241*	0.006	0.000	-0.26	-0.23
	3	1	0.589*	0.005	0.000	0.57	0.60
		2	0.706*	0.005	0.000	0.69	0.72
		4	0.464*	0.006	0.000	0.45	0.48
	4	1	0.125*	0.006	0.000	0.11	0.14
		2	0.241*	0.006	0.000	0.23	0.26
		3	-0.464*	0.006	0.000	-0.48	-0.45
To what extent can you control disruptive behaviour in the classroom?	1	2	0.175*	0.005	0.000	0.16	0.19
		3	-0.631*	0.005	0.000	-0.65	-0.62
		4	-0.083*	0.006	0.000	-0.10	-0.07
	2	1	-0.175*	0.005	0.000	-0.19	-0.16
		3	-0.806*	0.005	0.000	-0.82	-0.79
		4	-0.258*	0.006	0.000	-0.27	-0.24
	3	1	0.631*	0.005	0.000	0.62	0.65
		2	0.806*	0.005	0.000	0.79	0.82
		4	0.548*	0.006	0.000	0.53	0.57
	4	1	0.083*	0.006	0.000	0.07	0.10
		2	0.258*	0.006	0.000	0.24	0.27
		3	-0.548*	0.006	0.000	-0.57	-0.53
To what extent can you make my expectations about student behaviour clear?	1	2	0.140*	0.005	0.000	0.13	0.15
		3	-0.599*	0.005	0.000	-0.61	-0.59
		4	-0.094*	0.006	0.000	-0.11	-0.08
	2	1	-0.140*	0.005	0.000	-0.15	-0.13
		3	-0.739*	0.005	0.000	-0.75	-0.73
		4	-0.234*	0.006	0.000	-0.25	-0.22
	3	1	0.599*	0.005	0.000	0.59	0.61
		2	0.739*	0.005	0.000	0.73	0.75
		4	0.505*	0.006	0.000	0.49	0.52
	4	1	0.094*	0.006	0.000	0.08	0.11
		2	0.234*	0.006	0.000	0.22	0.25
		3	-0.505*	0.006	0.000	-0.52	-0.49

Table A.18 Tukey's HSD test for differences between clusters for teacher beliefs – continued

Multiple comparisons							
Tukey HSD							
Dependent variable			Mean difference (I-J)	Std. error	Sig.	95% confidence interval	
						Lower bound	Upper bound
To what extent can you get students to follow classroom rules?	1	2	0.152*	0.005	0.000	0.14	0.17
		3	-0.649*	0.005	0.000	-0.66	-0.63
		4	-0.106*	0.006	0.000	-0.12	-0.09
	2	1	-0.152*	0.005	0.000	-0.17	-0.14
		3	-0.801*	0.005	0.000	-0.81	-0.79
		4	-0.258*	0.006	0.000	-0.27	-0.24
	3	1	0.649*	0.005	0.000	0.63	0.66
		2	0.801*	0.005	0.000	0.79	0.81
		4	0.543*	0.006	0.000	0.53	0.56
	4	1	0.106*	0.006	0.000	0.09	0.12
		2	0.258*	0.006	0.000	0.24	0.27
		3	-0.543*	0.006	0.000	-0.56	-0.53
To what extent can you calm a student who is disruptive or noisy?	1	2	0.172*	0.005	0.000	0.16	0.19
		3	-0.668*	0.005	0.000	-0.68	-0.65
		4	-0.087*	0.006	0.000	-0.11	-0.07
	2	1	-0.172*	0.005	0.000	-0.19	-0.16
		3	-0.840*	0.005	0.000	-0.85	-0.83
		4	-0.259*	0.006	0.000	-0.28	-0.24
	3	1	0.668*	0.005	0.000	0.65	0.68
		2	0.840*	0.005	0.000	0.83	0.85
		4	0.581*	0.006	0.000	0.56	0.60
	4	1	0.087*	0.006	0.000	0.07	0.11
		2	0.259*	0.006	0.000	0.24	0.28
		3	-0.581*	0.006	0.000	-0.60	-0.56
To what extent can you use a variety of assessment strategies?	1	2	0.101*	0.005	0.000	0.09	0.11
		3	-0.719*	0.005	0.000	-0.73	-0.70
		4	-0.177*	0.007	0.000	-0.19	-0.16
	2	1	-0.101*	0.005	0.000	-0.11	-0.09
		3	-0.820*	0.005	0.000	-0.83	-0.81
		4	-0.277*	0.006	0.000	-0.29	-0.26
	3	1	0.719*	0.005	0.000	0.70	0.73
		2	0.820*	0.005	0.000	0.81	0.83
		4	0.543*	0.006	0.000	0.53	0.56
	4	1	0.177*	0.007	0.000	0.16	0.19
		2	0.277*	0.006	0.000	0.26	0.29
		3	-0.543*	0.006	0.000	-0.56	-0.53

Table A.18 Tukey's HSD test for differences between clusters for teacher beliefs – continued

Multiple comparisons							
Tukey HSD							
Dependent variable			Mean difference (I-J)	Std. error	Sig.	95% confidence interval	
						Lower bound	Upper bound
To what extent can you provide an alternative explanation?	1	2	0.143*	0.005	0.000	0.13	0.16
		3	-0.616*	0.005	0.000	-0.63	-0.60
		4	-0.110*	0.006	0.000	-0.13	-0.09
	2	1	-0.143*	0.005	0.000	-0.16	-0.13
		3	-0.759*	0.004	0.000	-0.77	-0.75
		4	-0.253*	0.006	0.000	-0.27	-0.24
	3	1	0.616*	0.005	0.000	0.60	0.63
		2	0.759*	0.004	0.000	0.75	0.77
		4	0.506*	0.006	0.000	0.49	0.52
	4	1	0.110*	0.006	0.000	0.09	0.13
		2	0.253*	0.006	0.000	0.24	0.27
		3	-0.506*	0.006	0.000	-0.52	-0.49
To what extent can you implement alternative instructional strategies?	1	2	0.156*	0.005	0.000	0.14	0.17
		3	-0.684*	0.006	0.000	-0.70	-0.67
		4	-0.136*	0.007	0.000	-0.15	-0.12
	2	1	-0.156*	0.005	0.000	-0.17	-0.14
		3	-0.840*	0.005	0.000	-0.85	-0.83
		4	-0.291*	0.007	0.000	-0.31	-0.27
	3	1	0.684*	0.006	0.000	0.67	0.70
		2	0.840*	0.005	0.000	0.83	0.85
		4	0.549*	0.007	0.000	0.53	0.57
	4	1	0.136*	0.007	0.000	0.12	0.15
		2	0.291*	0.007	0.000	0.27	0.31
		3	-0.549*	0.007	0.000	-0.57	-0.53
My role as a teacher is to facilitate students' own inquiry	1	2	0.041*	0.005	0.000	0.03	0.05
		3	-0.233*	0.005	0.000	-0.25	-0.22
		4	-0.033*	0.006	0.000	-0.05	-0.02
	2	1	-0.041*	0.005	0.000	-0.05	-0.03
		3	-0.274*	0.005	0.000	-0.29	-0.26
		4	-0.073*	0.006	0.000	-0.09	-0.06
	3	1	0.233*	0.005	0.000	0.22	0.25
		2	0.274*	0.005	0.000	0.26	0.29
		4	0.201*	0.006	0.000	0.18	0.22
	4	1	0.033*	0.006	0.000	0.02	0.05
		2	0.073*	0.006	0.000	0.06	0.09
		3	-0.201*	0.006	0.000	-0.22	-0.18

Table A.18 Tukey's HSD test for differences between clusters for teacher beliefs – continued

Multiple comparisons							
Tukey HSD							
Dependent variable			Mean difference (I-J)	Std. error	Sig.	95% confidence interval	
						Lower bound	Upper bound
Students learn best by finding solutions to problems on their own	1	2	0.004	0.006	0.960	-0.01	0.02
		3	-0.198*	0.006	0.000	-0.21	-0.18
		4	-0.087*	0.007	0.000	-0.11	-0.07
	2	1	-0.004	0.006	0.960	-0.02	0.01
		3	-0.202*	0.006	0.000	-0.22	-0.19
		4	-0.091*	0.007	0.000	-0.11	-0.07
	3	1	0.198*	0.006	0.000	0.18	0.21
		2	0.202*	0.006	0.000	0.19	0.22
		4	0.111*	0.007	0.000	0.09	0.13
	4	1	0.087*	0.007	0.000	0.07	0.11
		2	0.091*	0.007	0.000	0.07	0.11
		3	-0.111*	0.007	0.000	-0.13	-0.09
Students should be allowed to think of solutions themselves	1	2	0.022*	0.005	0.000	0.01	0.04
		3	-0.207*	0.005	0.000	-0.22	-0.19
		4	-0.057*	0.007	0.000	-0.08	-0.04
	2	1	-0.022*	0.005	0.000	-0.04	-0.01
		3	-0.230*	0.005	0.000	-0.24	-0.22
		4	-0.080*	0.006	0.000	-0.10	-0.06
	3	1	0.207*	0.005	0.000	0.19	0.22
		2	0.230*	0.005	0.000	0.22	0.24
		4	0.150*	0.006	0.000	0.13	0.17
	4	1	0.057*	0.007	0.000	0.04	0.08
		2	0.080*	0.006	0.000	0.06	0.10
		3	-0.150*	0.006	0.000	-0.17	-0.13
Thinking and reasoning processes are more important	1	2	0.023*	0.006	0.001	0.01	0.04
		3	-0.168*	0.006	0.000	-0.18	-0.15
		4	-0.025*	0.007	0.005	-0.05	-0.01
	2	1	-0.023*	0.006	0.001	-0.04	-0.01
		3	-0.191*	0.006	0.000	-0.21	-0.18
		4	-0.048*	0.007	0.000	-0.07	-0.03
	3	1	0.168*	0.006	0.000	0.15	0.18
		2	0.191*	0.006	0.000	0.18	0.21
		4	0.143*	0.007	0.000	0.12	0.16
	4	1	0.025*	0.007	0.005	0.01	0.05
		2	0.048*	0.007	0.000	0.03	0.07
		3	-0.143*	0.007	0.000	-0.16	-0.12

Table A.18 Tukey's HSD test for differences between clusters for teacher beliefs – continued

Multiple comparisons							
Tukey HSD							
Dependent variable			Mean difference (I-J)	Std. error	Sig.	95% confidence interval	
						Lower bound	Upper bound
I am satisfied with my performance in this school	1	2	0.051*	0.005	0.000	0.04	0.06
		3	-0.332*	0.005	0.000	-0.35	-0.32
		4	-0.072*	0.006	0.000	-0.09	-0.06
	2	1	-0.051*	0.005	0.000	-0.06	-0.04
		3	-0.383*	0.004	0.000	-0.40	-0.37
		4	-0.123*	0.006	0.000	-0.14	-0.11
	3	1	0.332*	0.005	0.000	0.32	0.35
		2	0.383*	0.004	0.000	0.37	0.40
		4	0.260*	0.006	0.000	0.24	0.28
	4	1	0.072*	0.006	0.000	0.06	0.09
		2	0.123*	0.006	0.000	0.11	0.14
		3	-0.260*	0.006	0.000	-0.28	-0.24

Note: * The mean difference is significant at the 0.05 level.

Source: OECD (2013), *Teaching and Learning International Survey (TALIS): 2013 complete database*, http://stats.oecd.org/index.aspx?datasetcode=talis_2013%20.