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Teaching Practices in Primary and Secondary Schools in Europe: Insights from Large-Scale Assessments in Education

Maria Magdalena Isac
Patrícia Dinis da Costa
Luísa Araújo
Elena Soto Calvo
Patrícia Albergaria-Almeida

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Contact information

Luísa Araújo

Address: Joint Research Centre, Unit JRC-DDG.01 – Econometrics and Applied Statistics

TP 361 – Via E .Fermi 2749 – I-21027 – Ispra (Va) - ITALY

E-mail: luisa.borges@jrc.ec.europa.eu

Tel.: +39 0332 78 3872

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Note

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EXECUTIVE SUMMARY

This report focuses on describing teaching practices in primary and secondary schools in Europe.

For primary education, the report uses combined data from the 2011 Third International Mathematics and Science Study (TIMSS) and the 2011 Program for International Reading Literacy Study (PIRLS). For secondary education, it uses data from the 2012 Program for International Student Assessment (PISA) and from the 2013 Teaching and Learning International Study (TALIS).

While the TIMSS/PIRLS study is conducted with pupils at the fourth grade level, PISA samples fifteen year-old students and the TALIS main study collects information from teachers at ISCED 2. For TIMSS/PIRLS, the incidence of the teaching practices analyzed relate to Reading Literacy, Science and Mathematics instruction. For PISA, only teaching practices related to Mathematics instruction, the main subject in PISA 2012, are analyzed. The analyses of teaching practices in TALIS 2013 are based on reported data from different ISCED 2 subject matter teachers.

Using data from the three surveys, this report details the frequency of teaching practices and establishes relationships between certain practices and students' achievement and school learning conditions. The main categories of teaching practices addressed include: 1) General and content-specific instructional practices; 2) The use of informational technology (ICT); 3) Teacher collaborative practices; and 4) Characteristics of the school learning environment at the classroom, school and educational system levels.

The breath of information herein provided allows for a better understanding of the frequency of different teaching practices in primary and secondary schools in European Union Member States (EU MS) and for cross-country comparisons. At the same time, the interpretation of the findings highlights the importance of considering the uniqueness of different learning contexts in any attempt to understand teaching effectiveness. Taken together, the research evidence gathered provides detailed information about teaching practices that can assist EU MS in discerning gaps in the available information, identifying country profiles, and addressing common challenges. The findings highlighted in each part of the report and related policy messages offer novel insights into teaching practices in primary and secondary schools in Europe.

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INTRODUCTION

The aim of this report is to offer a detailed description of teaching practices at the primary and secondary school levels and, when possible, explore relationships between teaching practices and other factors such as student achievement and class size. The latest data from several large-scale assessments in education is used for these purposes, namely TIMSS & PIRLS 2011, PISA 2012 and TALIS 2013. The focus of the report is on the mapping of the frequency of different teaching practices across European Member States (EU MS) at ISCED levels 1 and 2 as measured in TIMSS/PIRLS at the fourth grade level, in PISA for 15-year olds and in TALIS for teachers in ISCED level 2.

Each part of the report is divided in two chapters; the first is an overview of the survey, and the second presents the results of the analyses of different teaching practices. Within the second chapter of each part, a summary of the findings is presented in bullet points at the end of each section. Conclusions and policy messages are discussed at the end of each part concerning the three international surveys. The report addresses the teaching practices captured in the data collected in TIMSS/PIRLS (Part I), PISA (Part II) and TALIS (Part III).

Specifically, using TIMSS and PIRLS 2011 data collected in the teacher and student background questionnaires, the first part of the report describes the prevalence of different instructional and collaborative teaching practices across 17 participating EU MS. Using data collected in the school questionnaire and in the student questionnaire, the PISA part describes the frequency of different teaching practices in 26 participating EU MS and explores relationships between teaching practices and the learning environment and students´ achievement. The TALIS part describes and compares the teacher-reported data on the use of different active and non-active teaching practices across 18 EU MS. It also examines whether teachers' reported use of these teaching practices is related to the size of the class they teach. For the three large-scale surveys, the selection of the variables related to teaching practices was carried out according to data availability and on the basis of teaching effectiveness theoretical frameworks and related research findings. The Background and Rationale section of the report presents this theoretical framework.

Background and Rationale

The idea that teachers and the teaching practices they implement are important for students' educational outcomes has been steadily gaining ground since the publication of the Coleman report in the sixties (Coleman et al., 1968). This report had showed that students' socioeconomic background was the main determinant of educational outcomes and that the influence of teachers on student outcomes was minimal. Since then, more sophisticated study designs and methods have allowed for precise measurements of what goes on in schools and its relation to the educational outcomes of students. **Findings indicate that teachers and the environment they teach in can indeed make a difference**. Conceptual models now include different dimensions of the educational environment, such as teaching practices, school climate and resources and look for interactions among them to categorize effective schools. Within an educational effectiveness framework "an effective school is one that has an effect on student achievement over and above home influences" (Martin, Foy, Mullins, & O' Dwyer, 2013, p.111).

More specifically, empirical research has examined the impact of a wide range of education-related factors, such as students' home background, school environment and school instruction, on students' learning outcomes with the aim of identifying which factors are essential for educational effectiveness[1]. **The teachers' characteristics that have been more frequently studied can be classified into three large categories: background qualifications, beliefs and attitudes, and instructional practices**.

The **background qualifications** category includes teachers' degrees, college ratings, test scores and teaching experience. Higher teacher background qualifications have been associated with better student achievement (Palardy & Rumberger, 2008; Rice, 2003; Wayne & Youngs, 2003), although these findings have not always been replicated and null findings or even negative effects have also been reported (Buddin & Zamarro, 2009; Clotfelter, Ladd, &Vigor, 2007; Hanushek, Karin, O'Brien, & Rivkin, 2005).

The **teachers' beliefs and attitudes** category refers to teachers' self-efficacy, expectations for students' achievement and beliefs about the nature of the teaching and learning process. There is some evidence that teachers' beliefs about their students impact student learning. For example, some studies show that when teachers believe that their students will

[1] Educational effectiveness research seeks to investigate which "factors in teaching, curriculum, and the learning environment at different levels such as the classroom, the school, and the above-school levels can directly or indirectly explain the differences in the outcomes of students, taking into account student background characteristics, such as ability, SES and prior attainment". See Creemers & Kyriakides, 2008, p.12, and Chapter 1 of this report.

perform well and that they are motivated to learn this has a positive direct impact on students' learning outcomes (Lee, Smith, & Croninger, 1997; Staub & Stern, 2002; Caprara, Barbaranelli, Steca, & Malone, 2006). However, there are also studies suggesting that this impact is only indirect (Muijs & Reynolds, 2002) and null findings have also been reported (Driessen & Sleegers, 2000).

Last, the **instructional practices** category refers to the activities teachers carry out in the classroom. Research linking instructional practices and students' academic performance seems to converge in its findings: what teachers do in the classroom is a good predictor of their students' achievement (Brophy, 2000; Seidel & Shavelson, 2007; Hattie, 2009; Creemers & Kyriakides, 2008). Instructional practices consistently predict students' learning outcomes and their effects have been shown to be larger than teachers' background qualifications or their beliefs and attitudes (Kyriakides, Campbell, & Gagatsis, 2000; Nye, Konstanopoulos, & Hedges, 2004; Muijs & Reynolds, 2002; Palardy & Rumberger, 2008; Scheerens & Bosker, 1997; Stigler & Hiebert, 1999). Teaching practices are also one of the most malleable education-related factors (Scheerens & Bosker, 1997; Harris & Chrispeels, 2006).

Instructional practices are often classified into two types – **teacher-directed** or **constructivist** - depending on whether it is the teacher (direct instructional practices) or the student (constructivist teaching practices) that plays a pivotal role in the learning process. With respect to constructivist versus direct instructional practices, it has been suggested that a variety of teaching practices that combine self-regulated child-initiated activities (such as spontaneous and unstructured play) with teacher-directed adult-led activities (such as delivering content) seem to be the most effective and adequate approach for effective classroom learning (Creemers, Kyriakides, & Antoniou, 2013; Rowan, Correnti, & Miller, 2002), particularly for students with learning difficulties during the primary school years (Purdie & Ellis, 2005). Nevertheless, research also suggests that certain teaching practices seem to be more effective than others for particular learning domains, educational levels and specific student sub-populations (Seidel & Shavelson, 2007).

First, **distinct instructional practices seem to relate differently to students' outcomes depending on the learning domain under examination**. For instance, Meijnen, Lagerweij and De Jong (2003) found that time spent on different educational goals and the method used to assess students' progress were associated with students' growth in mathematics, but results were not replicated for word reading (decoding) or reading comprehension. More recently Boonen, van Damme and Onghena (2013) found that practices involving teaching estimation and classification were positively related to mathematics achievement, spending time on instruction and dividing students into homogenous reading groups were positively related to reading achievement, and using homogenous reading groups was positively related to spelling achievement in a large group of first graders. Nonetheless, other instructional activities such as the amount of time spent on mathematics instruction, frequency of book projects or peer teaching were negatively associated with achievements in mathematics, reading and spelling, respectively.

Second, there is evidence that **distinct instructional practices impact achievement differently depending on the educational level of the students**. For example, Kyriakides, Christoforou and Charalambus (2013) conducted a meta-analysis exploring the impact of teaching factors on students' achievement. They found that younger students benefited more from instructional practices such as asking them complex questions about the content of the lessons that have been covered in the class. However, older students benefited more from teaching practices aimed at developing higher-order thinking skills (e.g. concept mapping, critical thinking and cross-curricular competencies) or problem solving that require comparing and relating information that go beyond what has been directly stated.

Third, **the effectiveness of certain instructional practices seems to vary depending on other factors, such as the socio-demographic characteristics, level of achievement, ethnic or social and cultural background of the student** (Muijs, Harris, Chapman, Stoll, & Russ, 2004). More precisely, research suggests that children from disadvantaged backgrounds benefit more from teacher-directed and very structured instruction than students from more advantage backgrounds for whom active learning activities seem to be very effective (Huffman & Speer, 2000; Muijs & Reynolds, 2003; Mortimore, 1991; Scheerens, 1992; Slavin, 1996). Thus, placing emphasis on basic skills rather than on higher-order cognitive skills seems to have a greater positive effect on disadvantaged than on advantaged students (Brophy, 1992; Boonen, Damme, & Onghena, 2013; Teddlie & Stringfield, 1993; Walberg, 1986). Taken together, these findings suggest that educational effectiveness should take into consideration the specific learning domains, school stage and contextual characteristics of the learners.

In the last decades, research on teaching has focused on holistic aspects of teaching and on analysing teaching patterns instead of isolated teaching acts (Borko, 2004). Additionally, and as reported by Seidel and Shavelson (2007), research has been centred on examining large-scale surveys with statistical models that control for extraneous variables, consequently increasing statistical power in detecting the effects of teaching on students' learning outcomes. One of the latest theoretical models mapping in detail factors describing teacher behaviour in the classroom is the dynamic model of educational effectiveness developed by Creemers and Kyriakides (2008). The model is grounded on the assumption that the effects on student achievement are multilevel and, in this way, it refers to factors at different levels; student, classroom, school and system level. Seven teacher factors/practices are described in this model. They include orientation, structuring, teaching-modelling, application, management of time, teacher's role in making the classroom a learning environment and classroom assessment. For example, the school learning environment, where factors such as the extent of teacher collaboration and emphasis on academic achievement may vary, is likely to interact with and even condition classroom teaching practices. In addition, the dynamic aspect of the model emphasizes the constantly changing nature of these factors as they evolve, for example, trough different stages of teacher professional development.

Creemers and Kyriakides´ (2008) dynamic model of school effectiveness also considers teaching within a larger framework that includes factors that operate at higher levels, namely at the school and at the educational system level. The TIMSS/PIRLS, PISA and TALIS surveys do not follow a specific model of school effectiveness. However, they are informed by this theoretical and research-related background and include in their assessment frameworks school and system level factors that are likely to interact with classroom-level factors, such as tracking students by ability level, class size, school climate and teachers´ self-efficacy. They do so because these factors can be viewed as indicators of the quality of school systems. Accordingly, the analyses presented in this report include school effectiveness variables with the aim of contributing to a better understanding of the teaching practices implemented in primary and secondary schools and their relation with others factors at different levels of the educational process.

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PART I

Teaching Practices in Primary Schools in the EU

Chapter 1

This chapter provides a brief introduction to the main findings of the TIMSS and PIRLS 2011 Combined survey, describes the theoretical grounds that informed the data collection, and details the measurement of teaching practices and related contextual information.

1. Teaching Practices. Context, Conceptualization and Measurement

1.1. A brief introduction to TIMSS and PIRLS.

The Trends in International Mathematics and Science Study (TIMSS) and the Progress in International Reading Literacy Study (PIRLS) are international studies directed by the International Association for the Evaluation of Educational Achievement (IEA). With the aim of studying the effects of educational policies and practices in a comparative perspective, the IEA pioneered international large-scale assessments in education starting early in 1960's[2] . Since 1995, the IEA conducts continuous four-year assessment cycles for TIMSS focusing primarily on the achievement of fourth and eighth grade students in Mathematics and Science. The PIRLS five-year cycle assessments, in turn, started in 2001 and address mainly how well children read after the first four years of primary school.

TIMSS and PIRLS are international studies comparable to the Program for International Student Assessment (PISA) launched in 2000 by the Organization for Economic Cooperation and Development (OECD). Both assessments offer information on students' outcomes and contextual information on teaching practices and home literacy activities in countries around the globe. The characteristics of PISA are described later[3] in this report and the design of TIMSS and PIRLS will be further detailed. Yet, to better understand the assessment frameworks of TIMSS and PIRLS at the fourth grade level, some differences in comparison to PISA are worth mentioning. The most obvious distinction is that PISA surveys 15 year-olds, whereas PIRLS samples fourth grade students. The TIMSS survey has two target populations, namely, students at the fourth grade and students at the eighth grade[4]. Still, other fundamental differences are particularly relevant here. They are linked to the purpose of these assessments or, more precisely, to what they intend to measure. In that respect, the two IEA studies focus on students' achievement in Reading, Mathematics and Science with reference to an internationally agreed curriculum in these core academic areas. Conversely, PISA is not curriculum-based but takes a "functional literacy" perspective that aims to capture students' ability to apply their knowledge to real life situations in Reading, Mathematics, and Science. Moreover, TIMSS and PIRLS use teacher questionnaires to collect information about teaching and learning together with student achievement in order to identify potential relationships between students' achievement and

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[2] The origins of large-scale assessments in education are often traced back to the First International Mathematics Study (FIMS). See http://www.iea.nl/fims.html

[3] See Part II of this report.

[4] This report deals with PIRLS and TIMSS at the 4th grade only.

teaching practices and school characteristics. PISA's main focus, on the other hand, is on students' knowledge and skills - particularly in Reading, Mathematics and Science - that are essential for full participation in modern societies. Therefore, PISA is not designed to explicitly address teaching practices, although it collects some related contextual information from students and school principals[5].

Therefore, TIMSS and PIRLS are different from PISA in that their explicit focus is on curriculum and teaching practices. One of their main aims is to provide "high-quality data that will increase policy-makers understanding of key school and non-school-based factors that influence teaching and learning"[6]. Perhaps one of the most salient novelties in these IEA studies is that they introduced the concept of "opportunities to learn"[7]. In this respect, over the years, they have been providing data on the status and potential relationships between the intended curriculum (what national or regional authorities adopt as programs of study), the implemented curriculum (what is taught in schools), and the achieved curriculum (what students learn).

This information has been used by many countries to asses or initiate curricular reforms. For example, national curricula were revised in some countries based on results of TIMSS which indicated that higher-performing countries generally had greater levels of coverage of the intended curricula. Similarly, reforms of pre-service and in-service teacher training programs were also informed by IEA studies that indicated areas of relative weakness in teacher preparation or instructional materials and strategies. For instance (see Heyneman and Lee, 2014), some countries decreased the frequency of teacher lecturing and increase student engagement in lessons by means of extended, deep questioning teaching practices. Other countries encouraged teacher collaborative practices that seemed to be a feature of high-performing countries.

1.2. **Some highlights of TIMSS and PIRLS 2011 combined.**

In 2011, the cycles for TIMSS and PIRLS coincided for the first time and participating countries were offered the unprecedented opportunity to conduct both TIMSS and PIRLS with the same fourth grade students. Internationally, 34 countries[8] (17 of which EU Member States) took this opportunity and assessed the same fourth grade students in Reading, Mathematics and Science. The 17 EU MS that participated in TIMSS and PIRLS 2011 Combined, were: Austria (AT), Croatia (HR), Czech Republic (CZ), Finland (FI), Germany (DE), Hungary (HU), Ireland (IE),

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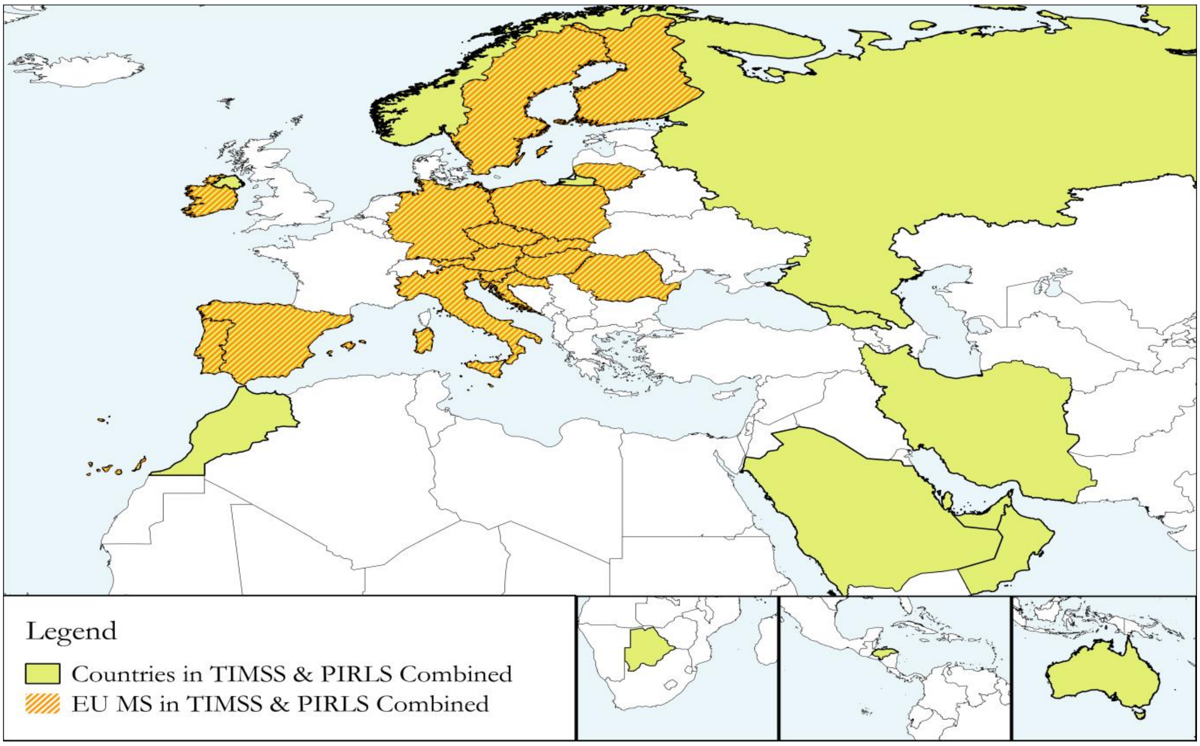
[5] For examples of principals' reports on teaching practices and school environment see Part II of this report.
[6] See www.iea.nl
[7] See www.iea.nl/studies.html
[8] 34 countries (and 3 benchmarking entities: Quebec, Canada; Aby Dhabi, UAE; and, Dubai, UAE).

Italy (IT), Lithuania (LT), Malta (MT), Poland (PL), Portugal (PT), Romania (RO), Slovak Republic (SK), Slovenia (SI), Spain (ES), and Sweden (SE).

A special international database was created by the TIMSS and PIRLS International Study Center[9] to include only the fourth grade students assessed in all three subjects. This was complemented by extensive background information about home, school and classroom contexts for teaching and learning in these three areas.

Martin & Mullis (2013) illustrate the potential of this database in the TIMSS and PIRLS 2011 Relationships Report, but mention that their work intends only to open the way for more in-depth analyses based on the common information identified and statistically combined from the two surveys. Accordingly, the results presented in their report do not deal explicitly with teaching practices. However, they do bring to light several aspects of learning outcomes in Reading, Mathematics and Science, the potential relationship between these outcomes as well the importance of other contextual factors - meaningful for both learning and teaching - such as the home and school environments. These aspects are worthwhile noting also in the context of addressing teaching practices. Elements such as student achievement are one of the main expected outcomes of teaching or the "achieved curriculum", and other, such as a supportive school environment is both relevant for teaching practices as well as for student achievement.

Countries Participating in TIMSS and PIRLS 2011 Combined



[9] See http://timssandpirls.bc.edu/timsspirls2011/international-database.html#database

A selection of the main internationally[10] relevant results of this report (Martin & Mullis, 2013) is provided below to illustrate how TIMSS and PIRLS offer a unique view of the interconnection between learning and teaching and the context in which they take place.

a) Regarding the main outcomes of teaching - student achievement in Reading, Mathematics and Science - TIMSS and PIRLS 2011 show that:

- More than half of the TIMSS and PIRLS participating countries are successful in ensuring a well-rounded foundation of skills in all subjects for most students (90% or more reaching the low international benchmark in all three subjects). Yet, educating students to high proficiency levels in all subjects seems to be overall challenging.
- Countries tend to be more successful in either one or two of the three subjects. However, it seems that being equally successful in educating students in all three subjects simultaneously is a difficult task. This is particularly true when it comes to educating substantial percentages of students to high levels of achievement.
- Strengths in some subjects may be fundamental for success in the others. Overall, fourth graders are likely to be at disadvantage in learning Mathematics and Science as well as reaching high performance levels or benchmarks in these content areas if they lack reading skills.

b) Regarding the influence of the home environment on student outcomes, TIMSS and PIRLS show that:

- Students' achievement in Reading, Mathematics and Science is not only the result of schooling. Overall, their achievement levels in all areas are dependent on the home environment. The educational levels of the parents, the home resources (e.g. books at home), the home literacy and numeracy activities parents engaged in with their children prior to compulsory school entry influence students' attainment of numeracy and literacy skills.

c) Regarding the school environment, TIMSS & PIRLS show that:

- The school learning environment is relevant for student achievement in all three curriculum content areas. Overall, some of school characteristics that were found to be associated with achievement are (ordered by the strength of the correlation): strong

[10] Please note that these findings refer to all 34 countries and not only to the 17 EU MS. Many of these aspects, relevant to the topic of teaching practices, will be addressed in detail with respect to the EU MS in Chapter 2 of this report.

emphasis on academic success, strong and orderly school environment, and adequate environment and resources.

1.3. **The Conceptualization of Teaching Practices in TIMSS and PIRLS 2011.**

In order to understand how teaching practices are conceptualized in the TIMSS and PIRLS 2011 joint framework, several sources of information must be considered. The overarching framework is best described by the TIMSS and PIRLS 2011 Relationships Report (Martin & Mullis, 2013). This framework is primarily informed by the TIMSS 2011 and PIRLS 2011 Contextual Frameworks (Mullis, Martin, Ruddock, O'Sullivan, & Preuschoff, 2009; Mullis, Martin, Kennedy, Trong, & Sainsbury, 2009), but also by research strands which play a role in informing the theoretical grounds for the data collection undertaken by the IEA.

By focusing on characteristics of effective schools, Martin & Mullis (2013) clearly situate their findings in the context of "educational effectiveness research" (EER). EER has traditionally informed the designs of international large-scale assessments undertaken by the IEA (Klieme, 2013). EER aims to test theories that explain "why and how some schools and teachers are more effective than others" (Creemers & Kyriakides, 2008, p.3). It seeks to investigate which "factors in teaching, curriculum, and the learning environment at different levels such as the classroom, the school, and the above-school levels can directly or indirectly explain the differences in the outcomes of students, taking into account student background characteristics, such as ability, SES[11] and prior attainment" (Creemers & Kyriakides, 2008, p.12). Research initiatives in this field (see also Scheerens & Bosker, 1997; Reynolds, Sammons, De Fraine, Van Damme, Townsend, Teddlie, & Stringfield, 2014) are also known to use, at times, terms such as "school effectiveness" or "teacher effectiveness" in order to underscore the importance of either school characteristics (e.g. school climate, teacher collaboration) or classroom factors (e.g. teacher instructional behavior).

Although alternative, broader conceptualizations could also apply, there are the two main concepts referring strictly to teaching practices that are measured identically in TIMSS and PIRLS 2011. They refer to two areas of activity of the teaching staff, which are different but yet interconnected. In this respect, consistent with theories on effective teaching, the conceptual frameworks differentiate between what the teacher does in the classroom – *teacher instructional*

[11] SES stands for socioeconomic status. "Socioeconomic status is commonly conceptualized as the social standing or class of an individual or group. It is often measured as a combination of education, income and occupation" (see American Psychological Association, 2015).

practices – from other, arguably equally important, teacher activities which are carried-out outside the classroom in collaboration with peers - *teacher collaborative practices*.

Teacher instructional practices, which could be improved by teacher collaboration, refer to several instructional strategies that teachers may use frequently in the classroom. Research within the educational effectiveness tradition (Creemers, 1994; Scheerens & Bosker, 1997) has identified several components of effective instructional strategies. At the moment, an overall agreement has been reached that both "traditional" direct instruction[12] as well as student-centered[13] views on teaching can serve as mapping concepts to define effective teaching practices[14]. Creemers & Kyriakides (2008), for example, make use of such theories as well as of results of empirical research to identify several "generic"[15] factors that best describe teachers' role in the classroom: a) orientation (e.g. clarifying the objectives of different learning tasks), b) structuring (e.g. outlining the content, reviewing), c) questioning (e.g. involving students in classroom discussion), d) teaching-modelling (e.g. helping students to self-regulate their learning), e) applications (e.g. using seatwork or small group tasks to provide practice), f) promoting a positive classroom leaning environment (e.g. fostering positive interactions with and between students), g) management of time (e.g. maximizing learning time) and h) classroom assessment (e.g. diversified, formative feedback).

The measures of instructional practices used in TIMSS and PIRLS attempt to tap into "generic" instructional practices but also "content-specific" practices for Reading, Mathematics and Science. Regarding "generic" strategies, the measures address elements such as structuring, questioning and engaging feedback. For instance, teachers are asked about the frequency of specific practices such as structuring the content by setting and communicating clear learning goals, connecting new content to students' prior experiences, providing interesting instructional materials, using higher-order questioning techniques, praising students for their achievement and encouraging them to further improve. In what concerns content-specific strategies, another set of measures capture practices aimed at developing Reading comprehension skills and strategies (e.g. making generalizations and drawing inferences based on a literary text), problem-solving skills in Mathematics (e.g. working problems collaboratively with teacher guidance) and inquiry-

[12] Direct instruction advocates the use of structure, questioning, monitoring and the use of informative and engaging feedback (see, Creemers & Kyriakides, 2008; Scheerens, 2010).

[13] Student – centered views are often inspired by constructivism and advocate teaching meta-cognitive skills, cognitive activation, discovery learning, and scientific inquiry (see Scheerens, 2010).

[14] For a comprehensive comparison of direct instruction and student-centered practices see Scheerens, 2010 and Vieluf, Kaplan, Klieme, & Bayer, 2012.

[15] These generic instructional practices are relevant across different subject matters.

based Science investigation skills (e.g. design experiments). In addition, some indicators are concerned with the integration of digital tools in teaching and learning.

Teacher collaborative practices refer to a set of behaviours that can serve the purpose of improving teaching. The conceptual frameworks of TIMSS and PIRLS 2011, as well as the corresponding international reports[16], situate the concept of teacher collaboration in close interconnection to the concept of "professional learning communities" (PCLs). Professional learning refers to teacher learning activities that help teachers to improve their classroom practices. One aspect of this learning is traditional teacher professional development programs. Yet, individual and collective learning can also take place through peer observation and collaboration. The concept of PCLs captures such learning. The concept was originally developed by Lave & Wenger in 1991 under "communities of practice". Although alternative definitions exist (Lomos, Hofman, & Bosker, 2011), educational effectiveness research (e.g. Stoll, Bolam, McMahon, Wallace & Thomas, 2006) commonly identifies a few central features of PCL's: a) shared values and vision (e.g. focus on academic success for all students), b) collective responsibility (e.g. accountability systems which put pressure on all and encourage teacher collaboration), c) reflective professional enquiry (e.g. reflective dialogue about educational issues, deprivatization of practice through mutual observation), d) collaboration (e.g. planning the curriculum jointly). The measure of teacher collaborative practices used in TIMSS and PIRLS attempts to tap into particular types of teacher collaboration. In addition to reporting on strictly collaborative teacher behaviours such as working together to plan and prepare instructional materials or try out new ideas, teachers are also asked about the frequency of their reflective dialogue (e.g. discussing how to teach a topic, share insights from their teaching experience) and deprivatization of practice (e.g visiting one another's classes for learning and feedback purposes).

Successful teacher collaborative and instructional practices require some favourable school conditions and resources. In that respect Martin & Mullis (2013) as well as the Contextual Frameworks of TIMSS and PIRLS 2011 describe, from a school effectiveness perspective,[17] several characteristics of effective schools. These characteristics refer to a school environment that is safe and orderly, that is characterized by a strong focus on academic success, and that has adequate resources. Both instructional and collaborative teaching practices are potentially shaped by such conditions. For example, providing effective instruction as well as learning with peers is

[16] See TIMSS 2011 Results in Mathematics, Mullis, Martin, Foy, & Arora, 2012; TIMSS 2011 Results in Science, Martin, Mullis, Foy, & Stanco, 2012; and PIRLS 2011 Results in Reading, Mullis, Martin, Foy, & Drucker, 2012
[17] For a detailed review of the school effectiveness research base used to inform TIMSS & PIRLS 2011 see Martin & Mullis, 2013.

likely to be facilitated if the teaching staff feels safe, has positive relationships with students and peers, has adequate resources such as instructional materials or workspace for collaboration, and has a common purpose of improving student achievement.

1.4. **The measurement of teaching practices in TIMSS and PIRLS 2011.**

Teachers' generic instructional practices are measured with the teacher scale "Engaging Students in Learning" addressed to teachers of Reading, Mathematics and Science. The scale contains six items related to the frequency (on a four-point scale with the following response categories: every or almost every lesson; about half the lessons; some lessons; never) of different teaching practices intended to interest students and reinforce learning, namely:

- Summarize what students should have learned from the lesson;
- Relate the lesson to students' daily lives;
- Use questioning to elicit reasons and explanations;
- Encourage all students to improve their performance;
- Praise students for good effort;
- Bring interesting materials to class.

An alternative measure for teachers' generic instructional practices is also proposed in the context of TIMSS 2011 and PIRLS 2011 Contextual Frameworks. It is argued that teacher instructional practices can also be measured based on the outcome of those practices, namely students' engagement in learning. This proxy measure is estimated based on students' responses to the questions in the scale "Students Engaged in Lessons". The scale measures separately (students reported separately about their Mathematics and Science lessons) students' degree of agreement (on a four-point scale with the following response categories: agree a lot; agree a little; disagree a little; disagree a lot) with five statements about their Mathematics and Science instruction:

- I know what my teachers expect me to do;
- I think of things not related to the lesson (reverse coded);
- My teacher is easy to understand;
- I am interested in what my teacher says;
- My teacher gives me interesting things to do.

For Reading, a similar measure is used, "Students Engaged in Reading Lessons":

- I like what I read about in school;
- My teacher gives me interesting things to read;
- I know what my teachers expect me to do;
- I think of things not related to the lesson (reverse coded);
- My teacher is easy to understand;
- I am interested in what my teacher says; and
- My teacher gives my interesting things to do.

Teachers' content-specific instructional practices are measured with several sets of items for Reading, Mathematics and Science. Teachers where asked to indicate to what extent (on a four-point scale: never or almost never; 2 or 3 times per month; 1-3 times per week; daily or almost daily) they use certain practices. The flowing items describe practices for developing reading comprehension skills and strategies:

- Locate information within the text;
- Identify the main ideas of what they have read;
- Explain or support their understanding of what they have read;
- Compare what they have read with experiences they have had;
- Compare what they have read with other things they have read;
- Make predictions about what will happen next in the text they are reading;
- Make generalizations and draw inferences based on what they have read;
- Describe the style or structure of the text they have read;
- Determine the author's perspective or intention.

Problem-solving skills in Mathematics were assessed with the items:

- Work problems (individually or with peers) with my guidance;
- Work problems together in the whole class with direct guidance from me;
- Work problems (individually or with peers) while I am occupied by other tasks;
- Memorize rules, procedures, and facts;
- Explain their answers.

For Science, the following inquiry-based investigation skills were reported on:

- Observe natural phenomena such as the weather or a plant growing and describe what they see;
- Watch me demonstrate an experiment or investigation;
- Design or plan experiments or investigations;
- Conduct experiments or investigations;
- Give explanations about something they are studying;
- Relate what they are learning in Science to their daily lives.

The integration of digital tools in teaching and learning is measured with items enquiring on the use of computer software (as a basis for instruction or as supplement) for Reading, Mathematics and Science; and the frequency of activities involving instructional software and aimed at looking up subject related information or/and at developing skills and strategies for Reading, Mathematics and Science. The frequency is measured on a four-point scale: never or almost never; 2 or 3 times per month; 1-3 times per week; daily or almost daily.

Teachers' collaborative practices are measured with the teacher scale "Collaborate to Improve Teaching". For TIMSS and PIRLS 2011, the information was collected from teachers of Reading, Mathematics and Science. The instrument is based on the frequency (on a four-point scale: never or almost never; 2 or 3 times per month; 1-3 times per week; daily or almost daily) with which teachers interacted with other teachers regarding five areas of activity meant to improve their teaching, namely:

- Discuss how to teach a particular topic;
- Collaborate in planning and preparing instructional materials;
- Share what I have learned about my teaching experiences;
- Visit another classroom to learn more about teaching;
- Work together to try out new ideas.

Teachers' perceptions of relevant aspects of the *school environment* (focus on academic success, safety, resources[18]) are captured by a set of scales:

The scale "School Emphasis on Academic Success" related to the extent (very high, high, and medium) to which teachers perceive the *focus on academic success* of the school in five areas, namely:

- Teachers' understanding of the school's curricular goals;

[18] See section 1.3.

- Teachers' degree of success in implementing the school's curriculum;
- Teachers' expectations for student achievement;
- Parental support for student achievement;
- Students' desire to do well in school.

The scale "Safe and Orderly School" environment measures teachers' degree of agreement (safe and orderly, somewhat safe and orderly, not safe and orderly) with five statements that characterize the *safety* of the school environment, namely:

- This school is located in a safe neighborhood;
- I feel safe at this school;
- This school's security policies and practices are sufficient;
- The students behave in an orderly manner;
- The students are respectful of the teachers.

The scale "Teacher Working Conditions" captures teachers' perception (hardly any problems, minor problems, moderate problems) concerning five potential problem areas in terms of *resources*:

- The school building needs significant repair;
- Classrooms are overcrowded;
- Teachers have too many teaching hours;
- Teachers do not have adequate workspace (e.g., for preparation, collaboration, or meeting with students); and
- Teachers do not have adequate instruction materials and supplies.

The next chapter reports on results of descriptive analyses using the information provided by all these items/scales to describe teacher instructional and collaborative practices and their context.

Chapter 2

This chapter describes the prevalence of different instructional and collaborative teaching practices across the 17 EU MS. Chapter 2 also introduces the premises needed to interpret the descriptive analyses based on TIMSS and PIRLS 2011 Combined data. Key findings are reported on four overarching topics: Goals and outcomes of teaching and learning; Generic and content-specific instructional practices; Teachers' collaborative practices; School environment and support that shape teaching practices.

2. Indicators of Teaching Practices in TIMSS & PIRLS 2011

2.1. **Introduction.**

This chapter provides information regarding several indicators reflecting or closely linked to instructional and collaborative teaching practices at the fourth grade level. The analyses makes use of the TIMSS and PIRLS combined database and aims to add to the findings reported by Martin & Mullis (2013) in the TIMSS and PIRLS 2011 Relationships Report by focusing on a descriptive in-depth analysis of such indicators[19]. When possible, findings are presented in relationship with the EU priorities in this area. The information is meant to show the state of the art and provide insights that can inform the implementation of reforms in the 17 participating Member States. The analyses show how teaching practices vary across countries and can enable individual European Member States to compare their policies with those in the other EU countries.

Nevertheless, before describing these practices, some characteristics of TIMSS and PIRLS 2011 data and of the current analyses must be considered in order to clarify how the statistical results should be interpreted.

TIMSS and PIRLS do not directly sample teachers[20]. Their objective is to obtain reliable estimates about the population of students at the fourth grade level in each country. Therefore, the TIMSS and PIRLS two-stage stratified cluster sample design involves first sampling schools and afterwards sampling one or more intact classes of students from each of the sampled schools.[21]

Information about most teaching practices addressed in this report is obtained from the teachers of Reading, Mathematics and Science of the sampled classes. This information has a valuable descriptive power. Yet, teacher data must be treated as a characteristic of the students. Taking this into account, the next sections of this chapter will mainly provide information on percentages of students in classrooms where teachers report to be using certain practices. Tables

[19] Most indicators on teaching practices were reported separately in the corresponding international reports (See TIMSS 2011 Results in Mathematics, Mullis, Martin, Foy, & Arora, 2012; TIMSS 2011 Results in Science, Martin, Mullis, Foy, & Stanco, 2012; and PIRLS 2011 Results in Reading, Mullis, Martin, Foy, & Drucker, 2012) but were not included in the TIMSS and PIRLS 2011 Relationships Report nor reported in interconnection for Reading, Mathematics and Science.

[20] Unlike in TALIS 2013 where nationally representative samples of teachers where surveyed.

[21] In this way, nationally representative samples of students and schools are represented by the data. Teacher data is nevertheless an attribute of the students.

located in Annex A will accompany the graphical representations of this chapter with the actual estimates[22], their standard errors and reliability.

The measures used to describe teaching practices in TIMSS and PIRLS 2011 do not rely on classroom observations[23]. They are self-reports from teachers. These instruments are of overall good measurement quality and comparability. Nevertheless, one must take into account that this information is subjective. Moreover, in a comparative context, such as the one presented here, one cannot rule out that answer patterns may reflect cultural differences and/or reference to a group standard such as specific educational policies. Therefore, cross-country comparisons must be made with caution and additional information on country specific contexts and policies may aid interpretation[24].

Across the TIMSS and PIRLS 2011 combined database for the 17 EU MS, the vast majority of teachers of Reading are also teaching Mathematics and Science at the same class. Accordingly, estimates of generic instructional practices, teacher collaborative practices and teachers' perceptions of the school environment are based on teachers of Reading. For all other content-specific aspects, separate analyses are carried out for the different learning domains using corresponding weights for teachers of Reading, Mathematics and Science.

TIMSS and PIRLS 2011 are the most up-to-date[25] comprehensive international source of information for primary education (4th grade). However, these surveys are cross-sectional and provide measurements for one specific point in time[26]. Readers are therefore encouraged to consider this information in triangulation with other sources, especially from national and/or macro-regional levels, to examine recurrent trends in TIMSS and PIRLS assessments since 1995

[22] All estimates are computed with the IDB Analyzer using IEA's guidelines, taking into account the complexity of the sampling design and applying sampling weights. See https://ec.europa.eu/jrc/en/event/workshop/workshop-using-pisa-piaac-timss-pirls-talis-datasets

[23] For example, for TIMSS at the 8th grade such measures can be inferred also from classroom aggregates of student self-reported observations of teaching practices. Although this is still not objective observation, it may provide a stronger measurement than teachers' reports. Nevertheless, with minor exceptions, such information was not collected for TIMSS and PIRLS at the 4th grade due to concerns regarding students' age and the burden of such additional instruments.

[24] See also Mullis, I.V.S., Martin, M.O., Minnich, C.A., Drucker, K.T., & Ragan, M.A. (2012) PIRLS 2011 Encyclopedia: Education Policy and Curriculum in Reading, Volumes 1 and 2 Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College, & Mullis, I.V.S., Martin, M.O., Minnich, C.A., Stanco, G.M., Arora, A., Centurino, V.A.S., & Castle, C.E. (2012). TIMSS 2011 Encyclopedia: Education Policy and Curriculum in Mathematics and Science, Volumes 1 and 2. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

[25] For four EU MS (DK, FI, BE-FL and PL) information for primary education is covered by TALIS 2013.

[26] TIMSS and PIRLS 2011 were carried out in 2010–2011.

and to be observant of the results of the next studies' cycle in 2015 for TIMSS and 2016 for PIRLS[27].

2.2. **Goals and outcomes of teaching and learning.**

One of the main aims of teaching is to enhance student learning and the outcomes of such learning. Research findings consistently show that teachers and teaching practices are the main factors influencing student achievement among those that educational policies could influence (Creemers & Kyriakides, 2008; Hattie, 2009; Seidel & Shavelson, 2007; Scheerens & Bosker, 1997). In the European context, a commitment was made to strive for achieving higher levels of student achievement in an equitable and inclusive manner (European Council, 2010; European Commission, 2012a). One of the Education and Training 2020 targets aims specifically at reducing the share of low achievers in Reading, Mathematics and Science to below 15% by 2020[28]. In this context, teaching-related policies and the work of teachers has gained an important role. Teachers are called to innovate their teaching and make efforts to improve the key competences of students (European Commission, 2012b).

The following section gives a brief overall description of student achievement in Reading, Mathematics and Science in the 17 analyzed EU MS with a particular emphasis on skills that students at different proficiency levels must acquire. These particular skills represent commonly agreed aims for teaching and learning across countries participating in TIMSS & PIRLS and involve the use of a diversified repertoire of instructional practices. In addition, the second part of this section will describe fourth graders' perceptions of instructional teaching practices for Reading, Mathematics and Science.

2.2.1. Standards and levels of performance in Reading, Mathematics and Science.

The TIMSS and PIRLS 2011 frameworks are based on an international consensus on what skills students should be able to master in Reading, Mathematics and Science at the fourth grade. In each domain, the assessments of student achievement were organized around two dimensions: a

[27] In a near future, some of the information reported in this chapter may be compared with findings of TIMSS 2015 and PIRLS 2016.

[28] Benchmark established on OECD PISA data for the population of 15 year-olds in each MS. Here, similar analyses and conclusions are presented with respect to primary education (4th graders) based on TIMMS and PIRLS 2011 Combined data.

content dimension - specifying the subject matter or content domains to be assessed, and a cognitive dimension - specifying the thinking processes that students are likely to use as they engage with the content[29]. The PIRLS assessment framework for Reading specifies two content domains or purposes for Reading: reading for literary experience and reading to acquire and use information. These purposes aim to account for most of the reading fourth graders do in and out of school. Half of the texts used for the assessment are literary and half are informational. The items within each of the two reading purposes measure four processes of reading comprehension: focus on and retrieve explicitly stated information, make straightforward inferences, interpret and integrate ideas and information, and examine and evaluate content, language, and textual elements.

The tasks assigned to students for the TIMSS Mathematics assessment covered three content domains or subject matters: number (30%), geometric shapes and measures (35%), and data display (15%). The items within each of the domains measure three cognitive domains or cognitive processes involved in working mathematically and solving problems: knowing, applying, and reasoning. The TIMSS Science assessment covers the content domains: Life Science (45%), Physical Science (35%), and Earth Science (20%) and similar cognitive domains as in Mathematics: knowing, applying, and reasoning.

In TIMSS and PIRLS 2011, as in previous assessment cycles, students' achievement for all three learning domains is reported according to four levels of performance[30]. These four levels summarize the achievement reached by students at different levels of proficiency: the "Low international benchmark", the "Intermediate international benchmark", the "High international benchmark" and, the "Advanced international benchmark". Box 1, 2 and 3 describe the skills students must demonstrate in order to be classified at each of the four levels of performance for Reading, Mathematics and, Science. For each domain, it is apparent that higher order skills rely on basic skills. For example, higher Reading comprehension processes such as making inferences or evaluating content rely on basic skills such as locating and retrieving information. Problem solving in Mathematics or skills related to scientific inquiry in Science both rest on the prerequisite that students have some basic Mathematical/Science knowledge (e.g. adding and subtracting numbers; knowing and understanding facts and principles of different content domains in Science).

[29] See TIMSS 2011 Results in Mathematics, Mullis, Martin, Foy, & Arora, 2012; TIMSS 2011 Results in Science, Martin, Mullis, Foy, & Stanco, 2012; and PIRLS 2011 Results in Reading, Mullis, Martin, Foy, & Drucker, 2012
[30] In addition to average achievement.

Box 1. The PIRLS 2011 International Reading Benchmarks

Low 400	Intermediate 475	High 550	Advanced 625
Literary When reading literary texts, students can locate and retrieve an explicitly stated detail. **Informational** When reading informational texts, students can locate and reproduce explicitly stated information that is at the beginning of the text.	**Literary** When reading literary texts, students can retrieve and reproduce explicitly stated actions, events and feelings; make straightforward inferences about the attributes, feelings and motivations of main characters; interpret obvious reasons and causes and give simple explanations; and begin to recognize language features and styles. **Informational** When reading informational texts, students can locate and reproduce one or two pieces of information from within the text; and use subheadings, textboxes and illustrations to locate parts of the text.	**Literary** When reading literary texts, students can locate and distinguish significant actions and details embedded across the text; make inferences to explain relationships between intentions, actions, events and feelings, and give text-based support; interpret and integrate story events and character actions and traits from different parts of the text; evaluate the significance of events and actions across the entire story; and recognize the use of some language features (e.g. metaphor, tone, imagery). **Informational** When reading informational texts, students can locate and distinguish relevant information within a dense text or a complex table; make inferences about logical connections to provide explanations and reasons; integrate textual and visual information to interpret the relationship between ideas; and evaluate content and textual elements to make a generalization.	**Literary** When reading literary texts, students can integrate ideas and evidence across a text to appreciate overall themes; and interpret story events and character actions to provide reasons, motivations, feelings and character traits with full text-based support. **Informational** When reading informational texts, students can distinguish and interpret complex information from different parts of text, and provide full text-based support; integrate information across a text to provide explanations, interpret significance and sequence activities; and evaluate visual and textual features to explain their function.

Source: Mullis, I.V.S., Martin, M.O., Foy, P., & Drucker, K.T. (2012). PIRLS 2011 international results in reading. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College

Box 2. The TIMSS 2011 (4th grade) International Mathematics Benchmarks

Low 400	Intermediate 475	High 550	Advanced 625
Students have some basic mathematical knowledge. Students can add and subtract whole numbers. They have some recognition of parallel and perpendicular lines, familiar geometric shapes, and coordinate maps. They can read and complete simple bar graphs and tables.	Students can apply basic mathematical knowledge in straightforward situations. Students at this level demonstrate an understanding of whole numbers and some understanding of fractions. Students can visualize three-dimensional shapes from two-dimensional representations. They can interpret bar graphs, pictographs, and tables to solve simple problems.	Students can apply their knowledge and understanding to solve problems. Students can solve word problems involving operations with whole numbers. They can use division in a variety of problem situations. They can use their understanding of place value to solve problems. Students can extend patterns to find a later specified term. Students demonstrate understanding of line symmetry and geometric properties. Students can interpret and use data in tables and graphs to solve problems. They can use information in pictographs and tally charts to complete bar graphs.	Students can apply their understanding and knowledge in a variety of relatively complex situations and explain their reasoning. They can solve a variety of multi-step word problems involving whole numbers including proportions. Students at this level show an increasing understanding of fractions and decimals. Students can apply geometric knowledge of a range of two- and three-dimensional shapes in a variety of situations. They can draw a conclusion from data in a table and justify their conclusion.

Source: Mullis, I.V.S., Martin, M.O., Foy, P., & Arora, A. (2012). TIMSS 2011 international results in mathematics. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

Box 3. The TIMSS 2011(4th grade) International Science Benchmarks

Low 400	Intermediate 475	High 550	Advanced 625
Students have some elementary knowledge of life science and physical science. Students demonstrate knowledge of some simple facts related to human health, ecosystems and the behavioral and physical characteristics of animals. They also demonstrate some basic knowledge of energy and the physical properties of matter.	Students can apply basic knowledge and understanding to practical situations in the sciences. Students recognize some basic information related to characteristics of living things, their reproduction and life cycles and their interactions with the environment, and show some understanding of human biology and health. They also show some knowledge of properties of matter and light, electricity and energy and forces and motion. Students know some basic facts about the solar system and show an initial understanding of Earth's physical characteristics and resources.	Students can apply knowledge and understanding to explain everyday phenomena. Students demonstrate some understanding of plant and animal structure, life processes, life cycles and reproduction. They also demonstrate some understanding of ecosystems and organisms' interactions with their environment, including understanding of human responses to outside conditions and activities. Students demonstrate understanding of some properties of matter, electricity and energy and magnetic and gravitational forces and motion. They show some knowledge of the solar system, and of Earth's physical characteristics, processes and resources. Students demonstrate elementary knowledge and skills related to scientific inquiry.	Students can apply knowledge and understanding of scientific processes and relationships in beginning scientific inquiry. Students communicate their understanding of characteristics and life processes of organisms, reproduction and development, ecosystems and organisms' interactions with the environment, and factors relating to human health. They demonstrate understanding of properties of light and relationships between physical properties of materials, apply and communicate their understanding of electricity and energy in practical contexts and demonstrate an understanding of magnetic and gravitational forces and motion. Students communicate their understanding of the solar system and of Earth's structure, physical characteristics, resources, processes, cycles and history.

Source: Martin, M.O., Mullis, I.V.S., Foy, P., & Stanco, G. (2012). TIMSS 2011 international results in science. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

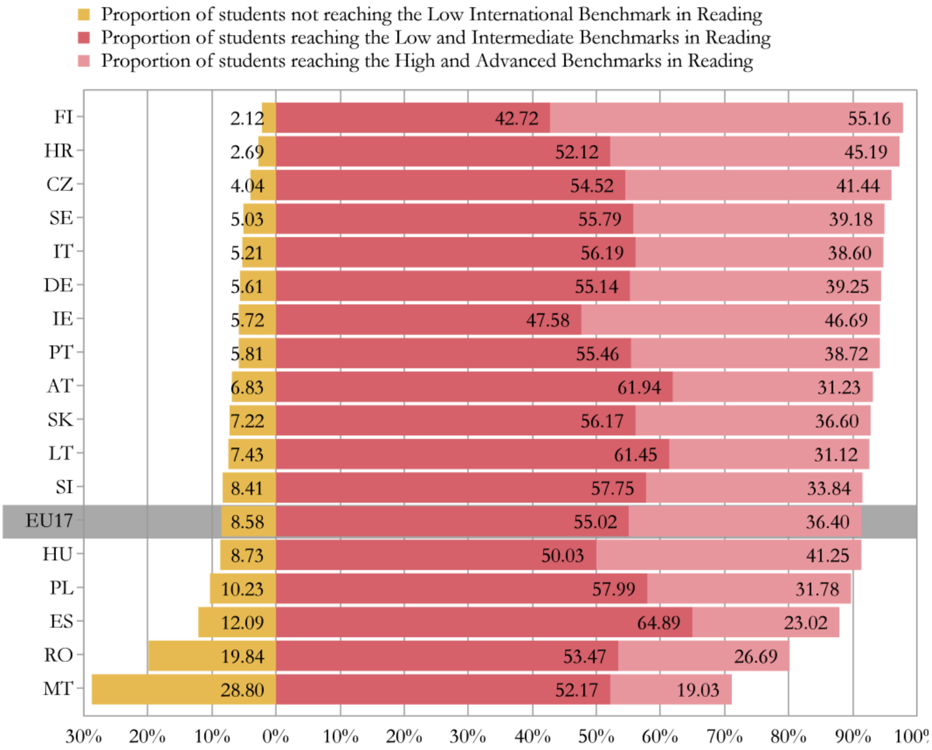
Graph 1 presents the percentage of students not reaching the Low international benchmark in Reading. It also shows the proportion of students reaching the Low and Intermediate benchmarks as well as those reaching higher levels of performance, more specifically the High and Advanced benchmarks.

On average, across the 17 European educational systems, the data indicates a high degree of success in terms of inclusiveness, meaning that these EU MS manage to bring the vast majority of students at least to a basic knowledge of content and skills level. Over 91% of the students are reaching the Low, Intermediate, High and Advanced benchmarks with only about 8% of them showing low achievement in Reading. Nevertheless, results vary widely among countries. On this metric, Finland, Croatia and Czech Republic have among the most inclusive educational systems with a share of low achievers[31] below 5%. Conversely, some Member States

[31] Low achievement is defined here as student performance below the "Low International Benchmark" of TIMSS & PIRLS 2011.

such as Malta and Romania are still struggling. The share of students at risk in these countries exceeds 15%.

Graph 1. PIRLS Reading Benchmarks

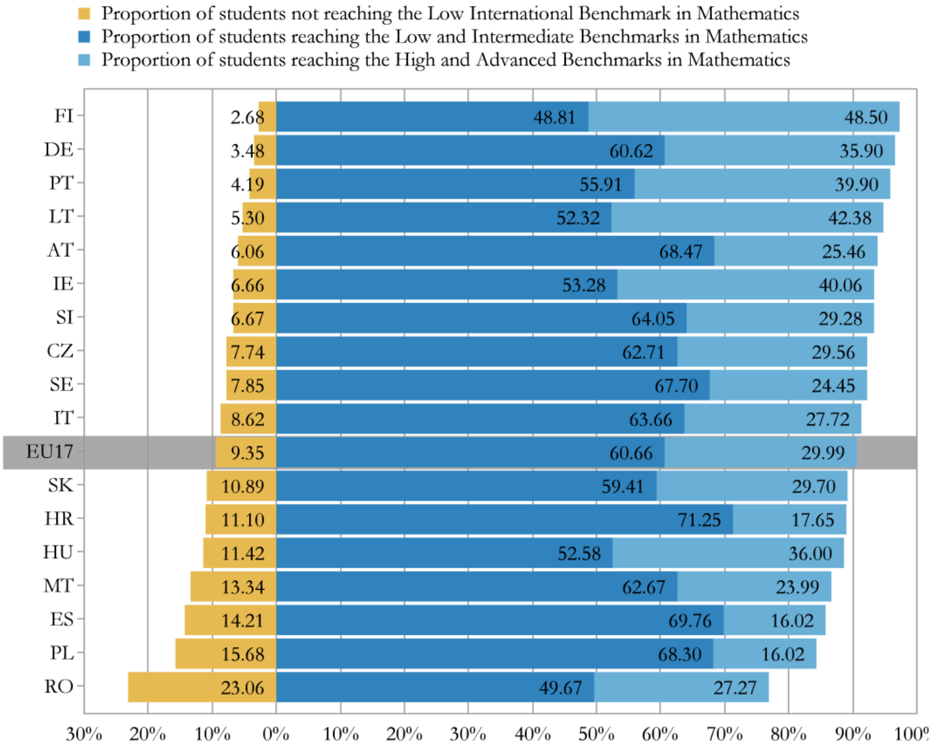


Source: CRELL analysis based on TIMSS and PIRLS 2011 Combined data. *See also Table 1, Annex A.*

Results also show that the 17 EU MS perform fairly well in terms of excellence, meaning that they succeed in educating many students at high and advanced content and skills levels. On average, nearly four in ten students (36.40%) perform at the High and Advanced benchmarks. In Finland, Ireland and Croatia, the share exceeds 45%, while in Member States such as Malta, Spain and Romania figures are slightly more modest (below 30%).

Similar results for Mathematics are shown in Graph 2. Here too, across the 17 EU MS the data indicates a high degree of success in terms of inclusiveness. Over 90% of the students are reaching the Low, Intermediate, High and Advanced benchmarks with only about 9% of them showing low achievement. However, country differences exist. On this metric, Finland, Germany and Portugal have a share of low achievers below 5%. On the other hand, in some EU MS such as Romania and Poland, the share of students at risk exceeds 15%.

Graph 2. TIMSS Mathematics Benchmarks



Source: CRELL analysis based on TIMSS and PIRLS 2011 Combined data. *See also Table 2, Annex A.*

For Mathematics, on average, across the 17 EU MS about 30% of the students perform at the High and Advanced benchmarks. In Finland, Lithuania and Ireland, the share exceeds 40%, while in Poland, Spain and Romania less than 20% of the students are reaching high and advanced proficiency levels.

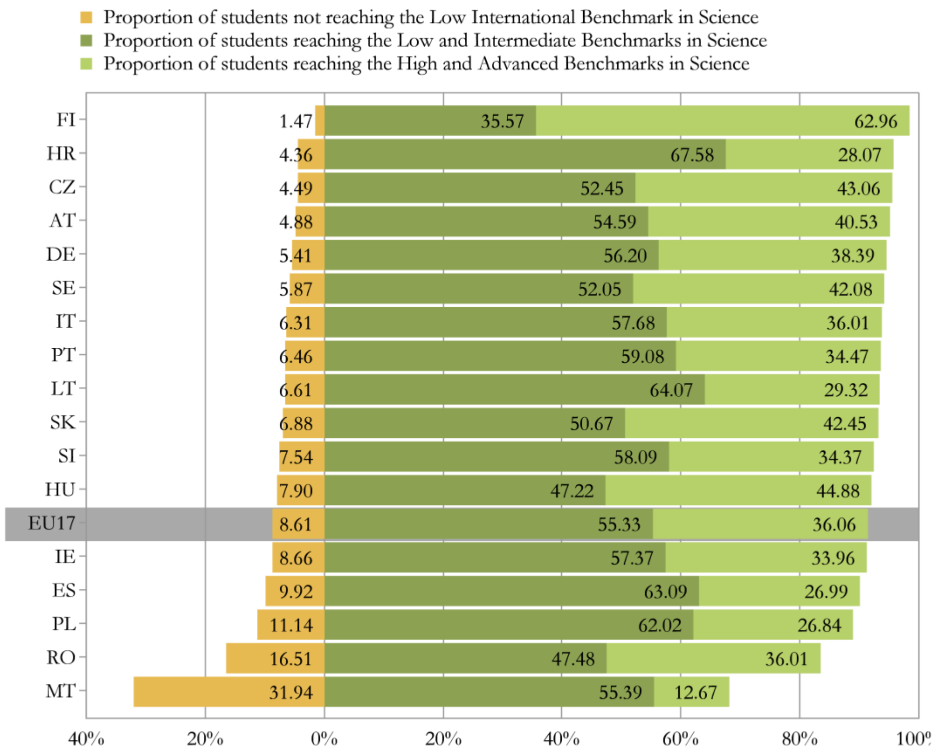
Graph 3 shows results for Science. Across the 17 EU MS, over 91% of the students reach the Low, Intermediate, High and Advanced benchmarks with only about 8% of them showing low achievement levels. Finland, Germany and Portugal have shares of low achievers below 5%. On the other hand, in some Member States such as Romania and Poland, the share of students at risk exceeds 15%.

Regarding Science, on average, across the 17 EU MS about 35% of the students perform at the High and Advanced benchmarks. However, there is considerable heterogeneity among countries. In Finland, the proportion of high achievers[32] exceeds 60%, while in Malta less than

[32] High achievement is defined here as student performance at or above the "High International Benchmark" of TIMSS & PIRLS 2011.

15% of the students reach high and advanced proficiency levels in Science. For all other EU MS, values lie between 25% and 45%.

Graph 3. TIMSS Science Benchmarks



Source: CRELL analysis based on TIMSS and PIRLS 2011 Combined data. *See also Table 3, Annex A.*

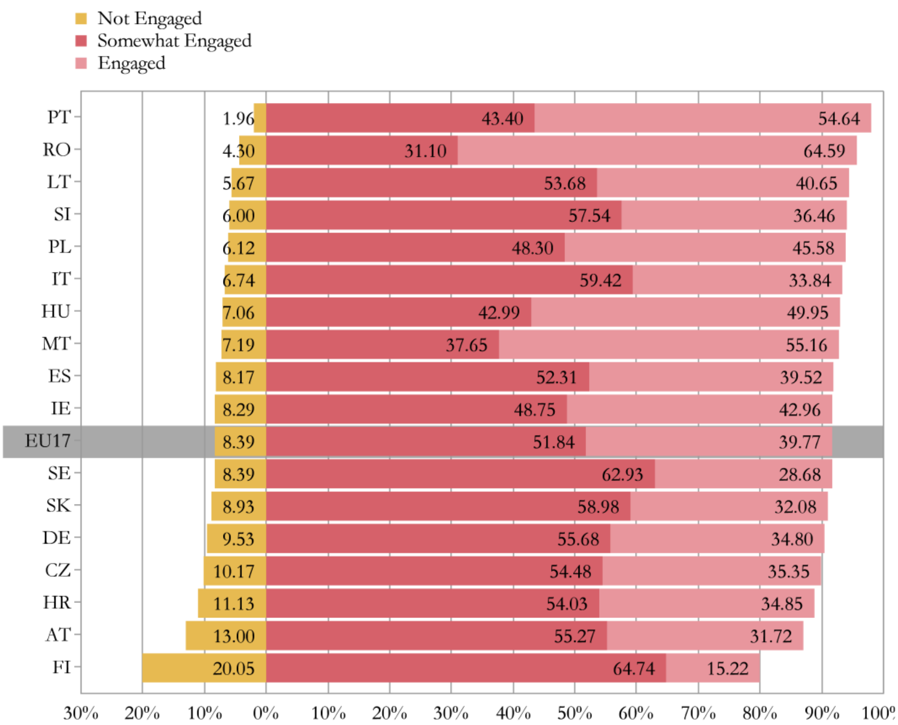
Across learning domains, the overall pattern shows that when countries are able to educate high proportions of students at or above the Low benchmark in Reading, they tend to perform similarly for Mathematics and Science. A clear example is Finland where the percentages of students not reaching the Low benchmark for Reading, Mathematics and Science range from 1.45% to 2.68% while large proportions of students have at least a well-rounded foundation of basic skills in all subjects. In addition, Finland has nearly half of its students or more reaching the High and Advanced proficiency levels in Reading, Mathematics and Science.

Conversely, in countries such as Romania and Malta, the share of low achievers across learning domains is quite high. In Romania, the percentages of students not reaching the Low benchmark for Reading, Mathematics and Science range from 16.51% to 23.06%. In Malta, low achievement is less pronounced in Mathematics (13.34%) in comparison to the other subjects, yet consistently high when it comes to Reading (28.80%) and Science (31.94%).

2.2.2. Students' perceptions of instructional teaching practices.

As described in Chapter 1, TIMSS and PIRLS measure students' perceptions of instructional teaching practices in Reading, Mathematics and Science. For each subject, students express their agreement with several items describing instructional activities (e.g. in terms of how interesting are the materials used or the tasks assigned).[33] Three scales were created to describe the levels of student engagement[34] with their instruction in the different subjects. Graphs 4, 5 and 6 in the following pages present this information for Reading, Mathematics and Science.

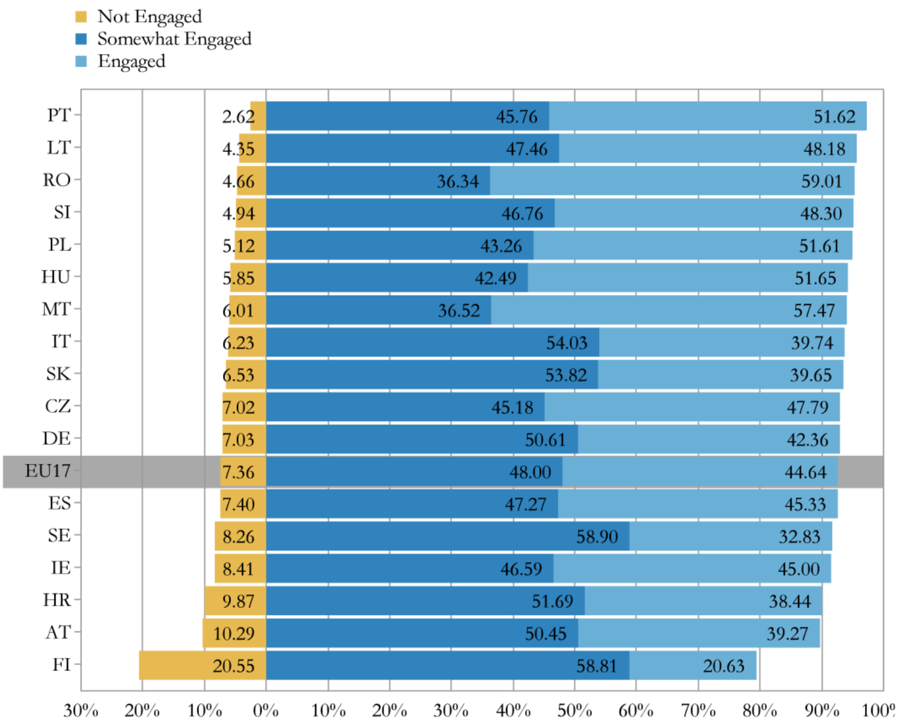
Graph 4. Students Engaged in Reading Lessons



Source: CRELL analysis based on TIMSS and PIRLS 2011 Combined data. *See also Table 4, Annex A.*

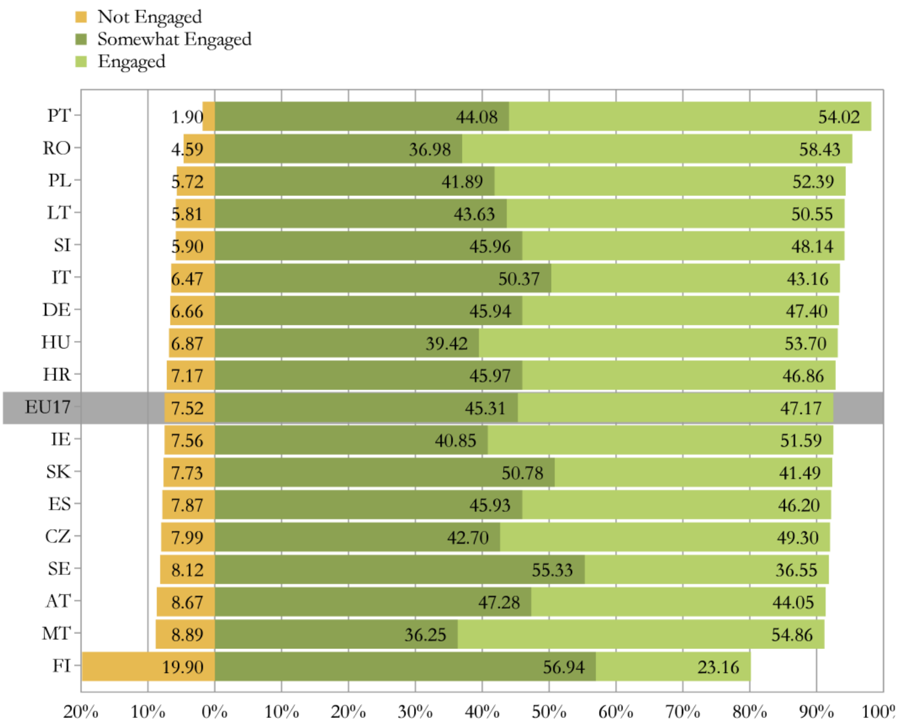
[33] For the exact wording of the items, please consult Chapter 1, Section 1.4.
[34] Students' engagement was classified in three categories: "Not engaged", "Somewhat Engaged" and, "Engaged". For Reading, "Not engaged" students "agreed a little" with three statements and "disagreed a little" with the other four, on average. Students in the "Engaged" category "agreed a lot" with four of the statements and "agreed a little" with the other three, on average, whereas all other students were considered "Somewhat Engaged". For Mathematics and Science, students considered to be "Not Engaged" "agreed a little" with two statements and "disagreed a little" with the other three, on average. "Engaged students" "agreed a lot" with three of the statements and "agreed a little" with the other two, on average, whereas all other students were considered "Somewhat Engaged".

Graph 5. Students Engaged in Mathematics Lessons



Source: CRELL analysis based on TIMSS and PIRLS 2011 Combined data. *See also Table 5, Annex A.*

Graph 6. Students Engaged in Science Lessons



Source: CRELL analysis based on TIMSS and PIRLS 2011 Combined data. *See also Table 6, Annex A.*

Across the participating EU MS, on average, over 39% of the fourth grade students reported being "Engaged" during Reading lessons (see Graph 4). Over 44% reported being Engaged during Mathematics lessons (see Graph 5) and over 41% in Science lessons (see Graph 6). Slightly higher shares of students reported being "Somewhat Engaged": over 51% for Reading, over 48% for Mathematics and over 50% for Science. Overall, on average, across learning domains and countries, 91% of the students or more reported being at least somewhat engaged in their lessons. On average, only about 8% of the students reported being "Not Engaged" in Reading lessons and 7% reported not being engaged in Mathematics and Science lessons. Variability among countries is most pronounced for the "Engaged" category. Consistent outliers across Reading, Mathematics, and Science for the category "Not Engaged" are Finland and Portugal. In Finland about 20% of the students report not being engaged in each of the three lesson types. In Portugal, substantially lower shares of students (about 2% on average across Reading, Mathematics and Science) report no engagement in such lessons.[35]

[35] Such statistics may appear puzzling. Earlier in this chapter Finland was consistently pointed out as a high achieving country. A large % of Not engaged students may seem a counterintuitive finding. Nevertheless, we remind the reader that the information described relies on students' self-reports and such measures may be affected by cultural values and/or other specific reference frames such as reference to high educational standards. In addition, the results are consistent with similar patterns for Finland regarding students' reports on other attitudinal measures (e.g. Students like Reading, Mathematics and Science in TIMSS and PIRLS 2011).

Highlights

- The different proficiency levels in TIMSS and PIRLS at the fourth grade provide information on the knowledge and skills teachers must teach/facilitate in the classroom as well as actual student achievement.
- On average, across subjects, over 90% of the fourth graders have at least a well-rounded foundation of basic skills (reaching the Low Benchmark).
- The EU MS where the vast majority of students – over 95% - reach the Low Benchmark) are also those with over 40% of the students reaching the High Benchmark (e.g. Finland – all subjects; Czech Republic – Mathematics & Reading; Croatia – Reading; Austria - Science).
- However, some educational systems have relatively high shares of low achievers across learning domains (e.g. Romania – all subjects; Malta – Reading & Science).
- On average, across learning domains and countries, a large proportion (over 91%) of fourth graders report being at least somewhat engaged with their Reading, Mathematics and Science instruction.
- In the best performing countries (e.g. Finland), higher shares of students tend to report not being engaged with their Reading, Mathematics and Science instruction.

2.3. Generic and content-specific instructional practices. Teachers' perspective.

Teacher instructional practices[36] have been consistently underscored for their important role in student learning (Creemers & Kyriakides, 2008; Hattie, 2009; Seidel & Shavelson, 2007; Scheerens & Bosker, 1997). They were shown to have the strongest association with student achievement above other personal teacher characteristics such as background qualifications (Boonen, Van Damme & Onghena, 2013; Creemers & Kyriakides, 2008; Muijs & Reynolds, 2010; Palardy & Rumberger, 2008). Some studies (Charalambous, Komitis, Papacharalambous, & Stefanou, 2014) also report that teachers themselves prefer to be evaluated based on their daily classroom practices rather than on the basis of other evaluation mechanisms.

For primary education, direct instruction methods (e.g. structuring the content, questioning) have been generally found (Creemers, Kyriakides & Antoniou, 2013; Hattie, 2009; Muijs, Campbell, Kyriakides & Robinson, 2005) to be suitable for this young age group.

[36] Teacher instructional practices refer to several instructional strategies which teachers may use frequently in the classroom. See also Chapter 1. Sections 1.3. & 1.4.

However, they seem to be highly effective in teaching basic skills but somewhat insufficient for addressing the development of higher order thinking skills for which more student-centered approaches (e.g. reflecting on one's own thinking, problem solving strategies) may be needed.

In the European context (European Commission, 2012a), teachers are called to innovate their teaching practices and give students a central role in their learning. Yet, this should be achieved in an inclusive way by ensuring that all students participate in education and develop at least basic skill levels. In this context, a mix of instructional approaches combining direct instruction with more student-centered approaches while taking into account the characteristics of the students (e.g. ability level, social background) should be considered (see also Creemers & Kyriakides, 2008). In most European countries, the choice of these methods is left at the discretion of teachers (Eurydice, 2013). Accordingly, the role of professional development programs is essential in preparing teachers for their activity.

The following section, consistent with the scientific literature (Creemers & Kyriakides, 2008; Charalambous, et al., 2014) and the frameworks of TIMSS and PIRLS 2011, lays out the distinction[37] between "generic" and "content specific" instructional practices. Generic instructional practices are those instructional strategies used by the teachers in the classroom that cut across different learning domains or subject matters. Content-specific practices are those instructional strategies that are most relevant for particular subject matters, in this case for Reading, Mathematics and, Science. Within each category, a further distinction is made between practices relevant for basic versus higher order skills. In addition, the last part of this section provides information regarding the integration of ICT in teaching and learning practices for Reading, Mathematics and Science.

2.3.1. Generic instructional practices.

Graph 7[38] illustrates the proportion of students whose teachers report using several generic instructional practices[39]. On both sides (right and left) of the graphical representation, solid blue lines indicate proportions of students categorized under "Most Lessons" according to their teachers' responses on the TIMSS and PIRLS scale: "Engaging Students in Learning". These teachers use three of the six practices in "every or almost every lesson" and the other three in "about half the lessons," on average. The right and left sides of the graph present also

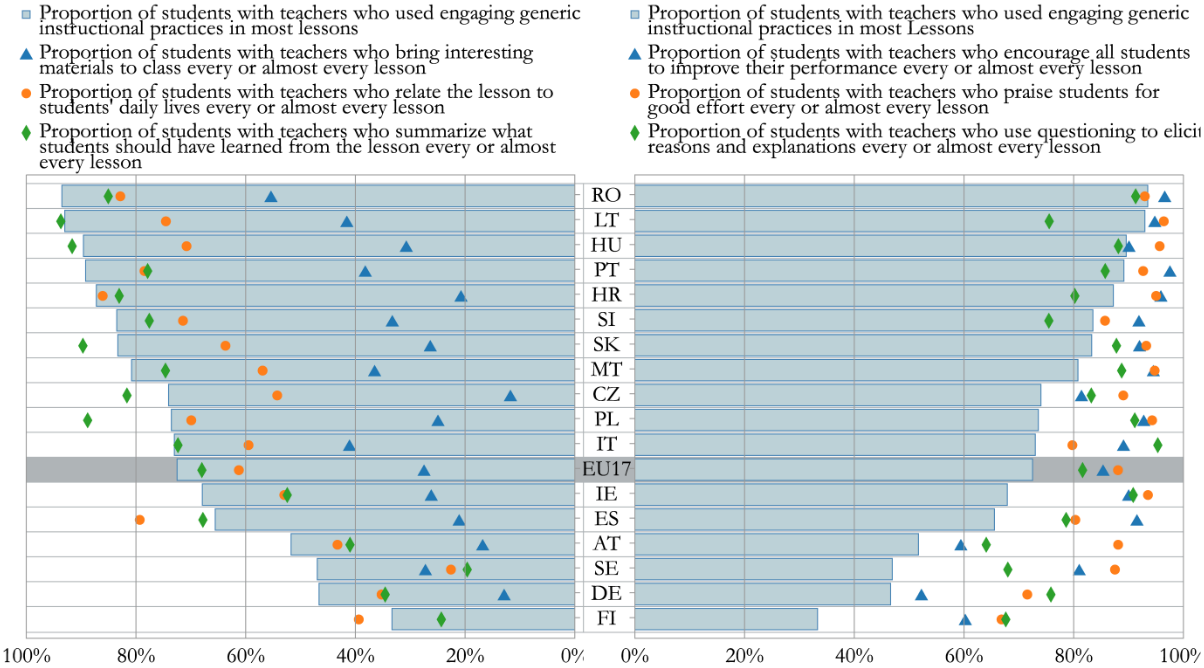
[37] See also Chapter 1. Sections 1.3. & 1.4.

[38] Please refer also to Tables 7.1. & 7.2. in Annex A. The estimate for FI on "bring interesting materials to the class" is not reliable, therefore not reported.

[39] Analyses based on teachers of Reading. Analyses using weights for teachers of Mathematics and Science yield similar results.

information on the proportion on students whose teachers use each of the six practices in "every or almost every lesson".

Graph 7. Generic Instructional Practices



Source: CRELL analysis based on TIMSS and PIRLS 2011 Combined data. *See also Table 7.1. & 7.2., Annex A.*

On average, many of the fourth graders (72.51%) have teachers who use a variety of generic instructional practices in most lessons in order to engage them in learning. Yet, differences among countries are apparent. In particular, in Romania and Lithuania more than 90% of the students have teachers that use a variety of strategies in most lessons. Conversely, in Finland, Germany and Sweden, less than half of the students have their teachers use these practices with the same frequency.

With respect to the use of each practice, on average, large shares of fourth graders are praised for good effort (88.09%), encouraged to improve their performance (85.37%), and involved in deep questioning (81.63%) at least in almost every lesson. Substantially fewer have their teacher summarizing the main points of the lesson (67.98%) or relate the lesson to their daily lives (61.24%); even fewer (27.48%) have their teachers bringing interesting materials to the class.

Instructional strategies such as the ones described above and in particular questioning, structuring (summarizing the main points of the lesson), orientation (relating the lesson to students' daily lives) and, engaging feedback (praising them for good effort, encouraging them to improve their performance) are fundamental for basic skills instruction (Creemers & Kyriakides, 2008)[40].

Looking across the countries, there is little variability for involving students in deep questioning, praising them for good effort and encouraging them to improve their performance. Notably, in Romania, Poland, and Ireland high proportions of students (more than 90%) are exposed to all three practices, while in all other countries the share of students whose teachers involve them in such practices is above 50%.

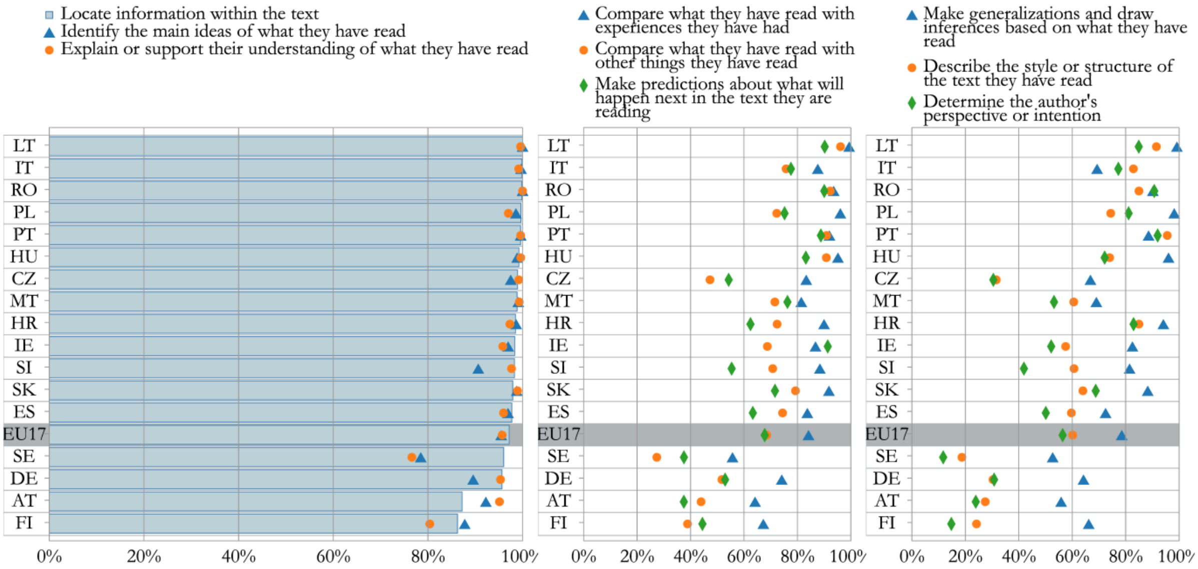
Considerable variation is nevertheless apparent for summarizing the main points of the lesson, relating the lesson to students' daily lives, and bringing interesting materials to the class. Specifically, the first two practices (summarizing the main points of the lesson, and, relating the lesson to students' daily lives) are highly emphasized (for more than 80% of the students) by teachers in Romania and Croatia. Conversely, in Sweden lower shares of students (about 20%) are engaged with such practices in almost every lesson. Bringing interesting materials to the class is less common across the 17 EU MS with extremes for Finland (2.63%) and Romania (55.38%).

[40] See also Chapter 1.

2.3.2. Content-specific instructional practices.

Graph 8[41] presents the percentage of students whose teachers report emphasizing at least weekly several reading comprehension strategies in their lessons. From left to right, these stategies are presented according to an ascending order of complexity. In general terms, they can be related to the different proficiency levels for Reading achievement of TIMSS and PIRLS 2011 (see Box1).

Graph 8. Instructional Strategies for Reading



Source: CRELL analysis based on TIMSS and PIRLS 2011 Combined data. *See also Tables 8.1. & 8.2., Annex A*

On average, almost all students are asked at least weekly to locate information within the text (97.17%), identify the main ideas of what they have read (95.48%) and, explain or support the understanding of what they have read (95.68%). Fewer (84.14%, 68.50% and 67.76%) are asked to compare what they have read with experiences they have had, compare what they have read with other things they have read and, make predictions about what will happen next in the text they are reading. Slightly smaller shares of students (78.52%, 60.16% and, 56.39%) are asked to make generalizations and draw inferences based on what they have read, describe the style or structure of the text and determine the author's perspective or intention.

Across countries, there is little variation in teachers' reported emphasis on reading comprehension strategies aimed at developing basic Reading skills (e.g. locating information, identifying main ideas and explaining). Nevertheless, progressing towards strategies involving

[41] Please refer also to Tables 8.1. & 8.2. in Annex A.

higher levels of complexity, the reported emphasis on such strategies varies considerably from country to country. In particular, large variation is noticeable for determining the author's perspective, describing the style of the text, and comparing what students have read with other readings. More specifically, less than 50% of the students in Finland, Austria, Czech Republic, and Germany are asked to compare what they have read with other readings, determine the author's perspective or to describe the style of the text, while over 80% are asked to do so at least on a weekly basis in Lithuania, Romania and, Portugal. As described previously in this chapter, the skills developed by such strategies are most commonly demonstrated by high and advanced learners in Reading (see Box1).

Graph 9[42] presents instructional strategies for Mathematics. On both sides (right and left) of the graphical representation, solid blue lines indicate proportions of students whose teachers emphasize at least weekly instructional strategies focused on developing basic key skills in Mathematics (ask students to memorize rules, procedures and facts and, explain their answers, respectively). The left side of the graph also presents information on the proportion of students whose teachers use several strategies to help them improve their problem solving skills. These include: working problems (individually or with peers) with teacher guidance; working problems together in the whole class with direct guidance from teacher; and working problems (individually or with peers) while the teacher is occupied by other tasks. The problem-solving skills developed by such strategies are most commonly demonstrated by high and advanced learners in Mathematics (see Box 2).

On average, only a few students (24.65%) are asked at least weekly to memorize rules, procedures and facts. More than half (62.08%) are on the other hand asked to explain their answers. Less than half (53.20% and, 40.93%) are involved in working problems (individually or with peers) with teacher guidance, and working problems together in the whole class with direct teacher guidance. Working problems (individually or with peers) while the teacher is occupied by other tasks occurs in almost every lesson for only 11.27% of the students.

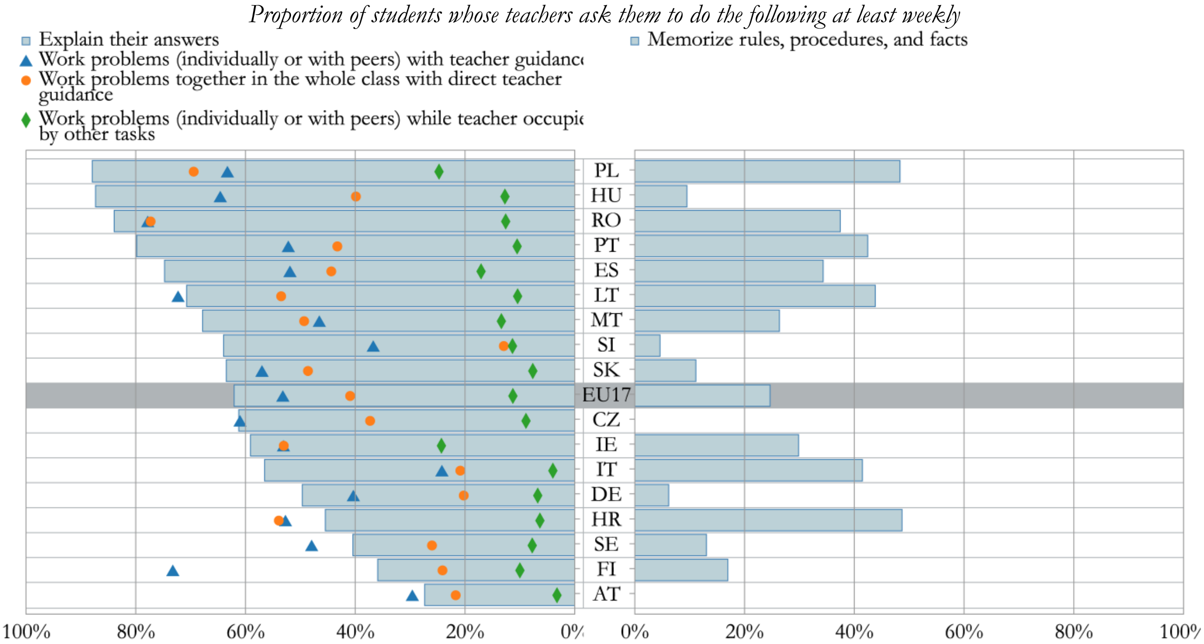
With one exception (working problems - individually or with peers - while the teacher is occupied by other tasks), most of these practices vary substantially from country to country with the highest variability for working problems together in the whole class with direct teacher guidance; asking students to explain their answers; and working problems (individually or with peers) with teacher guidance. In Austria, Sweden, Croatia, and especially in Finland, teachers put

[42] Please refer also to Table 9 in Annex A. Estimates for AT & CZ on "Memorize rules, procedures, and facts" are not reliable, therefore not reported.

more emphasis on students working problems (individually or with peers) with teacher guidance rather than on students explaining their answers. The focus on these issues is evenly shared in Lithuania and Czech Republic, while in the other countries the focus rests on the student ability to explain their answers.

Graph 9. Instructional Strategies for Mathematics

Proportion of students whose teachers ask them to do the following at least weekly



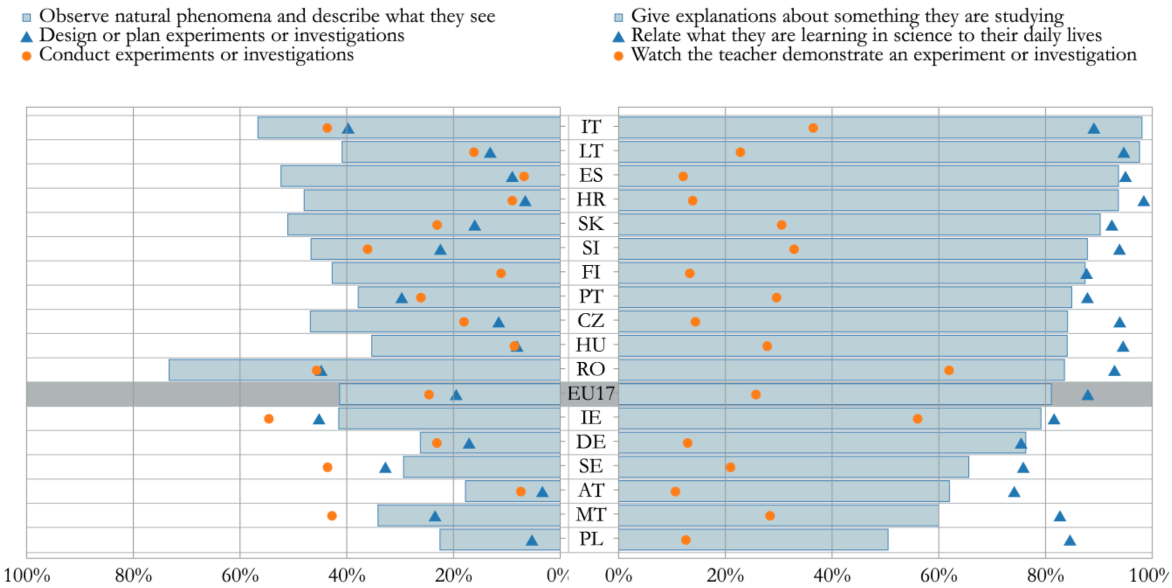
Source: CRELL analysis based on TIMSS and PIRLS 2011 Combined data. *See also Table 9, Annex A.*

Graph 10[43] presents the percentage of students whose teachers report using several instructional strategies at least in half of the Science lessons. These involve different levels of complexity. Strategies which involve students observing natural phenomena such as the weather or a plant growing and describing what they see, giving explanations about something they are studying, watching the teacher demonstrate an experiment or investigation, and relating what they are learning in Science to their daily lives are most commonly demonstrated by intermediate and high performers in Science. Strategies aimed at developing high and advanced scientific inquiry skills involve practices such as designing or planning experiments or investigations and conducting such experiments or investigations (see Box 3).

[43] Please refer also to Table 10 in Annex A. Estimates for FI on "design or plan experiments" and PL on "conduct experiments or investigations" are not reliable, therefore not reported.

Graph 10. Instructional Strategies for Science

Proportion of students whose teachers ask them to do the following at least half of the lessons



Source: CRELL analysis based on TIMSS and PIRLS 2011 Combined data. *See also Table 10 in Annex A. Estimates for FI & PL on "design or plan experiments" are not reliable, therefore not reported.*

On average, more than 80% of the students are asked in at least half of the lessons to relate what they are learning in Science to their daily lives (87.94%) and give explanations about something they are studying (81.11%). Less than half are asked to observe natural phenomena and describe what they see (41.36%) and even fewer have their teacher demonstrate an experiment (25.74%), conduct experiments (24.59%), and are involved in designing experiments (19.49%).

Nevertheless, all these practices vary from country to country with somewhat less variability for relating what is learned in Science to daily live. The highest variability regards observing natural phenomena closely followed by watching the teacher demonstrate an experiment, conducting experiments, explaining what is being studied in Science and designing experiments.

Notably, less than 20% of the students in a large number of countries (Austria, Croatia, Poland, Estonia, Finland, Lithuania and Czech Republic) were involved in designing experiments and in conducting such experiments, while in Ireland, Romania and Italy about 40% of the students are engaged in such practices in at least half of the lessons. In Romania, also over 60% of the students observe teachers demonstrate an experiment and observe natural phenomena.

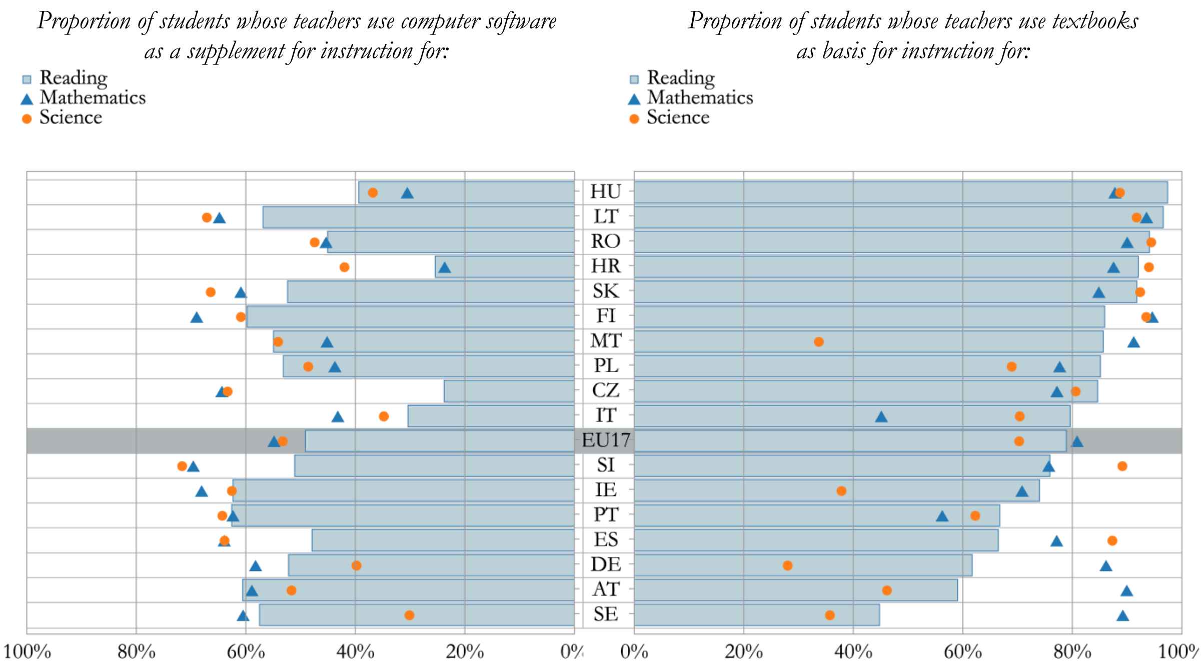
2.3.3. ICT integration in teaching and learning.

The effective use of ICT tools in teaching and learning is often perceived as a driver of pedagogical innovation (European Comission, 2012a). In the European context, strategies to foster ICT use in education at the primary level have been implemented in all EU MS (Eurydice, 2011). The reported use of ICT tools per se is less important than the way such tools are integrated in teaching and learning (European Comission, 2012a).

Graphs 11 and 12 provide information on the reported use of ICT for teaching Reading, Mathematics and Science at the fourth grade and the way such tools are used to develop skills and strategies in these learning domains.

Graph 11[44] describes the use of computer software[45] for Reading, Mathematics and Science instruction. This information is complemeted by indicating the extent to which the 17 EU MS make use of more traditional resources such as textbooks.

Graph 11. Resources for Teaching



Source: CRELL analysis based on TIMSS and PIRLS 2011 Combined data. *See also Table 11, Annex A.*

The right side of the graph shows the use of textbooks as a basis for instruction. Teachers report using textbooks for instruction in the three subjects for more than 70% of the students, on average. The values are somewhat higher for Mathematics (80.88%) and Reading

[44] Please refer also to Table 11 in Annex A.
[45] The use of such software implies also availability of computers.

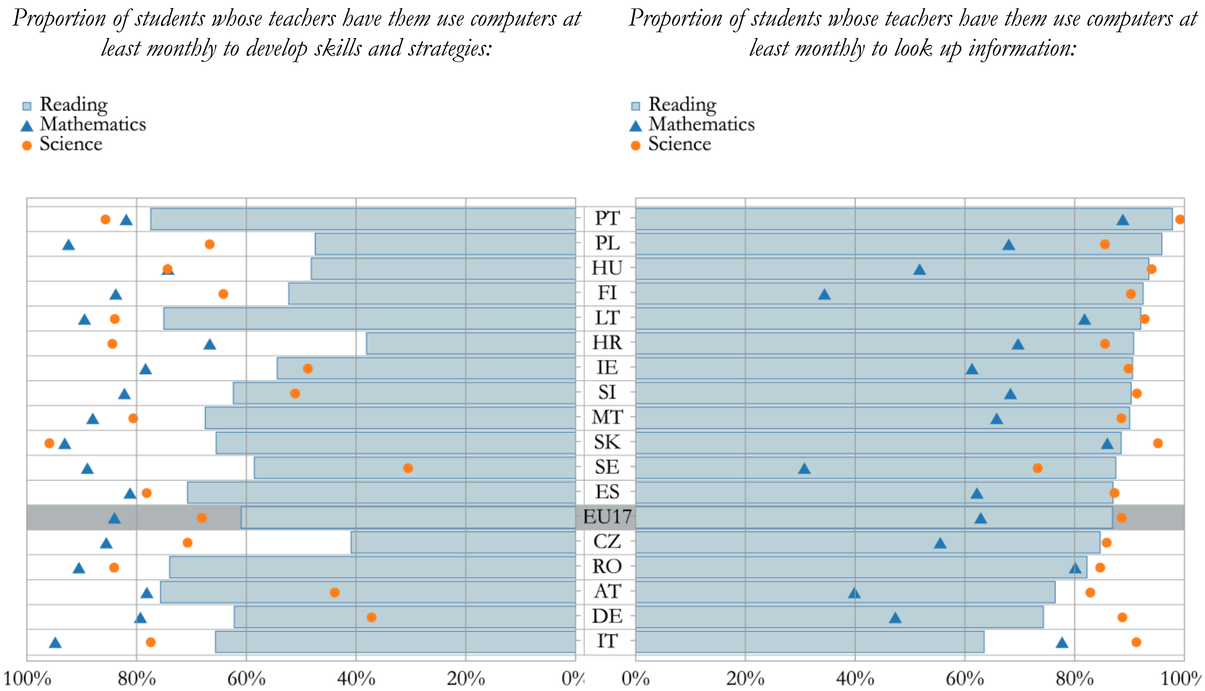
(78.92%) as compared to Science (70.30%). Variability among countries is most pronounced for Science. In severall countries, there is consistency across learning domains, with reported use of textbooks exceding 80% in all subjects in Romania, Lithuania, Hungary, Croatia, Slovak Republic and, Finland. Only in Sweden, Germany, Ireland and Malta less than 40% of students have teachers who use textbooks as a basis for instruction in Science.

The left side of the graph shows the use of computer software as a supplement[46] for Reading, Mathematics and Science instruction. On average, about half of the students (49.13% for Reading, 54.84% for Mathematics and, 53.26% for Science) are in classrooms where computer software is used for instruction in all subjects. From country to country, the use of software varies particularly for Mathematics and Science. In some countries (Ireland, Portugal and, Finland) there is consistency across learning domains with the use of softwares as supplement for instruction at about 60% or more. On the other hand, in a minority of countries, the teachers of less than 40% of students use computer software as supplement for instruction in Science (Sweden, Italy and Hungary) or Mathematics (Croatia and Hungary).

Graph 12 displays information about the purposes of using ICT tools in Reading, Mathematics and Science instruction[47]. The right side of the graph shows teachers' reports regarding the use of computers for looking up information. For all subjects, technology has an increasing role in locating information for assignments and such type of activities, although rather basic, involve the capacity to select the appropriate sources of information and analyze the meaning of such information[48]. On average, more than 80% of the students are asked at least monthly to look up information for Reading (86.92%) and Science (88.60%). A somewhat smaller proportion of students (62.91%, on average) were asked to do the same for Mathematics. Variability among countries is most pronounced for Mathematics. In some countries (Portugal, Lithuania, Slovak Republic), more than 80% of the students are asked to perform this activity for all three subjects. In contrast, in Sweden and Finland, less than 40% of the students are asked to use computers for looking up information for Mathematics lessons.

[46] The majority of EU 17 MS's indicated that software is used as a supplement and not as basis for instruction.
[47] Please refer also to Table 12 in Annex A.
[48] See PIRLS 2011 Results in Reading, Mullis, Martin, Foy, & Drucker, 2012; TIMSS 2011 Results in Mathematics, Mullis, Martin, Foy, & Arora, 2012 & TIMSS 2011 Results in Science, Martin, Mullis, Foy, & Stanco, 2012

Graph 12. Computer-based Practices



Source: CRELL analysis based on TIMSS and PIRLS 2011 Combined data. *See also Table 12, Annex A.*

The left side of the graph shows teachers' reports regarding the use of computers for developing skills and strategies in Reading, Mathematics and Science. This type of activity involves higher levels of complexity. For example, in Reading, students could highlight and interpret complex information from different parts of the text. In Mathematics and Science, it may assist students in problem-solving and/or visualizing and exploring scientific properties.

On average, slightly lower shares of students are involved with such strategies as compared to looking up information. More than 60% of the students, on average, are asked at least monthly to use computers for developing skills and strategies in Reading (60.93%) and Science (68.10%). A higher proportion of students (84.04%, on average) are asked to do the same for Mathematics.

Variability in computer use for developing skills and strategies amongst the 17 EU MS is most pronounced for Science. Some countries (Portugal, Lithuania, Malta, Slovak Republic, and Romania) put a very high emphasis on its use in activities, with about 80% of the students or more being involved in developing Mathematics and Science skills and strategies at least monthly. Conversely, in Sweden and Denmark, less than 40% of the students are asked to use computers for developing skills and strategies for Science lessons.

Highlights

- On average, large proportions of students (over 70%) have teachers that use a variety of generic instructional practices to engage them in learning on a daily basis.
- Across the 17 EU MS, the most commonly used generic instructional practices are praising students for good effort, encouraging them to improve their performance and involving them in deep questioning. A far less common practice is bringing interesting materials to the class on a daily basis.
- For Reading, Mathematics and Science, on average, the use of practices aimed at developing higher order skills (e.g. asking students to determine the style of a text, working problems collaboratively in the classroom and conducting experiments) is common only for half of the students or substantially less. These kinds of practices also vary widely from country to country.
- In the 17 EU MS, computer software is mainly used as a supplement and not as basis for instruction. On average, about half of students are in classrooms where computer software is used as a supplement for instruction in all subjects.
- On average, ICT software is used slightly more to look up information rather than for developing skills and strategies in Reading and Science while, for Mathematics, the opposite is true. Differences between countries are most pronounced for Science.

2.4. Teachers' collaborative practices.

The traditional role of the teacher is to engage students in learning with a variety of instructional practices. Professional learning can enable teachers to provide such quality instruction. A relatively recent form of professional learning[49] involves teacher collaboration and the creation of professional learning communities (PCLs). Given its relative novelty in practice[50], professional learning communities[51] are considered innovative for their potential to anchor professional development in teachers' daily work and practice, change attitudes, and introduce innovative ways in teaching and learning (European Commission, 2012a; European Commission, 2012b). In the European context, sharing and collaborating are perceived as highly important. European

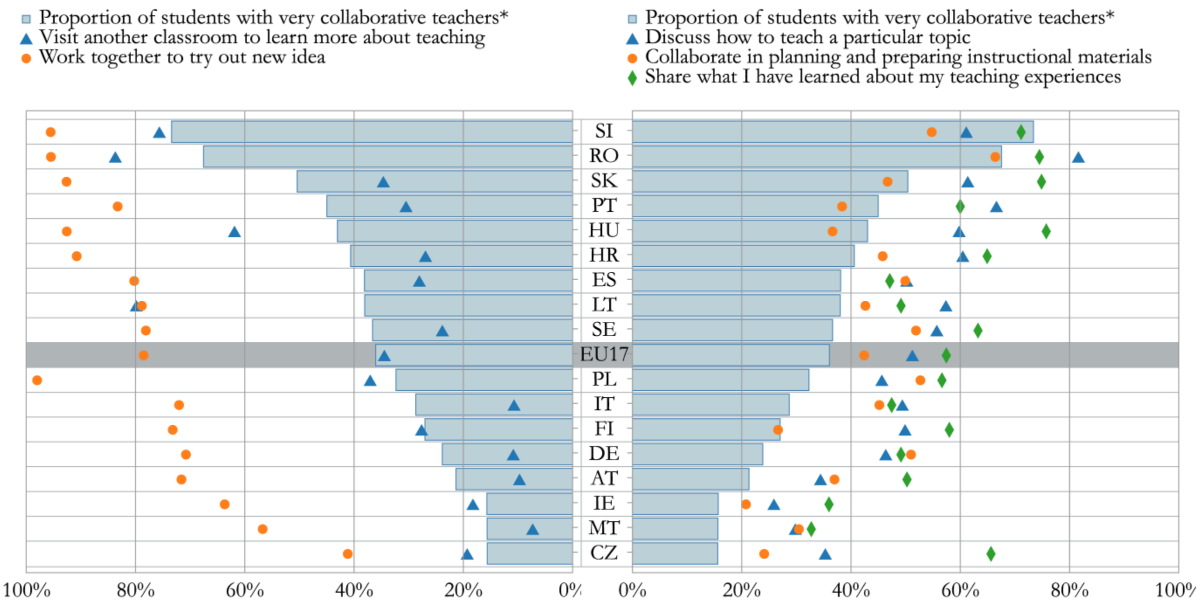
[49] Professional learning refers to teacher learning activities which help teachers to improve their classroom practices.
[50] Scholars pointed out its benefits starting early in the 1980s – e.g. Darling- Hammond, 1984.
[51] Concept originally developed by Lave & Wenger, 1991. See also Chapter 1.

Commission initiatives such as *eTwinning* aim to encourage this teacher collaboration also beyond school settings, at a European scale, through online platforms.

TIMSS and PIRLS 2011 cover important features of PCLs such as: teacher collaboration (working together to plan and prepare instructional materials or try out new ideas), reflective dialogue (e.g. discussing how to teach a topic, share insights from their teaching experience), and deprivatization of practice (e.g. visiting one another's classes for learning and feedback purposes).

Graph 13[52][53] illustrates the proportion of students whose teachers report using several collaborative practices. On both sides (right and left) of the graph, solid blue lines indicate proportions of students categorized under "Very collaborative" according to their teachers' responses on the TIMSS and PIRLS scale: "Collaborate to Improve Teaching"(5 items)[54]. These teachers report having interactions with other teachers at least "one to three times per week" in each of three of the five areas and "two or three times per month" in each of the other two, on average.

Graph 13. Teacher Collaborative Practices



Source: CRELL analysis based on TIMSS and PIRLS 2011 Combined data. *See also Table 13, Annex A. * Their teachers having interactions with other teachers at least "one to three times per week" in each three of five areas and at least "two to three times per month" in each of the other two.*

[52] Please refer also to Table 13 in Annex A.
[53] Analyses based on teachers of Reading. Analyses using weights for teachers of Mathematics and Science yield similar results.
[54] See Chapter 1, section 1.4. for scale description.

The right side of the graph presents also information on the proportion of students whose teachers use three of these practices (collaborate in planning and preparing instructional materials, share what they have learned about their teaching experiences and, discuss how to teach a particular topic) one to three times per week, or more. The left side of the graph presents also information on the proportion of students whose teachers use two of these practices (work together to try out new ideas and, visit another classroom to learn more about teaching) one to three times per month or more.

Across the 17 EU MS, on average, more than one third (36.06%) of fourth graders have teachers reporting a high degree of collaboration with other teachers with the goal of improving teaching and learning. There are however large differences among countries. In the Czech Republic, Malta and Ireland, less than 20% of the students have teachers that report being very collaborative. Conversely, in Slovenia and Romania, more than 60% report high levels of collaboration.

With regard to the use of each practice, on average, more than half of students have teachers sharing what they have learned about their teaching experiences (57.45%) and discuss how to teach a particular topic (51.24%) on a weekly basis. Slightly lower shares of students (42.42%, on average) have teachers collaborating weekly in planning and preparing instructional materials. There are rather large country differences, particularly when it comes to discussing how to teach a particular topic. Notably, in Malta and Ireland less than 20% of the students had teachers that reported being involved in all three forms of collaboration at least weekly, while in Romania more than 60% reported engaging in all these practices on a weekly basis.

Practices that require closer collaboration such as working together to try out new ideas and visit another classroom to learn more about teaching are less frequent as compared to the other three forms of collaboration. Examining the data for these practices in terms of frequency on a weekly basis yielded overall unreliable estimates. The left part of the graph describes therefore the frequency of these practices on a monthly basis. On average, about one third of the students (34.46%) have teachers visiting another classroom to learn more about teaching at least one to three times per month. On the other hand, about 3 out of 4 students (78.50%, on average) have teachers report working together to try out new ideas on a monthly basis. Across the 17 EU MS participating in TIMSS and PIRLS 2011, differences from country to country are pronounced for both practices, and in particular for visiting another classroom to learn more about teaching. Notably in Malta, Austria, Italy, Germany, Ireland and Czech Republic, less than 20% of the students have teachers visiting another classroom at least monthly, while in Romania, Lithuania, Slovenia and, Hungary, more than 60% of the students have teachers reporting engaging in this practice on a monthly basis.

Highlights

- Across the 17 EU MS more than one third (36.06%) of fourth graders have teachers report a high degree of collaboration with other teachers with the goal of improving teaching and learning, but large differences among countries are apparent.
- On a weekly basis, about half of students, on average, have teachers sharing what they have learned about their teaching experiences; discuss how to teach a particular topic; and collaborating in planning and preparing instructional materials.
- Practices such as working together to try out new ideas, and visit another classroom to learn more about teaching are less frequent when compared to the other three forms of collaboration and occur mostly on a monthly basis.
- On average, only about one third of the students have teachers visiting another classroom to learn more about teaching at least one to three times per month. However, the frequency of collaboration also varies widely from country to country.

2.5. School environment and support that shape teaching practices.

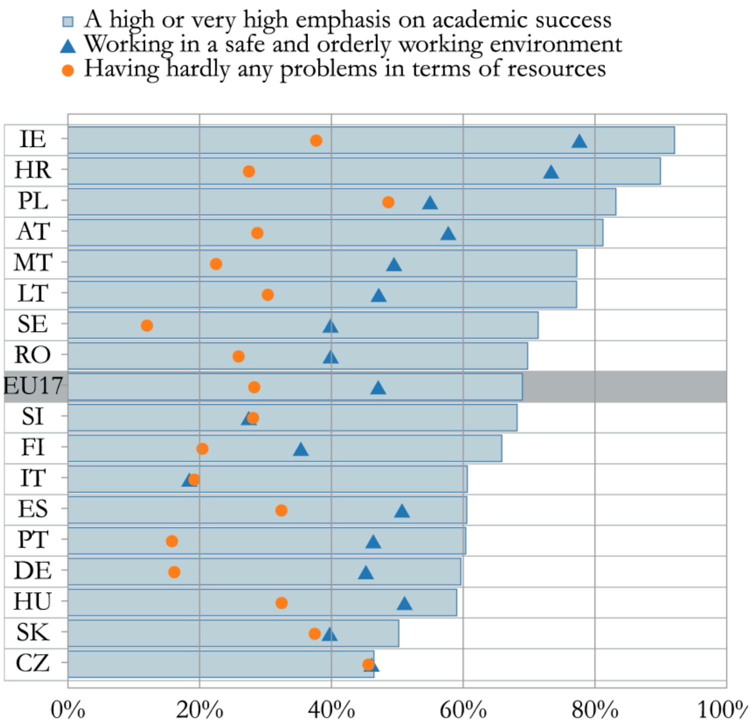
Professional learning communities and the quality and innovativeness of instructional teaching practices are potentially shaped by several processes at the school level. Features of the school environment such as distributed leadership (e.g. principals working jointly with teachers and allowing them to take on leadership roles), trust and positive working relationships (shared values and collective commitment to students' learning, close collaboration with parents), adequate resources (time and space for collaboration, availability of instructional materials), and school safety and discipline are among the necessary conditions for high quality teaching practices (Martin & Mullis, 2013; Stoll, et al. , 2006)[55].

[55] See also Commission of the European Communities, (2008).

Graph 14[56] depicts information about the proportion of students whose teachers report on their perceptions regarding several aspects of the school environment (in terms of focus on academic success, safety and resources)[57].

Graph 14. School Environment and Support

Proportion of students whose teachers report:



Source: CRELL analysis based on TIMSS and PIRLS 2011 Combined data. *See also Table 14, Annex A.*

On average, across countries, more than two thirds of the students (69.00%) have their teachers report a high or very high emphasis on academic success. Less than half (47.11%) are attending schools judged by their teachers to be safe and orderly and even fewer (28.30%) have their teachers signaling having hardly any problems in terms of resources. For all measures, there is substantial variability among countries, particularly for perceptions of safe and orderly school environments. In countries such as Sweden, Portugal, Germany and Italy, less than 20% of the students had their teachers report that they have hardly any problems in terms of resources. In Ireland, Croatia, Austria, Poland, Hungary and, Spain, more than half of the students were attending schools judged by their teachers to be safe and orderly, and having a high or very high emphasis on academic success.

[56] Analyses based on teachers of Reading. Analyses using weights for teachers of Mathematics and Science yield similar results

[57] See Chapter 1, section 1.4. for scale description.

Highlights

- On average, across the 17 EU MS more than two thirds of fourth grade students have their teachers report a high or very high emphasis on academic success.
- Only about half of the students, on average, attend schools judged by their teachers to be safe and orderly.
- Positive perceptions regarding the availability of resources are not common. Only about one third of the students, on average, have teachers who signal that they have hardly any problems in terms of resources.

2.6. Conclusion and discussion.

The current descriptive analyses of teaching practices in TIMSS and PIRLS 2011 Combined allow for a cross-cultural comparison of the prevalence of different instructional and collaborative teaching practices in the experience of fourth graders in primary schools across the 17 EU MS. In addition, they provide similar insights into the outcomes of teaching and learning – student achievement in Reading, Mathematics and Science – as well as into several features of the school environment. Key findings are reported on four overarching topics.

One of the main aims of teaching is to ensure that all students develop core competences or key basic skills. In the European context, the Member States strive to reach higher levels of student achievement in an inclusive manner aiming to reduce the share of low achievers in Reading, Mathematics and Science to below 15% by 2020 (European Council, 2010); accordingly, the first focus of this chapter was on the goals and outcomes of teaching and learning. Student achievement in Reading, Mathematics and Science was described for primary education for the 17 EU MS participating in TIMSS and PIRLS 2011 Combined. The analyses where carried out with a particular emphasis on skills that students at different proficiency levels must acquire. In addition, the analyses addressed also students' perception of instructional teaching practices by describing their reported levels of engagement in Reading, Mathematics and Science. Key findings show that, on average, the 17 EU MS are successful in ensuring a well-rounded foundation of skills for most students (over 90% of the students reach the Low International Benchmark in all subjects) and are therefore rather inclusive. Still, if some of the most inclusive systems[58] are also performing well in terms of excellence with over 40% of the students reaching the High International Benchmark in one or all subjects[59], some of the 17 EU MS[60] are still struggling with the share of students at risk exceeding 15%. In addition, across learning domains and countries, a large proportion (over 91%) of students report being at least somewhat engaged with their Reading, Mathematics and Science instruction.

Taken together, the findings imply that a focus on core competences or basic skills for all students is common across the 17 EU MS, and this approach is well supported by research (e.g. Creemers & Kyriakides, 2008), which identifies it as an important feature of effective educational systems. Therefore, this aim must be maintained and admirable efforts to achieve excellence should not come at the cost of inclusiveness and equity. The research knowledge on effective programs for primary education could provide useful leads on the issue. For example, empirical findings suggests that instructional methods aimed at building key competences, such as direct instruction and cooperative learning aligned with teacher professional development, show high evidence of effectiveness both for struggling as well as intermediate and advanced learners (Hattie, 2009; Slavin, Lake, Davis, & Madden, 2009[61]).

The second focus of this chapter was on generic and content-specific instructional practices. Teacher instructional practices refer to several instructional strategies that teachers may use frequently in the classroom. Within educational institutions, these strategies were shown to be proximal to student achievement and found to have the strongest impact on performance.

The reported analyses made use of information collected from teachers of Reading, Mathematics and Science to describe the use of generic and content-specific instructional practices across the 17 EU MS. Information is also provided on the integration of ICT in teaching and learning. The key findings emerging from these analyses document that, across the 17 EU MS, the most commonly used generic instructional practices are among the strategies fundamental for the development of basic skills (e.g. praising students for good effort, encouraging them to improve their performance and involving them in deep questioning). Regarding content-specific instructional practices for Reading, Mathematics and Science, the overall pattern indicates that the use of practices aimed at developing higher order skills (e.g. asking students to determine the style of a text, working problems collaboratively in the classroom and conducting experiments) is common only for half or less of the students; and, in

[58] The ones that manage to bring the vast majority of students - over 95% - to the low international benchmark.
[59] E.g. Finland – all subjects; Czech Republic – Mathematics & Reading; Croatia – Reading; Austria – Science.
[60] Malta and Romania.
[61] See also the Best Evidence Encyclopedia at http://www.bestevidence.org/csr/elem_csrq/elem_csrq.htm.

addition, these kinds of practices also vary widely from country to country. The ICT integration in learning and teaching is rather moderate. On average, about half of students are in classrooms where computer software is used as a supplement for instruction in all subjects and (with some exceptions[62]) tend to use such software slightly more to look up information rather than for developing skills and strategies.

These findings are consistent with the focus on key skills described above. In the European context teachers are called to innovate their practices and ensure that most students participate in education and develop at least basic skill levels. Therefore, a consistent high focus on well documented effective generic instructional strategies aimed at developing key basic skills may be justified.

Nevertheless, research findings indicate that high quality teaching involves the use of a diversified repertoire of instructional strategies (Creemers & Kyriakides, 2008). Additionally, the use of educational technology is a promising avenue of educational innovation, but it makes only a modest difference in students' achievement on its own (Cheung & Slavin, 2011) and must be supported and integrated with other instructional strategies. The evidence also seems to suggest that, in order to implement such practices in the classrooms, teachers must be provided with integrated tools, materials, and professional development (Hattie, 2009). Therefore, the relatively limited use of some of the practices aimed at developing higher order skills and non-cognitive outcomes, and especially the high variability among countries in this respect, may be a cause of concern. Provided the emphasis EU MS assign to these strategies (Eurydice, 2011), the same stands true when the ICT integration in learning and teaching is considered.

The third focus of this chapter was on teachers' collaborative practices and some other features of professional learning communities (PCLs). These practices are valued in the European context for their potential to anchor professional development in teachers' daily work and practice, change attitudes, and introduce innovative ways in teaching and learning (European Commission, 2012a; European Commission, 2012b).

Key findings regarding these practices indicate that they exist in most of the 17 EU MS but their occurrence is not all that common. More specifically, on a weekly basis, only about half of students, on average, have teachers who share what they have learned about their teaching experiences, discuss how to teach a particular topic, and collaborate in planning and preparing instructional materials. Moreover, more active practices that involve higher time investments and

[62] For Mathematics.

a reduction in individual teacher autonomy are less common by far. Accordingly, practices such as working together to try out new ideas and visit another classroom to learn more about teaching are less frequent[63]. For example, only about one third of the students have teachers who visit another classroom to learn more about teaching at least one to three times per month. Moreover, the frequency of collaboration also varies widely from country to country.

Although more information is needed in this respect and associations with student achievement were found to be small in some studies (Lomos et al., 2011), the academic literature (Stoll et al., 2006) documents the importance of these practices for teachers' behavior in the classroom and student learning. The low frequency of these practices in the 17 EU MS as well as the high variability among countries could be an indication that they are difficult to implement. Collaborative professional learning seems to be dependent on many factors (e.g. individual orientation to change, the social context of schools and professional learning infrastructure) and efforts to implement them should take these kind of factors into account (Stoll et al., 2006).

The fourth and last focus of this chapter was on some of the factors in the school environment and support that potentially shape teaching instructional and collaborative practices. Key findings show that across the 17 EU MS, more than two thirds of fourth grade students have their teachers reporting a high or very high emphasis on academic success and about half of the students, on average, attend schools judged by their teachers to be safe and orderly. Moreover, substantial variability is found among countries. Positive perceptions regarding the availability of resources are not common. Only about one third of the students, on average, have teachers who signal that they have hardly any problems in terms of resources (including adequate workspace for collaboration and instructional materials). Therefore, particularly in terms of resources but not only, these findings could indicate a misalignment between the support provided to teachers and their professional needs.

In conclusion, as detailed earlier in this chapter, we remind the reader that the information provided above, along with its potential implications must be interpreted with care[64]. Similarly to PISA and TALIS, the TIMSS and PIRLS surveys have a cross-sectional design and the contextual information is based on subjective judgments of students and teachers. Therefore, we can describe different teaching practices, but strong inferences on the impact of such practices on student outcomes cannot be drawn. In addition, these practices can only be mapped in terms of their frequency on a particular metric and may depend on specific features of the

[63] These findings are consistent with the results of TALIS 2013 for lower secondary education.
[64] See also Section 2.1. of this chapter.

educational systems or cultural norms. For example, here instructional practices were mainly looked at in terms of their reported occurrence on a weekly or monthly basis. There is however the possibility that some practices were reported less just because the sequence of lesson types on a weekly basis could vary from country to country. Similarly, different patterns of teacher collaboration in some of the countries may depend on country-specific formal conditions or cultural norms giving more or less value to such practices.

Policy implications

- The common focus on core competences or basic skills for all students must be maintained and efforts to achieve excellence should not come at the cost of inclusiveness and equity.
- The consistent high focus on well documented effective generic instructional strategies aimed at developing key basic skills should also be maintained.
- A further effort could be made to integrate a diversified repertoire of instructional strategies for addressing different learning domains and levels of skills.
- Teacher collaboration could be further encouraged by exploring more the role of individual and school level conditions that support the development of professional learning communities.
- Further efforts could be made to ensure that schools receive adequate resources, are safe and orderly environments and promote a high focus on academic success for all students.

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PART II

Teaching Practices in Secondary Schools in the EU

Chapter 1

This chapter provides a brief introduction of the main findings of the PISA 2012 survey and details the contextual information specific to Mathematics teaching practices that was gathered in school and student questionnaires.

1. A Brief Introduction to PISA

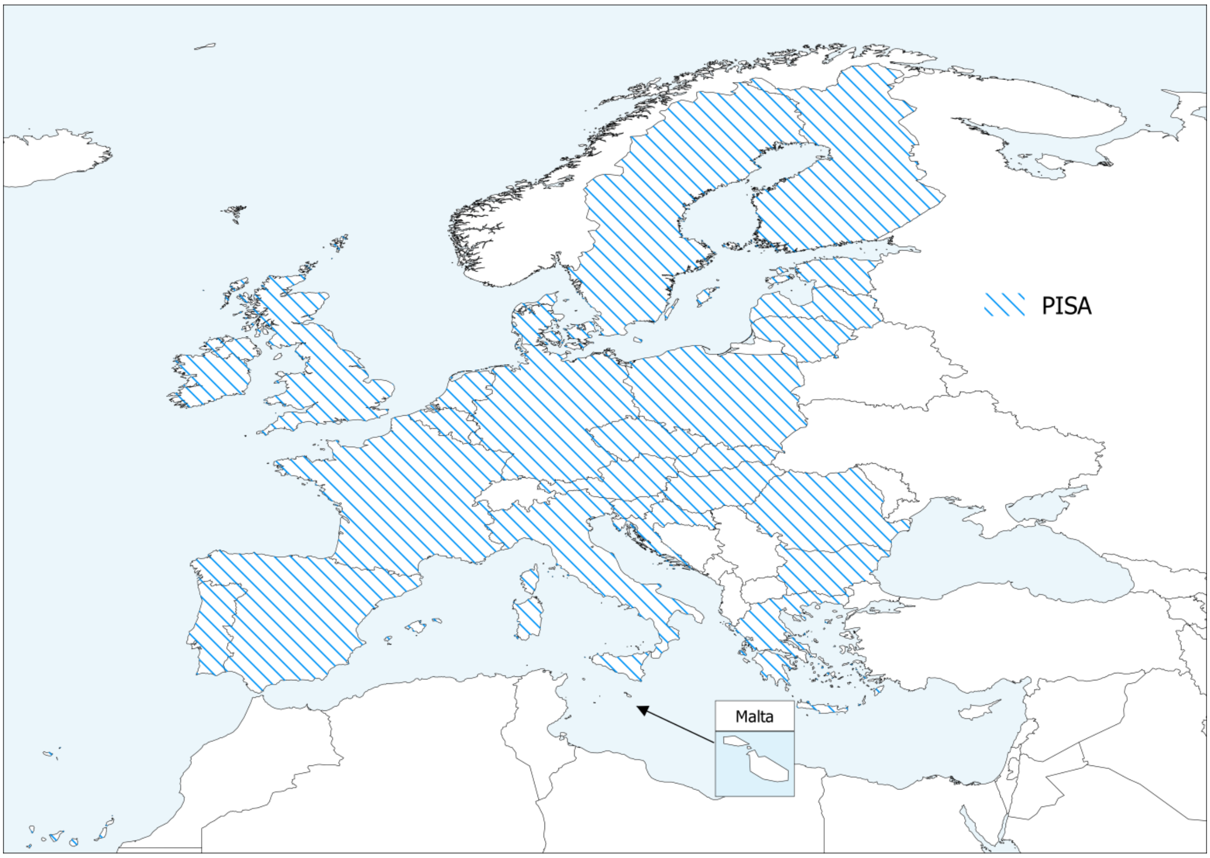
The Program for International Study Assessment (PISA) was launched in 2000 by the Organization for Economic Co-operation and Development (OECD). Since then the OECD has been running this international large assessment of 15 year old students' skills in Mathematics, Science and Reading every three years. Each PISA assessment cycle has a main domain, which in 2012 was Mathematics, in 2015 will be Science and in 2018 it will be Reading. Mathematical literacy in PISA is defined as "an individual's capacity to formulate, employ, and interpret Mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena. It assists individuals to recognize the role that Mathematics plays in the world and to make the well-founded judgments and decisions needed by constructive, engaged and reflective citizens" (OECD, 2013, p. 4).

In fact, PISA is a cognitive test in many ways different from content-based tests that measure knowledge of a given subject matter studied in school. It is designed to measure students' ability to use or apply the knowledge acquired in school to solve problems they might encounter in everyday life. As such, it is supposed to capture the ability of 15 year-olds to either enter the work force or to pursue further studies. Nonetheless, the assessment of Mathematics, for example, as assessed in PISA is highly correlated with the curricula-based Mathematics tested in the Third International Mathematics and Science Study TIMSS (OECD, 2010). This suggests that both assessments test similar skills at roughly the same time during students' schooling (TIMSS in 8^{th} grade).

In PISA, students' test scores in Mathematics, as it is also the case in Science and Reading, are computed according to Item Response Theory (IRT) and standardized with an OECD mean of 500 and a standard deviation of 100. As it is widely known by educational stakeholders – decision-makers, teachers, students, parents and the general public - PISA offers comparative indicators of students' achievement and has been used to monitor educational systems worldwide. One of the central purposes of PISA is to collect and report trend information about students' performance in Reading, Mathematics and Science, thus enabling countries to monitor their progress in meeting key learning objectives. Importantly, PISA is used to assess student learning outcomes since 2000 and every three years in many OECD and non-OECD countries with 43 countries participating in the first assessment cycle, 41 in the second assessment in 2003, 57 in the third assessment in 2006 and 75 in the fourth cycle. In the last

PISA assessment implemented in 2012 sixty five countries and economies participated (OECD, 2013b). The twenty six EU MS that participated in this last assessment, and for which data is available[65], were: Austria (AT), Belgium (BE), Bulgaria (BG), Croatia (HR), the Czech Republic (CZ), Denmark (DK), Estonia (EE), Finland (FI), France (FR), Germany (DE), Greece (EL), Hungary (HU), Ireland (IE), Italy (IT), Latvia (LV), Lithuania (LT), Luxembourg (LU), the Netherlands (NL), Poland (PL), Portugal (PT), Romania (RO), the Slovak Republic (SK), Slovenia (SL), Spain (ES), Sweden (SE) and the United Kingdom (UK). The map showing the EU MS participating countries is presented next.

EU MS participating in PISA 2012 for which data is available



In the framework of ET2020, EU MS use PISA data to monitor benchmarks for low achievement in education and training (European Commission, 2013). This is the case of the share of low achievers in Europe. The EU benchmark target should be of at most 15% of low achievers in 2020 (European Commission, 2014a). Reducing the percentage of poorly performing students is considered one of the most important tasks for school systems in many

[65] Analyses based on the official OECD-PISA 2012 database (http://pisa2012.acer.edu.au/downloads.php). Cyprus data not available.

countries, given the large economic and social costs associated with poor performance in school and with inequality (OECD, 2010). For example, Hanushek and Woessmann (2012) have used PISA data to show that education is conducive to economic growth and a recent European Commission report highlights that "If every EU Member State achieved an improvement of 25 points in its PISA score (which is what for ex. Germany and Poland achieved over the last decade), the GDP of the whole EU would increase by between 4% and 6% by 2090; such 6% increase would correspond to 35 trillion Euro" (Woessmann, 2014, p. 10). With respect to inequality, PISA results have called attention to equity issues associated with socio-economic status (SES), gender and migrant status, by showing that disadvantaged groups tend to score lower (OECD, 2014b). Some countries are better than others at breaking the disadvantaged trap. Thus, the countries that participate in every assessment cycle can monitor whether equity increased or decreased over time in their own school systems and in comparison with other systems. PISA data collection and analysis procedures are kept consistent over time, which ensures comparability. For instance, OECD uses the same approach in evaluating equity by assessing the gap between those students that score at the 75th percentile (the top range) in PISA and those that score at the 25th percentile, or at the bottom of the attainment range.

Importantly, the PISA design also includes information on teaching and learning and allows for establishing relationships among cognitive and non-cognitive domains. For instance, "Across most countries and economies, socio-economically disadvantaged students not only score lower in Mathematics, they also reported lower levels of engagement, drive, motivation and self-beliefs" (OECD, 2013b, p. 18). Similarly, PISA brought attention to several factors affecting students' learning outcomes other than the number of hours they sit in a classroom. For example, it corroborates the empirical evidence reported by Heckman and Kautz (2013) on the importance of preschool attendance on PISA scores by showing that, after controlling for socio-economic status, 15 year-olds that attended preschool perform better than those that did not (OECD, 2013c). Such relationships can be drawn on the basis of the information collected in the students' questionnaire. Additionally, information about teachers' beliefs, attitudes and pedagogical practices are collected both in the students' and in the school questionnaires. These data collection instruments capture the perceptions students have of their teachers and their teaching practices and, in the case of the school questionnaire, it captures the perceptions of principals about the teaching practices of their staff in the sampled schools.

With each successive PISA study both different and similar aspects related to teaching and learning and achievement are explored by the OECD. For example, the results of PISA 2003 showed that the construct *disciplinary climate in the Mathematics classroom* was strongly associated with mathematical literacy, while other variables – such as class size, mathematical activities offered at school level, and avoidance of ability grouping – had no substantial effect once the socio-economic status was taken into account (OECD, 2013c). Thus, a disruptive classroom climate with students that do not listen and where there is noise and disorder negatively affects students' achievement. Conversely, also in what concerns school climate, PISA 2012 showed that creative extracurricular activities in school, such as school plays or musicals and art clubs or art activities, were associated with better performance in Mathematics in some countries (OECD, 2013c).

Other findings related to school climate and teaching instructional and collaborative practices in PISA 2012 were (OECD, 2013c):

- Schools whose student population is predominantly socio-economically disadvantaged tend to have a more negative disciplinary climate;
- The relationship between the student-teacher ratio and the Mathematics performance of schools remained weak in 2012;
- School autonomy has a positive relationship with student performance when accountability measures are in place and/or when school principals and teachers collaborate in school management;
- Schools in high-performing systems tend to have more responsibility for curricula and assessments;
- Receiving written feedback from students regarding lessons, teachers or resources as quality-assurance and improvement practices of the school tends to result in better performance across the OECD countries.
- Systems with larger proportions of students who arrive late for school and skip classes tend to show lower overall performance.

In PISA, as previously mentioned, information about teaching and learning is collected mainly in the school questionnaire, which school principals respond to, and to a lesser extent collected in the students' questionnaire. More specifically, and as explained in the PISA assessment framework, the school questionnaire is designed to capture the following (OECD, 2013a):

- The quality of the schools' human and material resources,
- Public and private management and funding,
- Decision-making processes,

- Staffing practices and the school's curricular emphasis and extra-curricular activities offered.
- Context of instruction, including institutional structures and types, class size, classroom and school climate and reading activities in class.
- Aspects of learning and instruction in reading, including students' interest, motivation and engagement.

The students' questionnaire also covers disciplinary climate and teacher practices and support and, in what regards Mathematics classes, it is also designed to capture the use of Information and Communication Technologies (ICT).

Specifically, it is designed to capture the following aspects:

- Family background
- School climate
- Teaching and learning practices
- Problem solving

In what refers to ICT, students are asked whether they use ICT to accomplish specific Mathematics tasks. As explained in the PISA 2012 technical report, ICT experience, attitudes and skills are considered an input factor linked to the learning conditions for mathematical literacy (OECD, 2014c). That is, ICT skills may function as input much like family background and support and may affect educational outcomes in terms of learning motivation and mathematical performance.

Chapter 2

This chapter focuses on the analyses of teaching-related practices in PISA 2012. It describes the prevalence of teachers' instructional practices, opportunities to learn, ICT use in the classroom, collaborative practices and school climate across the 26 EU MS. In addition, it presents findings relative to the relationship between teaching practices and school environment and resources, to the association between ability grouping and students' achievement, and to the association between class size and achievement. It concludes by presenting an estimate of how much of the variation in Mathematics achievement is associated with teaching practices and the school learning environment. Key findings are also reported for the different topics covered.

2. Indicators of Teaching Practices in PISA 2012

2.1. Introduction.

This part of the report focuses on the context of instruction specific to Mathematics instruction, which was the main domain in PISA 2012 and, as such, more information about teaching practices in the Mathematics classroom was collected in the school questionnaire and in the students' questionnaire. Given that the use of ICT for instructional purposes can give an indication of how innovation in education is achieved through the use of new technologies, CRELL analysis also describes in detail how students perceive the use of ICT in their Mathematics classes. Our analysis focuses on the description of the reported frequency of instructional practices and their relationship with factors related to school learning conditions/school climate and collaborative practices. This approach is followed because the link between classroom teaching practices and students' achievement is indirect in the sense that principals, not teachers, respond to questions about teaching practices in their schools. Thus, we do not have information from Mathematics teachers that taught the sampled students and any direct link between achievement and isolated factors need to be taken with caution. The information available is relative to the students attending schools where the principals report that teachers expose the students to certain learning experiences and have certain expectations for their learning and achievement. Additionally, CRELL used information from the students' questionnaire in what relates to their perception of their teachers' instructional practices and ICT use in the Mathematics classroom, which sheds light on teaching practices and on how pervasive or otherwise limited the use of ICT is in Mathematics classrooms across EU MS. The aim is to complement the information available in OECD PISA reports and to describe differences and similarities within and across EU MS in what concerns specific teaching practices. Therefore, we refer to the EU average[66] rather than to the OECD average and draw comparisons that are specific to Mathematics instruction and their relationship to other country or school level factors. For example, much is known about ability grouping between and within schools in different countries, but less is known about this practice within classrooms.

Additionally, in order to examine how much of the variation in Mathematics achievement is associated with teaching practices and school learning environment in EU MS, CRELL undertook a multilevel statistical analysis, controlling for background student variables likely to impact results, such as gender and socio-economic status. Such an analysis offers an insight on the combined aspects that may influence students' achievement.

[66] Non-weighted average, following the same approach as OECD for reporting OECD averages.

In sum, in view of offering an overview of teaching practices related to instructional practices, collaborative practices and learning environment/climate, reported by school principals and students, CRELL undertook the analysis described below for each of the 26 EU MS participating in PISA, as well for the EU 26 average. Tables in Annex B present the estimates, the standard errors and reliability of the information presented in the graphs of this chapter[67]. The country-specific mean achievement in Mathematics can also be found in Annex B for some of the variables related with principals' reporting on the frequency of specific teaching practices. As it has been mentioned above, the analysis based on the information collected in the school questionnaire refers to the percentage of 15 year-old students in schools where the principal reported specific teaching practices. Regarding the information based on the students' questionnaire CRELL ran analysis using indexes constructed by OECD.

2.2. Instructional practices.

Educational outcomes can be influenced by a variety of factors that include, but are not limited to, students' socio-demographic characteristics, classroom and school opportunities to learn, school disciplinary climate, and system-level educational policies such as tracking students by ability. With respect to classroom instructional practices, teachers' use of varied teaching strategies, their involvement in school management and collaboration have been shown to affect learning and to also be related to the teachers' job satisfaction (McDonnell, 1995). For example, TALIS results indicate that "Teachers' use of collaborative teaching practices five times a year or more also increases both their reported levels of self-efficacy and their job satisfaction" (OECD, 2014d, p. 3). The following section explores the variables in the PISA questionnaires that are specific to instructional practices in the Mathematics classroom and were selected because they share commonalities with the variables included in the PIRLS/TIMSS combined survey and with the TALIS survey.

2.2.1. Ability grouping for Mathematics instruction.

With respect to instructional practices, the school questionnaire collects information on ability grouping **within classrooms** with the prompt "Schools sometimes organize instruction differently for students with different abilities and interests in Mathematics", followed by the

[67] All estimates presented in the annex take into account the complexity of the sampling design and applying sampling weights.

question "Which of the following options describe what a school does for students in Mathematics classes?"

1) Students are grouped by ability within their Mathematics classes.
2) In Mathematics classes, teachers use pedagogy suitable for students with heterogeneous abilities (i.e. students are not grouped by ability).

The Lickert scale used distinguishes the following response options:

a) For all classes, b) for some classes, c) not for any classes

Next, the distribution of each ability grouping instructional practice for the EU MS and the average across 26 EU is presented.

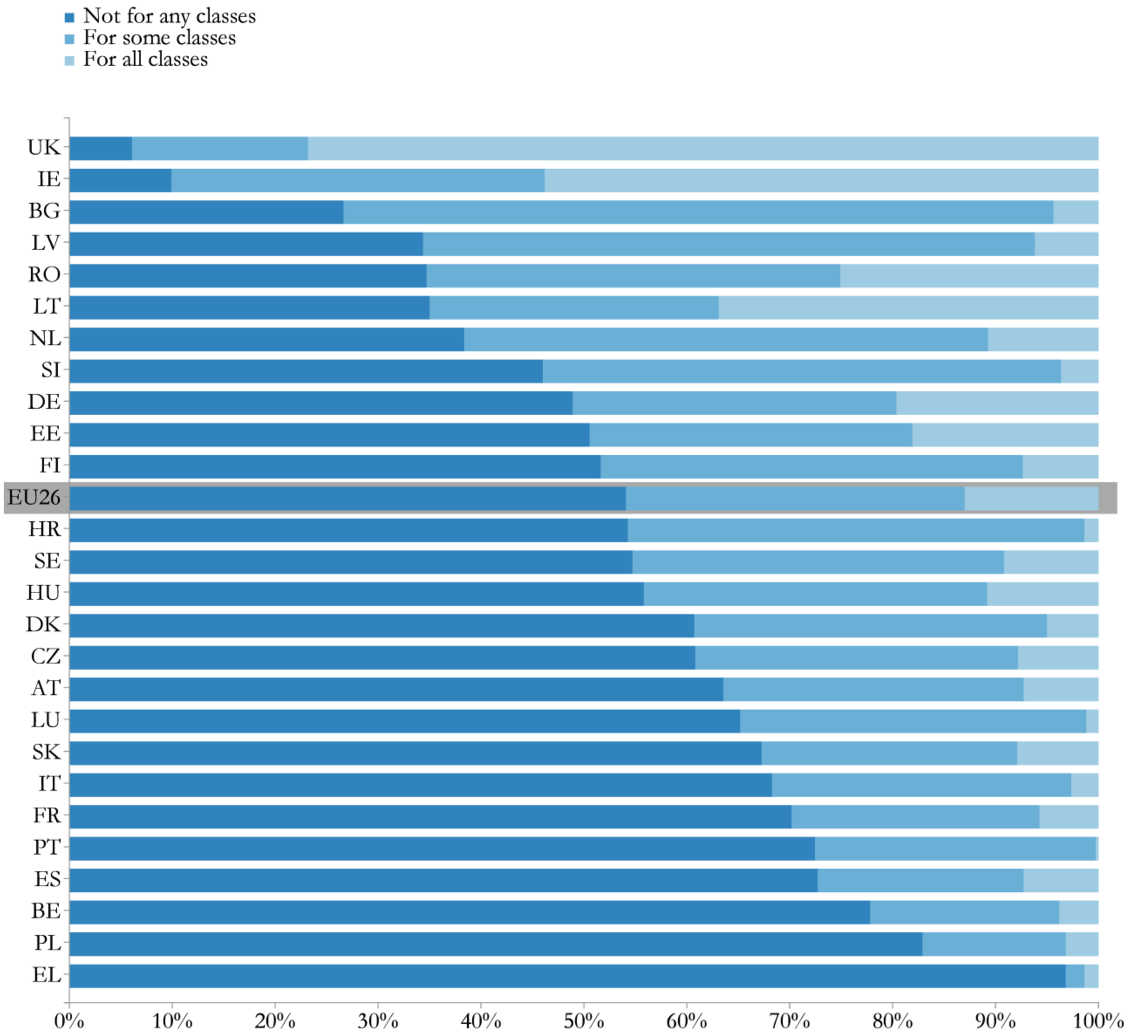
Graph 1 shows that on average across 26 EU 13% of 15-year-olds are in schools reporting that students are grouped by ability within their Mathematics classes in all classes; 33% are in schools whose students are grouped by ability within their classes in some classes and 54% are in schools reporting they are not grouped by ability within any of their classes.

The analysis of the graph also shows that:

- In 17 out of 26 countries, at least 50% of 15-year olds are in schools reporting that teachers do not use ability grouping within classes;
- In 19 out of 26 countries less than 10% of 15-year olds are in schools reporting that teachers use ability grouping for all classes.

Across countries, the proportions of 15-year-olds in these categories of ability grouping within classes vary considerably. Over 96% of 15-year-olds were in schools where school principals report that students in any classes are grouped by ability in Greece, and between 51% and 83% in Austria, Belgium, Czech Republic, Denmark, Spain, Estonia, Finland, France, Croatia, Hungary, Italy, Luxembourg, Poland, Portugal, Slovak Republic and Sweden. In the United Kingdom over 94% of 15-year-olds are in schools where school principals reported that students are grouped by ability within their Mathematics classes for all or some classes. In Germany, Estonia, Ireland, Lithuania and Romania from 50% to 90% of 15-year-olds are in schools where school principals reported that students are grouped by ability within their classes in all or some classes.

Graph 1 – Distribution by answer category of school principals' views on students are grouped by ability within their Mathematics classes for the EU MS[68]



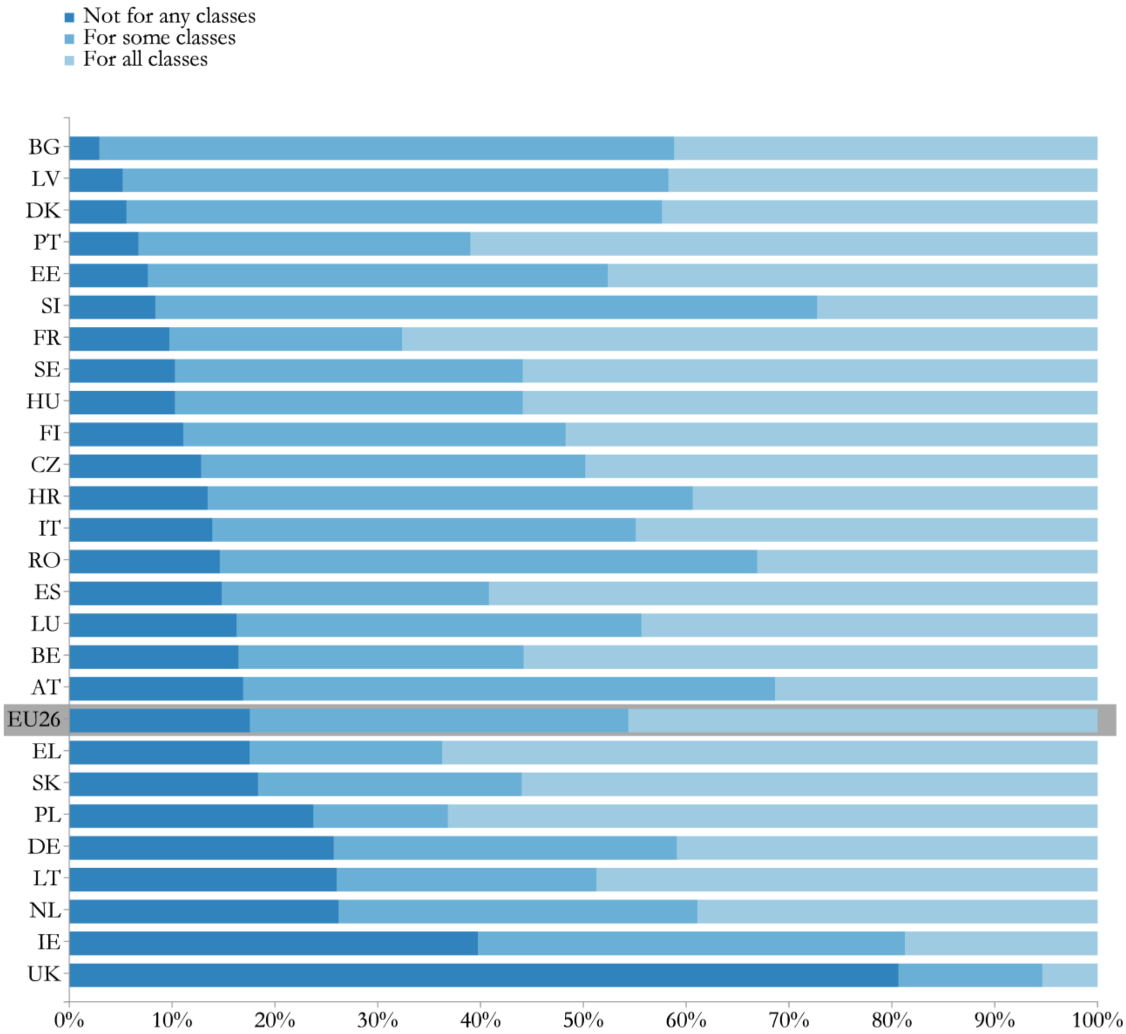
Source: CRELL analysis based on PISA 2012 data. *See also Table 1, Annex B.*

The differences found between EU MS may be related to the type of educational system in terms of whether they are stratified or comprehensive. For instance, Germany has a stratified system whereby students are streamed to follow either vocational or general education schools at the onset of lower secondary education and Poland has a comprehensive system, with all students enrolled in secondary education in general schools. Differences can be found in terms of the percentage of students in schools where principals reported that they are grouped by ability within their classes in all classes (20% in Germany and 3% in Poland).

[68] Countries are ranked in ascending order of the percentage of the "Not for any classes" category.

Graph 2 refers to the second ability grouping instructional practice measuring if "Teachers use pedagogy suitable for students with heterogeneous abilities, in Mathematics classes".

Graph 2 – Distribution by answer category of school principals' views on teachers use pedagogy suitable for students with heterogeneous abilities, in Mathematics classes for the EU MS[69]



Source: CRELL analysis based on PISA 2012 data. *See also Table 2, Annex B.*

The analysis of the graph shows that, on average across 26 EU participating countries:

- 46% of 15-year-olds are in schools reporting that teachers use pedagogy suitable for students with heterogeneous abilities in all classes;

[69] Countries are ranked in ascending order of the percentage of the "Not for any classes" category.

- 37% are in schools where teachers use pedagogy suitable for students with heterogeneous abilities within classes only in some classes;

- 17% are in schools reporting that teachers do not use pedagogy suitable for students with heterogeneous abilities in any classes.

At the EU level the percentage of students in schools reporting that teachers do not use pedagogy suitable for students with heterogeneous abilities in any classes is lower than the OECD average (17% for the EU and 21% for the OECD) (OECD, 2013d).

In the United Kingdom over 80% of the 15-year-olds are in schools where teachers do not use pedagogy suitable for students with heterogeneous abilities in any classes. The same is true for 40% of the Irish students enrolled in schools that don't implement this practice in any class. In Bulgaria, Denmark, Estonia, France, Latvia, Portugal and Slovenia less than 10% of 15-year-olds are in schools where principals report that teachers use pedagogy suitable for students with heterogeneous abilities in any of their classes. On the other hand, in Belgium, Czech Republic, Spain, Finland, France, Greece, Hungary, Poland, Portugal and Slovak Republic, more than 50% of the students attend schools where in all classes teachers use pedagogy suitable for students with heterogeneous abilities within their classes.

Regarding the prevalence of school systems grouping students **within schools**, the OECD (2013d) created an index of ability grouping within schools. This index was derived from two items measuring whether the school organizes Mathematics instruction differently for students with different abilities, according to the following three categories:

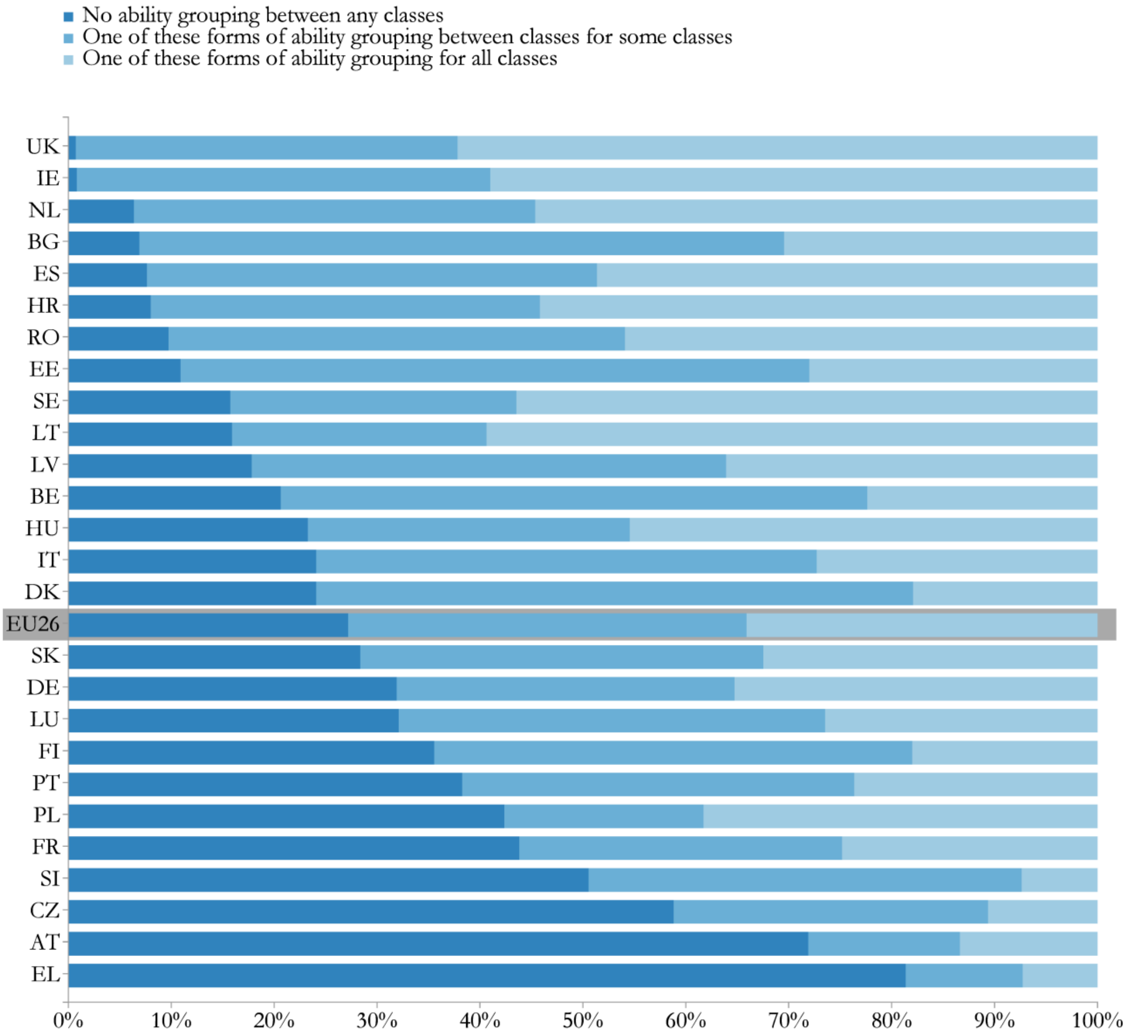
(i) "no ability grouping between any classes" - no Mathematics classes study different levels of difficulty or different content;

(ii) "one of these forms of ability grouping between classes for some classes" - some Mathematics classes study different levels of difficulty or different content;

(iii) "one of these forms of ability grouping for all classes" - all Mathematics classes study different levels of difficulty or different content.

The distribution of the index of ability grouping **within schools** across EU MS and for the EU MS participating in PISA 2012 is presented in graph 3.

Graph 3 – Distribution by answer category of school principals' views on ability grouping within schools for the EU MS[70]



Source: CRELL analysis based on PISA 2012 data. *See also Table 3, Annex B.*

The results show that, on average, across the EU MS 27% of students are in schools whose principals reported not having ability grouping between any Mathematics classes, while 34% of students attend schools whose principal reported that there is ability grouping within schools for all Mathematics classes. These results are about the same as those reported for the OECD average (OECD, 2013d).

Across countries, the percentages of 15-year-olds in these categories of ability grouping within schools present a wide variation. The percentages of not having ability grouping between classes vary between 1%, in the United Kingdom, and 82% in Greece. The percentage of students in schools whose principals reported that there is one of the forms of ability grouping

[70] Countries are ranked in ascending order of the percentage of the "No ability grouping between any classes" category.

between classes for some classes is less than 20% in Poland, Austria and Greece and over 50%, in Belgium, Denmark, Estonia and Bulgaria.

2.2.2. Teacher instructional intentions in Mathematics classes.

Regarding **teachers focus/intentions** on certain pedagogical practices, as reported by the school principals, a continuous index was constructed by OECD based on the following items, ranging from "Strongly agree" to "Strongly disagree"(OECD, 2014c):

How much do you agree with these statements about teachers in your school?

i) Mathematics teachers are interested in trying new methods and teaching practices;

ii) There is consensus among Mathematics teachers that it is best to adapt academic standards to the students' levels and needs;

iii) There is consensus among Mathematics teachers that the social and emotional development of the students is as important as their acquisition of mathematical skills and knowledge in Mathematics classes.

Higher values of the index are associated with a higher consensus of the teachers' intentions in the three composing items.

Graph 4 presents the analysis of the index on teacher focus (left part) and the percentage of principals answering "Strongly agree" and "Agree" to the three items composing the index.

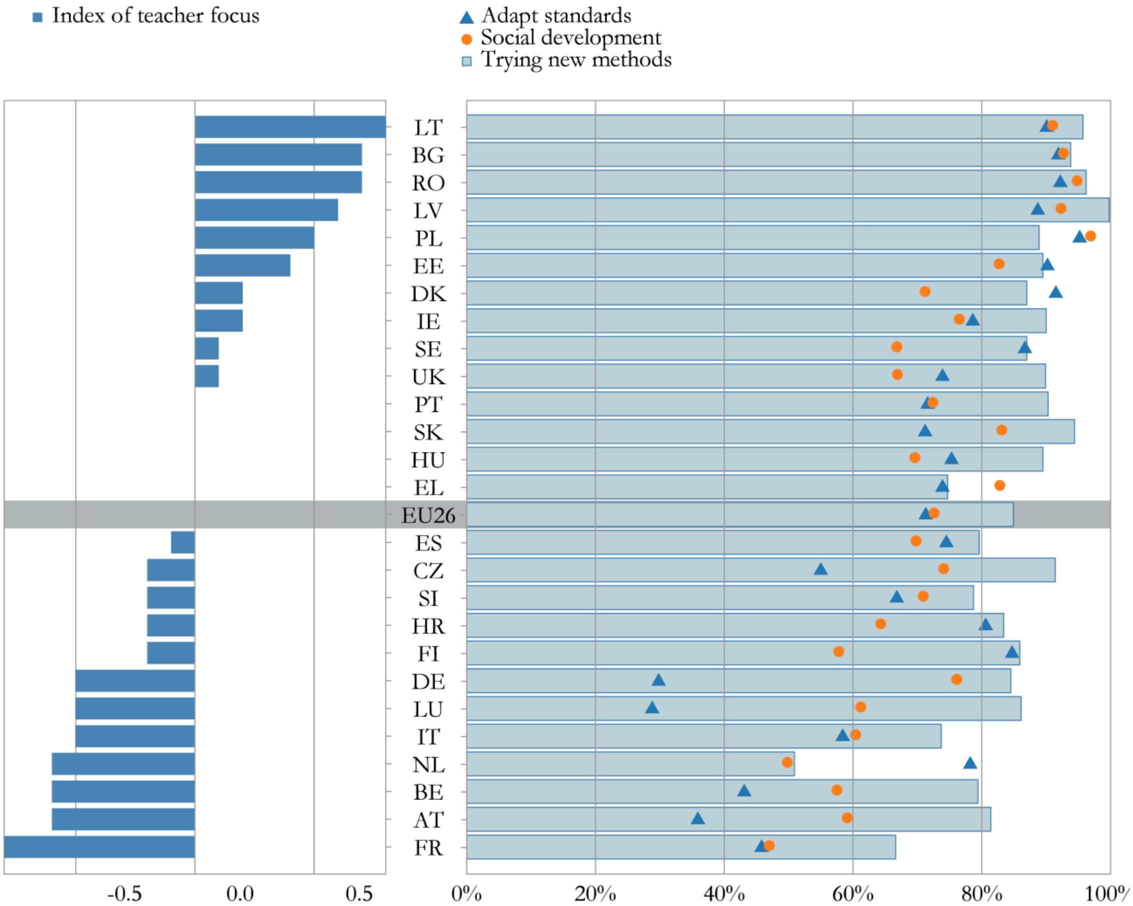
At the EU level the left part of the graph 4 shows that the index of teacher focus is approximately zero, as is the case for the OECD average (OECD, 2014c). Among EU MS the index on teacher focus varies from -0.8, in France, and 0.8 in Lithuania. Twelve countries present positive values for this index, indicating that there is a higher consensus regarding teacher focus on trying new methods, adapt academic standards to the students' levels and needs and in considering the social and emotional development of students in these MS. The right part of the graph shows the following for the 26 EU average:

- 85 % of 15-year-olds students are in schools where principals reported strongly agree or agree with "teachers are interested in trying new methods and teaching practices";

- 71% of students attend schools whose principals agree or strongly agree with "there is a consensus among teachers that it is best to adapt academic standards to the students' levels and needs";

- 73% of 15-year-olds students are in schools where principals reported strongly agree or agree with the statement "the social and emotional development of the students is as important as their acquisition of mathematical skills and knowledge in Mathematics classes".

Graph 4 – School principals' views on teacher focus index and the four items on teachers intentions included in the index, for EU MS[71]



Source: CRELL analysis based on PISA 2012 data. *See also Tables 4.1 and 4.2, Annex B.*

The results of the variable measuring the teachers intentions in trying new methods and teaching practices indicates that in all EU MS over 50% of principals reported that they strongly agree or agree with it. The highest percentages for this variable are found for Latvia, Romania and Lithuania. The lowest values are found in the Netherlands, France and Greece and these countries also present negative or close to negative values for the index of teacher focus. Also,

[71] Countries are ranked in ascending order of the index of teacher focus. The index has a mean of zero and a standard deviation of one, as constructed by OECD.
In the right part of the graph the results correspond to the percentage of the principals' answering "Strongly agree" and "Agree" to the items.

the Czech Republic presents a negative value for the index on teacher focus but around 91% of the students are in schools reporting that teachers are interested in trying new methods and teaching practices.

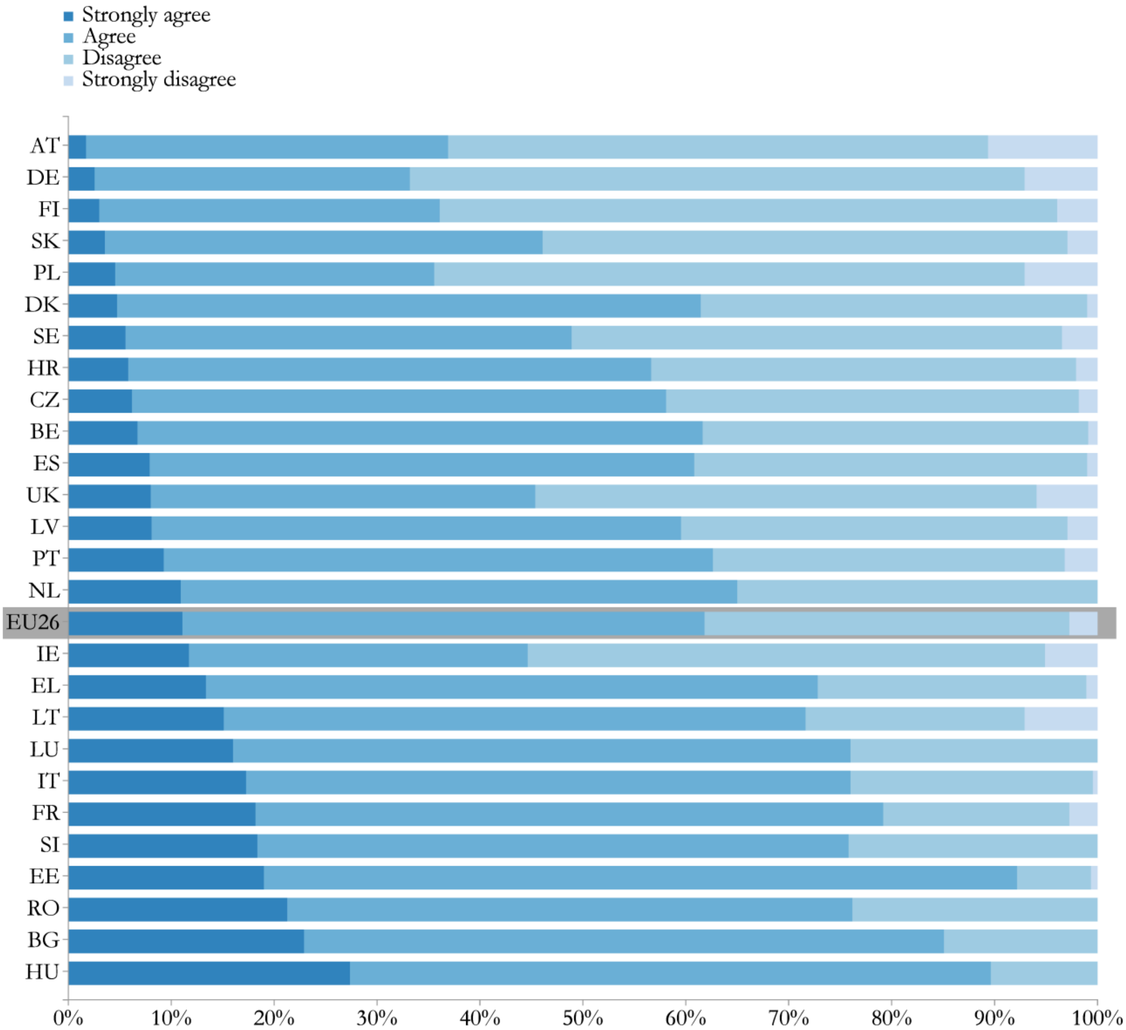
The percentage of students attending schools where principals reported that they strongly agree or agree with the statement "there is consensus among Mathematics teachers that it is best to adapt academic standards to the students' levels and needs" vary from 29% in Luxemburg and 96% in Poland. This variation in Luxemburg, Germany, Austria, France, Belgium, the Check Republic and Italy is between 20% and 60%. For these countries there is also a lower consensus regarding teacher focus. However in the Czech Republic there is a strong agreement that teachers try new methods and practices. In 19 EU MS at least 60% of students attend schools where there is strong agreement or agreement with respect to adapting these standards.

Concerning the importance of social and emotional development of the students as well as their acquisition of mathematical skills and knowledge in Mathematics classes, the range of the percentage of students that are in schools were the principals reported strongly agree or agree with this varies from 47% in France to 97% in Poland. In 25 out of 26 EU MS principals report that at least 50% of 15-year olds are in schools where teachers believe that the social and emotional development of students is as important as their acquisition of mathematical skills. The analysis also shows that the results vary widely among countries when comparing the index of teacher focus with teachers' intentions. For example, France presents the lowest index value and it also presents the lowest values for teachers' intentions to value students' social development and adapt standards to students' needs. In contrast, Latvia presents one of the highest index values and very high percentage of agreement for all teacher intentions.

The school questionnaire also asked principals to provide information that can be complementary to the index of teacher focus and that reflect a more traditional intention. Specifically, school principals reported to what extend they "Strongly disagree", "Disagree", "Agree" or "Strongly agree" with "There is a preference among Mathematics teachers **to stay with well-known methods and practices**".

For the 26 EU MS as a whole, 62% of students are in schools were principals strongly agree or agree with this statement. The countries were school principals disagree more with this practice are Austria Denmark, Poland and Finland and a lower level of disagreement can be found in Estonia and Bulgaria (graph 5). In 22 EU MS at least 40% of students attend schools where there is strong agreement or agreement to stay with well-known methods and practices.

Graph 5 – Distribution by answer category of school principals' views of variable measuring teachers' intentions – stay with well-known methods for the EU MS[72]



Source: CRELL analysis based on PISA 2012 data. *See also Table 5, Annex B.*

The following box illustrates that, considering a 75% threshold for teacher instructional intentions, in the great majority of EU MS principals report that teachers are interested in trying new methods and teaching practices. This ubiquitousness stands out in contrast with the reduced number of MS where principals report that teachers adapt academic standards to the students' levels, consider that social and emotional development are as important as the acquisition of mathematical skills and knowledge and stay with well-known methods. This suggests that, from the perspective of the principals, teachers are committed to trying new methods and teaching practices.

[72] Countries are ranked in ascending order of the percentage of the "strongly agree" category.

Box 1 - Summary table of the teacher instructional intentions variables[73]

MS	***Teacher instructional intentions*** **MS where at least 75% of the students attend schools whose principals agree or strongly agree that:**			
	Teacher focus			
	Teachers are interested in trying new methods and teaching practices	Teachers adapt academic standards to the students' levels	Social and emotional development are as important as the acquisition of mathematical skills and knowledge	Teachers' intentions – stay with well-known methods
AT	X			
BE	X			
BG	X	X	X	X
CZ	X			
DE	X		X	
DK	X	X		
EE	X	X	X	X
EL			X	
ES	X			
FI	X	X		
FR				X
HR	X	X		
HU	X	X		X
IE	X	X	X	
IT				X
LT	X	X	X	
LU	X			X
LV	X	X	X	
NL		X		
PL	X	X	X	
PT	X			
RO	X	X	X	X
SE	X	X		
SI	X			X
SK	X		X	
UK	X			
EU26	X			

[73] Shaded cells with an X symbol are indicative of countries above the 75% threshold.

2.2.3. Opportunity to learn in Mathematics classes.

In order to identify teaching practices that are related with the type of Mathematics content taught by teachers, the PISA 2012 questionnaire framework defines Opportunity to Learn (OTL) as the coverage of content categories and problem types to differentiate it from teaching practices and quality of teaching (OECD, 2013a). In this sense, students' processes of learning can be measured by different types of experience that students have with various kinds of Mathematics tasks and also by their familiarity with certain Mathematics topics, as reported by the students. Regarding these processes OECD (2014c) constructed 3 scales:

i) Experience with applied mathematical tasks;

ii) Experience with pure mathematical tasks;

iii) Familiarity with Mathematics Concepts;

Higher values of these scales are associated with a higher experience/familiarity with specific Mathematics tasks or concepts.

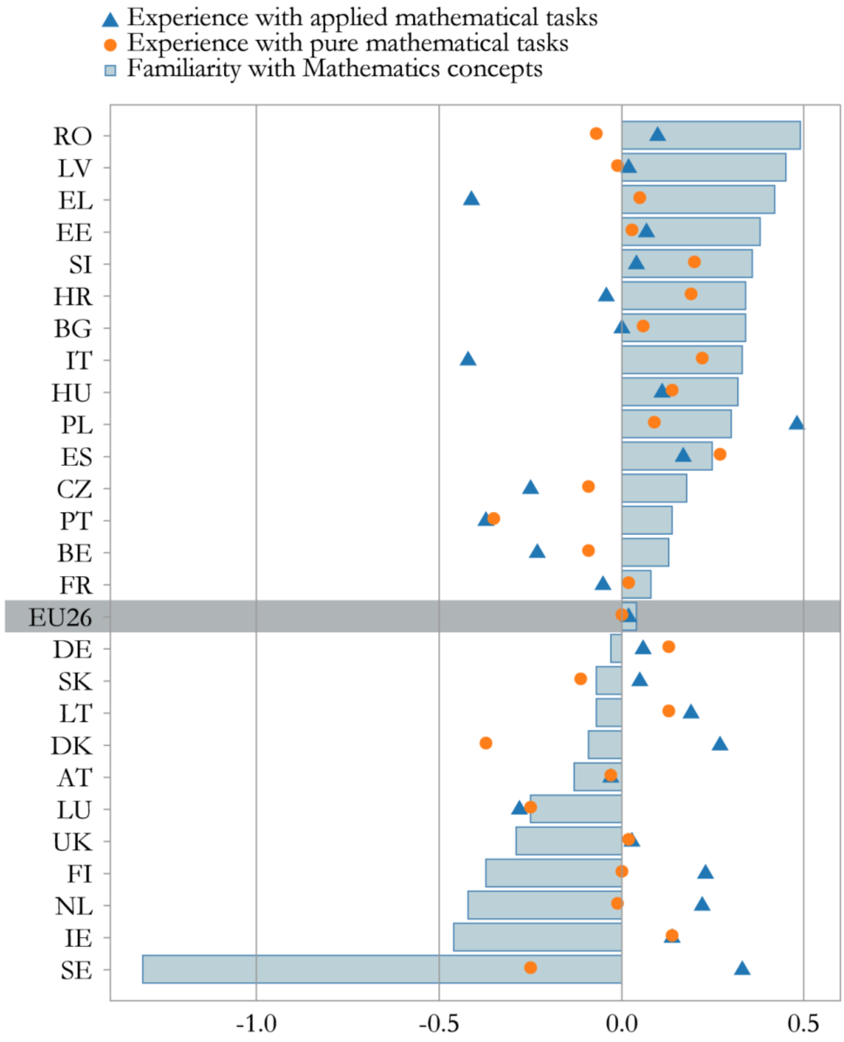
Graph 6 shows the results of the 3 scales by country.

There is substantial variation of the experience and familiarity with Mathematics tasks or topics in some countries, suggesting considerable variability in the implemented curriculum.

On average, across EU MS the value of the three OTL scales is zero.

Fifteen EU MS present positive values for the scales on familiarity with Mathematical concepts and fourteen do so for experience with pure mathematical tasks. The countries with a higher familiarity with Mathematical concepts are Romania, Latvia and Greece. The highest student exposure to pure mathematical tasks is in Spain, Italy and Slovenia. Also, in 15 EU MS the scale on experience with applied mathematical tasks present positive values and its highest values are in Poland, in Sweden and in Denmark.

Graph 6 – Students report on opportunities to learn Mathematics tasks and concepts for EU MS[74]



Source: CRELL analysis based on PISA 2012 data. *See also Table 6, Annex B.*

2.2.4. Teaching practices in Mathematics classes.

Regarding other types of teaching practices in Mathematics classes, students were asked to report the frequency of teachers' use of different strategies to foster student learning. The frequency of its use was based on whether different practices happen in "every lesson", in "most lessons", in "some lessons", or "never or hardly ever". Three indices, on strategies to foster students' learning, were developed as following:

i) the index of teacher-directed instruction – it refers to the frequency with which the teacher sets clear goals for student learning;

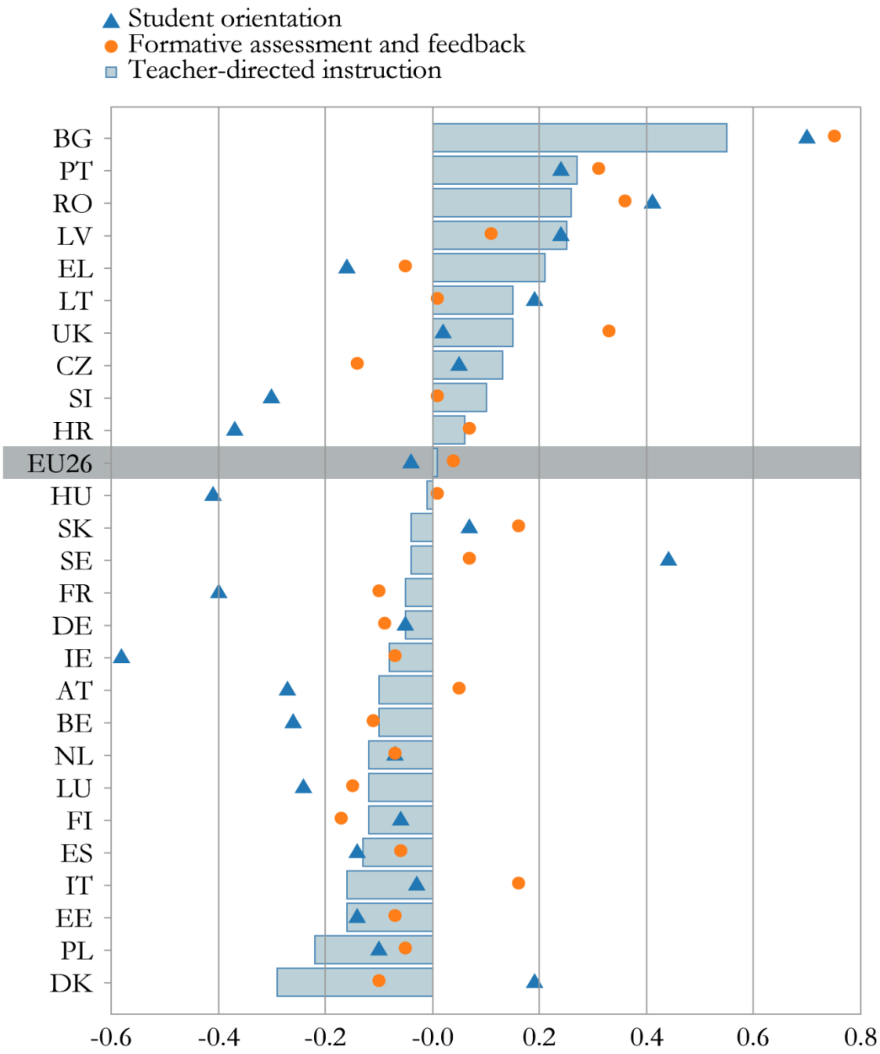
[74] Countries are ranked in ascending order of the index measuring familiarity with Mathematics concepts. The indexes have a mean of zero and a standard deviation of one, as constructed by OECD.

ii) the index of teachers' student orientation – it is related with students reports on the frequency with which, in Mathematics lessons, the teacher gives different work to students who have difficulties learning and/or to those who can advance faster;

iii) the index of teachers' use of formative assessment and feedback – it is associated with the frequency with which, in Mathematics lessons, the teacher tells students how well they are doing in Mathematics.

Higher values on these indexes suggest that students reported that their most recent Mathematics teacher more frequently used strategies to foster student learning when compared with the OECD average (OECD, 2013c).

Graph 7 – Students report on teaching practices in Mathematics classes for EU MS[75]



Source: CRELL analysis based on PISA 2012 data. *See also Table 7, Annex B*

[75] Countries are ranked in ascending order of the index of teacher-directed instruction. The index has a mean of zero and a standard deviation of one, as constructed by OECD.

As the graph above shows, on average, across EU MS the values of the indexes teacher-directed instruction, and formative assessment and feedback, are slightly higher than the ones for the OECD average. The opposite relationship is found for the index on student orientation.

Across EU MS that participated in PISA 2012, there is a large variation in the extent to which students are exposed to different teaching strategies to foster student learning. In 7 countries either positive or negative values of the indexes can be found. The highest values of the three indexes are noticeably found in Bulgaria, Portugal and Romania.

2.2.5. Teacher quality in Mathematics classes.

In order to capture aspects of teacher quality in Mathematics classes our analysis focuses on the results of three indexes, based on the students reporting, and briefly described below:

i) disciplinary climate – it includes information on students behaviour and attitudes within the classroom in terms of interruptions that occur in Mathematics lessons (e.g. noise, disorder, students not working well, students take much time to quiet down, etc.);
ii) teacher support – it refers to the students answers on items related with teachers interest and perseverance in making concepts clear to students;
iii) teachers' use of cognitive activation strategies - it is related to teachers' use of strategies, such as giving students problems that require them to think for an extended time, presenting problems for which there is no immediately obvious way of arriving at a solution, and helping students to learn from their mistakes.

Higher values of the index on disciplinary climate indicate that students perceive a better disciplinary climate in the classroom. For the measures ii) and iii) on teacher quality, higher values on the indexes suggest that students reported that their most recent Mathematics teacher more frequently supported or used cognitive-activation strategies than the OECD average.

Graph 8 presents the values of the indexes measuring teacher quality for the 26 EU average and for each EU country.

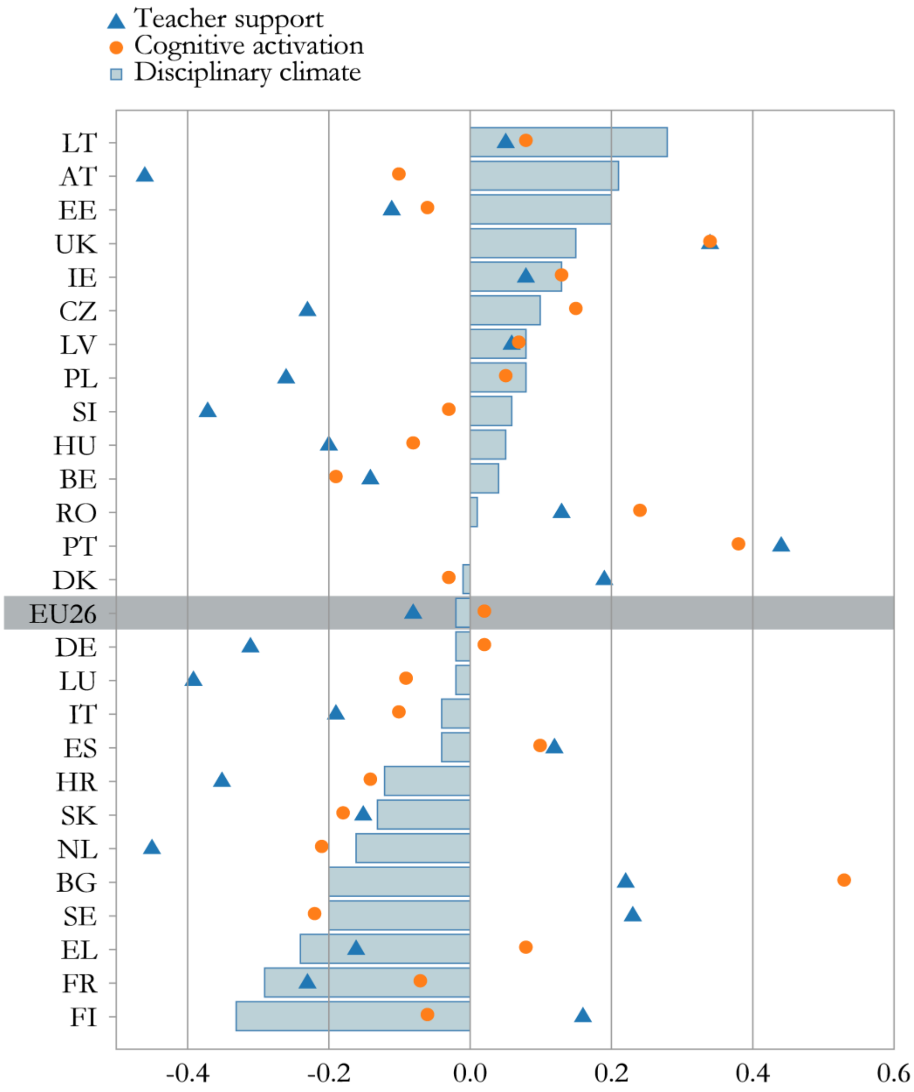
As the graph illustrates, the results from these indexes vary greatly across EU MS. In particular, the results reveal that:

- At the EU level the index on disciplinary climate is about zero which means that on average in EU MS students' perception of disciplinary climate in the classroom is similar to the OECD participating countries in PISA. Disciplinary climate varies widely within countries. In EU MS students reported a better disciplinary climate in the Mathematics classroom in Lithuania, Austria and Estonia. The lowest values of this index can be found in Finland, France and Greece.

- On average, among EU MS, the teacher support index presents a negative value, meaning that students reported that their most recent Mathematics teacher less frequently supported them than the most recent Mathematics teacher of the average student in OECD countries. The highest values of this index are in Portugal, the United Kingdom and Sweden. Additionally, in half of the EU MS negative values of this index are found.

- On average among EU MS the teachers' use of cognitive activation strategies is similar to the OECD average. In 42% of the EU MS students report on teachers' use of cognitive activation strategies is higher than its use on average among OECD countries. The highest values of this index are in Bulgaria, Portugal and United Kingdom.

Graph 8 – Students report on teaching quality for EU MS[76]



Source: CRELL analysis based on PISA 2012 data. *See also Table 8, Annex B.*

2.2.6. ICT[77] in Mathematics lessons.

For the last PISA cycle, several countries offered anecdotal evidence that they were encouraging teachers to try new methods and to make better use of information and communication technologies (ICT) (OECD, 2013d).

PISA 2012 has an indicator of students' reported use of ICT in Mathematics lessons. It is a scale (USEMATH) based on seven items reporting the use of ICT in specific Mathematics tasks: drawing the graph of a function; calculating with numbers; constructing geometric figures;

[76] Countries are ranked in ascending order of disciplinary climate index. The indexes have a mean of zero and a standard deviation of one, as constructed by OECD.
[77] There is no data for this index in Bulgaria, France, Lithuania, Luxemburg, Romania and United Kingdom.

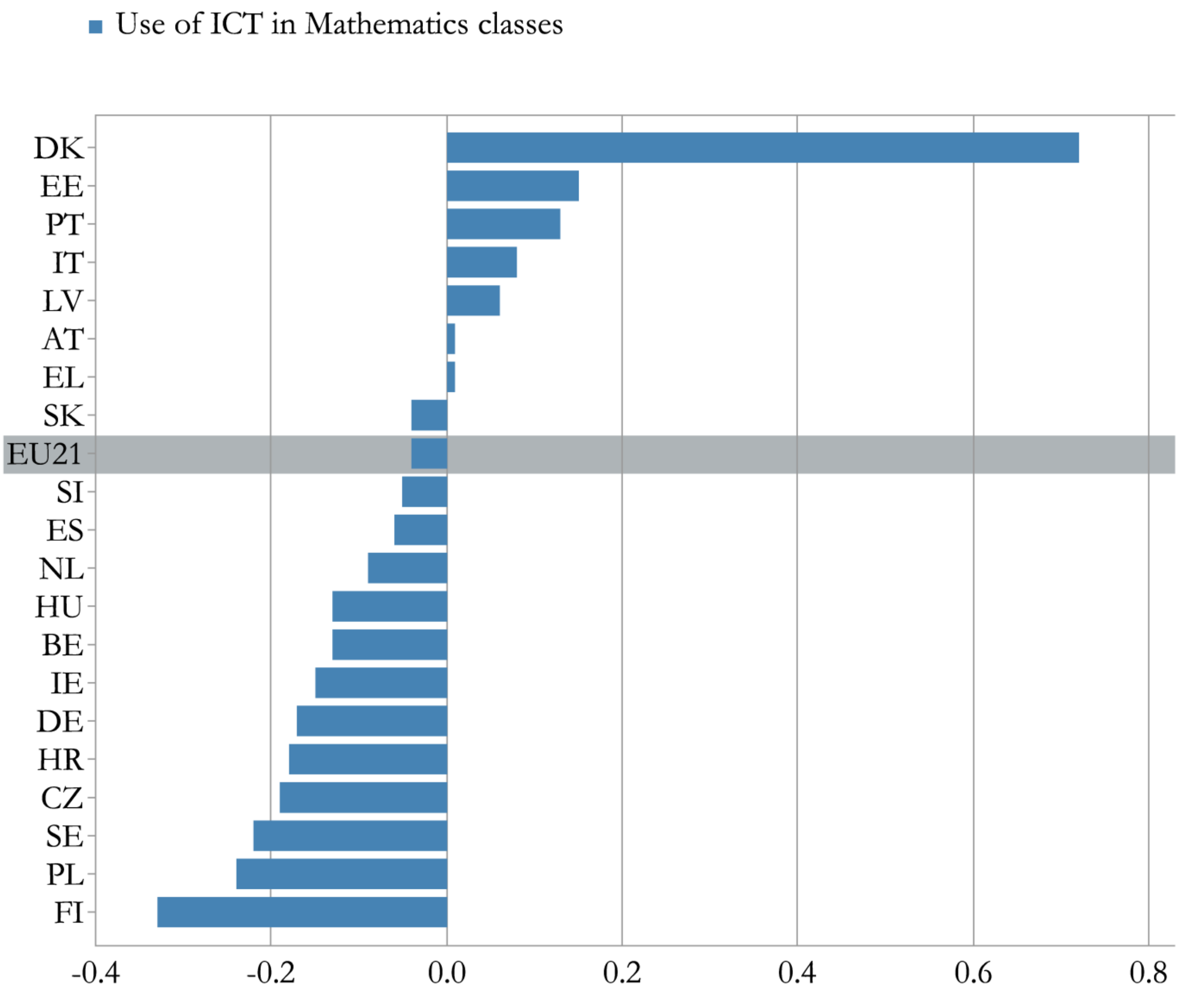
entering data in a spreadsheet; rewriting algebraic expressions and solving equations; drawing histograms and finding out how the graph of a function like $y=ax^2$ changes depending on a.

The variables included three response categories: "Yes, students did this", "Yes, but only the teacher demonstrated this" and "No".

Higher values on the index of teacher use of ICT in Mathematics lessons indicate greater incidence of its use, according to students' perceptions.

The results of the indicator on use of ICT in Math lessons are presented in graph 9.

Graph 9 – Students views on use of ICT in Mathematics classes for the EU MS[78]



Source: CRELL analysis based on PISA 2012 data. *See also Table 9, Annex B.*

[78] Countries are ranked in ascending order according with the index of use of ICT in Mathematics classes. The index has a mean of zero and a standard deviation of one, as constructed by OECD.

The graph shows that across EU MS the value of the index is below zero, which indicates that students' perceptions about the use of ICT in Mathematics classes in EU MS is lower than the OECD average. The highest incidence of this practice is found in Denmark, Estonia and Portugal and lower values of this index are found in Finland, Poland and Sweden. The results of the International Computer and Information Literacy Study (ICILS) carried out in 2013 also showed that in Denmark computers are frequently used in teaching and that teachers of different subjects, not only Mathematics, report a low use of ICT in Poland Germany and Croatia (European Commission, 2014b).

Highlights

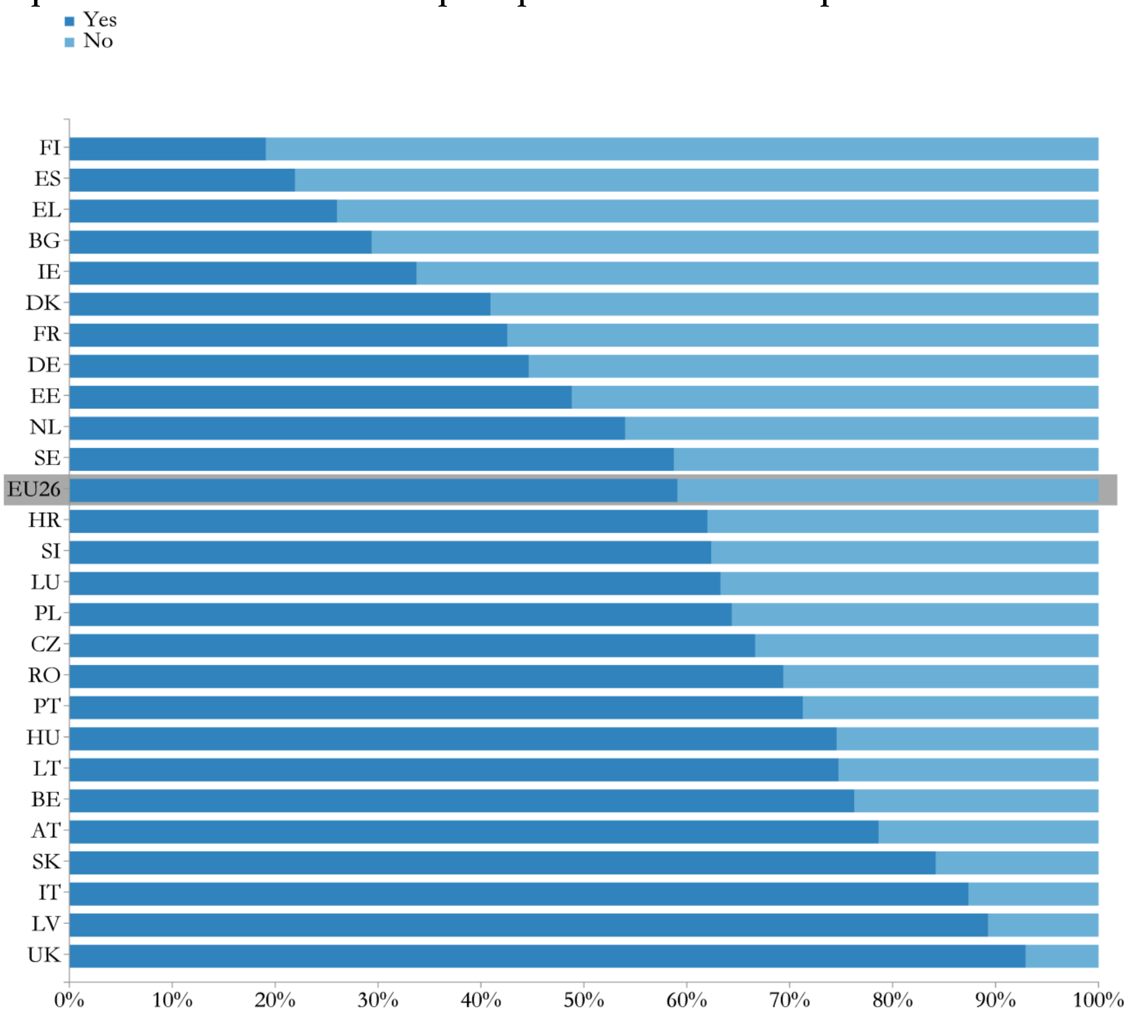
- In eleven MS countries, principals report that less than 50% of students are in schools where there is no ability grouping within Mathematics classrooms.
- In twenty MS countries principals report that more than 40% of students are in schools where teachers use pedagogy suitable for students with heterogeneous abilities within Mathematics classrooms.
- Ability grouping within schools varies widely across member. In ten out of twenty six MS more than 30% of the students attend schools where there is no ability grouping within schools.
- In about half of MS there is a consensus that teachers do try new methods, adapt academic standards to students' and believe that social and emotional development are important for Mathematics knowledge.
- In all MS over 50% of students are in schools where principals report that they strongly agree or agree that teachers try new methods and teaching practices.
- Fifteen EU MS countries present high experience/familiarity with applied Mathematics tasks or concepts and fourteen do so for pure mathematical tasks.
- In 42% of MS students report on teachers' use of cognitive activation strategies is higher than they do, on average, among OECD countries.
- Out of 21 MS, only in seven – Denmark, Estonia, Portugal, Italy, Latvia, Austria and Greece - is there a high incidence of ICT use in Mathematics lessons.

2.3. Collaborative practices in Mathematics lessons.

As it is the case with the TALIS framework regarding collaborative practices, in PISA the school questionnaire asks principals if the following method is used: **Teacher peer review** of lesson plans, assessment instruments, and lessons. The response categories are "Yes" or "No".

Graph 10 indicates that, on average, across EU MS close to 60% of students are in schools where principals report having teacher peer review, for example, of lesson plans, assessment instruments and lessons. This finding is in line with the average reported for OECD countries (OECD, 2013d). The percentage of occurrence of this practice varies between 19%, in Finland, and 93% in the United Kingdom. Additionally, in more than two thirds of the participating countries over 50% of the 15-year-olds are in schools where there is teacher peer review.

Graph 10 – Distribution of school principals' views on teacher peer review for EU MS[79]



Source: CRELL analysis based on PISA 2012 data. *See also Table 10, Annex B.*

[79] Countries are ranked in ascending order according with percentage in the answer category "Yes".

Highlights

- On average across EU MS close to 60% of students are in schools where principals report having teacher peer review, as is the case for the OECD average.
- In about one third of the MS less than 50% of students are in schools where principals reported that teachers engage in peer review in their schools.
- The highest percentage of peer review can be found in the UK, Latvia and Italy and the lowest in Finland, Spain and Greece.

2.4. School learning environment/climate.

The conceptualization of school climate in PISA is similar to the same construct in PIRLS/TIMSS. Specifically, the PISA assessment framework refers that school climate is related to norms and values and also to the quality of relationships between staff and students to the general school atmosphere (OECD, 2013a). Accordingly, the school questionnaire includes variables about a school's academic focus, the value that staff assigns to education, and what staff considers to be aspects that facilitate learning. Additionally, questions related to the learning environment and in particular whether discipline problems hinder learning are also included in the questionnaire.

More broadly, school climate is one of the aspects captured in the concept of opportunities to learn in schools and relates to expectations for student learning and to specific factors in the learning environment. Effective schools have been found to have high expectations for students' learning and to have a safe and orderly learning environment (Creemers and Kyriakides, 2008). School effectiveness research in educational evaluation and policy has expanded the concept of opportunities to learn to include not only curricula content and the information on which students are tested, but also the quality of resources, school conditions and teaching and students experiences (McDonnell, 1995).

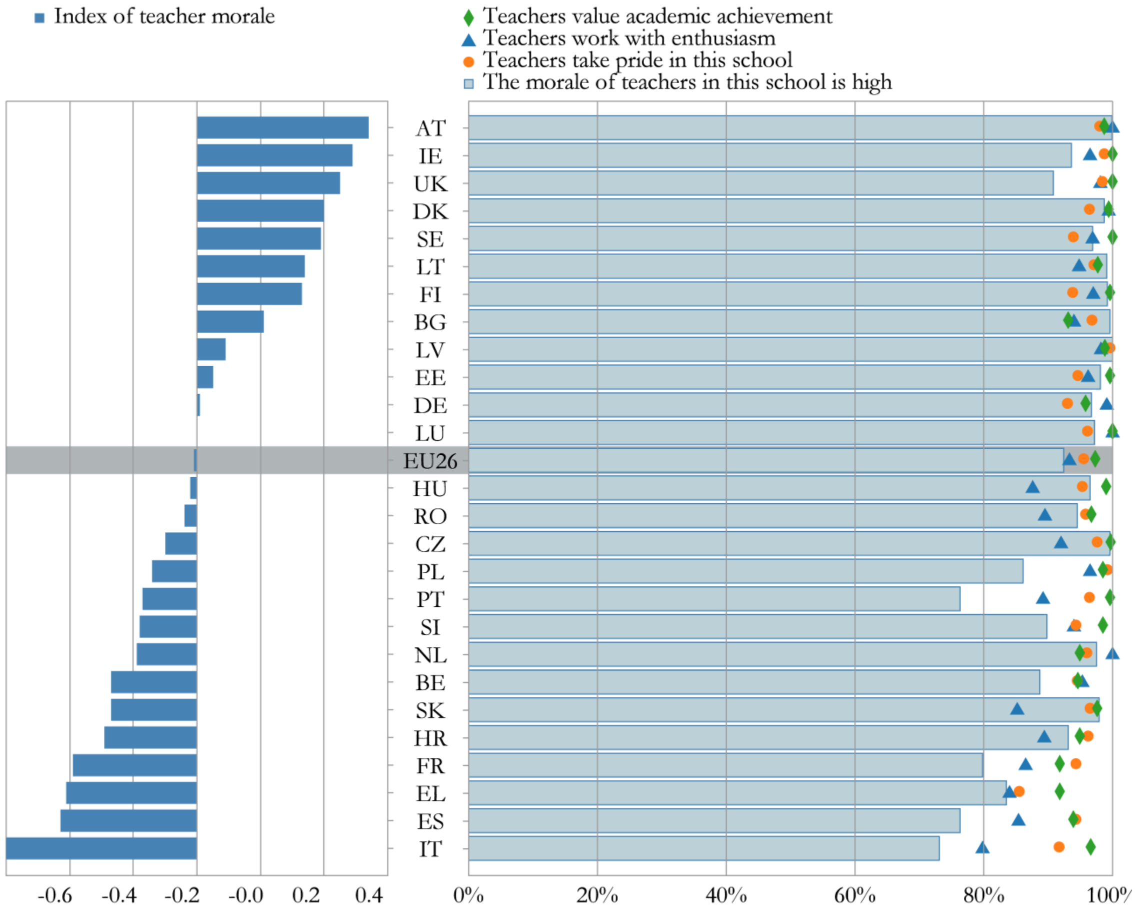
2.4.1. School learning environment.

2.4.1.1. Teachers morale.

Teacher morale in PISA is a measure of school learning environment captured in an index that has a mean of zero and a standard deviation of one in OECD countries. The measure is based on school principals' answers to whether and to what extent they agree with the following statements: the morale of teachers in this school is high; teachers work with enthusiasm; teachers take pride in the school and teachers value academic achievement. For each variable composing the index there are four response categories: "Strongly agree", "Agree, "Disagree" and "Strongly disagree". Positive values of the index indicate principals' perceptions that teacher morale is higher and negative values indicate principals' perceptions that teacher morale is lower than the OECD average (OECD, 2013d, 2014c). Although this index refers to the principals perception of teacher morale for all teachers, the assumption is that is also captures the morale of Mathematics teachers.

Graph 11 shows, for the EU MS, the index on teachers' morale and the percentage of students in schools whose principals reported to "strongly agree" or "agree" with the statements of the variables included in the index.

Graph 11 – School principals' views of teacher morale for the EU MS[80]



Source: CRELL analysis based on PISA 2012 data. *See also Tables 11.1 e 11.2, Annex B.*

On average across EU MS the index of teacher morale is zero and the school principals' views of teacher morale are the following:

- 92% of students attend schools whose principals agree or strongly agree that morale of the teachers in the school is high.
- 93% of students attend schools whose principals agree or strongly agree that teachers work with enthusiasm.

80 Countries are ranked in ascending order according with the index on teachers' morale. The index has a mean of zero and a standard deviation of one, as constructed by OECD.

- 96% of students attend schools whose principals agree or strongly agree that teachers take pride in their school.
- 97% of students attend schools whose principals agree or strongly agree that teachers value academic achievement.

These findings are in line with the ones across OECD countries (OECD, 2013d).

The highest positive values of the index are found for Austria, United Kingdom and Ireland, and the lowest negative values for the index were found in Italy, Spain and Greece. In addition, about half of the countries present positive values for the index.

At country level, the main findings are:

- In 23 MS at least 80% of students attend schools whose principals agree or strongly agree that the morale of teachers in their school is high, while between 73% and 76% of students in Italy, Spain and Portugal attend such schools.
- In all EU MS over or equal to 80% of students are in schools where the principals agree or strongly agree that teachers work with enthusiasm.
- In the 26 EU MS at least 86% of students attend schools whose principals agree or strongly agree that teachers take pride in their school.
- In all EU MS over 90% of students attend schools whose principals agree or strongly agree that teachers value academic achievement.

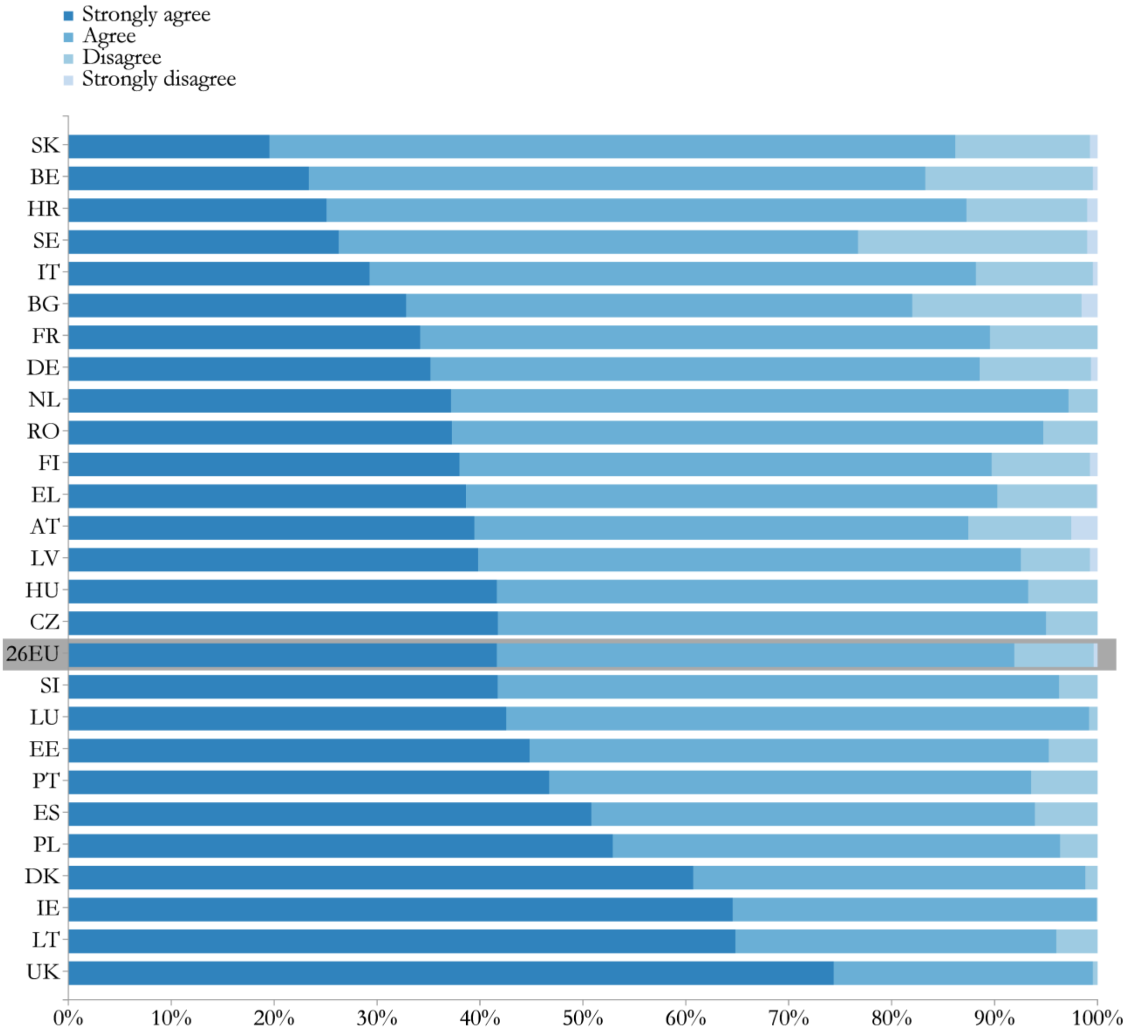
Comparing the index of teacher morale with the four variables from which it was derived; Italy and Portugal present negative values of the index and also the lowest percentage of principals' agreement that teachers' morale is high. However, these countries present higher percentages of teachers that values academic achievement, work with enthusiasm and take pride in their school. On the other hand, Austria presents the highest positive index of teacher morale and the highest values for all four variables.

2.4.1.2. Maximize achievement in Mathematics.

Regarding the school principals' views on consensus among Mathematics teachers that academic achievement must be kept as high as possible, their level of agreement is measured in a Lickert scale with the following response options: strongly disagree, disagree, agree and strongly agree.

Graph 12 shows that at the EU level, 92% of students attending schools whose principals agree or strongly agree that there is a consensus among Mathematics teachers about their intentions to maximize achievement. At least 85% of students in 23 EU participating countries in PISA attend such schools, whereas between 76% and 83% of students in Sweden, Bulgaria and Belgium attend such schools.

Graph 12 – School principals' views on consensus among Mathematics teachers that academic achievement must be kept as high as possible for EU MS[81]



Source: CRELL analysis based on PISA 2012 data. *See also Table 12, Annex B.*

The following box illustrates that, considering a 90% threshold for variables measuring school learning environment in all EU MS principals report that teachers value academic achievement. Also, with the exception of the findings for Greece, the same is true for the perception that teachers take pride in their school. For teachers morale, their enthusiasm and their notion that academic achievement must be kept as high as possible findings reveal more variation among EU MS.

[81] Countries are ranked in ascending order according with the answer category "strongly agree".

Box 2 - Summary table of the school learning environment variables

	School learning environment. **MS where at least 90% of the students attend schools whose principals agree or strongly agree that:**				
	Teachers morale				Academic achievement must be kept as high as possible
MS	The morale of teachers in the school is high	Teachers work with enthusiasm	Teachers take pride in their school	Teachers value academic achievement	
AT	X	X	X	X	
BE		X	X	X	
BG	X	X	X	X	
CZ	X	X	X	X	X
DE	X	X	X	X	
DK	X	X	X	X	X
EE	X	X	X	X	X
EL				X	X
ES			X	X	X
FI	X	X	X	X	
FR			X	X	
HR	X		X	X	
HU	X		X	X	X
IE	X	X	X	X	X
IT			X	X	
LT	X	X	X	X	X
LU	X	X	X	X	X
LV	X	X	X	X	X
NL	X	X	X	X	X
PL		X	X	X	X
PT			X	X	X
RO	X		X	X	X
SE	X	X	X	X	
SI		X	X	X	X
SK	X		X	X	
UK	X	X	X	X	X
EU26	X	X	X	X	X

2.4.2. School climate for EU MS.

The PISA school questionnaire contains items measuring the school principals' perceptions of potential phenomena hindering instruction at school. These items were used to construct two indexes:

i) student-related factors affecting school climate (STUDCLIM)

ii) teacher related factors affecting school climate (TEACCLIM).

All items contain four response categories: "Not at all", "Very little", "To some extent" and "A lot". All the items were reverted for both scales. The indexes have a mean of zero and a standard deviation of one, in OECD countries. Higher values on these indexes indicate a positive student behavior or positive teacher factors affecting school climate (OECD, 2013d, 2014c).

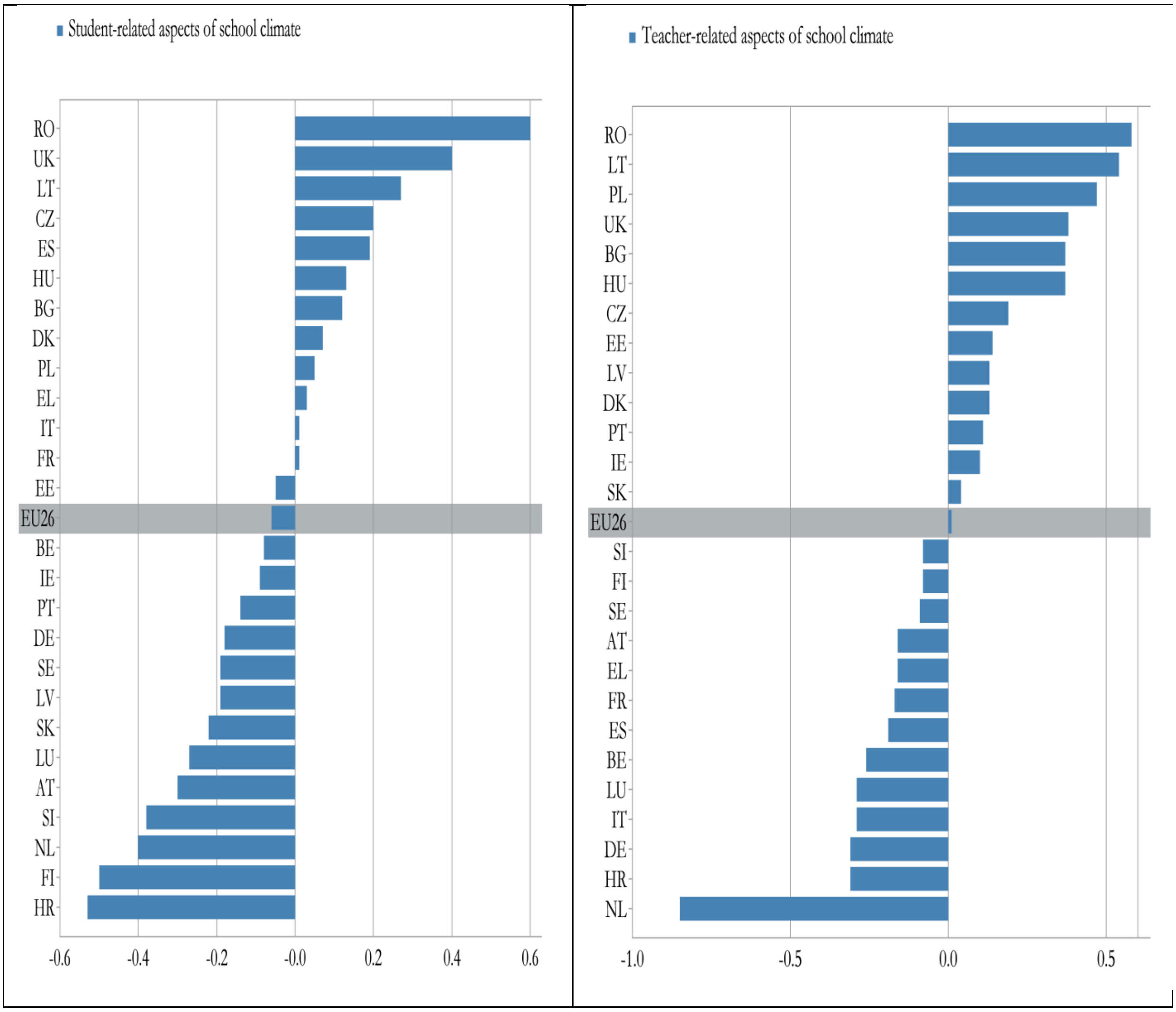
The first index was derived from school principals' reports on: student truancy; students skipping classes; students arriving late for school; students not attending compulsory school events; students lacking respect for teachers; disruption of classes by students; student use of alcohol or illegal drugs; and students intimidating or bullying other students.

The following graph indicates that at the EU level there is a negative value of the STUDCLIM index (-0.1), indicating that school principals believe that students' behavior hinders learning to a greater extent, compared to the OECD average. The same is true for 58% of the EU participating countries in PISA. On the other hand in Romania, United Kingdom, Latvia, Czech Republic, Spain, Hungary, Bulgaria, Denmark, Poland, Greece, France and Italy there are positive values for this index reflecting principals' perceptions that students' behavior hinders learning to a lesser extent.

Concerning the index of teacher-related factors affecting school climate, the EU average and half of the countries present positive values of the index reflecting principals' perceptions that these teacher-related issues hinder learning to a lesser extent, compared to the OECD average. The highest positive values are found in Romania, Poland and Lithuania. The negative values indicate that school principals believe that these teacher-related issues hinder learning to a greater extent and these are more pronounced in the Netherlands, Denmark and Croatia.

Moreover, about one third of the EU MS present positive values for both student-related aspects of school climate and teacher-related aspects of school climate.

Graph 13 - Indexes of student[82] and teacher[83] related aspects of school climate for EU MS



Source: CRELL analysis based on PISA 2012 data. *See also Tables 13.1 and 13.2, Annex B.*

[82] Countries are ranked in ascending order according with the index STUDCLIM. The index has a mean of zero and a standard deviation of one, as constructed by OECD.
[83] Countries are ranked in ascending order according with the index TEACCLIM. The index has a mean of zero and a standard deviation of one, as constructed by OECD.

Highlights

- In twenty three MS at least 80% of students attend schools whose principals agree or strongly agree that the morale of teachers in their school is high.
- In all MS over or equal than 80% of students are in schools where the principals agree or strongly agree that teachers work with enthusiasm, over 90% of students attend schools whose principals agree or strongly agree that teachers take pride in their school and value academic achievement.
- In twenty three MS 85% of students attend schools whose principals agree or strongly agree that there is a consensus among Mathematics teachers about their intentions to maximize achievement.
- In twelve EU MS factors associated with student behavior positively affect school climate.
- In thirteen EU MS factors associated with teacher -related issues positively affect school climate.

2.5. Relationships.

The previous sections offered an overview of three aspects related to teaching practices: 1) the perceptions of principals and students on the incidence of different instructional practices, 2) the extent to which collaborative practices are used and 3) the nature of the school learning environment. In the next section, CRELL reports statistical analyses that seek to capture relationships among these aspects. For example, in looking at teachers' use of different instructional methods and practices in the Mathematics classroom we are considering how subject-specific content is taught. And this may depend, among other things, on the structure of the learning environment.

2.5.1. Relationship between teaching instructional practices and the school learning environment[84].

As reported in the previous section regarding teachers' instructional focus, the factor that stands out with a higher perceived emphasis across the EU MS is the tendency of teachers to be interested in trying new methods and teaching practices. To explore how this might be related to the school learning environment and to collaborative practices, specifically in what relates to teacher monitoring by external evaluators and teacher peer review, CRELL ran a logistic regression. Logistic regression coefficients and corresponding standard errors are presented in the table below in order to capture possible relationships between teachers' intentions in trying new methods and each of the four types of teacher monitoring: teacher peer review, student achievement tests, external observers and principal or senior staff, as reported by the schools' principals. The answer categories for the four variables on teacher monitoring are "Yes" or "No".

[84] Results based on school principals' reports.
Significant results in the logistic regressions of teachers trying new methods and teaching practices with teachers monitoring. Significance was tested at 5% level. Cells are in blank when no significant relationship was found. No control variables were used for this regression.
The reference category is the combination of the categories "Strongly disagree" and "disagree". The categories "strongly agree" and "agree" were combined.
The sign of the coefficient (beta) indicates the direction of the relationship between teachers trying new methods and each one of the four teacher monitoring methods: positive values of the coefficient reflect a positive relationship between teacher monitoring and the likelihood of the principals agreeing or strongly agreeing with teachers trying new methods in their school. Negative values of the coefficient reflect a negative relationship.

Table 1. Relationships between teachers trying new methods and practices and teachers monitoring

	Teacher monitoring							
	Teacher peer review[85]		Student achievement tests[85]		External Observers[85]		Principal or senior staff[85]	
MS	**Coefficient**	**S.E.**	**Coefficient**	**S.E.**	**Coefficient**	**S.E.**	**Coefficient**	**S.E.**
AT	1.79	0.47	1.55	0.50				
BE	0.93	0.33					0.71	0.35
BG								
HR	1.46	0.43			1.62	0.46		
CZ							2.51	1.05
DK								
EE								
FI								
FR	1.14	0.31						
DE	1.78	0.39						
EL								
HU	1.02	0.51					2.32	0.89
IE								
IT	0.88	0.29					0.71	0.29
LV								
LT								
LU	0.11	0.01					-0.68	0.01
NL	0.77	0.32						
PL								
PT								
RO								
SK	1.86	0.77	1.52	0.72				
SI	0.42	0.08	0.60	0.08	-1.64	0.11		
ES								
SE	1.23	0.44						
UK								
EU26	-0.48	0.11	0.46	0.13	3.06	0.13	-1.56	0.13

` *Source:* CRELL analysis based on PISA 2012 data.

First, in twelve out of 26 EU MS teacher peer review have positive and statistically significant coefficients. This indicates that in these countries students attending schools where principals report that there is teacher peer review in their schools are also more likely to attend schools where teachers try new methods. However, for the EU average[86] this association is reversed; having teacher peer review is less likely to be associated with a higher agreement regarding teachers trying new methods and practices.

[85] Dichotomous variables where the reference category is No.
[86] No country effects were considered in the logistic regression.

Second, in Austria, Slovak Republic and Slovenia there is a positive effect of having student achievement tests, as an aspect of teaching monitoring, on school principals' agreement that teachers try new methods. The same is true, on average, across EU MS.

Third, on average across EU MS and in Croatia, having external observers is more likely to be related with school principals' reports on teachers trying new methods. The opposite relationship is found in Slovenia.

Finally, in 4 countries – Belgium, Croatia, Hungary and Italy - having principals or senior staff monitoring the teachers is more likely in schools where principals report to "Strongly agree" or "agree" that teachers try new methods. The opposite relationship is found in Luxemburg and on average across the EU.

In the EU MS, the different relationships found appear to be country specific. Nonetheless, overall, the relationship between trying new methods and having teacher peer review is the one that is positive and statistically significant in a larger number of countries.

2.5.2. Relationship between use of ICT[87] in Mathematics lessons and ICT availability at school.

The purpose of this section is to assess whether the use of ICT in Mathematics lessons is related with ICT availability at school[88]. This can provide insight into the interplay between school learning environment in terms of resources such as ICT and the actual use of these resources. Describing this relationship can inform recent calls for action with respect to ICT resources and use. More specifically, the European Commission's call for MS to modernize the ICT infrastructure of schools (European Commission, 2012)

Table 2 shows that across the 21 participating EU MS and within countries the higher the availability of ICT resources at school, the greater the use of ICT in Mathematics lessons. The coefficients are statistically significant for all countries. Although the correlations are low and correlation does not imply causation, this relationship suggests that ICT use is related to available resources. In order to encourage teachers to use ICT the conditions for such use in terms of available resources should be assessed.

[87] There is no data for this index in Bulgaria, France, Lithuania, Luxemburg, Romania and United Kingdom.
[88] More detailed information about this index can be found in OECD (2014, Vol V, p. 334).

Table 2. Correlation between use of ICT in Mathematics lessons and ICT availability at school[89]

MS	Corr.	S.E.
DK	**0.08**	**0.02**
CZ	**0.12**	**0.02**
IE	**0.12**	**0.02**
FI	**0.13**	**0.02**
AT	**0.14**	**0.02**
PL	**0.14**	**0.02**
ES	**0.14**	**0.01**
HR	**0.15**	**0.02**
EE	**0.15**	**0.02**
DE	**0.15**	**0.02**
HU	**0.16**	**0.03**
NL	**0.17**	**0.02**
SK	**0.17**	**0.02**
SE	**0.17**	**0.02**
LV	**0.18**	**0.02**
PT	**0.18**	**0.02**
BE	**0.2**	**0.01**
SI	**0.2**	**0.02**
EL	**0.24**	**0.02**
IT	**0.24**	**0.01**
EU21	**0.16**	**0**

Source: CRELL analysis based on PISA 2012 data.

2.5.3. Relationship between student and teacher related aspects of school climate and Mathematics teachers' intentions.

Next, CRELL explored a possible relationship between student and teacher related aspects of school climate and the following teacher intentions:

i) Maximize achievement in Mathematics;

ii) Social development;

iii) Development of Mathematics skills.

Schools whose principals reported that student behavior positively affects school climate also tend to report that the Mathematics teachers' intentions are higher, in terms of maximizing achievement, students' social development and development of Mathematics skills (table 3). The same is true for the relationship between teacher aspects of school climate and some teacher intentions (table 3).

[89] Results based on students and on school principals' reports.
Countries are ranked in ascending order of the correlation values.
Values that are statistically significant at the 5% level ($p < 0.05$) are in bold.

Table. 3 Correlation between student and teacher aspects of school climate and some teacher intentions[90]

	Correlation between *student* aspects of school climate and teacher intentions						Correlation between *teacher* aspects of school climate and teacher intentions					
	Maximize achievement		Social development		Development of Mathematics skills		Maximize achievement		Social development		Development of Mathematics skills	
MS	**Corr.**	**S.E.**	**Corr.**	**S.E.**	**Corr.**	**S.E.**	**Corr.**	**S.E.**	**Corr.**	**S.E.**	**Corr.**	**S.E.**
AT	**0.25**	0.07	0.05	0.09	0.12	0.10	**0.21**	0.07	**0.24**	0.08	0.07	0.11
BE	**0.24**	0.07	**0.13**	0.06	**0.17**	0.07	0.04	0.06	0.11	0.07	*0.10*	0.06
BG	**0.17**	0.07	0.04	0.07	0.05	0.07	**0.19**	0.07	0.09	0.08	0.03	0.07
HR	0.12	0.07	0.06	0.08	0.09	0.07	**0.20**	0.07	*0.15*	0.08	0.13	0.10
CZ	**0.16**	0.07	**0.11**	0.07	0.05	0.07	*0.13*	0.07	**0.21**	0.05	**0.12**	0.06
DK	**0.26**	0.06	**0.16**	0.08	0.07	0.08	**0.31**	0.06	**0.18**	0.07	0.04	0.08
EE	**0.19**	0.05	**0.23**	0.06	0.02	0.06	**0.18**	0.06	**0.23**	0.07	0.07	0.05
FI	**0.11**	0.05	0.02	0.06	0.04	0.07	*0.11*	*0.06*	*0.16*	*0.09*	0.02	0.07
FR	**0.28**	0.07	0.07	0.09	**0.18**	0.07	**0.19**	0.07	**0.28**	0.08	**0.22**	0.06
DE	**0.19**	0.07	0.12	0.08	0.06	0.07	**0.14**	0.06	**0.16**	0.05	0.03	0.06
EL	**0.26**	0.09	0.13	0.09	0.04	0.10	**0.24**	0.07	**0.22**	0.08	0.03	0.09
HU	**0.24**	0.10	0.10	0.07	0.00	0.08	**0.24**	0.08	**0.24**	0.07	0.02	0.06
IE	**0.22**	0.07	**0.24**	0.08	0.02	0.08	**0.29**	0.06	**0.27**	0.07	0.02	0.08
IT	**0.26**	0.03	0.00	0.05	**0.23**	0.04	**0.10**	0.04	**0.32**	0.04	0.08	0.05
LV	**0.21**	0.06	**0.24**	0.08	**0.22**	0.07	**0.28**	0.06	**0.30**	0.07	**0.15**	0.07
LT	**0.17**	0.06	0.11	0.07	0.03	0.06	**0.19**	0.06	**0.29**	0.07	0.01	0.06
LU	**0.37**	0.00	**0.40**	0.00	**0.32**	0.00	**0.32**	0.00	**0.31**	0.00	0.25	0.00
NL	**0.16**	0.08	0.09	0.09	0.07	0.07	0.05	0.09	0.13	0.09	0.07	0.09
PL	**0.15**	0.07	**0.21**	0.07	0.09	0.09	**0.25**	0.07	**0.27**	0.08	0.12	0.09
PT	**0.19**	0.08	**0.17**	0.09	0.04	0.09	**0.27**	0.08	**0.18**	0.08	**0.19**	0.08
RO	0.08	0.07	0.08	0.08	0.05	0.09	0.07	0.07	0.10	0.07	0.10	0.09
SK	**0.32**	0.07	*0.11*	0.07	**0.25**	0.07	**0.37**	0.07	**0.27**	0.06	0.09	0.08
SI	**0.19**	0.01	**0.08**	0.01	**0.18**	0.01	**0.33**	0.01	**0.26**	0.01	**0.15**	0.01
ES	**0.13**	0.05	**0.18**	0.05	0.06	0.06	**0.19**	0.04	**0.32**	0.06	0.05	0.05
SE	**0.18**	0.08	0.07	0.08	**0.20**	0.08	**0.19**	0.07	**0.15**	0.07	**0.19**	0.08
UK	0.09	0.06	**0.14**	0.06	**0.14**	0.06	**0.17**	0.07	**0.24**	0.06	**0.18**	0.07
EU26	**0.20**	0.01	**0.12**	0.01	**0.09**	0.01	**0.20**	0.01	**0.22**	0.01	**0.07**	0.01

Source: CRELL analysis based on PISA 2012 data.

On average across EU MS, there is a weak positive correlation coefficient between the index of student-related factors affecting school climate and

i) teacher intention in maximizing achievement (0.20).

ii) social development is (0.12);

iii) development of Mathematics skills is (0.09).

[90] Results based on school principals' reports.
Values that are statistically significant at the 5% level ($p < 0.05$) are in bold.

Concerning the index of student-related factors affecting school climate, the correlation between this index and teacher intentions varies between 0.07 (development of Mathematics skills) and 0.22 (social development).

Twenty two EU MS present a positive and statistically significant correlation between students related aspects of school climate and teachers intentions on maximizing achievement. This relationship is stronger in Luxembourg and Slovak Republic. The same is true for the relationship between teacher related aspects of school climate where positive and statistically significant values are found in 21 EU MS. The highest values for the correlation coefficient are in Slovak Republic, Slovenia, Luxemburg and Denmark. For the variables on social development and development of Mathematics skills a smaller number of countries correlate significantly positively with student and teacher-related aspects of school climate.

2.5.4. Relationship between ability grouping and students' achievement.

Ability grouping within schools has been shown to negatively correlate with students' achievement in PISA. In particular, the correlation between Mathematics performance in OECD countries and ability grouping for all Mathematics classes is -0.25 (OECD, 2013d). Thus, this type of context-specific, institutional stratification at the school level seems to be related to lower achievement. However, research also shows that classroom level inputs may be more closely associated with students' achievement (Wang, Haertel & Walberg, 1993). Moreover, in terms of ability grouping within classrooms, this practice may not have the same negative effect because it may reflect adaptive classroom teaching practices that benefit students. In fact, as acknowledged by the OECD PISA Governing Board and as research by Slavin (1990) suggests, ability grouping may better address the needs of individual students and be academically more beneficial if implemented only for some subjects.

CRELL found that ability grouping **within classrooms** is not, on average, associated with a negative correlation with students' achievement (table 4). Rather, the correlation between Mathematics performance in EU MS and ability grouping for all Mathematics classes is 0.08. Twelve EU MS out of 26 present significant positive correlations for this relationship. The findings suggest that, in general, in EU MS ability grouping **within classrooms** is not associated with lower achievement, as is the case for ability grouping **within schools.** Nevertheless, the results vary among countries, which may reflect specific characteristics of different educational systems.

Table 4. Correlation between ability grouping within classes, reported by the principals, and students Mathematics achievement[91]

MS	Corr.	S.E.
EL	-0.08	0.05
IE	-0.02	0.04
LV	-0.02	0.04
BG	-0.01	0.06
HU	-0.01	0.05
PL	-0.01	0.04
ES	-0.01	0.02
SE	-0.01	0.03
DK	0	0.03
EE	0	0.02
FI	0.01	0.02
HR	0.04	0.06
RO	0.05	0.06
LT	**0.09**	0.04
FR	0.1	0.06
BE	**0.11**	0.05
UK	**0.11**	0.04
CZ	**0.12**	0.04
IT	**0.12**	0.03
PT	**0.12**	0.04
SI	**0.15**	0.02
LU	**0.17**	0.01
NL	**0.2**	0.06
DE	**0.23**	0.05
SK	**0.24**	0.05
AT	**0.31**	0.04
EU26	**0.08**	0.01

Source: CRELL analysis based on PISA 2012 data.

2.5.5. Relationship between class size and students' achievement.

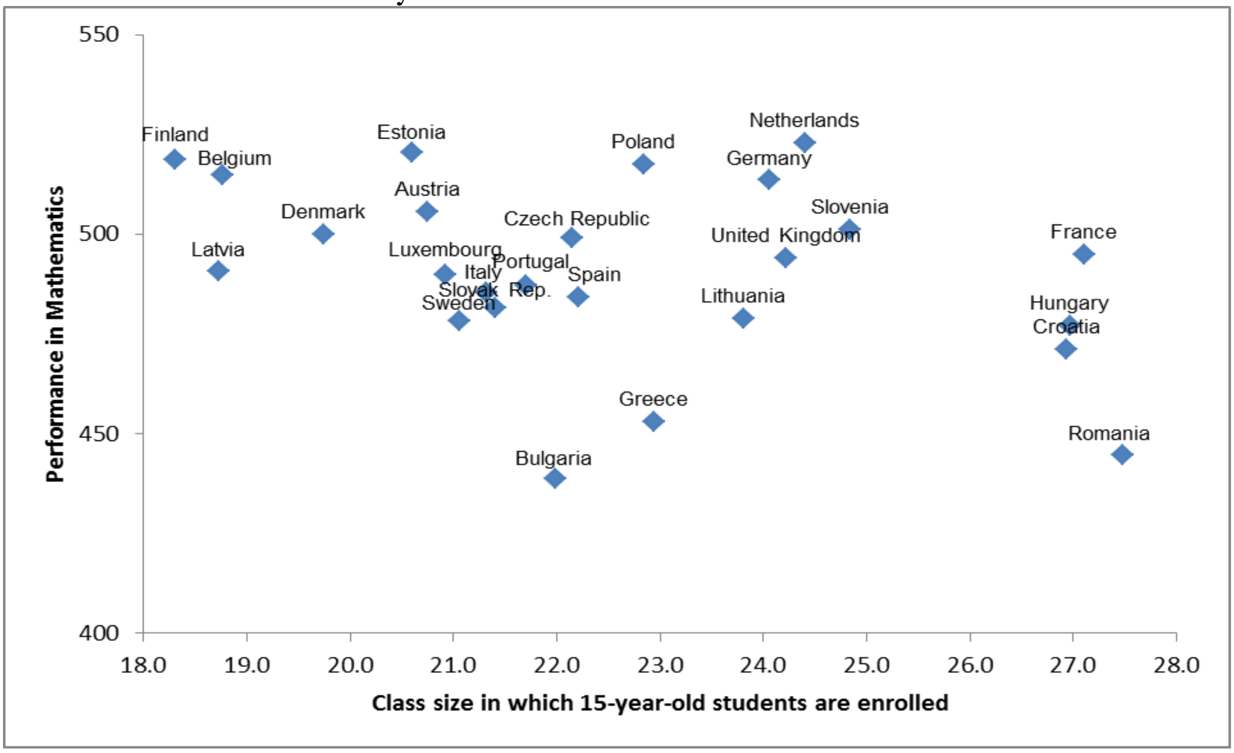
As is the case with ability grouping **within schools,** PISA also addresses the relationship between class size and achievement **within schools.** Results suggest that student-teacher ratio in OECD countries and the Mathematics performance of schools is weak (OECD, 2013d). CRELL analysed this relationship in EU MS to in order to portray this aspect in the instructional settings under analysis (26 EU MS). With respect to policy measures, although class size continues to be considered an indicator of school quality, reducing class size is not viewed as a priority because its relationship with students' achievement is weak (OECD, 2012a). However, several studies have shown that smaller class sizes may allow teachers to spend more time with each student and

[91] Countries are ranked in ascending order of the correlation values.
Values that are statistically significant at the 5% level (p < 0.05) are in bold.

thus better ensure individual needs are met. The effect of such advantages may reveal itself in non-cognitive measures that are not directly related to achievement, such as decreased early school leaving (Ehrenberg, Brewer, Gamoran & Willms, 2001).

The PISA surveys indicate that the association between class size and achievement is weak. That is, there is no clear pattern across the OECD participating countries in terms of smaller class sizes being associated with lower achievement or with higher achievement. CRELL calculations for PISA 2012, whose main domain was Mathematics, confirms that for this cycle the findings are similar. Across the EU there is wide variation between class size and Mathematics achievement. As the graph shows, there is variation across countries and countries with similar class sizes have very different average achievement. Likewise, countries with similar achievement levels have very different class sizes. The countries where minor changes were observed in 2012 compared to 2009 were Estonia, Poland, the Slovak Republic, Romania and Slovenia. The average class size increased in Poland and Romania in 2012 and achievement increased substantially in the first country and slightly in the second. From 2009 to 2012 the average class size decreased in Estonia, the Slovak Republic and in Slovenia and the achievement increased a little in Estonia and is about the same in Slovenia.

Graph 14: Scatterplot between performance in Mathematics and class size in which 15-year-old students are enrolled[92]



Source: CRELL analysis based on PISA 2012 data.

[92] There is no data in one of the variables for Ireland.

Highlights

- In EU MS, the relationship between teachers trying new methods and teacher monitoring appears to be country specific. However, the relationship between trying new methods and having teacher peer review is positive and statistically significant in a larger number of countries.
- ICT use is related to available ICT resources in schools.
- Schools where principals report that student behavior and teacher aspects positively affect school climate also tend to report that Mathematics teachers' intentions are higher in terms of maximizing achievement; students' social development; and development of Mathematics skills.
- Eighteen out of 26 EU MS present positive correlations between ability grouping within classes and Mathematics achievement. The findings suggest that, in general, in EU MS ability grouping within classrooms is not associated with lower achievement.
- Classroom size does not appear to be related to Mathematics achievement. In line with previous findings for PISA 2009, the relationship between class size and achievement in PISA 2012

2.6. Do instructional practices and school learning environment explain Mathematics achievement at the EU level?

The aim of this section is to present an estimate of how much of the variation in Mathematics is associated with teaching practices and school learning environment in EU MS. Multilevel modelling (Goldestein, 2003) was used due to the hierarchical structure of the data, in which students are clustered within schools and schools are nested in countries. Level 1 consists of students' variables, Level 2 represents the schools/classrooms and Level 3 stands for the EU MS. In this analysis CRELL estimated 3 different models. Model (1) is the baseline model, or the null model (no predictors included) and was used in order to determine the proportion of variability, calculated using the variances estimated for the errors between students, between schools within countries and between the countries. This model is useful to calculate the decomposition of the variance when individual, school and country-level explanatory variables are incorporated in the regression. Model (2) was estimated adding demographic predictors at level 1, level 2 and level 3. In particular, the level 1 predictors are gender, grade, socio-economic status (PISA index of economic, social and cultural status) and immigration status; the level 2 predictors are class size, diverse ethnic background, school average of PISA index of economic, social and cultural status, school funding (private vs public), school size, student-teacher relations and the level 3 includes the country average of PISA index of economic, social and cultural status (ESCS). Lastly, in model (3)[93], in order to answer our research question CRELL added to model (2) variables measuring teaching practices and school learning environment (OECD, 2014c), in terms of opportunity to learn, teaching practices, teacher quality, ICT use in Mathematics' lessons and ability grouping within classrooms[94].

The results (Table 14 in Annex B) show that the proportion of variability between schools is 0.376, which indicates that **37.6%** of the total variability in Mathematics achievement is **between schools**. The estimates pertaining to the proportion of variance in our analysis at the country level is 0.06 indicating that **6%** of the variation in students' Mathematics results is due to **country characteristics**.

The estimates of the final model (3) show that the **variables measuring teaching practices and school learning environment** explain 30.3% of the between school variation in

[93] Due to the rotation of the student context questionnaire, in which only two thirds of the students answered questions for some variables, the rate of missing is very high for some variables and indexes. These missing values may compromise the estimates obtained for our model. Therefore, these results should be used with caution and findings replicated in 2015, when no rotation will be adopted.

[94] Description and descriptive statistics on opportunity to learn variables, teaching practices variables, teacher quality variables, ICT use in Mathematics' lessons and ability grouping within classrooms are available in section 2.2.

students Mathematics achievement. Thus, this indicates that at the EU level **teaching practices and school learning environment explain 30% of students' Mathematics achievement.** This means that opportunities to learn, teaching practices, teacher quality, ability grouping and use of ICT in Mathematics lessons can influence almost one third of the variation of students' achievement.

Additionally, all the variables of the final model can explain 47% of the variance in students' achievement. This suggests that a big proportion of the variation in students' Mathematics achievement is influenced by factors related to students' background (e.g. gender, socio-economic status and immigration status), school and classroom teaching characteristics (e.g. school size, teacher cognitive activation and support of students).

The following table presents a summary of the findings, indicating the specific variables that explain variation in students' achievement.

Table 5. Model summary

		Statistically significant coefficient	
		Yes	No
Control variables	Gender	X	
	ESCS (Socio-economic Status)	X	
	Immigration background	X	
	Class size		X
	Diverse ethnic backgrounds	X	
	School average of ESCS	X	
	School funding (private vs public)		X
	School size		X
	Student-teacher relations		X
	Country average of ESCS		X
Variables measuring teaching practices and school learning environment	Ability grouping in Mathematics classes	X	
	ICT use in Mathematics lessons	X	
	Opportunities to learn		
	Experience with applied mathematical tasks	X	
	Experience with pure mathematical tasks	X	
	Familiarity with Mathematics concepts	X	
	Teaching practices		
	Teacher-directed Instruction	X	
	Formative Assessment	X	
	Student Orientation	X	
	Teacher quality		
	Disciplinary climate	X	
	Teacher support	X	
	Cognitive activation in Mathematics lessons	X	

The results also indicate[95] that ability grouping within Mathematics classes favors students' achievement. For the EU has a whole, the use of ICT in Mathematics classes has a negative association with students' achievement as well as the experience with applied mathematical tasks. Regarding ICT use, the results should be interpreted with caution because it is an indirect measure and, more importantly, it does not discriminate whether both teachers and students use ICT for instructional purposes or if only the teacher demonstrates ICT use. On the other hand, students who have a higher familiarity with Mathematics concepts and students who have more experience with pure mathematical tasks tend to score higher in Mathematics. Teacher-directed instruction, formative assessment and student orientation do not have a beneficial impact on students' achievement. Conversely, attending schools with a better disciplinary climate positively affects students' scores in Mathematics. The same is true for students reporting having higher teacher support and a higher cognitive activation in Mathematics lessons. In terms of background variables (fixed part), the model shows that, boys perform better than girls in Mathematics and that immigrant status is associated with lower achievement. In terms of school factors, what stands out is that the existence of different ethnic backgrounds has a negative influence on students' achievement, and that the higher the average socio-economic status of the students attending a school, the higher their Mathematics achievement.

These results suggest that teaching practices and school learning environment matter for students' achievement in EU MS. The finding that, for example, teacher-directed instruction and ICT use are negatively associated with students' achievement suggests that other features of instruction and/or teacher quality may be more relevant in terms of raising students' achievement. Nonetheless, the findings have limitations related to the PISA survey design and the specific population of 15-year old pupils. In the case of the ICT index the concepts of use are very broad and may not capture whether only teachers demonstrate concepts using ICT or whether students are also engaged in their use. Second, due to the rotation design of the students' questionnaire there is a high rate of missing data because not all students respond to all questions. This design will not be adopted in 2015, when all students will have a chance to respond to all questions in the questionnaire. In addition, the school questionnaire was only answered by school principals. In that sense, the teachers' questionnaire to be implemented in 2015 can perhaps better capture the nature of teaching practices actually adopted by teachers. As such, it would be desirable to pursue this type of analysis in subsequent PISA cycles. This would enable a more precise examination of whether the effect found in PISA 2012 for teaching

[95] See Table 14 in Annex A for coefficients statistically significant of the variables assessing teaching practices and school learning environment.

practices and school learning environment is similar in magnitude and holds for a different main domain, which in 2015 will be Science.

Highlights

- At the EU level teaching practices and school learning environment can explain 30% of the variation in students' Mathematics achievement.

2.7. Conclusion and Discussion.

The findings pertaining to teaching practices in PISA 2012 for EU MS provide detailed information on ability grouping within classes, on the focus of teachers´ instruction, on students´ opportunities to learn, on school climate and ICT use. In addition, the analyses presented address teachers´ collaborative practices, factors related to the school learning environment and relationships among some of these factors and students´ achievement.

Results show that **ability grouping within classrooms** is not a common practice in MS, that it varies among countries and that, unlike tracking at the school and classroom levels, it is not always related with lower student achievement. Although these results are a starting point for policy analyses, they should be complemented by more precise information obtained from teachers themselves, which will be available in the PISA 2015 teacher questionnaire. Given the recurrent findings that ability tracking at the system and classroom levels is related to lower student achievement, it seems crucial to understand how teachers who teach heterogeneous classes address the needs of diverse ability students on a daily basis. There is a particular need to collect this information at the secondary school level, since most of the research showing a positive relation between the use of ability grouping within the same classroom and student achievement has been conducted at the primary school level (Slavin, 1990). TALIS results have revealed that secondary teachers across EU MS report using student-oriented practices, such as ability grouping and give students individually adapted tasks, but evidence on the link between the use of these practices and student achievement is needed.

Concerning the relationship between ability grouping and students' Mathematics achievement, the findings suggest that, in general, in EU MS ability grouping **within classrooms** is not associated with lower achievement, as is the case for ability grouping **within schools.** Nevertheless, the results vary among countries, which may reflect specific characteristics of different educational systems. This finding corroborates the need identified by the European Commission for MS to cooperate in identifying the right mix of policy measures that diminish, rather than exacerbate the negative effects of tracking between schools and classrooms (Commission of the European Communities, 2008). The scope for collaboration could include gathering evidence and reflecting on how teachers in different MS differentiate instruction to address the needs of different students, with different abilities within the same classroom.

Findings also show that there is general agreement among principals in MS that teachers try new methods and teaching practices. Again, the introduction of the Teachers questionnaire in

PISA 2015 can help identify which specific methods and practices teachers actually use and whether "Different teaching approaches can improve attitudes, raise attainment levels, and open up new learning possibilities" (Commission of the European Communities, 2008). Moreover, in general, principals in EU MS, agree that there is a high prevalence of the use of different teaching strategies to foster student learning and there is a strong focus on maximizing students´ achievement. In contrast, the importance principals say teachers attach to the social and emotional development of students varies more among MS. Even so, in almost all countries more than fifty percent of students are in schools where principals agree that teachers consider students´ social and emotional well-being to be as important as their mastery of mathematics skills. As a recent PISA in focus shows, countries where there is a higher the consensus on this measure of students´ well-being also tend to register higher student achievement (OECD, 2015). Thus, MS could gain from looking further at how the social and emotional development of students is covered in teacher training programs, both during initial and continuous professional training.

The analysis presented also indicates that collaborative practices, namely teacher peer review, vary widely among MS, being a very common practice in the UK, Latvia and Italy, and rarely implemented in countries such as Finland and Spain. This may reflect different school cultures and may not be closely related with students´ achievement for in high achieving countries like Finland teachers rarely engage in this collaborative practice. However, it could also be that the PISA questionnaire is rather limited in capturing different collaborative practices. In fact, research shows that "Although an increasing number of professional development activities for teachers are structured around collaboration, evidence on conditions for successful collaboration and positive outcomes related to collaborative practices remains relatively scarce and inconclusive" (Schleicher, 2015, p.53). Nonetheless, the relationship between trying new methods and peer review suggests that teachers who collaborate in reviewing each other's lessons more are also more likely to try new methods. Clearly, more empirical evidence on how collaboration among teachers may enhance their efficacy and improve student achievement is needed (Liaw, 2009; Puchner and Taylor, 2006) cited in Schleicher, 2015).

With respect to the school learning environment, the findings show that valuing academic achievement is perceived to be a common trait in schools in EU MS, but great variation exists among countries with respect to students´ exposure to different teaching strategies. Similarly, principals across MS strongly agree that teachers take pride in their school, but more variation was found among EU MS regarding teachers´ morale, their enthusiasm and their notion that academic achievement must be kept as high as possible. As highlighted in the European Commission's Communication on School Cooperation (2008) teachers need to be prepared to tackle poor performance and their morale is most likely to affect students´ learning. As is the case for other teaching practices discussed above, the introduction of the Teachers questionnaire in PISA 2015 has the potential to contribute to our understanding of teachers´ morale and its relationship with students´ achievement.

According to the available data in PISA 2012, the incidence of ICT use in MS is low and its use is related to the ICT resources at school. Therefore, increasing availability of ICT resources may be justified in order to develop the use of ICT in Mathematics classes. As the European Commission has noted "technology offers unprecedented opportunities to improve quality, access and equity in education and training. It is a key lever for more effective learning and to reducing barriers to education, in particular social barriers" (European Commission, 2012, p. 9). However, ICT use cannot be dissociated from other indicators of school quality and the impact of ICT on achievement remains difficult to measure. In particular, the benefits of ICT may depend, to a large extent, on the ability of schools and teachers to create conditions for frequent ICT use and to adapt teaching methods conducive to student learning (Spiezia, 2010).

In accord with previous findings by Hanushek and Woessmann (2011, p. 1) relative to OECD countries, the association between classroom size in EU MS and students´ achievement is weak, namely "Better-performing countries do not have smaller classes on average". However, care must be exercised in interpreting this finding because it could be that low achieving students are placed in smaller classrooms in order to allow teachers to better address their individual needs (OECD, 2014a). If this is the case, statistical analyses would reflect that larger classes are associated with higher student achievement. Thus, MS should consider this information in light of their knowledge of how particular school systems make instructional decisions. Additionally, class size can be considered an indicator of other school quality outcomes, such as decreased early school leaving (Ehrenberg, Brewer, Gamoran & Willms, 2001) and in this respect it may be worthwhile considering its relation to non-cognitive measures.

CRELL`s estimates using a multilevel model also suggest that instructional practices and the school learning environment can explain a large variation in students' Mathematics achievement. That is, students' opportunities to learn, teaching practices, teacher quality, ability grouping and use of ICT in Mathematics lessons can influence students' achievement. These estimates offer a glimpse of what may matter for students´ achievement and should be viewed as tentative insofar as the present PISA 2012 design imposes limitations on possible inferences.

Since in PISA 2015 responses from all students are expected and teachers´ responses to a questionnaire will be collected, there will be available data to test whether the variables included in these estimates do continue to explain variation in students´ achievement.

Lastly, although research clearly indicates that what students learn in school is related to what is taught PISA data does not allow for a full understanding of students´ opportunities to learn specific Mathematics content. Teaching practices reveal the implemented curricula, which is based on the intended curricula (Schmidt & Maier, 2009). What teachers actually teach is based on the intended curricula developed and followed either at the national or at the regional level within countries. The strategies they use to implement curricula reflect the teaching practices. As such, both curriculum documents' coverage of topics and concepts and the way teachers teach them are intertwined, and are likely to affect students' achievement. Exploring how, for example, the opportunities teachers give students to learn applied mathematical tasks and pure Mathematics is related to the Mathematics curricula of different MS may provide further insights on the teaching and learning of Mathematics.

In conclusion, the analyses of PISA data presented describe teaching and learning in EU MS, but findings are based on reported frequencies and correlations. As previously noted, variables capture the perceptions of school principals and students and not those of the teachers that teach the sampled students and correlation does not imply causation. Nevertheless, the findings offer insights that can be helpful to MS in their efforts to strengthen teachers´ professional development and to better understand the prevalence of some teaching methods and teacher intentions in their respective contexts. Furthermore, by providing a comparative analyses this report can inform cooperation among MS in tackling common challenges.

Policy Implications

- There is a need to better understand how ability grouping within classrooms can be implemented in different MS to the benefit of all students and increase equity.
- Trying new methods and teaching practices are perceived as a common interest among teachers in EU MS, but more research is needed to understand how teachers can support learners and activate their thinking.
- Valuing academic achievement is perceived as a common trait in schools in EU MS, but more research is needed to understand the variation among countries with respect to students´ exposure to different teaching strategies.
- EU MS could gain a better understanding of what influences student achievement from examining students´ experience with Mathematics tasks tested in PISA and the Mathematics content covered in curricula.
- EU MS should consider the effect of ICT use in conjunction with other teaching measures related to school resources, opportunities to learn and teacher quality.
- The implementation of collaborative professional development activities in EU MS should consider how peer review can be promoted to positively influence students´ learning processes and achievement.
- The relationship between class size and student achievement in EU MS should be interpreted in light of country-specific policies that address the needs of diverse learners.

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PART III

Teaching Practices and Other Aspects of Teaching in TALIS 2013

Chapter 1

This chapter provides general information about the OECD Teaching and Learning International Survey (TALIS) and the different aspects of teaching surveyed in it in 2013. The first and second parts of this chapter provide a description of the survey and of the TALIS theoretical framework, respectively. The third part describes how teaching practices are operationalized in TALIS 2013 and the recent findings reported in the TALIS 2013 international report regarding the relationship between teaching practices and different teaching-related factors (i.e. classroom context, classroom disciplinary climate, learning domains and class-size). Last, the aims of these chapters are specified.

1. Teaching Practices. Context, Conceptualization and Measurement

1.1. A brief introduction to the Teaching and Learning International Survey (TALIS)

The Teaching and Learning International Survey (TALIS) is a large-scale international study conducted by the Organization for Economic Co-operation and Development (OECD). It aims to help countries review and develop educational policies for school effectiveness by providing comparable data on teachers' and principals' working conditions and the learning environment at their schools. TALIS does this by surveying school principals and school teachers, targeting primarily those at ISCED (International Standard Classification of Education) level 2[96] in different countries or economies.

TALIS was launched in 2008 and uses self-reported data collected in five-year cycles. The second time-point of data collection has taken place in 2013. In this second and latest data collection, school principal and school teacher questionnaires consisted of seven parts and combined closed-question items with Likert-scale items[97]. While some themes appeared in both questionnaires, others were only surveyed in either the school principal or the teacher questionnaire. Common themes surveyed in both questionnaires were individual demographic characteristics of the respondent, work status and work experience, school climate and job satisfaction. In addition, the 2013 principal questionnaire comprised informative items about school background, school leadership, school formal appraisal and teacher induction and mentoring, whist the 2013 teacher questionnaire comprised additional informative items about engagement in professional development activities, teacher feedback, characteristics of their own teaching practices and teacher mobility.

Eighteen EU MS participated in TALIS 2013 for which we have available and comparable data[98], providing useful comparable data for cross-country analyses and therefore allowing for the identification of educational practices. The dissemination and exchange of these practices though peer learning are key to educational policy in the EU. This has been highlighted in the Education and Training 2020 strategic framework (ET2020) for European cooperation in education and training[99] as a way of improving the quality and effectiveness of teaching. Among

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[96] TALIS 2013 used the International Standard Classification of Education ISCED 2011, in which ISCED level 2 corresponds to lower secondary education. See http://www.uis.unesco.org/Education/Documents/isced-2011-en.pdf

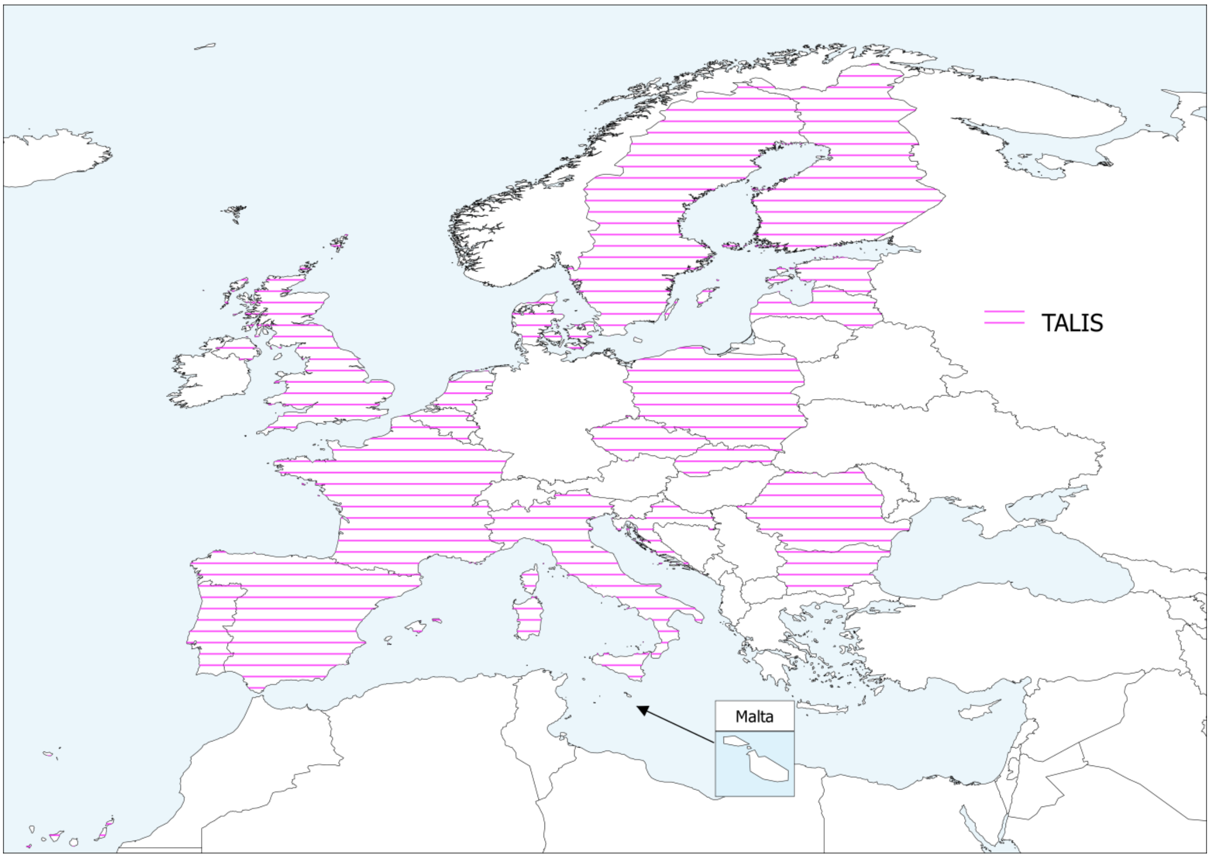
[97] In Likert-scale items the respondents have to choose the answer that best describes their level of agreement/disagreement to a statement from a fixed-choice response scale where the possible answers are arranged in an ordinal manner

[98] Analyses based on the official OECD-TALIS 2013 database (http://stats.oecd.org/Index.aspx?datasetcode=talis_2013). Cyprus data not available.

[99] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52009XG0528%2801%29&from=EN

the four strategic objectives included in ET2020, two specifically address the need of improving education and training by increasing, at all levels of education and training, their quality and efficiency and by enhancing creativity and innovation. Hence, comparable data on teachers' practices, including the use of traditional and innovative instructional practices across EU MS, are a fundamental piece of information towards these aims. The following map shows the 18 EU MS that participated in TALIS 2013 and for which data is available: Belgium (BE), Bulgaria (BG), Croatia (HR), Czech Republic (CZ), Denmark (DK), Estonia (EE), Finland (FI), France (FR), Italy (IT), Latvia (LV), Netherlands (NL), Poland (PL), Portugal (PO), Slovak Republic (SK), Spain (ES), England (ENG-UK), Romania (RO) and Sweden (SE).

EU MS participating in TALIS 2013 for which data is available



1.2. TALIS Conceptual framework

TALIS questionnaires gather information on teaching and learning aspects that have been considered important in academic research and regarded as priority matters for educational policy by the representatives of the participating countries[100]. They offer an exceptional opportunity to examine the extent to which teaching practices, as reported by teachers, relate to diverse aspects of teaching such as teachers' background, experience or beliefs within and across countries. TALIS uses a two-dimensional model as a framework (OECD, 2013a). One dimension is based on the Programme for International Student Assessment's (PISA) framework (OECD, 2013b) and makes a three-level distinction: student, teachers/classroom and school. The other dimension is based on Purves' (1987) model of school context which considers a three-level distinction: inputs, processes and outcomes. As a result, the TALIS conceptual framework considers nine different constructs of teaching and learning aspects (see Table 1).

Table 1. TALIS two-dimensional conceptual framework

	Input	Processes	Output
Student	Socio-demographic characteristics	Attendance/Truancy, time spent on learning, extracurricular activities and learning and thinking strategies	Academic achievement, content-related attitudes, beliefs and motivation, motivation
Teacher/ classroom	Class size, socio-demographic characteristics, work status and work experience, professional development	Instructional teaching practices and active teaching practices, teacher expectations, pedagogical beliefs and teacher-student relationships	Classroom environment, teacher efficiency and satisfaction
School	School size, socio-economic background and ethnic composition, school funding and management, parental and community involvement and support	Co-operation practices, shared norms and values, leadership, professional development opportunities	School climate, aggregated class and teacher outcomes

These nine constructs may be stable, fairly stable or malleable. They might also be more or less closely related to each other. Although effective teaching and learning may include many factors, the current work will focus on specific aspects that are considered in the TALIS conceptual framework, that have been analysed in TALIS 2013 international report (OECD, 2014a) and that have deserved attention by the European Commission's report of the main findings (OECD, 2014b). This European Commission report of the main findings highlighted the association between teachers' participation in professional development activities (such as engaging in collaborative research, conducting observation visits to other classrooms or participating in teachers' networks) and their likelihood of using innovative pedagogies more frequently. The conclusions drawn emphasised the importance of developing communities of

[100] OECD countries and economies that completed the priority rating included Australia, Austria, Belgium (Fl.), Belgium (Fr.), Canada, Korea, Czech Republic, Denmark, Estonia Finland, France, Iceland, Ireland, Italy, Luxembourg, Mexico, Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Turkey, United Kingdom and United States.

practices among teachers and other stakeholders in school education and stressed the importance of teachers sharing best practices and being informed of the latest pedagogical research. A general description of the findings reported in TALIS 2013 international report with regard to the different dimensions considered in the TALIS framework is provided in the following sub-sections.

1.2.1. School dimension: School and professional climate.

School climate is a well-established influential factor for school effectiveness at all school levels (Cohen, McCabe, Lichelli, & Pickeral, 2009; MacNeil, Prater, & Busch, 2009; Sherblom, Marshall, & Sherblom, 2006; Stewart, 2008; Thapa, Cohen, & Guffey, & Higgins-D'Alessandro, 2013). A healthy school climate is also beneficial to teachers because it allows them to move towards their goals, transmit their culture and values, maintain solidarity and coordinate with each other (Fulton, Yoon, & Lee, 2005; Hoy & Woolfolk, 1993; Weiss, 1999). TALIS 2013 approach to assess schools' climate considers how students and teachers influence the school climate separately. In addition, it also considers the teacher-student relationships and the professional climate of the school because positive teacher-student relationships have been shown to have a positive impact on several education-related factors (Eccles et al., 1993; Eliot, Cornell, Gregory, & Fan, 2010).

With regard to how students influence the school climate, TALIS items asked principals to report on the frequency (i.e. never, rarely, monthly, weekly or daily) with which certain disruptive behaviors (i.e. arriving late at school, absenteeism, cheating, vandalism and theft, intimidation or verbal abuse among students, physical injury caused by violence among students, intimidation or verbal abuse of teachers or staff and use/possession of drugs and/or alcohol) occurred in the school. TALIS results indicate that students' weekly absenteeism and late arrival to school are the two most frequent disruptive behaviors among the ones surveyed as reported by teachers across countries. Cheating, vandalism and theft, intimidation or verbal abuse among students vary extensively across TALIS countries.

With regard to how teachers influence the school climate, TALIS asked teachers to report on their behaviors such as arriving late, absenteeism and discrimination. Findings revealed that the extent to which teachers work in schools where teachers arrive late differs broadly across countries. Interestingly, the number of teachers working in schools where absenteeism or discrimination is problematic is lower than the number of those working in schools where teachers arrive late.

To gather information on the teacher-student relationships at school, teachers and principals were asked to report on the importance they give to students' well-being and opinions, to whether students' special needs are taken into consideration and whether students and teachers get on well with each other. TALIS informs that a large majority of teachers and principals report positive relationships between students and teachers. Yet, regarding the need for extra assistance to students with special needs, there is some variation across countries.

Finally, the professional climate in the school takes into account the communication, shared beliefs and respect amongst colleagues. TALIS data shows that most teachers in the surveyed countries work in contexts with a positive professional climate among the teaching staff. In order to analyze the relationship between the extent to which principals allow other stakeholders to participate in school decisions and teacher co-operation, OECD developed an index of participation among stakeholders taking into consideration teachers' agreement or disagreement with statements related to participation among stakeholders. This index included items asking the degree that the school provides staff and parents/guardians with opportunities to actively participate in school decisions and whether there is a culture of shared responsibility or a collaborative culture in the school. The analysis of data found a positive relationship between participation among stakeholders and teacher co-operation. Concerning the variance in teacher collaboration and teacher exchange, TALIS results show that in both cases it lies mainly at the teacher level, that is, the variability observed appears to be explained almost exclusively by differences among teachers, which suggest that teachers' individual culture may influence the likelihood of their engagement in collaborative activities.

1.2.2. Classroom dimension: Teacher/classroom's environment.

Classroom environment refers to how teachers spend their class time during an average lesson and the classroom disciplinary climate. TALIS 2013 international report results suggest that when school climate is good and teachers actively cooperate together towards common goals the possibilities of teachers employing instructional practices, such as working in small groups or using information and communication technology (ICT) for learning increase. This potentially enhances students' learning and engagement.

Lower secondary teachers reported using the majority of the class time on teaching and learning activities while administrative tasks seem to be the ones that occupy less time in the class. However, important variations of time spent on teaching and learning can be found across countries. Moreover, in almost all TALIS countries a positive relationship was found between the classroom disciplinary climate and the use of teaching practices such as small group work and use of ICT for projects or class work. In addition, TALIS 2013 international report created two indexes to measure teacher co-operation; one measuring exchange and co-ordination for teaching and the other measuring professional collaboration. Regarding the first one, teachers were asked to indicate how often (from never to once a week or more) they:

- Exchange teaching materials with colleagues
- Engage in discussions about the learning development of specific students
- Work with other teachers in school to ensure common standards in evaluations for assessing student progress
- Attend team conferences

In what concerns the professional collaboration index, teachers were asked to indicate how often (from never to once a week or more) they:

- Teach jointly as a team in the same class
- Observe other teachers' classes and provide feedback
- Engage in joint activities across different classes and age groups (e.g. projects)
- Take part in collaborative professional learning

The TALIS 2013 international report focuses mainly on the findings with regard to the teachers that never perform the activities listed above, reporting that 45% of the teachers surveyed informed that they had never observed other teachers' classes to provide feedback and around 40% had never taught jointly.

1.3. Teaching Practices: Results of TALIS 2013 International Report

Unlike other teaching and learning international surveys (e.g. PISA, PIRLS and TIMSS) TALIS does not allow for examinations of the relationships between aspects of teaching and learning and students' achievement. This is because students' outcomes are not surveyed in TALIS. However, studies examining the link between instructional practices and students' achievement seem to converge in their findings: what teachers do in the classroom is a good predictor of their students' achievement (Brophy, 2000; Seidel & Shavelson, 2007; Hattie, 2013; Creemers & Kyriakides, 2006). The basic dimensions of teaching practices that TALIS considers are structure, student orientation and enhanced activities. In TALIS the term "instructional teaching practices" refers to teachers' pedagogical behaviors and includes both constructivist and direct instructional practices.

To specifically refer to constructivist teaching practices, in which the students play a pivotal role in the learning process, TALIS uses the term "active teaching practices". Unlike passive (or direct) teaching practices, active teaching practices involve analysis, evaluation and synthesis of knowledge (such as such as concept mapping, reflective activities, critical thinking and problem solving). These skills are usually harder to learn and teach because their application is not only expected in the context in which they have been learnt but also in novel situations. For instance, some ways teachers enhance the use of active teaching practices is by promoting discussions among students (Adesope & Nesbit, 2013; Orlich, Harder, Callahan, Trevisan, & Brown, 2012). Despite the fact that the relationships between active teaching practices and students' achievement cannot be examined using TALIS data, research suggests that active teaching practices have positive effects on students' learning (Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013; Johnson & Johnson, 2009).

1.3.1. Operalization of teaching practices in TALIS 2013.

The teacher questionnaire in TALIS 2013 asked teachers to indicate in a five-point Likert scale the frequency (from "never or hardly ever" to "in almost every lesson") with which they used eight teaching practices throughout the year in a specific target class. The teaching practices surveyed were the following:

a) I present a summary of recently learned content

b) Students work in small groups to come up with a joint solution to a problem or task

c) I give different work to the students who have difficulties learning and/or to those who can advance faster

d) I refer to a problem from everyday life or work to demonstrate why new knowledge is useful

e) I let students practice similar tasks until I know that every student has understood the subject matter

f) I check my students' exercise books or homework

g) Students work on projects that require at least one week to complete

h) Students use ICT for projects or class work

Among these eight teaching practices, items *b, g* and *h* can be considered informative of active teaching practices according to the TALIS 2013 conceptual framework (OECD, 2013a). These refer to learning activities that require discussion among students (students work in small groups to come up with a joint solution to a problem or task), to develop ideas or work over the same topic (students work on projects that require at least one week to complete) or to use new methodologies to improve the learning deliverables (students use ICT for projects or class work). Therefore, these three practices are based on a constructivist view of learning whereby students play a pivotal role in the learning process because they need to be capable of developing and applying their knowledge to novel situations. The target class was defined as the first ISCED level 2 class that the teacher taught in the school after 11 a.m. on the previous Tuesday.

TALIS found that in OECD countries teachers reported using small-group work more frequently (47%), followed by ICT use for projects (37%) and projects taking at least one week to complete (27%). The relationship between these three active teaching practices and other teaching and learning aspects were examined and reported in TALIS 2013 international report. More in-depth examination of the use of these practices among teachers across EU MS contributes to further promote and disseminate best practices. Indeed, one of the four strategic objectives included in ET2020 specifically refers to the need of enhancing creativity and innovation at all levels of education and training. These conclusions stress the importance of transversal skills acquisition such as digital competence and learning to learn and how this could be achieved through converging synergies among education, research and innovation. The three active teaching practices included in TALIS 2013 can be thought to tap into these transversal skills.

With regard to the other teaching practices surveyed in TALIS, which hereafter we will name "non-active teaching practices", the findings indicate that across OECD countries presenting a summary of recently learned content and checking students' exercise books or homework were the most frequently teaching practices used in the classroom. More than 70% of teachers reported the use of these teaching practices frequently or in all lessons, although this percentage was much lower in certain countries (namely Iceland, Korea, Sweden and Belgium). Similar patterns of reported frequencies across countries were found for referring to a problem from everyday life or work to demonstrate why new knowledge is useful. While 60% of teachers reported using this teaching practice frequently or in all lessons only less than half of the teachers in Iceland, Korea and Sweden reported doing so. Roughly the same percentage of teachers (67%) reported that they let students practice similar tasks until they have understood the subject matter, however the percentage of teachers using this teaching practice frequently is much lower in a few specific countries (i.e. Iceland, Japan and Korea). CRELL considered these five teaching practices (i.e. I present a summary of recently learned content, I give different work to the students who have difficulties learning and/or to those who can advance faster, I refer to a problem from everyday life or work to demonstrate why new knowledge is useful, I let students practice similar tasks until I know that every student has understood the subject matter and I check my students' exercise books or homework) "non-active teaching practices" because they include both direct instructional practices and constructivist practices. For example, for practices such as presenting a summary of content, giving students different tasks depending on their abilities or checking students' exercise books or homework, it is the teacher other than the students that plays a pivotal role. Therefore, these can be considered direct instructional practices according to the TALIS conceptual framework. However, other practices such as referring to a problem from everyday life or work to demonstrate why new knowledge is useful or letting students practice similar tasks until the teachers know that every student has understood the subject matter, may require students to map concepts or reflect upon their own knowledge and therefore may be considered constructivist instructional practices according to the TALIS conceptual framework.

As stated in the introduction of this work, research suggest that a good balance of teaching practices that combine constructivist and direct instructional practices is the most effective and adequate approach for effective classroom learning (Creemers, Kyriakides, & Antoniou, 2013). Identifying teachers' preferences over active and non-active teaching practices in relation to class size makes a relevant contribution to the ET2020 objectives, because it can shed light on how teaching practices may vary according to existing learning conditions. It has been suggested that having less students per class can have an impact on the amount of time and attention teachers give to students individually and the quality of students' interaction among themselves (OECD, 2012). Although there is limited evidence to support the notion that smaller classes increase students' achievement, some studies suggest that smaller classes allow for a shift in teaching strategies that can favor students' learning outcomes (Hattie, 2013).

1.3.2. Education-related factors examined in TALIS and the identified relationships with the three active teaching practices.

1.3.2.1. Classroom context.

The teacher's questionnaire 2013 asked teachers to indicate in a five-point Likert scale the percentage (i.e. none; 1% to 10%; 11% to 30%; 31% to 60%; more than 60%) of students in the target class being:

- Low academic achievers
- Students with special needs
- Students with behavioral problems
- Students from socioeconomically disadvantaged homes
- Academically gifted students

According to TALIS 2013 international report, teachers who report having higher proportions of gifted students tend to also report using active teaching practices frequently in their classrooms while teachers who report having higher proportions of low academic achieving students do not tend to report using active teaching practices frequently. In some specific countries (i.e. Finland, France, Israel, Japan, Norway and Flanders [Belgium]) teachers who report having higher proportions of students with special needs in their classrooms tend to report using active teaching practices frequently, in particular, ICT for projects or class work.

1.3.2.2. Classroom disciplinary climate.

The teacher's questionnaire 2013 asked teachers to indicate in a four-point Likert scale (from strongly disagree to strongly agree) how much they agreed or disagreed with four statements relating to the learning atmosphere in the target class:

- When the lesson begins, I have to wait quite a long time for students to quiet down
- Students in this class take care to create a pleasant learning atmosphere
- I lose quite a lot of time because of students interrupting the lesson
- There is much disruptive noise in this classroom

Classroom disciplinary climate had the strongest association with teachers' reported frequency of use of the three active teaching practices among all the education-related factors surveyed in TALIS 2013 international report. Analyses examining this link revealed that teachers that reported better classroom disciplinary climate reported also more frequent use of two out of the three active teaching practices surveyed in TALIS (i.e. practices involving small group work and use of ICT for projects) in almost all countries. Nevertheless, frequent use of projects requiring more than one week to complete has a positive relationship with disciplinary climate in fewer countries.

1.3.2.3. Learning domains: Mathematics, Science and Humanities.

According to the TALIS 2013 international report the subject field taught by the teacher is related to his/her choice of teaching practices used in the classroom. For instance, regarding making students work in small groups to come up with a joint solution to a problem or task, Mathematics, Science and Humanities teachers in many countries (i.e. Australia, Bulgaria, Chile, Croatia, Czech Republic, France, Korea, Netherlands, Poland, Portugal, Serbia, Singapore, Slovak Republic, Spain or Belgium) do not tend to report using this active teaching practice frequently or in all or nearly all lessons. However, Iceland and Abu Dhabi are exceptions with a large number of Mathematics and Science teachers that report using this practice often. In the case of Humanities, teachers report using this active teaching practice frequently or in all or nearly all lessons in many countries (i.e. Denmark, Estonia, Iceland, Latvia, Norway, Sweden and Alberta (Canada)). Nevertheless, Humanities teachers in certain countries or economies report not using this practice often (i.e. Australia, Croatia, France, Israel, Korea, Mexico, Netherland, Poland, Portugal and Spain).

With regard to the active teaching practice of having students work on projects that take at least one week to complete, Mathematics, Science and Humanities teachers report not using this practice very often. Lastly, Mathematics and Science teachers in Denmark and Norway tend to significantly report making students use ICT for projects or class work frequently or in all or nearly all lessons, and this is also true for Humanities teachers in Australia, Denmark, Iceland, Norway, Sweden and Ablberta (Canada). Nevertheless, Mathematics, Science and Humanities teachers in many countries or economies tend to report not making students use ICT for projects or class work frequently or in all or nearly all lessons (i.e. Bulgaria, Croatia, France, Japan, Korea, Mexico, Portugal, Romania, Serbia, Singapore, Slovak Republic, Spain, England (United Kingdom) and Flanders).

1.3.2.4. Class size.

Over the last decade, a decrease in the number of students per class in primary and lower secondary levels across OECD countries has been observed (OECD, 2014c). However, large differences in lower secondary education class sizes still remain across OECD countries, varying from less than 20 students per class (i.e. Iceland, Slovenia, Luxembourg, United Kingdom, Estonia and Switzerland) to over 30 students per class (i.e. Chile, Japan, Korea, Indonesia and China). There is a long and ongoing debate on the cost-effectiveness of class size and how class size may relate to students' achievement has become a matter of concern for educational policy over recent years (see Woessmann, 2006 for a review). Empirical evidence suggesting that students in smaller classes show better performance across school subjects, better engagement and that small-size class advantages exist and even remain in the subsequent school years comes from the Project Student-Teacher Achievement Ratio (STAR). STAR was a large-scale study aimed at examining the effects of class sizes on different student outcomes (Finn & Achilles, 1990). However, some researchers draw attention to the fact that the added value of small class sizes in terms of academic gains is small or even null (Hanushek, 2003), or have found that only specific sub-populations of students, such as those from disadvantaged backgrounds, benefit from being in smaller classes (Jepsen & Rivkin, 2002, 2009; Krueger, 2003; Krueger & Whitmore, 2001), that gains occur only at certain school levels (Krueger, 1999) or that these gains are not long-lasting (Doss & Holley, 1982). Hence, controversy with regard to the extent to which smaller classes positively influence performance still remains (Angtist & Lavy, 1999; Hoxby, 2000, Hanushek, 1999; Woessmann & West, 2006). Despite the efforts made in a large number of countries to reduce the number of students per class, class size continues to be a controversial issue among educational policy-makers and practitioners.

Nonetheless, it has been suggested that having a small number of students in class is associated with a more frequent use of innovative teaching practices (Hattie, 2013). According to the TALIS 2013 international report, certain teaching practices are related to the size of the class, although this is only true for certain teaching practices and only in some OECD countries. For instance, teachers with a large number of students in the class tend to report less use of practices involving small group work throughout the year in their classrooms in the Czech Republic, France, Israel, Korea and Poland. Having a large number of students in their classroom is associated with a more frequent use of ICT for projects in countries such as Denmark, Estonia, Israel, Latvia and Sweden.

Chapter 2

This chapter first provides an overview of the current study. The second part describes in detail the methodology used to analyze the relationships between class-size and teaching practices. The results section is divided in two parts. First, it presents the results for the active teaching practices. Second, it presents the findings for the non-active teaching practices surveyed in TALIS 2013. Finally, this chapter includes concluding remarks regarding the findings.

2. Active and non-active teaching practices in EU and their relationship with different class sizes

2.1. A Brief Introduction to this Chapter: Methodology, Results and Discussion of the Findings

This chapter first presents a description of the methodology used to explore the relationship between teachers' preferences for the use of particular active and non-active teaching practices throughout the year and their relationships with the size of the class they teach. A new categorical variable for class size, where classes are categorized as small, average or large at the country level was produced for the current study to explore overall patterns for these relationships among the eight teaching practices surveyed in TALIS 2013. For ease of data display and discussion of the findings, data for the three active teaching practices is first presented and discussed and then data for the non-active teaching practices is presented and discussed in different sub-sections. The reported frequency of use throughout the year as reported by teachers for each teaching practice is first discussed individually. Then, for each particular practice, the differences among teachers' choices regarding the use of each teaching practice in the participating 18 EU MS in relation to class size are described, highlighting statistically significant results. Finally, concluding remarks with respect to the findings are presented.

2.2. Aims

This chapter aims to describe, compare and contrast the frequency of using specific instructional practices across countries as reported by teachers, and its relationship with the size of the class they teach using country-specific criteria. Research in this area is crucial for educational policy for three main reasons:

1. Empirical research has shown that instructional practices consistently predict students' learning outcomes over and above other teachers' characteristics such as their background qualifications or their beliefs and attitudes (Kyriakides, Campbell, & Gagatsis, 2000; Nye, Konstanopoulos, & Hedges, 2004; Mujis & Reynolds, 2002; Palardy & Rumberger, 2008; Scheerens & Bosker, 1997; Stigler & Hiebert, 1999).

2. Teachers' instructional practices (and beliefs) were rated as a priority theme to be included for examination in TALIS by the 25 OECD countries that participated in this rating[101], obtaining a second place (following school leadership) in the overall ranking.

3. The TALIS 2013 international report indicates that the frequency with which teachers use different types of teaching practices varies across countries and is differently related to the size of the class they teach.

4. There are differences in the number of students per class in lower secondary education across OECD countries and in the EU MS varying from less than 20 to over 30 students per class.

Therefore, there is a converging interest in examining and further understanding how teachers' instructional practices (and their associated opportunities for learning) relate to classroom learning conditions. As such, the following chapter provides an in-depth examination of teachers' use of distinct teaching practices surveyed in TALIS 2013 and their relationship with the size of the class teachers teach. This is addressed by categorizing class size at the country level in small, average or large classes. Because TALIS does not assess students' performance, these chapters cannot establish any relationship between teachers' preferences over specific teaching practices in relation to the size of their classes and their students' achievement. Instead, the focus is on providing new insights on how class size might be related to teachers' instructional choices.

2.3. Methodology

Across countries where data is available, the average lower secondary school class size in OECD countries is 24, and 28 for G20 countries[102] (OECD, 2014c). In TALIS 2013 teachers were asked to report the number of students currently enrolled in the target class. In the TALIS 2013 international report the average class size was calculated by obtaining the mean of the class sizes reported by the individual teacher using the final teacher estimation weight. The average class size in lower secondary education across the 18 EU MS that participated in TALIS 2013 is 21

[101] OECD countries and economies that completed the priority rating included Australia, Austria, Belgium (Fl.), Belgium (Fr.), Canada, Korea, Czech Republic, Denmark, Estonia Finland, France, Iceland, Ireland, Italy, Luxembourg, Mexico, Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Turkey, United Kingdom and United States.

[102] G20 countries are: Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Korea, Mexico, the Russian Federation, Saudi Arabia, South Africa, Turkey, the United Kingdom and the United States; the European Union is the 20th member of the G20 but is not included in the calculation.

students per class. Although the educational effects of smaller class sizes have been a key issue for policy-makers and educational practitioners, there is still a lack of agreement on how many students per class correspond to a "small class". Currently, large differences in lower secondary education class sizes still remain across OECD countries, varying from less than 20 students per class (i.e. Iceland, Slovenia, Luxembourg, United Kingdom, Estonia and Switzerland) to over 30 students per class (i.e. Chile, Japan, Korea, Indonesia and China). CRELL categorized the variable class size into three main groups for each country: small class size (comprising the 10% smaller classes reported by teachers in the country), large class size (comprising the 10% larger classes reported by teachers in the country) and average class size (comprising the 80% of classes not falling into either the small- or the large-size category). This categorization was previously applied by OECD in an Education at a Glance report (OECD, 2012) with the aim of grasping the extent of the variation among class sizes in each country. CRELL followed the same approach to describe, compare and contrast the frequency of teachers' reported use of the distinct teaching practices across the 18 participating EU MS. While allowing for comparisons, this categorization uses country class sizes as a reference point, instead of an international average. By using country-specific criteria to categorize class size we can better grasp variations within countries and across countries.

Table 1 displays the number of cases, number of teachers to which the samples population corresponds to and range, mean and standard deviation for each class size category obtained for each country and for the EU 18 average included in the analyses.

Table 1. List of TALIS 2013 countries displaying the number of cases (n), teachers' weight values applied (TCHWGT), range, standard deviation (SD) and mean number of students for small, average and large classes

MS	N	Number of teachers to which the samples population corresponds to	Small class		Average class		Large class	
			range	mean (SD)	range	mean (SD)	range	mean (SD)
BG	2,828	25,307	1-13	11 (2)	14-27	23 (3)	28-36	29 (1)
HR	3,054	13,933	1-12	8 (3)	13-25	20 (3)	26-85	27 (4)
CZ	3,010	35,116	1-13	10 (3)	14-29	21 (4)	30-70	31 (3)
DK	1,413	21,026	1-16	14 (3)	17-25	21 (2)	26-75	30 (8)
EE	2,615	6,444	1-8	6 (2)	9-25	16 (5)	26-90	30 (8)
FI	2,289	15,289	1-11	8 (3)	12-22	17 (3)	23-95	31 (16)
FR	2,592	170,651	1-20	17 (4)	21-29	26 (2)	30-37	31 (1)
IT	2,650	140,558	1-16	13 (4)	17-26	22 (3)	27-80	29 (4)
LV	1,920	11,643	1-8	6 (2)	9-27	18 (5)	28-90	31 (9)
NL	1,506	44,026	1-20	16 (5)	21-29	26 (2)	30-60	32 (5)
PL	3,341	115,140	1-13	11 (2)	14-27	22 (4)	28-89	30 (5)
PT	3,419	41,903	1-16	13 (3)	17-28	23 (3)	29-80	30 (4)
SK	2,996	22,997	1-11	8 (3)	12-25	19 (4)	26-93	29 (6)
ES	2,889	177,444	1-13	10 (3)	14-30	24 (5)	31-90	36 (12)
ENG-UK	1,975	168,599	2-15	11 (4)	16-30	25 (4)	31-94	34 (11)
BE	2,556	16,092	1-10	7 (3)	11-23	17 (4)	24-65	26 (6)
RO	2,668	55,466	1-14	10 (4)	15-29	23 (4)	30-90	32 (5)
SE	2,329	20,910	1-11	7 (0)	12-28	20 (4)	29-95	41 (18)
EU 18			1-13	10 (3)	14-27	21 (4)	28-95	31 (7)

Source: CRELL analysis based on TALIS 2013 data.

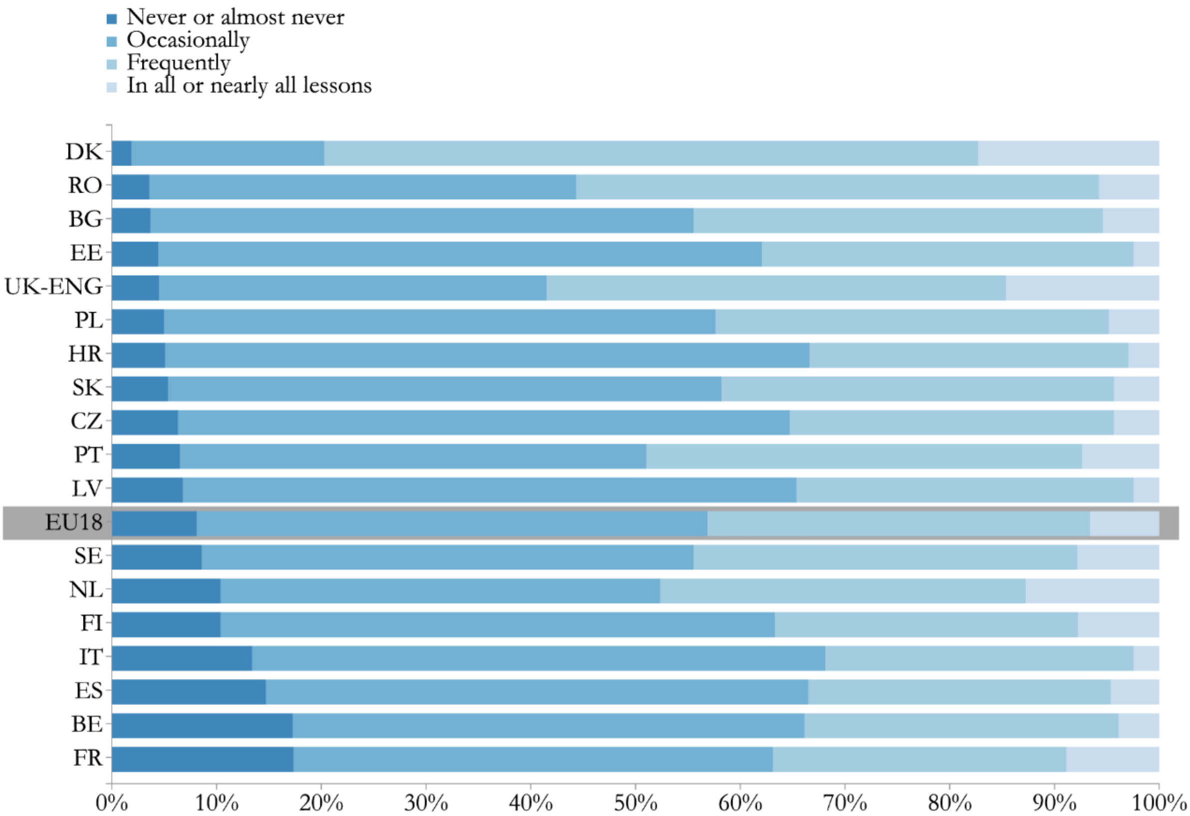
2.4. Results

2.4.1. Active teaching practices.

As discussed in this chapter, three of the eight practices surveyed in TALIS are considered informative of active teaching according to the TALIS 2013 conceptual framework. The frequency with which teachers report using each of these active teaching practices and the frequency with which teachers report using each of these active teaching practices in all or nearly all lessons in relation to the size of the class they teach are presented and described below.

2.4.1.1. Students work in small groups to come up with a joint solution to a problem or task.

Graph 1. Teachers' reported frequency of making students work in small groups to come up with a joint solution to a problem or task throughout the year



Source: CRELL analysis based on TALIS 2013 data.

Graph 1 presents the frequency (in all or nearly all lessons, frequently, occasionally or never or nearly never) with which teachers make students work in small groups to come up with a joint solution to a problem or task as reported by teachers in TALIS 2013. On average, across the 18 European educational systems, the data indicates that 48.7% teachers report using this active teaching practice occasionally; 36.5% report using it frequently; 8.1% report never or nearly never using it in their lessons; and 6.6% report using it in all or nearly all lessons.

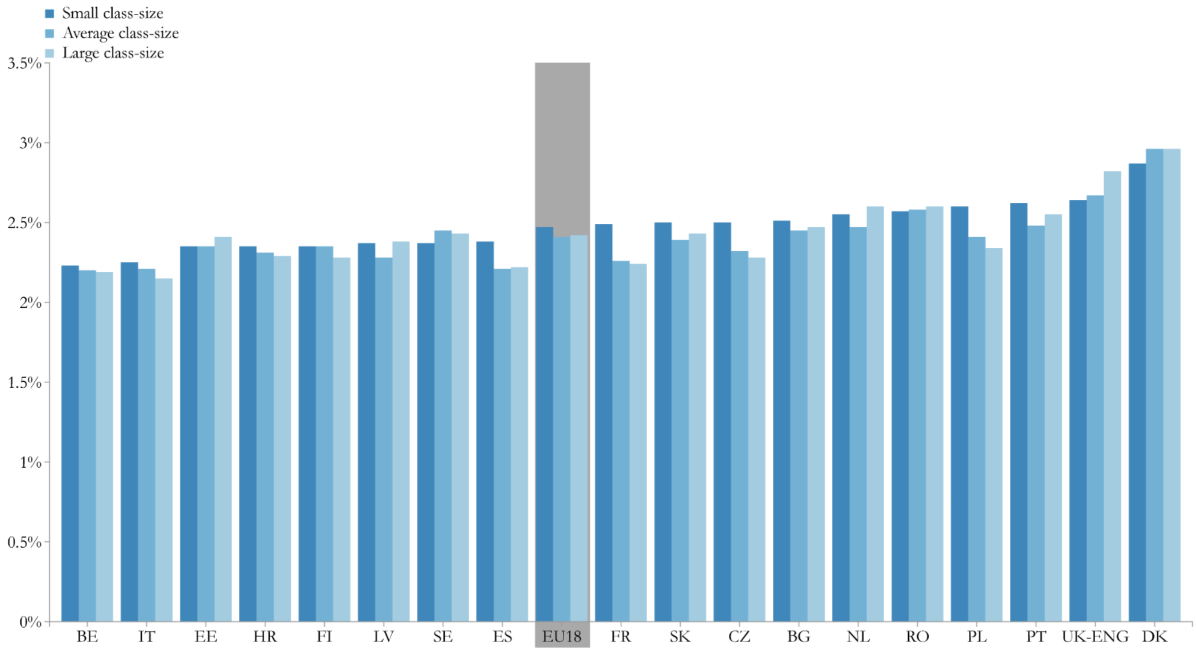
At country level, the main findings are:

- In more than half of the countries over 50% of the teachers surveyed report using this active teaching practice occasionally (i.e. Spain, Bulgaria, Poland, Slovak Republic, Finland, Italy, Estonia, Czech Republic, Latvia and Croatia).

- A high share of teachers in France and Belgium (over 17%) report to never or almost never use this active teaching practice.

- Denmark is the country where the surveyed teachers report using this active teaching practise more often, with 62.4% of teachers reporting to use it frequently and 17.2% of teachers reporting to use it in all or nearly all lessons.

Graph 2. Group chart displaying the means for the reported frequency of teachers making students work in small groups to come up with a joint solution to a problem or task in all or nearly all lessons grouped by class size (small, average or large).

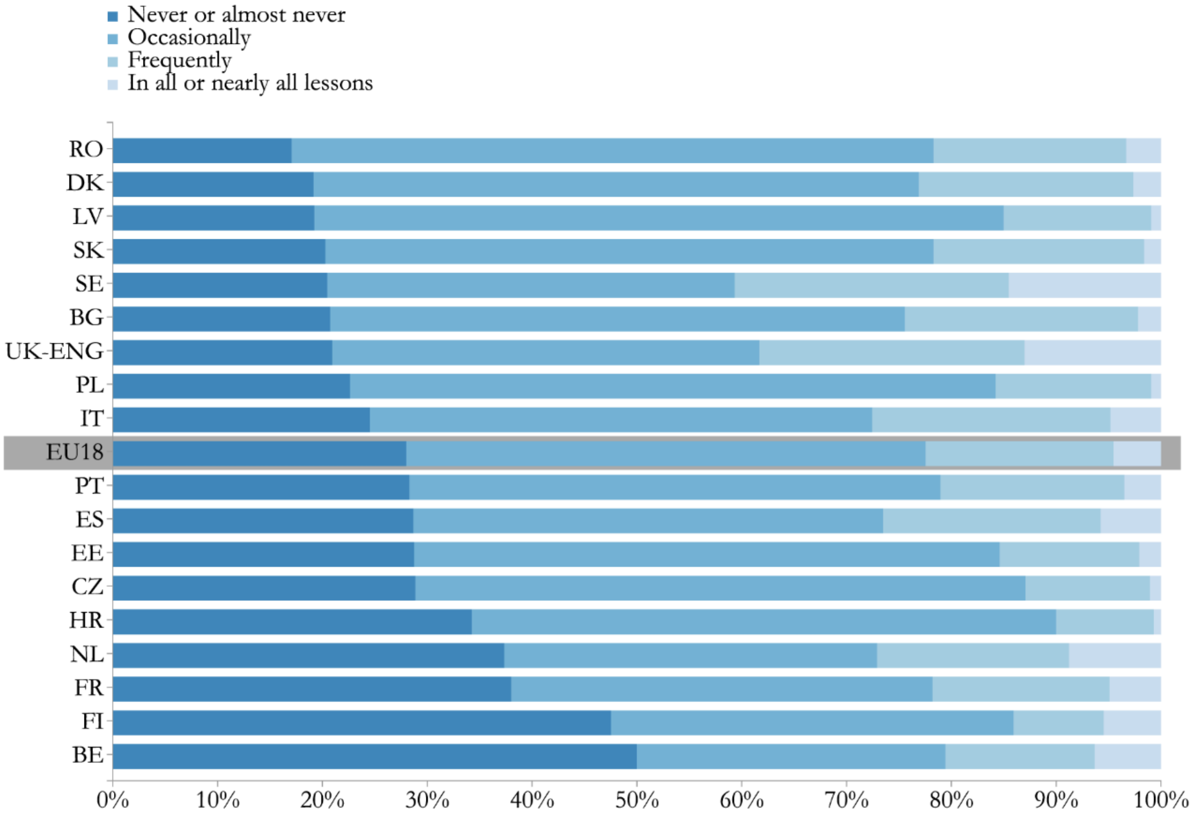


Source: CRELL analysis based on TALIS 2013 data.

Graph 2 presents the percentage of teachers making students work in small groups to come up with a joint solution to a problem or task in all or nearly all lessons grouped by class size. On average across the 18 EU participating countries, results show that teachers tend to report using this active teaching practice in all or nearly all lessons more in small-size classes than in average- or large-size classes. In particular, teachers report making students work in small groups in all or nearly all lessons in small-size classes significantly more frequently than in average-size classes in Portugal and in the Slovak Republic. In addition, in Czech Republic, France, Poland and Spain teachers report making students work in small groups in all or nearly all lessons significantly more frequently in small-size classes than in average- or large-size classes. However, in England teachers report making students work in small groups in all or nearly all lessons significantly more frequently in large-size classes than in average -size classes.

2.4.1.2. Students work on projects that require at least one week to complete.

Graph 3. Teachers' reported frequency of making students work on projects that require at least one week to complete throughout the year



Source: CRELL analysis based on TALIS 2013 data.

Graph 3 presents the frequency (in all or nearly all lessons, frequently, occasionally or never or nearly never) with which teachers make students work on projects that require at least one week to complete as reported by teachers in TALIS 2013. On average, across the 18 European educational systems, the data indicates that 49.8% of teachers report using this active teaching practice occasionally, while 28.2% report never or nearly never using it, 18% report using it frequently, 4.6% report using it in all or nearly all lessons.

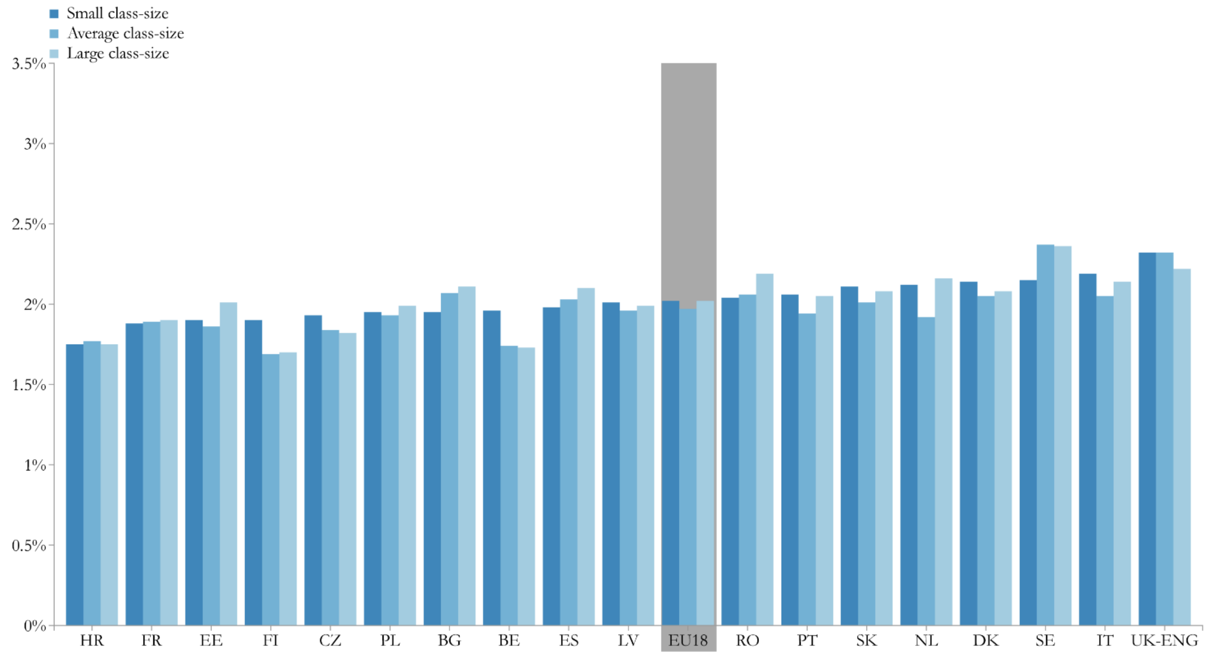
At country level, the main findings are:

- Over 50% of the teachers surveyed in Croatia, Latvia, Poland, Czech Republic, Slovak Republic, Estonia, Bulgaria, Denmark, Romania and Portugal report using this active teaching practice occasionally.

- In the majority of the EU MS less than 5% of teachers surveyed report using this active teaching practice in all or nearly all lessons (i.e. Croatia, Latvia, Poland, Czech Republic, Slovak Republic, Estonia, Bulgaria, Denmark, Romania, Portugal, Italy and France). Sweden is an exception with 14.5% of teachers reporting using this teaching practice in all or nearly all lessons.

- Over 20% of teachers surveyed in all countries (except for Romania, Latvia and Denmark) report to never or almost never use this active teaching practice in their classroom.

Graph 4. Group chart displaying the means for the reported frequency of teachers making students work on projects that require at least one week to complete in all or nearly all lessons grouped by class size (small, average or large).

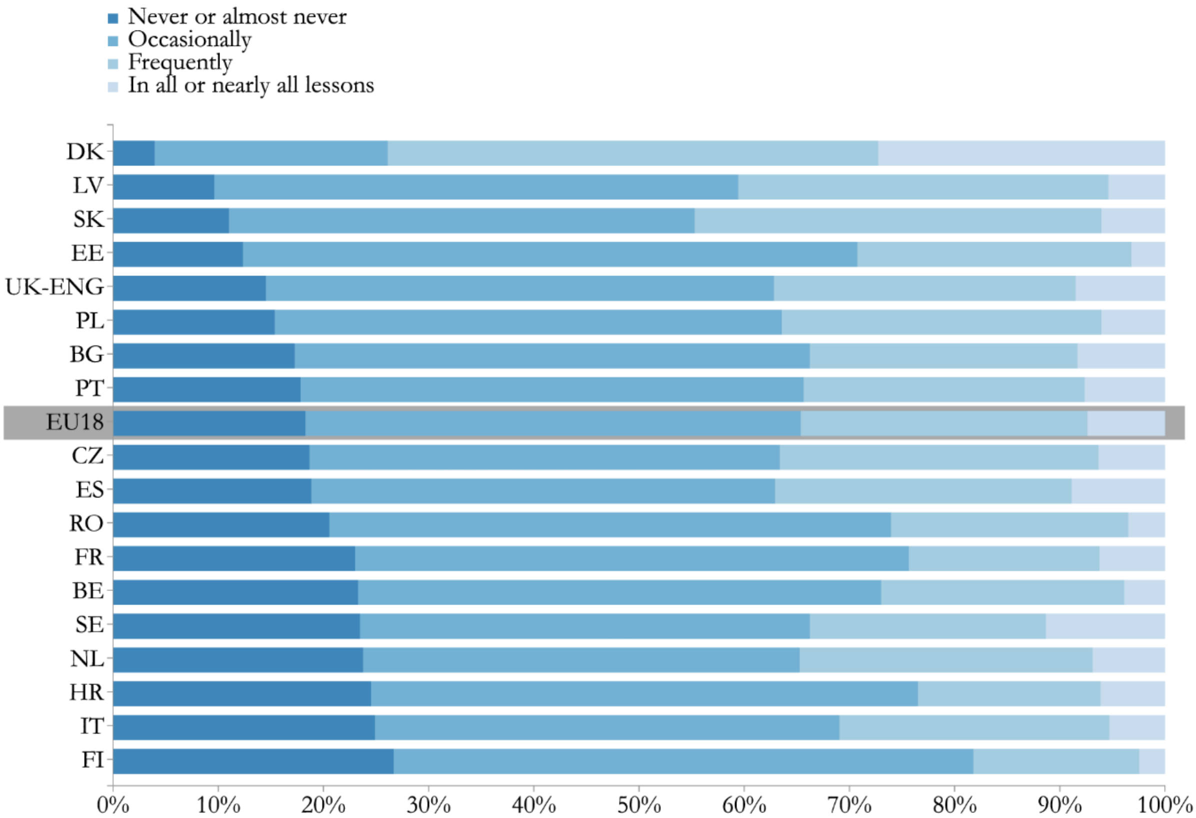


Source: CRELL analysis based on TALIS 2013 data.

Significant differences in teachers' reported frequencies in making students work on projects that require at least one week to complete were found in relation to class size across countries, with significantly more frequent use of this active teaching practice in large-size classes in comparison with average-size classes overall, but also in small classes in comparison with average-size classes overall. More precisely, teachers in Estonia, the Netherlands, Portugal and Romania working in large-size classes reported using this active teaching practice significantly more frequently than those working in average-size classes. In Czech Republic, Finland, the Netherlands, Portugal and Belgium teachers working in small-size classes reported using this active teaching practice significantly more frequently than those working on average-size classes. Teachers in Bulgaria and Sweden working in large-size classes reported making students work on projects that require at least one week to complete significantly more frequently than teachers in small-size classes did, while in Belgium the opposite pattern was found.

2.4.1.3. Students use ICT for projects or class work.

Graph 5. Teachers' reported frequency of making Students use ICT for projects or class work throughout the year



Source: CRELL analysis based on TALIS 2013 data.

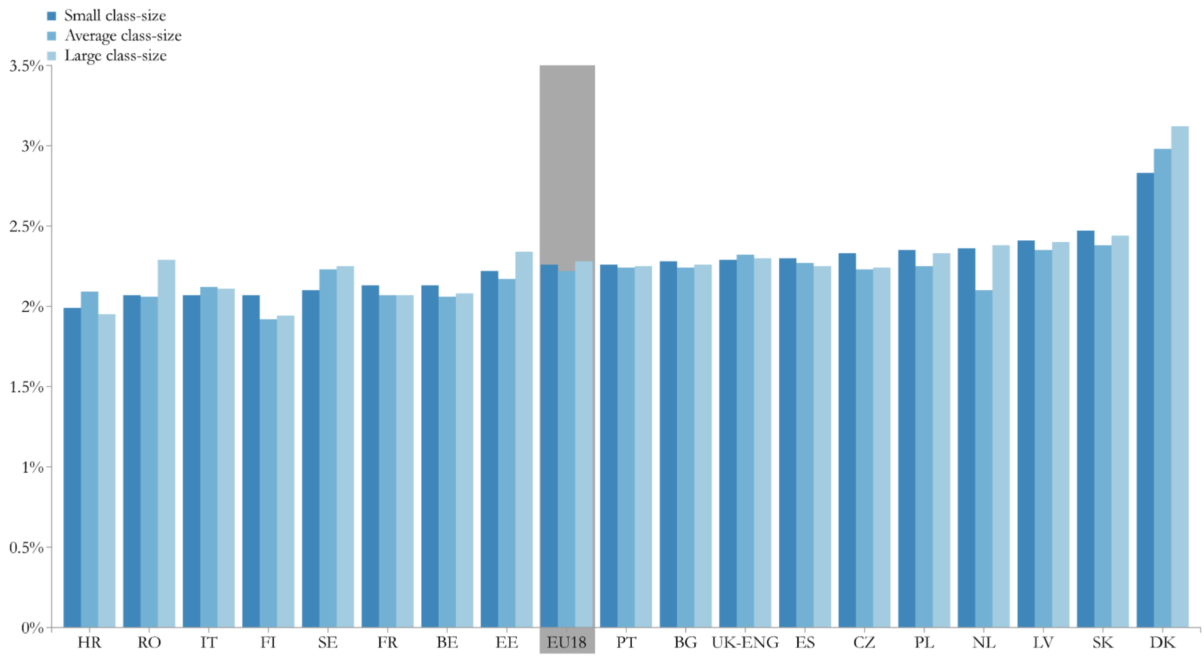
Graph 5 presents the frequency (in all or nearly all lessons, frequently, occasionally or never or nearly never) with which teachers make students use ICT for projects or class work as reported by teachers in TALIS 2013. On average, across the 18 European educational systems, the data indicates that 47.4% of teachers report using this teaching practice occasionally, while 27.4% report using it frequently, 18% reporting to never or nearly never use it and 7.2% report using it in all or nearly all lessons.

At country level, the main findings are:

- A large percentage of teachers surveyed in Denmark (27.3%) report using this active teaching practice in all or nearly all lessons while in the rest of the surveyed countries the percentage of teachers that report using this active teaching practice in all or nearly all lessons does not reach the 10% or very close to this percentage (i.e. 11.3% of teachers in Sweden).

-Over 20% of teachers in many countries report to never or almost never use this active teaching practice in their lessons (i.e. Romania, France, Belgium, the Netherlands, Croatia, Italy, Finland and Sweden).

Graph 6. Group chart displaying the means for the reported frequency of teachers making students use ICT for projects or class work in all or nearly all lessons grouped by class size (small, average or large).



Source: CRELL analysis based on TALIS 2013 data.

Significant differences in teachers' reported frequencies regarding making students use ICT for projects or class work were observed across countries, with teachers working with small-size classes report using ICT significantly more frequently than those working in average-size classes but with teachers working in large-size classes report using ICT significantly more frequently than those in average-size classes. More precisely, teachers working in large-size classes reported using this active teaching practice more frequently than those working in average-size classes in Estonia, the Netherlands, Poland and Romania. In addition, in Czech Republic, Finland and the Netherlands teachers working in small-size classes reported using this active teaching practice significantly more frequently than those working on average-size classes. Lastly, teachers in Denmark and Estonia reported using the practice of working on projects that require at least one week to complete significantly more frequently in large-size classes than in small-size classes.

Highlights

- Roughly 50% of the surveyed teachers in the 18 EU MS report using the tree active teaching practices surveyed in TALIS 2013 - making students work in small groups, making students work on projects that require at least one week to complete and use ICT for projects or class work - occasionally in their classes throughout the year. Denmark stands out as the country where teachers tend to report using active teaching practices more often in their classrooms.

- Across the 18 EU MS surveyed in TALIS 2013 teachers tend to report making students work in small groups to come up with the solution to a problem or task and to make them use ICT for projects or class work quite frequently, while a large percentage of surveyed teachers report to never or almost never make students work in projects that require at least one week to complete.

- Teachers across the 18 EU MS tend to opt for the use of the active teaching practice of making students work in small groups to come up with a joint solution to a problem or task in all or nearly all lessons when they work in small-size classes.

- Making students work on projects that require at least one week to complete or use ICT for projects or classwork are active teaching practices that teachers tend to use in all or nearly all lessons when teaching small-size classes (i.e. Czech Republic, Finland and the Netherlands) or in large-size classes (i.e. Estonia, the Netherlands and Romania), but not in average-size classes.

2.4.1.4 Conclusion and discussion.

The ET2020 establishes as priorities the increase of basic skills' levels among students and the assurance of high quality teaching in the EU. One of the four strategic objectives included in ET2020 specifically refers to the need of enhancing creativity and innovation at all levels of education and training. These Council conclusions stress the importance of transversal skills acquisition such as digital competence and learning to learn. The three active teaching practices surveyed in TALIS 2013 provide useful information on teachers' use of innovative and creative activities in the classroom across EU MS. We know from TALIS 2013 international report that classroom disciplinary climate (the amount of noise, interruptions, learning atmosphere and the time it takes for students to quiet down during lessons) is strongly related to teachers' use of small groups or ICT in their classrooms. For almost all countries a more positive classroom climate is associated with teachers' use of small groups and ICT. CRELL results suggest that the majority of teachers in the educational systems examined in this study report an "occasional" use of these practices overall. We also show that across the 18 EU MS there is a preference among teachers for specific teaching practices in relation to the size of their class, although exceptions are always present for specific countries.

The current results suggest that teachers' preferences in the use of practices that motivate students to interact with each other, to actively participate in open discussions and to use ICT may be influenced by country-specific characteristics. Although facilities to access ICT resources have been made in most European countries over the last years, it seems that having access to ICT resources in schools is not a sufficient strategy. This may also apply to the use of other innovative practices for which teachers may need assistance, especially in integrating innovative pedagogical approaches in their teaching repertoire. How the use new technologies and other novel pedagogical strategies can be successfully implemented in the classrooms to support student learning should further consider in educational policy.

According to TALIS 2013 international report, more than a third of EU teachers do not receive formative induction courses. These initial programmes assist teachers with the acquisition of crucial skills enabling them to deliver high quality teaching. Given the existing research evidence associating the use of active teaching practices with better students' outcomes (Dunlosky et al., 2013; Johnson & Johnson, 2009), educational policies should include how to use and implement these specific teaching practices in the classrooms and ensure that teachers are receiving the appropriate training to understand how these practices can enhance learning and to use them appropriately. Although in many EU countries the use of innovative practices is suggested in official documents, there are still countries where no specific recommendation on the use of teaching practices are made to teachers (Ranguelov, Horvath, Dalferth, & Noorani, 2011). The European Commission has highlighted the need to support teachers with adequate induction and training.

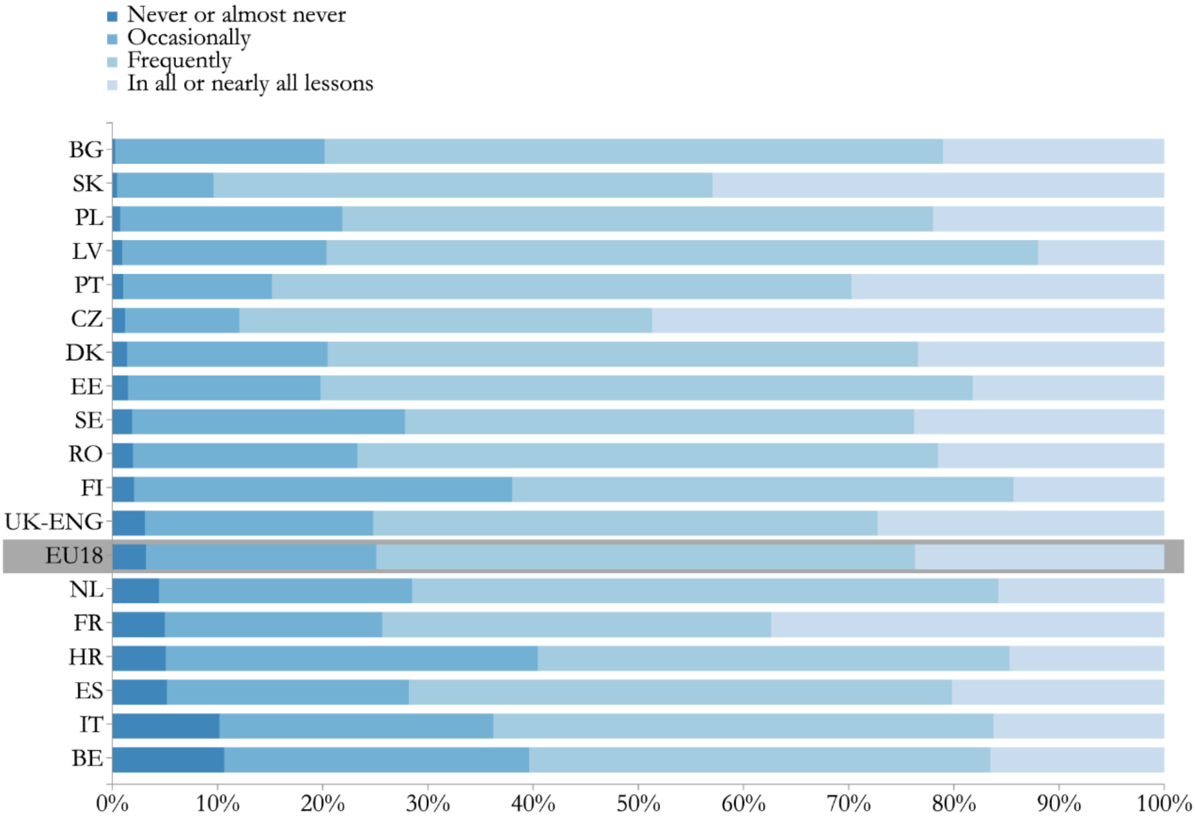
2.4.2. Non-active teaching practices.

As discussed in these chapters, non-active teaching practices are the five practices not identified as active practices among the eight practices surveyed in TALIS 2013 teachers' questionnaire. These are:

- I present a summary of recently learned content
- I give different work to the students who have difficulties learning and/or to those who can advance faster
- I refer to a problem from everyday life or work to demonstrate why new knowledge is useful
- I let students practice similar tasks until I know that every student has understood the subject matter
- I check my students' exercise books or homework

2.4.2.1. I present a summary of recently learned content.

Graph 7. Teachers' reported frequency of presenting a summary of recently learned content throughout the year



Source: CRELL analysis based on TALIS 2013 data.

Graph 7 presents the frequency (in all or nearly all lessons, frequently, occasionally or never or nearly never) with which teachers presenting a summary of recently learned content as reported by teachers in TALIS 2013. On average, across the 18 European educational systems, the data indicates that 51.4% of teachers report using this non-active teaching practice frequently, while 23.6 report using it in all or nearly all lessons, 21.7% report using it occasionally and just a 3.3% reporting to never or nearly never use it in their lessons.

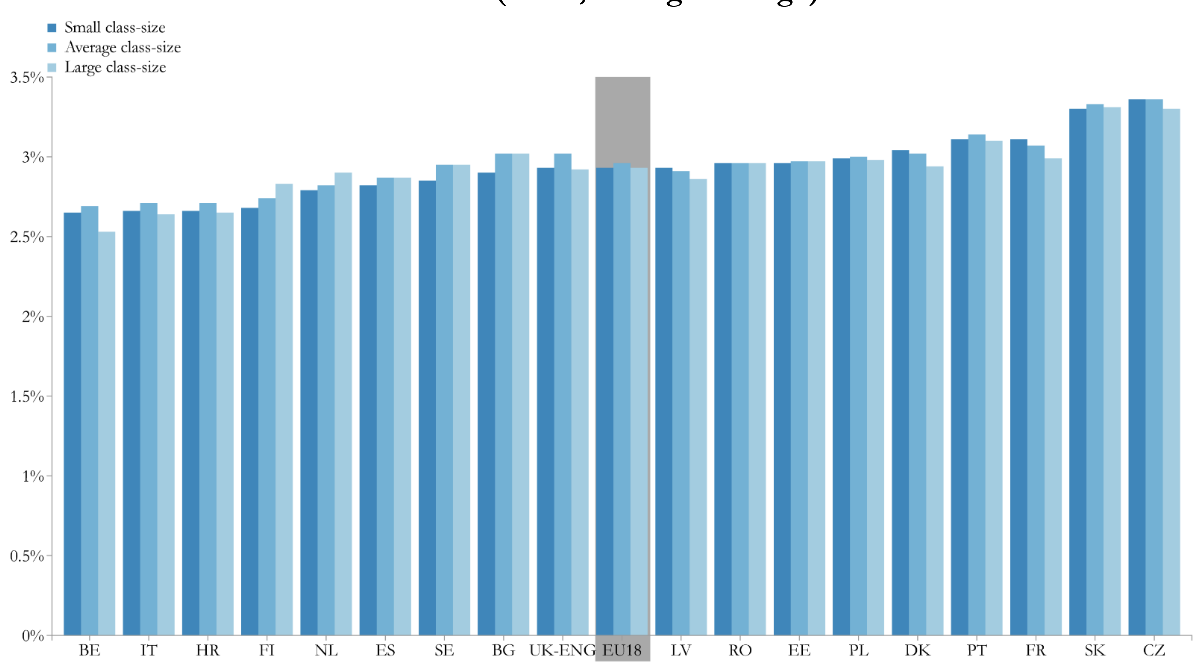
At country level, the main findings are:

- In more than half of the EU MS over 50% of the teachers surveyed report using this non-active teaching practice frequently (i.e. Spain, Portugal, Romania, the Netherlands, Denmark, Poland, Bulgaria, Estonia and Latvia).

- In Czech Republic, Slovak Republic and France over 35% of teachers report using this non-active teaching practice in all or nearly all lessons.

-Belgium and Italy have the higher share of teachers reporting not using this non-active teaching practice in their lessons with over 10% of teachers reporting to never or almost never presenting a summary of recently learned content.

Graph 8. Group chart displaying the means for the reported frequency of teachers presenting a summary of recently learned content in all or nearly all lessons grouped by class size (small, average or large).

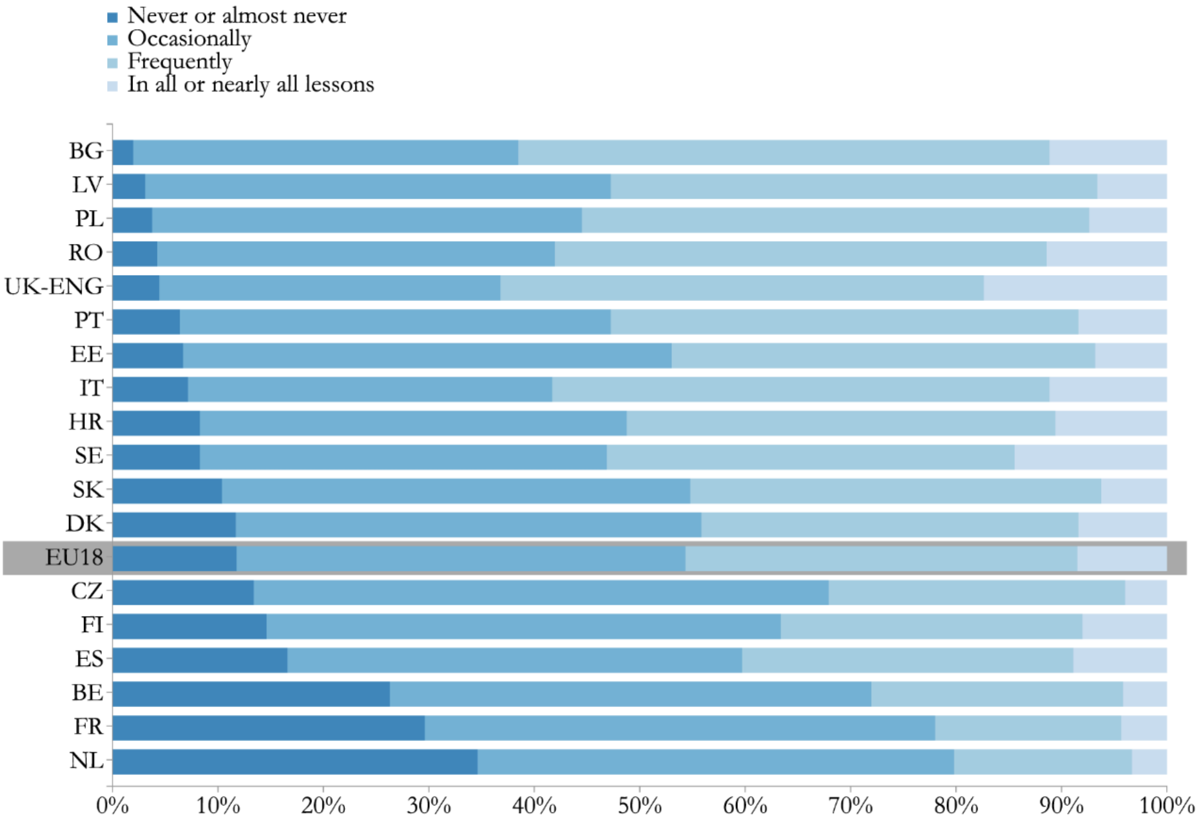


Source: CRELL analysis based on TALIS 2013 data.

Teachers' reported frequencies regarding presenting a summary of recently learned content in relation to the size of the class they teach in varied across very few countries. In Belgium, teachers working in large-size classes reported using this teaching practice significantly less frequently than those working in average-size classes. In Bulgaria teachers working in average-size classes reported using this teaching practice more frequently than teachers working in small-size classes. In Finland teachers working in large-size classes reported using this teaching practice significantly more frequently than those in small-size classes.

2.4.2.2. I give different work to the students who have difficulties learning and/or to those who can advance faster.

Graph 9. Teachers' reported frequency of giving different work to the students who have difficulties learning and/or to those who can advance faster throughout the year



Source: CRELL analysis based on TALIS 2013 data.

Graph 9 presents the frequency (in all or nearly all lessons, frequently, occasionally or never or nearly never) with which teachers give different work to the students according to their abilities as reported by teachers in TALIS 2013. On average across the 18 EU participating countries, 42.6% of teachers report using this non-active teaching practice occasionally, while 37.2% of teachers report using it frequently, 11.8% report to never or nearly never use it and 8.5% report using it in all or nearly all lessons.

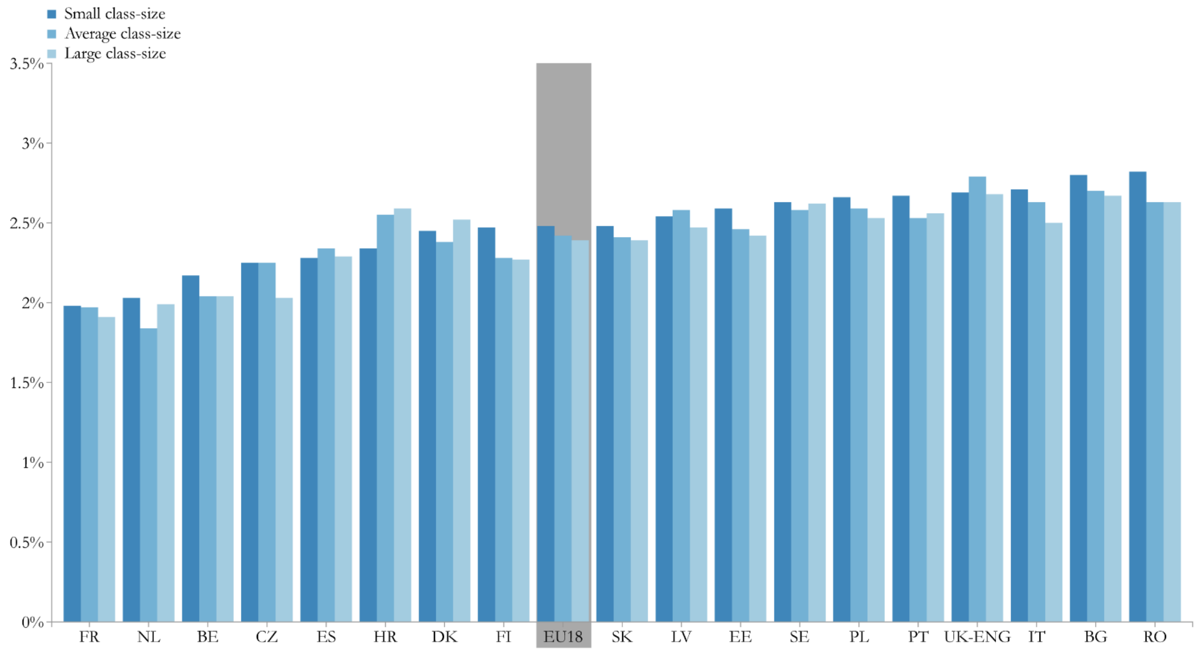
At country level, the main findings are:

- In the majority of the EU MS surveyed over 40% the teachers surveyed report using this non-active teaching practice occasionally (i.e. Croatia, Poland, Portugal, Spain, Denmark, Latvia, Slovak republic, the Netherlands, Belgium, Estonia, France and Finland) and reaching over 50% in Czech Republic.

-Only in five of the surveyed countries (i.e. United Kingdom-England, Italy, Bulgaria, Romania, Croatia and Sweden) over 10% of the surveyed teachers report using this non-active teaching practice in all or nearly all lessons.

-Over 25% of the teachers surveyed in Belgium, France and the Netherlands report to never or almost never use this non-active teaching practice.

Graph 10. Group chart displaying the means for the reported frequency of teachers giving different work to the students who have difficulties learning and/or to those who can advance faster in all or nearly all lessons grouped by class size (small, average or large).

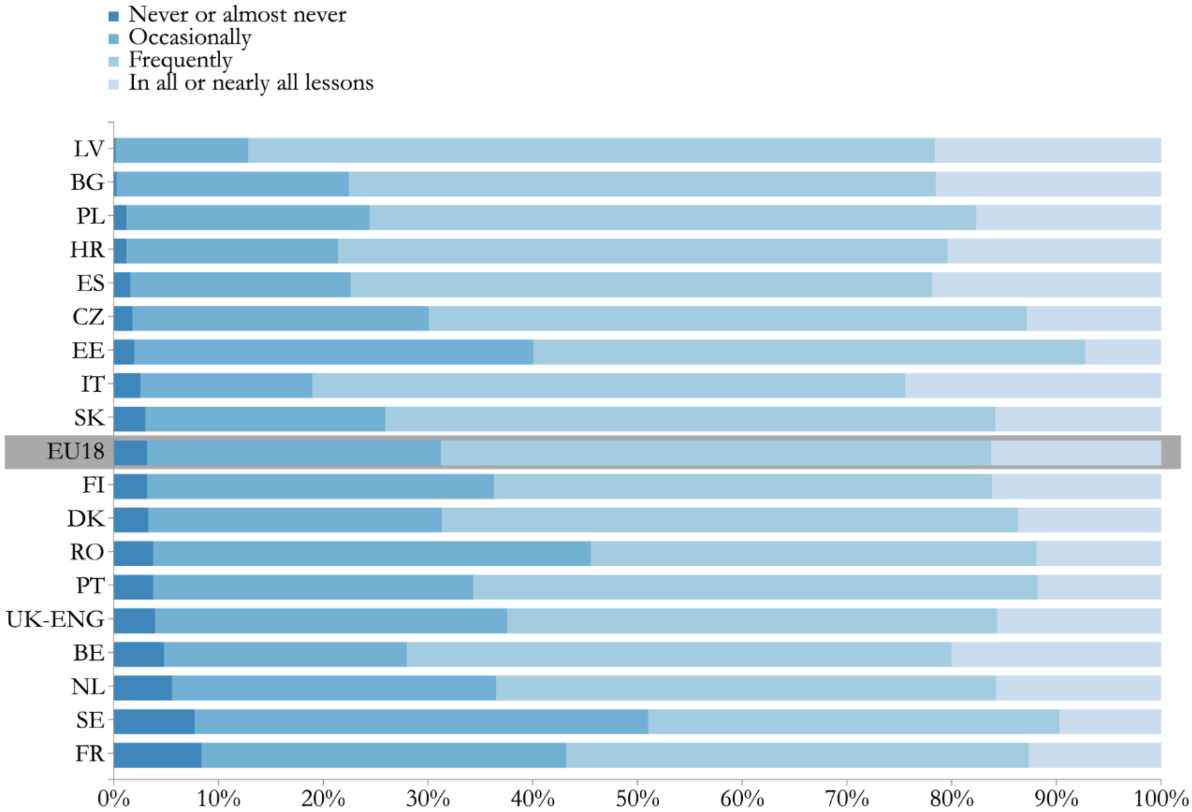


Source: CRELL analysis based on TALIS 2013 data.

Significant differences in the frequency with which teachers reported giving different work to the students who have difficulties learning and/or to those who can advance faster in relation to the size of the class they teach were observed across many countries. Teachers working with small-size classes reported using this teaching practice significantly more frequently than those working in average-size or large-size classes and teachers working in average-size classes reported using this teaching practice significantly more frequently than those working in large-size classes overall. This pattern of frequency reached statistical significance in countries such as Estonia, Finland and Romania, although the opposite pattern was observed in Croatia. Teachers working in average-size classes reported using this teaching practice significantly more frequently than those working in large-size classes overall, this particular pattern reached statistical significance in Czech Republic and Italy, while in Denmark the opposite pattern was found. In addition, in the Netherlands, Portugal and Belgium teachers working with small-size classes reported using this teaching practice significantly more frequently than those working in average-size classes.

2.4.2.3. I refer to a problem from everyday life or work to demonstrate why new knowledge is useful

Graph 11. Teachers' reported frequency of referring to a problem from everyday life or work to demonstrate why new knowledge is useful throughout the year



Source: CRELL analysis based on TALIS 2013 data.

Graph 11 presents the frequency (in all or nearly all lessons, frequently, occasionally or never or nearly never) with which teachers refer to a problem from everyday life or work to demonstrate why new knowledge is useful as reported by teachers in TALIS 2013. On average across the 18 EU participating countries, 52.6% of teachers report using this non-active teaching practice frequently, while 28% report using it occasionally, 16.2% report using it in all or nearly all lessons and just 3.2% report to never or nearly never use it in their lessons.

At country level, the main findings are:

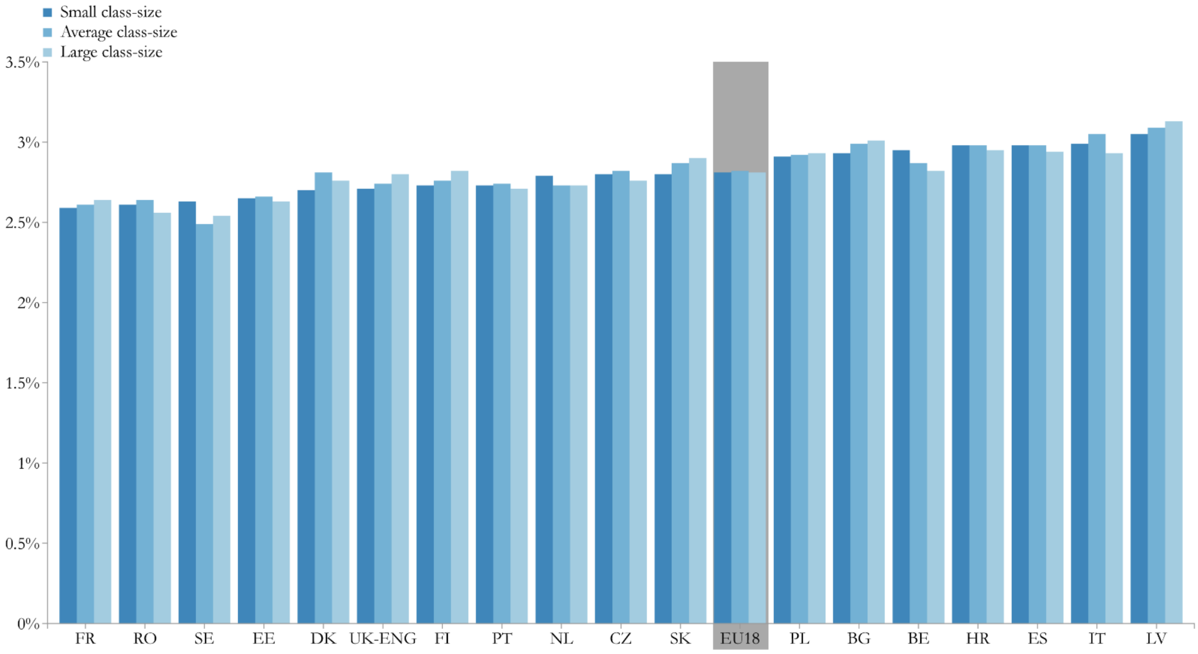
- Over 65% of teachers in Latvia report using this non-active teaching practice frequently.

- For all EU MS surveyed, the percentage of teachers reporting to never or almost never using this non-active teaching practice does not reach 10%.

- For the vast majority of countries over 10% of the teachers surveyed report using this non-active teaching practice in all or nearly all lessons.

- Over 20% of the teachers surveyed in Belgium, Croatia, Bulgaria, Latvia, Spain and Italy report to refer to a problem from everyday life or work to demonstrate why new knowledge is useful in all or nearly all lessons.

Graph 12. Group chart displaying the means for the reported frequency of teachers referring to a problem from everyday life or work to demonstrate why new knowledge is useful in all or nearly all lessons grouped by class size (small, average or large).

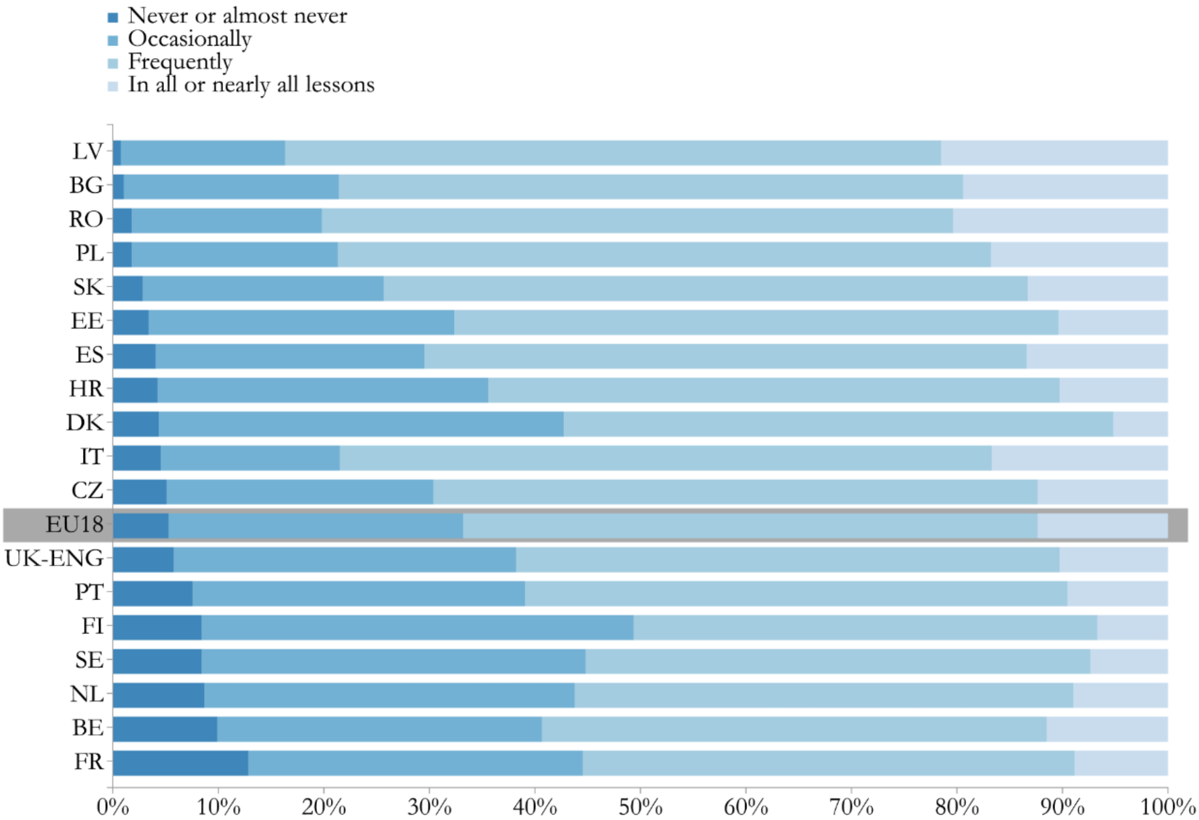


Source: CRELL analysis based on TALIS 2013 data.

Significant differences in the frequency with which teachers reported referring to a problem from everyday life or work to demonstrate why new knowledge is useful in relation to the size of the class they teach were observed across very few countries, with no statistically significant differences overall. Nevertheless, teachers working with large-size classes reported using this teaching practice significantly more frequently than those working in small-size classes in Slovak Republic. In Belgium, teachers working with small-size classes reported using significantly more frequently than those working in large-size classes. In addition, teachers working with average-size classes in Italy reported using this teaching practice significantly more than those working in large-size classes.

2.4.2.4. I let students practice similar tasks until I know that every student has understood the subject matter.

Graph 13. Teachers' reported frequency of letting students practice similar tasks until they know that every student has understood the subject matter throughout the year



Source: CRELL analysis based on TALIS 2013 data.

Graph 13 presents the frequency (in all or nearly all lessons, frequently, occasionally or never or nearly never) with which teachers let students practice similar tasks until they know that every student has understood the subject matter as reported by teachers in TALIS 2013. On average across the 18 EU MS participating countries, 54.5% of teachers report using this non-active teaching practice frequently, while 27.9% of teachers report using it occasionally, 12.4% report using it in all or nearly all lessons and just 5.3% report never or nearly never using it in their lessons.

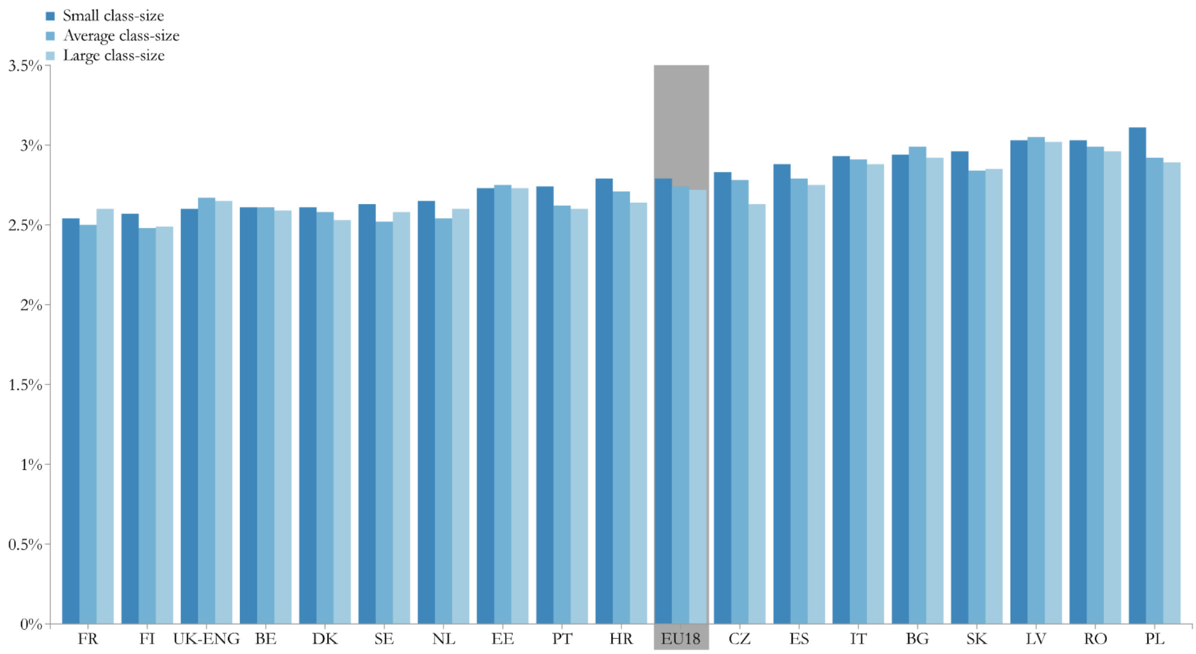
At country level, the main findings are:

- In the majority of the EU MS surveyed over 50% the teachers surveyed report using this non-active teaching practice frequently, reaching over 62% of teachers in Latvia.

- For all countries surveyed the percentage of teachers reporting to never or almost never using this non-active teaching practice does not reach 10%, except in France (i.e. 12.8%).

-The percentage of the teachers surveyed that report using this non-active teaching practice in all or nearly all lessons is nearly or over 20% for Bulgaria, Romania and Latvia.

Graph 14. Group chart displaying the means for the reported frequency of teachers letting students practice similar tasks until the teacher knows that every student has understood the subject matter in all or nearly all lessons grouped by class size (small, average or large).

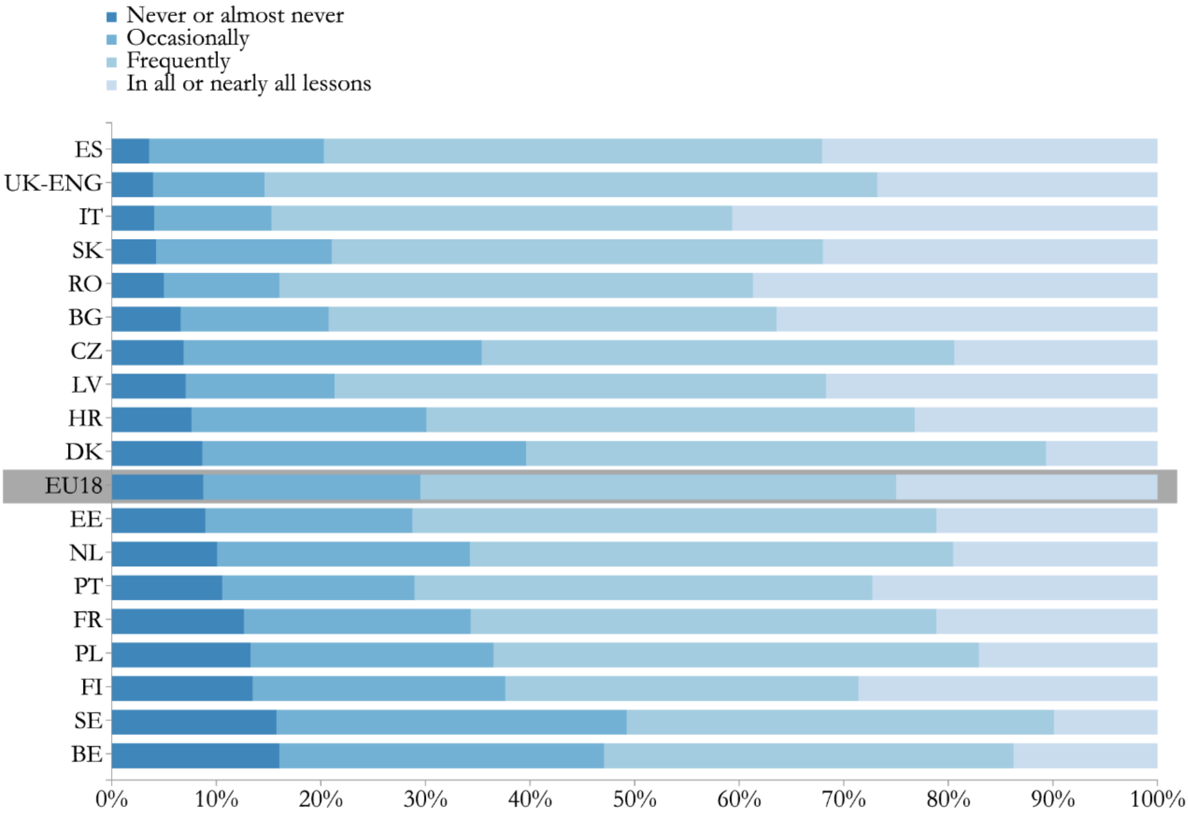


Source: CRELL analysis based on TALIS 2013 data.

Significant differences in teachers' reported frequencies regarding letting students practice similar tasks until the teacher knows that every student has understood the subject matter in relation to the size of the class they teach were observed across very few countries. Teachers working with small-size classes reported using this teaching practice significantly more frequently than those working in average and large-size classes overall and this pattern was particularly evident in Poland and Portugal. Teachers working in small-size classes in Croatia, Czech Republic and Spain reported using this teaching practice significantly more frequently than those working in large-size classes. Teachers working in small-size classes in Sweden reported using this teaching practice significantly more frequently than those working in average-size classes. This teaching practice is significantly more used by teachers in average-size classes than in large-size classes overall, with this pattern reaching statistical significance in countries such as Bulgaria, Croatia and Czech Republic.

2.4.2.5. I check my students' exercise books or homework

Graph 15. Teachers' reported frequency of checking their students' exercise books or homework throughout the year



Source: CRELL analysis based on TALIS 2013 data.

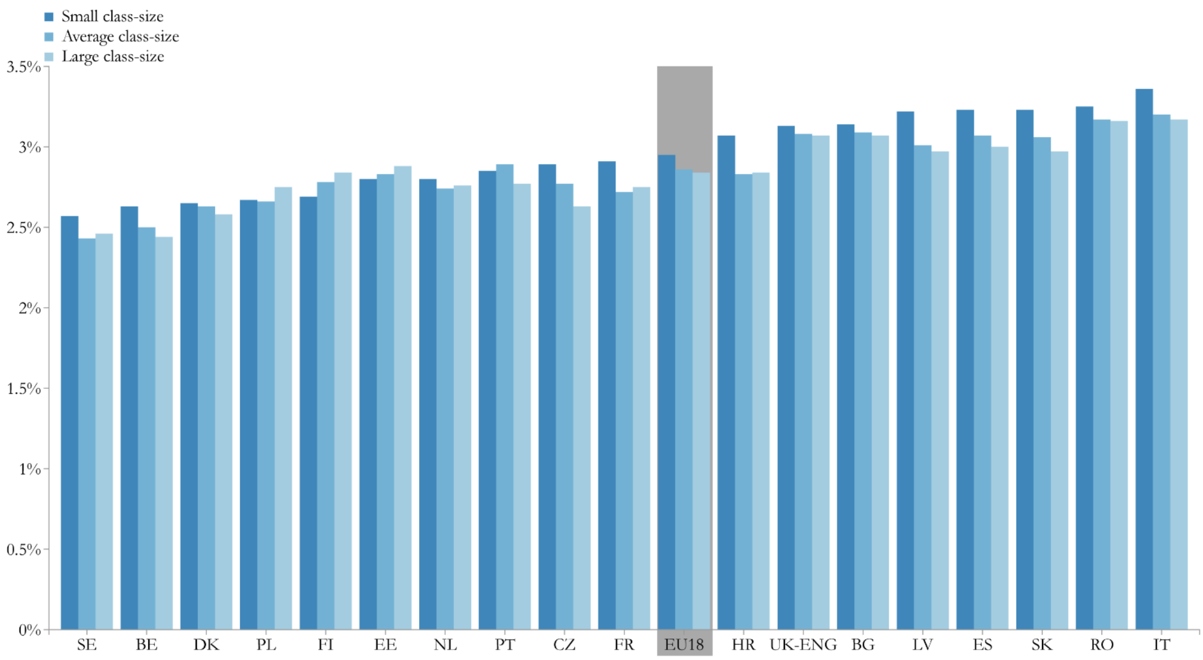
Graph 15 presents the frequency (in all or nearly all lessons, frequently, occasionally or never or nearly never) with which teachers check my students' exercise books or homework as reported by teachers in TALIS 2013. On average across the 18 EU participating countries, 45.5% of teachers report using this non-active teaching practice frequently, whist 25% report using it in all or nearly all lessons, 20.7% report using it occasionally and only 8.8 % report to never or almost never use it.

At country level, the main findings are:

- For all of the countries surveyed the percentage of teachers surveyed that report using this non-active teaching practice frequently never reaches the 50%, with the sole exception of Estonia (i.e. 50.1%) and England (58.6%).

- In Sweden (15.8%) and in Belgium (16%) a high percentage of teachers report to never or almost never use this non-active teaching practice in their classroom.

Graph 16. Group chart displaying the means for the reported frequency of teachers checking their students' exercise books or homework in all or nearly all lessons grouped by class size (small, average or large).



Source: CRELL analysis based on TALIS 2013 data.

Significant differences in teachers' reported frequencies in checking their students' exercise books or homework in relation to the size of the class they teach were observed across a few countries. There was a significant trend of teachers that report using this teaching practice significantly less often in average- and large-size classes than in small-size classes. This trend reached statistical significance in Croatia, France, Italy, Latvia, Slovak Republic, Spain and Belgium. In addition, teachers in Czech Republic teaching in average-size classes reported using this practice significantly more frequently than those in large-size classes while the opposite pattern was observed in Poland.

Highlights

- Roughly 50% of the surveyed teachers in the 18 EU MS participating in TALIS 2013 report using non-active teaching practices frequently with exception of the non-active teaching practice of giving students different work depending on their abilities, for which a high percentage of the surveyed teachers report using it only occasionally (i.e. Croatia, Poland, Portugal, Spain, Denmark, Latvia, Slovak Republic, the Netherlands, Belgium, Estonia, France and Finland).

- Across the 18 EU MS surveyed, the percentage of teachers that report to never or almost never use non-active teaching practices in their classroom throughout the year is very low (below 10%). However, France 12.8% of teachers report to never or almost never let students practice similar tasks until students have understood the subject matter. In Sweden and in Belgium around 16% of teachers report to never or almost never check students' exercise books. Giving students different work depending on their abilities is a less used practice overall, 12% of the surveyed teachers report to never or nearly ever do this.

- Across the 18 EU MS teachers working in small-size classes tend to opt for non-active teaching practices - letting students practice similar tasks until they have understood the subject matter, checking their students' exercise books or homework or giving students different tasks depending on their abilities - much more often than teachers working in average- or large-size classes.

- Teachers working in average-size classes report that they present a summary of the recently learned content more often than teachers in large-size classes across the 18 EU MS overall. This pattern is particularly strong in Belgium.

- No differences for the non-active teaching practice of referring to a problem of everyday life or work to demonstrate why knowledge is useful were found across the 18 EU MS among teachers working in small-, average- or large-size classes.

2.4.2.6 Conclusion and Discussion.

Ensuring high quality teaching is a key policy objective in EU. Thus, it is important to identify the aspects of teaching and learning that can be controlled by policy and professional practice to the benefit of students' learning outcomes. The present findings suggest that teachers in many countries show particular preferences over certain types of teaching practices and that these relate to the size of the class they teach. In other words, we find that teachers across many EU MS may rely on certain teaching practices depending on the number of students they have in their class. It has been suggested that smaller classes improve students' engagement in school (Dee & West, 2011). Students' engagement is characterized as their commitment to learn (Fredricks, Blumenfeld, & Paris, 2004). Active behavioral engagement can be reflected by their attendance, absence of disruptive behaviors, completion of assignments in time and their efforts and attention during class, while emotional and cognitive active engagement refers to their affective reactions to other class-mates, their teachers and to others school personnel (Fredricks et al., 2004; Glanville & Wildhagen, 2007). Having fewer students per class is believed to allow teachers to increase the time they individually spend with their students and reduce the time they spend in managing the classroom (Achilles, Kiser-Kling, Owen, & Aust, 1994). This one-to-one interaction is likely to result in better teacher performance, better students' engagement and social dynamics within the school. CRELL results show that teachers in small classes use more teaching practices such as giving different work to students depending on their abilities, letting students practice different tasks or checking students' exercise books than in average- and large-size classes. Findings also show that, with regard to active teaching practices, teachers in small-size classes report making students work in small groups more often than those in average- and large-size classes.

Nevertheless, for many OECD countries class size reductions have not resulted in better achievement of the students. Despite the fact that research shows that reducing class-size alone is not consistently linked to better students' performance, this information may be highly relevant to policy-makers who wish to examine the frequency of use of different types of teaching practices employed by teachers and how these may vary according to class size. The current results complement other research findings and can be used in combination to improve teaching and learning efficiency. For instance, we know that teaching practices also relate to other teaching aspects such as teaching beliefs, professional development training and teacher characteristics (Svenja, David, Eckhard, & Sonja, 2012). From the TALIS 2013 report we know that challenging classrooms have a stronger influence on teachers' self-efficacy and job satisfaction than the number of students enrolled in the classroom.

Policies should aim to develop training programmes for teachers with a view to provide them with new knowledge about pedagogical methods and tools for teaching, as results show that teachers across the MS continue to rely to a larger extent on the use of non-active teaching practices than on innovative ones. Policies need to ensure that teachers are engaging in professional development activities that equip them with knowledge and resources on how to improve and implement teaching practices, particularly in challenging teaching contexts. The present findings contribute to further our knowledge on teaching practices and this knowledge can facilitate peer learning among EU MS.

2.5. Conclusion and Discussion

The analyses presented in this chapter provide an in-depth insight on how teaching practices relate to class size by describing, comparing and contrasting the particular teaching practices that teachers opt for throughout the year and how these choices relate to the size of the class they teach. The results suggest that teachers do show certain preferences for the use of particular teaching practices and that these choices are associated with the size of the class they teach. Nevertheless, and as highlighted in these chapters, these results cannot be directly linked with students' achievement because students' performance is not assessed in TALIS. This means that, despite the fact that certain patterns of preference in teaching practices' choices can be observed across the 18 EU MS surveyed in TALIS 2013, we are unable to examine whether these choices that relate to class size have an impact on students' performance. This relationship was explored in the PISA part of this report and results confirm that small class size is not related to better achievement across the 26 EU MS participating in PISA 2012. The findings highlight that results vary widely across MS.

We know from OECD PISA 2012 results (OECD, 2013c) (that measures students' achievement) that reducing class size alone does not seem to be an effective measure to better students´ achievement and that other aspects of teaching and learning, such as higher teacher quality, seem to be more important. Moreover, OECD TALIS 2013 results indicate that only for very limited number of countries there is a positive relationship between smaller class size and aspects of teaching such as teacher satisfaction (OECD, 2014a). Teachers' self-efficacy and satisfaction about their jobs seems to be more strongly related to other aspects, such as classroom composition (percentage of students with behavioral problems, low achievers and academically gifted students in the classroom).

Nonetheless, class size reductions have been associated with positive students' outcomes other than achievement, such as effort, self-control, confidence and emotional stability in primary schoolers (Project STAR, Finn, Fulton, Zaharias, & Nye, 1989). These abilities, frequently referred as "non-cognitive skills" in social and economic studies, have been shown to contribute to success not only in education (Deke & Haimson, 2006) but also in the labour-market (Heckman, Stixrud, & Urzua, 2006; Kuhn & Weinberger, 2005). Thus, smaller class sizes may not facilitate learning *per se* but may provide a learning context that enhances the development of non-cognitive competences and learning behaviors that are important for a successful life at an individual level and for economic growth and progress for the society.

Policy Implications

- Class size is related to the implementation of different active teaching practices, but this information should be used in combination with other educational-related factors, such as aspects of classroom climate. MS should gather more information on how class size might be related to the implementation of different active teaching practices.

- Educational policies should aim to provide training programmes to increase teachers' knowledge of new pedagogical methods and tools for teaching. Availability of ICT resources alone does not guarantee integration of ICT in teaching practices. Teachers need guidance and training on how to successfully implement the use of new technologies and other novel pedagogical strategies in their classrooms.

- Teacher professional development should lead teachers to reflect on how different teaching practices can enhance learning and how to use different practices effectively to the benefit of their students as well as to instruct them on how to improve and implement teaching practices. This could be particularly beneficial to teachers working in challenging teaching contexts, that is, in classes where there are a high percentage of low achievers or students with behavioral problems or low percentages of academically gifted students and also when the classroom disciplinary climate hinders learning.

- MS should gather more information on how class size may be related to non-cognitive competences.

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ANNEXES

ANNEX A: TIMSS and PIRLS 2011 detailed data

Table 1. PIRLS Reading Benchmarks						
	Proportion of students not reaching the Low International Benchmark in Reading		Proportion of students reaching the Low and Intermediate Benchmarks in Reading		Proportion of students reaching the High and Advanced Benchmarks in Reading	
MS	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**
AT	6.83	0.58	61.94	1.28	31.23	1.54
HR	2.69	0.35	52.12	1.36	45.19	1.48
CZ	4.04	0.60	54.52	1.47	41.44	1.56
FI	2.12	0.37	42.72	1.29	55.16	1.31
DE	5.61	0.71	55.14	1.21	39.25	1.35
HU	8.73	0.94	50.03	1.52	41.25	1.48
IE	5.72	0.62	47.58	1.27	46.69	1.38
IT	5.21	0.63	56.19	1.20	38.60	1.19
LT	7.43	0.75	61.45	1.51	31.12	1.37
MT	28.80	0.86	52.17	1.16	19.03	0.73
PL	10.23	0.68	57.99	1.10	31.78	1.14
PT	5.81	0.73	55.46	1.40	38.72	1.62
RO	19.84	1.86	53.47	1.75	26.69	1.55
SK	7.22	1.07	56.17	1.08	36.60	1.25
SI	8.41	0.70	57.75	1.18	33.84	1.23
ES	12.09	1.02	64.89	1.36	23.02	1.25
SE	5.03	0.45	55.79	1.30	39.18	1.37
EU17	8.58	0.20	55.02	0.32	36.40	0.33
Cells with cases shaded in grey should be interpreted with caution due to high sampling variability associated with the estimates.[103]						

[103] To provide a measure of accuracy for all reported estimates, the coefficient of variation (CV) was calculated for each of them. The CV tests the precision of the estimates and is computed by dividing the estimate by its standard error and multiplying the resulting ratio by 100. A CV = 0.0 or < 16.5% is considered acceptable. A CV >16% and < 33.3% should be interpreted with caution due to high sampling variability associated with the estimates. A CV > 33.3% should not be interpreted. Therefore, when estimates are unreliable, they are reported neither in the tables nor in the corresponding graphs. When they should be interpreted with caution, table cells with such cases are shaded in grey.

Table 2. TIMSS Mathematics Benchmarks						
	Proportion of students not reaching the Low Benchmark in Mathematics		Proportion of students reaching the Low and Intermediate Benchmarks in Mathematics		Proportion of students reaching the High and Advanced Benchmarks in Mathematics	
MS	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**
AT	6.06	0.69	68.47	1.35	25.46	1.51
HR	11.10	0.82	71.25	1.07	17.65	0.91
CZ	7.74	0.83	62.71	1.30	29.56	1.32
FI	2.68	0.51	48.81	1.26	48.50	1.35
DE	3.48	0.53	60.62	1.20	35.90	1.27
HU	11.42	1.06	52.58	1.18	36.00	1.32
IE	6.66	0.79	53.28	1.82	40.06	1.74
IT	8.62	0.81	63.66	1.40	27.72	1.39
LT	5.30	0.58	52.32	1.39	42.38	1.53
MT	13.34	0.66	62.67	1.01	23.99	0.97
PL	15.68	0.90	68.30	1.14	16.02	1.01
PT	4.19	0.65	55.91	1.61	39.90	1.88
RO	23.06	1.82	49.67	1.21	27.27	1.73
SK	10.89	1.27	59.41	1.43	29.70	1.64
SI	6.67	0.64	64.05	1.15	29.28	1.17
ES	14.21	1.25	69.76	1.07	16.02	1.13
SE	7.85	0.62	67.70	1.57	24.45	1.62
EU17	9.35	0.22	60.66	0.32	29.99	0.34
Cells with cases shaded in grey should be interpreted with caution due to high sampling variability associated with the estimates.						

Table 3. TIMSS Science Benchmarks						
	Proportion of students not reaching the Low Benchmark in Science		Proportion of students reaching the Low and Intermediate Benchmarks in Science		Proportion of students reaching the High and Advanced Benchmarks in Science	
MS	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**
AT	4.88	0.55	54.59	1.36	40.53	1.53
HR	4.36	0.57	67.58	1.03	28.07	1.10
CZ	4.49	0.59	52.45	1.25	43.06	1.41
FI	1.47	0.31	35.57	1.26	62.96	1.30
DE	5.41	0.71	56.20	1.12	38.39	1.26
HU	7.90	0.90	47.22	1.48	44.88	1.60
IE	8.66	0.94	57.37	1.61	33.96	1.65
IT	6.31	0.79	57.68	1.52	36.01	1.55
LT	6.61	0.81	64.07	1.52	29.32	1.52
MT	31.94	1.14	55.39	1.00	12.67	0.71
PL	11.14	0.65	62.02	1.01	26.84	1.21
PT	6.46	0.81	59.08	1.69	34.47	1.92
RO	16.51	1.74	47.48	1.35	36.01	1.94
SK	6.88	1.04	50.67	1.35	42.45	1.61
SI	7.54	0.60	58.09	1.16	34.37	1.29
ES	9.92	1.04	63.09	1.25	26.99	1.35
SE	5.87	0.67	52.05	1.44	42.08	1.48
EU17	8.61	0.21	55.33	0.32	36.06	0.36
Cells with cases shaded in grey should be interpreted with caution due to high sampling variability associated with the estimates.						

Table 4. Students Engaged in Reading Lessons						
	Not Engaged		Somewhat Engaged		Engaged	
MS	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**
AT	13.00	1.00	55.27	1.05	31.72	1.06
HR	11.13	1.00	54.03	0.88	34.85	1.29
CZ	10.17	0.91	54.48	1.09	35.35	1.39
FI	20.05	1.06	64.74	0.98	15.22	0.74
DE	9.53	0.73	55.68	0.96	34.80	1.13
HU	7.06	0.52	42.99	0.94	49.95	1.18
IE	8.29	0.74	48.75	1.29	42.96	1.49
IT	6.74	0.62	59.42	0.95	33.84	1.11
LT	5.67	0.51	53.68	1.20	40.65	1.24
MT	7.19	0.42	37.65	0.84	55.16	0.85
PL	6.12	0.41	48.30	1.01	45.58	1.12
PT	1.96	0.40	43.40	1.69	54.64	1.78
RO	4.30	0.70	31.10	1.34	64.59	1.73
SK	8.93	0.66	58.98	1.05	32.08	1.21
SI	6.00	0.56	57.54	1.19	36.46	1.23
ES	8.17	0.75	52.31	1.34	39.52	1.68
SE	8.39	0.79	62.93	1.03	28.68	1.27
EU17	8.39	0.18	51.84	0.27	39.77	0.31
Cells with cases shaded in grey should be interpreted with caution due to high sampling variability associated with the estimates.						

Table 5. Students Engaged in Mathematics Lessons						
	Not Engaged		Somewhat Engaged		Engaged	
MS	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**
AT	10.29	0.77	50.45	0.99	39.27	1.11
HR	9.87	0.86	51.69	0.96	38.44	1.05
CZ	7.02	0.65	45.18	1.08	47.79	1.38
FI	20.55	1.02	58.81	0.86	20.63	0.86
DE	7.03	0.51	50.61	0.98	42.36	1.03
HU	5.85	0.47	42.49	0.85	51.65	0.98
IE	8.41	0.66	46.59	1.10	45.00	1.34
IT	6.23	0.50	54.03	1.07	39.74	1.21
LT	4.35	0.42	47.46	1.06	48.18	1.11
MT	6.01	0.38	36.52	0.85	57.47	0.85
PL	5.12	0.34	43.26	0.88	51.61	0.85
PT	2.62	0.40	45.76	1.52	51.62	1.66
RO	4.66	0.74	36.34	1.41	59.01	1.61
SK	6.53	0.52	53.82	1.11	39.65	1.23
SI	4.94	0.41	46.76	1.11	48.30	1.25
ES	7.40	0.77	47.27	1.15	45.33	1.42
SE	8.26	0.79	58.90	1.00	32.83	1.29
EU17	7.36	0.15	48.00	0.26	44.64	0.29
Cells with cases shaded in grey should be interpreted with caution due to high sampling variability associated with the estimates.						

Table 6. Students Engaged in Science Lessons						
	Not Engaged		Somewhat Engaged		Engaged	
MS	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**
AT	8.67	0.66	47.28	0.91	44.05	1.04
HR	7.17	0.70	45.97	1.02	46.86	1.19
CZ	7.99	0.70	42.70	1.16	49.30	1.30
FI	19.90	1.07	56.94	1.07	23.16	0.91
DE	6.66	0.62	45.94	0.97	47.40	1.21
HU	6.87	0.54	39.42	0.92	53.70	1.12
IE	7.56	0.68	40.85	1.05	51.59	1.35
IT	6.47	0.52	50.37	1.01	43.16	1.19
LT	5.81	0.47	43.63	1.06	50.55	1.14
MT	8.89	0.46	36.25	0.90	54.86	0.86
PL	5.72	0.36	41.89	1.06	52.39	1.07
PT	1.90	0.38	44.08	1.70	54.02	1.86
RO	4.59	0.55	36.98	1.52	58.43	1.75
SK	7.73	0.55	50.78	0.89	41.49	1.00
SI	5.90	0.51	45.96	1.11	48.14	1.14
ES	7.87	0.73	45.93	1.25	46.20	1.45
SE	8.12	0.63	55.33	0.96	36.55	1.18
EU17	7.52	0.15	45.31	0.27	47.17	0.30
Cells with cases shaded in grey should be interpreted with caution due to high sampling variability associated with the estimates.						

Table 7.1. Generic Instructional Practices. Part 1								
	Proportion of students with teachers who used engaging generic instructional practices in most lessons		Proportion of students with teachers who encourage all students to improve their performance every or almost every lesson		Proportion of students with teachers who praise students for good effort every or almost every lesson		Proportion of students with teachers who use questioning to elicit reasons and explanations every or almost every lesson	
MS	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**
AT	51.72	3.49	59.44	3.59	88.11	2.30	64.07	3.37
HR	87.23	2.25	95.90	1.24	95.04	1.36	80.22	2.77
CZ	74.04	3.61	81.43	3.09	89.05	2.55	83.22	3.08
FI	33.32	3.23	60.25	2.65	66.85	3.21	67.63	3.22
DE	46.63	3.27	52.25	3.38	71.55	2.89	75.85	2.94
HU	89.58	1.96	90.09	2.00	95.68	1.43	88.15	2.21
IE	67.90	3.14	90.03	2.12	93.55	1.42	90.86	2.36
IT	73.01	3.12	89.09	1.99	79.77	2.82	95.34	1.68
LT	92.98	1.57	94.79	1.59	96.43	1.58	75.54	3.15
MT	80.79	0.10	94.53	0.06	94.77	0.04	88.76	0.09
PL	73.56	3.07	92.78	1.88	94.31	1.66	91.14	1.62
PT	89.17	2.12	97.56	1.15	92.67	1.56	85.75	2.94
RO	93.51	1.82	96.61	1.26	92.97	2.12	91.31	2.07
SK	83.29	2.59	92.01	1.68	93.23	1.55	87.80	2.12
SI	83.50	2.84	91.90	1.97	85.72	2.32	75.48	3.17
ES	65.55	3.48	91.54	2.21	80.31	3.33	78.63	3.01
SE	46.94	3.97	81.02	2.79	87.53	2.96	68.00	4.05
EU17	72.51	0.69	85.37	0.54	88.09	0.54	81.63	0.66

Table 7.2. Generic Instructional Practices. Part 2								
	Proportion of students with teachers who used engaging generic instructional practices in most lessons		Proportion of students with teachers who bring interesting materials to class every or almost every lesson		Proportion of students with teachers who relate the lesson to students' daily lives every or almost every lesson		Proportion of students with teachers who summarize what students should have learned from the lesson every or almost every lesson	
EU MS	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**
AT	51.72	3.49	16.80	2.11	43.27	3.34	40.98	3.17
HR	87.23	2.25	20.74	2.98	86.07	2.23	83.06	2.76
CZ	74.04	3.61	11.73	2.44	54.25	4.19	81.64	3.35
FI	33.32	3.23			39.38	3.50	24.33	2.96
DE	46.63	3.27	12.88	2.21	35.23	3.62	34.57	3.94
HU	89.58	1.96	30.72	3.00	70.78	3.16	91.63	1.89
IE	67.90	3.14	26.17	3.29	52.96	3.54	52.42	3.45
IT	73.01	3.12	41.07	3.49	59.48	3.49	72.34	3.39
LT	92.98	1.57	41.56	3.15	74.54	2.90	93.70	1.50
MT	80.79	0.10	36.50	0.12	56.92	0.14	74.62	0.11
PL	73.56	3.07	24.94	3.03	69.92	3.30	88.81	2.07
PT	89.17	2.12	38.19	5.06	78.45	3.10	77.87	3.42
RO	93.51	1.82	55.38	3.83	82.85	2.47	85.05	3.16
SK	83.29	2.59	26.34	3.24	63.68	3.17	89.67	1.57
SI	83.50	2.84	33.27	3.37	71.43	3.36	77.57	3.05
ES	65.55	3.48	21.08	3.15	79.31	3.14	67.80	3.80
SE	46.94	3.97	27.23	3.37	22.58	3.70	19.61	3.02
EU17	72.51	0.69	27.48	0.74	61.24	0.78	67.98	0.71
Cells with cases shaded in grey should be interpreted with caution due to high sampling variability associated with the estimates. Cells are left blank when estimates are unreliable.								

Table 8.1. Instructional Strategies for Reading Comprehension. Part 1						
Proportion of students whose teachers ask them to do the following at least weakly						
	Locate information within the text		Identify the main ideas of what they have read		Explain or support their understanding of what they have read	
MS	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**
AT	87.22	2.47	92.24	1.61	95.11	1.23
HR	98.52	1.07	98.63	0.74	97.32	1.02
CZ	98.94	0.79	97.49	1.10	99.19	0.53
FI	86.25	2.23	87.77	2.83	80.40	2.82
DE	95.63	1.44	89.56	2.16	95.33	1.45
HU	99.23	0.54	98.85	0.85	99.61	0.39
IE	98.34	0.87	96.95	1.13	95.81	1.75
IT	99.86	0.13	99.67	0.33	99.17	0.63
LT	100.00	0.00	100.00	0.00	99.58	0.42
MT	98.84	0.00	99.10	0.00	99.29	0.03
PL	99.65	0.35	98.59	0.74	96.98	1.23
PT	99.59	0.41	99.59	0.41	99.59	0.41
RO	99.84	0.16	100.00	0.00	100.00	0.00
SK	97.92	1.00	98.76	0.62	98.92	0.87
SI	98.28	0.79	90.63	2.86	97.66	1.00
ES	97.72	0.92	96.92	1.41	95.97	1.78
SE	96.01	1.25	78.48	3.46	76.60	4.00
EU17	97.17	0.27	95.48	0.38	95.68	0.37

Table 8.2. Instructional Strategies for Reading Comprehension. Part 2												
Proportion of students whose teachers ask them to do the following at least weakly:												
	Compare what they have read with experiences they have had		Compare what they have read with other things they have read		Make predictions about what will happen next in the text they are reading		Make generalizations and draw inferences based on what they have read		Describe the style or structure of the text they have read		Determine the author's perspective or intention	
MS	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**
AT	64.14	3.44	43.94	3.27	37.49	3.05	55.83	3.41	27.43	2.96	23.89	2.64
HR	89.95	2.06	72.40	3.14	62.43	3.19	94.10	1.90	84.95	2.60	82.95	2.49
CZ	83.29	2.90	47.28	3.85	54.26	3.87	66.79	3.78	31.56	3.70	30.46	3.79
FI	67.24	3.50	38.87	3.51	44.43	3.43	66.16	3.21	24.17	2.62	14.74	2.12
DE	74.14	3.14	51.72	3.52	52.93	3.50	64.21	3.69	30.34	3.35	30.75	3.34
HU	95.16	1.47	90.82	1.88	83.15	2.91	96.03	1.30	73.99	3.38	72.13	3.18
IE	86.76	2.42	68.74	3.35	91.34	1.64	82.51	3.04	57.51	3.64	52.12	4.07
IT	87.62	2.06	75.75	2.88	77.56	2.73	69.29	3.22	82.88	2.18	77.25	2.70
LT	99.36	0.46	96.12	1.10	90.21	1.89	99.16	0.60	91.48	1.83	84.89	2.40
MT	81.44	0.12	71.55	0.13	76.27	0.13	69.02	0.14	60.55	0.15	53.17	0.15
PL	96.05	1.56	72.26	3.19	75.17	3.00	98.16	0.98	74.40	3.55	81.09	2.55
PT	91.98	2.41	90.91	2.26	88.78	2.65	88.56	2.31	95.55	1.52	91.95	2.05
RO	93.58	1.83	92.29	2.08	90.04	2.27	90.16	2.26	84.96	2.74	90.68	2.09
SK	91.79	1.90	79.27	2.78	71.59	2.87	88.24	2.20	63.98	2.96	68.78	3.32
SI	88.41	2.49	70.75	4.00	55.38	3.90	81.45	2.84	60.66	3.69	41.91	3.73
ES	83.71	2.66	74.44	3.31	63.30	4.03	72.47	3.58	59.66	3.74	50.10	4.00
SE	55.69	4.06	27.37	3.29	37.52	4.00	52.67	4.60	18.69	3.27	11.69	2.29
EU17	84.14	0.60	68.50	0.72	67.76	0.74	78.52	0.68	60.16	0.72	56.39	0.71
Cells with cases shaded in grey should be interpreted with caution due to high sampling variability associated with the estimates.												

Table 9. Instructional Strategies for Mathematics										
Proportion of students whose teachers ask them to do the following at least weakly										
	Memorize rules, procedures, and facts		Explain their answers		Work problems (individually or with peers) with teacher guidance		Work problems together in the whole class with direct teacher guidance		Work problems (individually or with peers) while teacher occupied by other tasks	
MS	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**
AT			27.34	3.26	29.60	3.50	21.69	3.42	3.23	1.00
HR	48.72	3.40	45.46	3.70	52.72	2.86	53.93	3.28	6.35	1.47
CZ			61.22	3.40	60.99	3.45	37.29	4.17	8.88	2.82
FI	16.97	2.93	35.89	3.15	73.25	2.97	24.10	3.21	9.99	2.22
DE	6.19	1.64	49.65	3.28	40.34	3.50	20.23	2.87	6.75	1.86
HU	9.50	1.95	87.33	2.28	64.60	3.36	39.88	3.72	12.72	2.56
IE	29.87	3.92	59.11	3.94	53.08	3.81	53.03	3.43	24.30	3.30
IT	41.49	3.87	56.53	3.81	24.21	3.13	20.85	3.33	3.98	1.18
LT	43.84	3.27	70.73	3.42	72.28	2.74	53.50	3.30	10.41	2.03
MT	26.35	0.14	67.83	0.15	46.54	0.14	49.32	0.14	13.37	0.08
PL	48.33	3.59	87.92	2.12	63.30	3.49	69.44	3.33	24.73	3.51
PT	42.46	4.88	79.83	3.26	52.20	4.73	43.26	4.66	10.50	2.52
RO	37.45	3.02	83.93	3.08	77.82	3.27	77.29	2.96	12.58	2.66
SK	11.14	2.13	63.51	3.49	57.00	3.29	48.62	3.58	7.64	2.26
SI	4.62	1.42	63.99	3.41	36.72	3.16	12.93	2.34	11.35	2.16
ES	34.33	3.82	74.76	3.31	51.89	3.92	44.37	3.76	17.07	3.11
SE	13.06	3.29	40.42	4.20	47.95	3.95	26.02	3.93	7.75	2.27
EU17	24.65	0.71	62.08	0.79	53.20	0.82	40.93	0.82	11.27	0.57
Cells with cases shaded in grey should be interpreted with caution due to high sampling variability associated with the estimates. Cells are left blank when estimates are unreliable.										

Table 10. Instructional Strategies for Science Investigation												
Proportion of students whose teachers ask them to do the following at least half of the lessons:												
	Relate what they are learning in Science to their daily lives		Give explanations about something they are studying		Watch the teacher demonstrate an experiment or investigation		Observe natural phenomena and describe what they see		Design or plan experiments or investigations		Conduct experiments or investigations	
MS	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**
AT	74.16	2.96	62.01	3.39	10.66	1.78	17.76	2.42	3.33	1.01	7.38	1.49
HR	98.43	0.82	93.66	1.58	13.89	2.28	47.97	3.60	6.54	1.79	8.99	2.02
CZ	93.93	2.05	84.13	2.84	14.39	2.60	46.82	4.34	11.52	2.66	18.03	3.24
FI	87.70	2.37	87.43	2.40	13.35	2.41	42.73	3.40			11.09	1.97
DE	75.44	3.16	76.30	2.93	12.95	2.52	26.19	3.14	17.07	2.79	23.11	3.19
HU	94.56	1.54	84.08	2.78	27.86	3.16	35.32	3.78	8.08	1.83	8.59	2.10
IE	81.62	3.38	79.17	3.03	56.05	3.76	41.50	3.58	45.19	3.33	54.60	3.47
IT	89.08	2.35	98.09	1.03	36.48	3.44	56.64	3.56	39.75	3.45	43.65	3.65
LT	94.69	1.42	97.63	1.03	22.83	3.35	40.88	3.35	13.12	2.24	16.17	2.61
MT	82.72	0.08	60.01	0.13	28.39	0.10	34.16	0.12	23.46	0.10	42.77	0.10
PL	84.61	2.78	50.50	3.86	12.61	2.45	22.52	3.37	5.29	1.55		
PT	87.87	3.92	84.93	4.20	29.61	4.02	37.86	4.00	29.70	3.95	26.11	3.86
RO	92.94	1.35	83.56	2.66	61.93	3.42	73.31	3.21	44.79	3.62	45.65	3.84
SK	92.44	1.77	90.25	2.07	30.56	3.43	51.04	3.41	16.02	2.55	23.06	2.84
SI	93.88	1.75	87.85	2.35	32.90	3.48	46.69	3.29	22.45	2.90	36.10	3.81
ES	95.00	1.55	93.69	2.07	12.11	2.88	52.33	4.17	8.98	2.52	6.78	2.22
SE	75.84	3.90	65.63	4.42	20.99	3.82	29.36	4.19	32.76	4.47	43.60	4.47
EU17	87.94	0.59	81.11	0.67	25.74	0.73	41.36	0.84	19.49	0.66	24.59	0.71
Cells with cases shaded in grey should be interpreted with caution due to high sampling variability associated with the estimates. Cells are left blank when estimates are unreliable.												

Table 11. Resources for Teaching												
	Proportion of students whose teachers use of textbooks as a basis for instruction for						Proportion of students whose teachers use computer software as a supplement for					
	Reading		Mathematics		Science		Reading		Mathematics		Science	
MS	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**
AT	59.06	3.22	89.95	2.25	46.16	3.33	60.57	3.56	58.89	3.63	51.65	3.70
HR	92.05	1.98	87.54	2.28	94.00	1.33	25.40	2.78	23.68	2.90	41.98	3.32
CZ	84.64	3.13	77.20	3.43	80.62	3.31	23.78	3.30	64.36	3.96	63.32	3.94
FI	85.92	2.29	94.60	1.69	93.50	1.76	59.75	3.92	68.97	3.58	60.89	3.07
DE	61.70	3.28	86.17	2.34	28.03	2.86	52.21	3.82	58.22	3.38	39.78	3.25
HU	97.42	1.09	87.79	2.29	88.71	2.56	39.38	3.49	30.51	3.65	36.80	3.56
IE	74.00	3.36	70.83	3.48	37.86	3.64	62.34	3.51	68.07	3.35	62.55	3.34
IT	79.61	2.88	45.13	3.04	70.41	3.62	30.37	3.26	43.20	3.39	34.79	3.60
LT	96.60	1.48	93.55	1.76	91.76	1.73	56.85	3.47	64.82	3.23	67.12	2.87
MT	85.66	0.10	91.22	0.08	33.72	0.12	54.96	0.14	45.16	0.13	54.11	0.13
PL	85.13	2.77	77.69	3.17	68.95	3.79	53.14	3.81	43.73	3.98	48.60	4.06
PT	66.75	5.06	56.26	4.93	62.28	4.95	62.57	4.48	62.35	4.12	64.29	4.53
RO	94.09	1.54	90.03	2.47	94.42	1.66	45.07	3.98	45.35	3.98	47.43	3.80
SK	91.79	1.66	84.84	2.37	92.40	1.82	52.38	3.62	60.90	3.54	66.42	3.00
SI	75.91	3.01	75.70	3.11	89.15	2.37	51.07	3.91	69.59	3.70	71.63	3.36
ES	66.48	3.60	77.15	3.21	87.32	2.53	47.89	4.19	63.95	3.51	63.88	3.20
SE	44.80	4.56	89.23	2.76	35.73	4.43	57.51	4.07	60.49	4.26	30.11	4.38
EU17	78.92	0.71	80.88	0.68	70.30	0.71	49.13	0.87	54.84	0.86	53.26	0.85

Table 12. Computer-based Practices												
	Proportion of students whose teachers have them use computers at least monthly to look up information for						Proportion of students whose teachers have them use computers at least monthly to develop skills and strategies					
	Reading		Mathematics		Science		Reading		Mathematics		Science	
MS	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**
AT	76.45	3.19	39.87	3.67	82.87	2.85	75.66	2.79	78.13	3.20	43.89	3.93
HR	90.77	4.40	69.69	8.64	85.54	5.85	38.10	7.17	66.66	9.25	84.42	5.79
CZ	84.67	4.41	55.52	5.75	85.85	4.26	40.91	6.26	85.53	4.97	70.71	5.65
FI	92.48	2.89	34.42	4.76	90.26	3.28	52.28	4.78	83.80	3.96	64.19	4.25
DE	74.30	3.50	47.33	4.15	88.71	3.30	62.19	4.28	79.31	3.61	37.18	4.35
HU	93.54	2.45	51.75	5.94	94.05	3.35	48.18	6.05	74.28	5.06	74.36	4.78
IE	90.57	2.92	61.31	5.56	89.83	2.97	54.37	5.10	78.37	4.03	48.80	4.81
IT	63.51	8.10	77.72	7.16	91.26	3.77	65.62	6.39	94.83	3.20	77.43	6.02
LT	92.05	2.97	81.82	3.79	92.78	2.59	75.05	4.37	89.50	3.08	83.98	4.14
MT	90.04	0.08	65.81	0.16	88.52	0.08	67.49	0.15	88.00	0.11	80.61	0.10
PL	95.92	2.88	68.01	10.35	85.53	6.31	47.45	8.42	92.41	5.71	66.68	8.90
PT	97.84	1.06	88.79	3.34	99.24	0.61	77.43	5.32	81.88	5.89	85.68	4.73
RO	82.27	5.29	80.12	7.54	84.67	6.08	73.98	6.48	90.51	6.30	84.10	4.51
SK	88.48	3.90	85.95	3.83	95.19	2.30	65.49	5.58	93.10	2.46	95.90	1.54
SI	90.32	2.81	68.32	5.64	91.35	3.45	62.38	5.46	82.22	4.89	51.12	6.21
ES	87.01	4.95	62.20	7.12	87.27	4.52	70.72	9.19	81.20	5.52	78.17	5.25
SE	87.50	3.57	30.76	5.11	73.27	4.96	58.54	5.75	88.97	3.26	30.53	5.15
EU17	86.92	0.94	62.91	1.43	88.60	0.95	60.93	1.42	84.04	1.16	68.10	1.23
Cells with cases shaded in grey should be interpreted with caution due to high sampling variability associated with the estimates.												

Table 13. Teacher Collaborative Practices												
	Proportion of students with very collaborative teachers*		Proportion of students whose teachers are engaged weekly in the following activities:						Proportion of students whose teachers are engaged monthly in the following activities:			
			Discuss how to teach a particular topic		Collaborate in planning and preparing instructional materials		Share what I have learned about my teaching experiences		Visit another classroom to learn more about teaching		Work together to try out new idea	
MS	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**
AT	21.34	3.24	34.43	3.06	36.98	3.50	50.26	3.34	9.72	2.24	71.59	2.94
HR	40.62	3.79	60.47	3.39	45.81	3.58	64.93	3.51	26.93	3.26	90.76	2.03
CZ	15.63	2.72	35.31	3.93	24.12	3.41	65.63	4.53	19.29	2.99	41.15	4.07
FI	27.03	2.79	49.91	3.21	26.66	2.73	58.01	3.24	27.65	3.33	73.19	3.59
DE	23.86	2.63	46.37	3.68	51.00	3.03	49.15	3.25	10.86	2.13	70.77	3.05
HU	43.04	4.02	59.79	3.82	36.63	4.32	75.74	2.81	61.88	3.60	92.58	1.65
IE	15.71	2.64	25.90	2.99	20.79	2.59	35.98	3.65	18.25	2.77	63.68	3.34
IT	28.71	3.16	49.40	3.74	45.20	3.43	47.46	3.49	10.72	2.01	72.03	3.41
LT	38.04	3.29	57.38	3.42	42.64	2.95	49.16	3.40	79.85	2.67	78.84	3.15
MT	15.65	0.09	29.82	0.12	30.48	0.13	32.74	0.11	7.31	0.08	56.73	0.12
PL	32.32	2.96	45.66	3.40	52.71	3.63	56.65	3.56	37.04	3.39	98.00	0.95
PT	44.98	4.83	66.63	3.83	38.38	3.82	60.01	3.83	30.49	4.90	83.27	3.93
RO	67.55	3.84	81.63	3.03	66.42	3.56	74.49	3.20	83.69	2.63	95.48	1.31
SK	50.42	3.33	61.38	3.05	46.71	3.18	74.88	2.71	34.65	3.57	92.63	1.92
SI	73.41	3.46	61.11	3.91	54.79	3.47	71.14	3.55	75.63	3.16	95.53	1.37
ES	38.10	3.83	50.22	4.03	49.95	4.10	47.10	3.69	28.06	3.78	80.24	3.22
SE	36.63	4.57	55.72	4.86	51.91	4.69	63.25	4.40	23.85	3.20	78.10	3.67
EU17	36.06	0.82	51.24	0.85	42.42	0.83	57.45	0.83	34.46	0.75	78.50	0.68

** Their teachers having interactions with other teachers at least "one to three times per week" in each of three of the five areas and "two or three times per month" in each of the other two, on average.*
Cells with cases shaded in grey should be interpreted with caution due to high sampling variability associated with the estimates.

Table 14. School Environment and Support						
	Proportion of students whose teachers report:					
	A high or very high emphasis on academic success		Working in a safe and orderly working environment		Having hardly any problems in terms of resources	
MS	**%**	**S.E.**	**%**	**S.E.**	**%**	**S.E.**
AT	81.22	2.57	57.74	3.39	28.77	3.49
HR	89.94	2.21	73.36	3.14	27.49	3.03
CZ	46.46	4.56	46.11	3.79	45.63	4.09
FI	65.86	3.45	35.37	3.49	20.42	3.02
DE	59.66	3.44	45.24	3.88	16.16	2.56
HU	59.02	3.85	51.11	3.76	32.45	3.48
IE	92.09	1.79	77.66	3.34	37.70	4.02
IT	60.62	3.37	18.44	2.86	19.21	2.64
LT	77.22	3.18	47.19	3.18	30.35	3.17
MT	77.25	0.11	49.51	0.12	22.50	0.11
PL	83.18	2.84	54.99	3.37	48.66	3.63
PT	60.39	4.60	46.37	5.12	15.81	4.72
RO	69.80	3.33	39.90	3.60	25.92	3.38
SK	50.22	3.31	39.74	3.69	37.48	3.32
SI	68.18	3.52	27.46	3.10	28.12	3.62
ES	60.55	4.10	50.73	3.76	32.42	3.79
SE	71.40	4.14	39.87	4.74	12.01	2.88
EU17	69.00	0.82	47.11	0.87	28.30	0.82

ANNEX B. PISA 2012 detailed data[104]

Table 1. Distribution by answer category of school principals' views on students are grouped by ability within their Mathematics classes for the EU MS[105]

		Students in schools where the principal reported students are grouped by ability within their Mathematics classes			
MS		% of students	S.E.	Mathematics mean	S.E.
Austria	For all classes	*7.3*	*1.4*	*422*	*14.5*
	For some classes	29.2	3.7	489	8.0
	Not for any classes	63.5	3.8	525	4.2
Belgium	For all classes	*3.8*	*0.9*	*469*	*24.5*
	For some classes	18.4	2.5	505	11.4
	Not for any classes	77.8	2.5	521	3.8
Bulgaria	For all classes	*	*	*	*
	For some classes	69.0	3.7	437	5.2
	Not for any classes	26.6	3.4	445	10.3
Czech Republic	For all classes	*7.8*	*1.7*	*489*	*13.6*
	For some classes	31.4	3.5	480	8.5
	Not for any classes	60.8	3.3	509	4.7
Germany	For all classes	19.6	2.4	466	10.0
	For some classes	31.5	3.4	522	8.5
	Not for any classes	48.9	3.5	531	5.6
Denmark	For all classes	*5.0*	*1.5*	*502*	*14.3*
	For some classes	34.3	3.9	500	4.2
	Not for any classes	60.7	3.7	501	3.1
Spain	For all classes	*7.3*	*1.4*	*487*	*8.4*
	For some classes	20.0	2.3	484	4.4
	Not for any classes	72.7	2.5	484	2.1
Estonia	For all classes	18.1	2.3	520	4.9
	For some classes	31.4	2.6	521	3.3
	Not for any classes	50.5	3.1	520	3.1
Finland	For all classes	*7.4*	*1.8*	*512*	*8.2*
	For some classes	41.0	3.0	520	2.5
	Not for any classes	51.6	3.1	518	3.1
France	For all classes	*5.7*	*1.3*	*496*	*28.9*
	For some classes	24.1	3.0	471	11.1
	Not for any classes	70.2	3.3	503	4.4

[104] Notes:
Percentages and means are computed with the IDB Analyzer using IEA's guidelines, taking into account the complexity of the sampling design and applying sampling weights. See https://ec.europa.eu/jrc/en/event/workshop/workshop-using-pisa-piaac-timss-pirls-talis-datasets.
To provide a measure of accuracy for some of the reported estimates, the coefficient of variation (CV) was calculated for each of them. The CV tests the precision of the estimates and is computed by dividing the estimate by its standard error and multiplying the resulting ratio by 100. Lower CV's are associated with higher levels of precision and we adopted the cut-off points suggested by Jensen et al. (2012) as follows: for CV's equal to 0.0 to 16.5%, estimates can be considered for unrestricted interpretation; for CV's greater than 16.5% and up to 33.3%, estimates can be considered for unrestricted interpretation, but with caution because of the high sampling variability associated with the estimates and finally, values higher than 33.3% reflect very high variability and should not be interpreted.
[105] When estimates are unreliable, they are not reported and the corresponding cells include an *. Estimates that should be interpreted with caution are presented in italic.

		Students in schools where the principal reported students are grouped by ability within their Mathematics classes			
MS		% of students	S.E.	Mathematics mean	S.E.
United Kingdom	For all classes	76.9	2.6	490	4.7
	For some classes	17.1	2.4	502	7.3
	Not for any classes	*6.1*	*1.5*	*537*	*10.6*
Greece	For all classes	*	*	*	*
	For some classes	*	*	*	*
	Not for any classes	96.8	1.3	452	2.7
Croatia	For all classes	*	*	*	*
	For some classes	44.3	4.1	465	5.7
	Not for any classes	54.3	4.1	476	6.2
Hungary	For all classes	*10.8*	*2.6*	*461*	*13.9*
	For some classes	33.3	3.4	491	9.1
	Not for any classes	55.8	3.9	473	5.7
Ireland	For all classes	53.8	3.9	505	3.9
	For some classes	36.3	3.9	498	5.8
	Not for any classes	*9.9*	*2.5*	*506*	*9.4*
Italy	For all classes	*2.6*	*0.6*	*436*	*12.5*
	For some classes	29.1	1.9	476	4.7
	Not for any classes	68.3	2.0	494	2.9
Lithuania	For all classes	36.9	3.7	468	5.0
	For some classes	28.1	3.6	487	4.5
	Not for any classes	35.0	3.3	487	5.8
Luxembourg	For all classes	1.2	0.0	537	8.4
	For some classes	33.6	0.1	462	1.6
	Not for any classes	65.2	0.1	503	1.3
Latvia	For all classes	*6.2*	*2.0*	*491*	*13.2*
	For some classes	59.4	3.4	491	3.5
	Not for any classes	34.3	3.3	488	6.1
Netherlands	For all classes	*10.7*	*2.8*	*452*	*17.9*
	For some classes	50.9	4.6	528	8.2
	Not for any classes	38.4	4.0	533	7.7
Poland	For all classes	*	*	*	*
	For some classes	*13.9*	*3.2*	*524*	*14.3*
	Not for any classes	83.0	3.3	516	3.9
Portugal	For all classes	*	*	*	*
	For some classes	27.2	3.5	469	7.7
	Not for any classes	72.4	3.5	494	4.5
Romania	For all classes	25.1	3.5	442	8.2
	For some classes	40.2	3.9	440	5.2
	Not for any classes	34.7	3.8	452	8.4
Slovak Republic	For all classes	*7.9*	*1.7*	*415*	*14.0*
	For some classes	24.8	3.6	462	9.3
	Not for any classes	67.3	3.6	497	5.5
Slovenia	For all classes	3.6	0.2	496	6.4
	For some classes	50.4	0.7	490	1.9
	Not for any classes	46.0	0.7	520	2.0
Sweden	For all classes	*9.2*	*2.0*	*490*	*9.5*
	For some classes	36.0	3.3	475	4.3
	Not for any classes	54.7	3.5	479	3.3
EU 26 average	For all classes	13.0	0.4	478	3.6
	For some classes	33.0	0.6	489	2.0
	Not for any classes	54.1	0.6	499	1.1

Table 2. Distribution by answer category of school principals' views on teachers use pedagogy suitable for students with heterogeneous abilities, in Mathematics classes for the EU MS[106]

		Students in schools where the principal reported teachers use pedagogy suitable for students with heterogeneous abilities, in Mathematics classes			
MS		% of students	S.E.	Mathematics mean	S.E.
Austria	For all classes	31.4	3.9	492	7.9
	For some classes	51.8	4.4	520	5.5
	Not for any classes	*16.9*	*2.9*	*495*	*12.1*
Belgium	For all classes	55.8	3.3	520	4.8
	For some classes	27.7	2.8	501	8.9
	Not for any classes	16.4	2.2	528	9.0
Bulgaria	For all classes	41.2	3.8	447	7.1
	For some classes	55.9	3.8	434	6.5
	Not for any classes	*	*	*	*
Czech Republic	For all classes	49.8	3.7	495	5.6
	For some classes	37.4	3.6	495	6.5
	Not for any classes	12.8	2.0	522	12.0
Germany	For all classes	40.9	3.5	532	6.8
	For some classes	33.4	3.2	512	10.5
	Not for any classes	25.7	3.1	496	9.2
Denmark	For all classes	42.4	3.6	502	3.8
	For some classes	52.1	3.7	500	3.6
	Not for any classes	*5.5*	*1.7*	*493*	*14.4*
Spain	For all classes	59.2	2.6	483	2.6
	For some classes	26.0	2.2	486	3.9
	Not for any classes	14.8	2.0	487	4.7
Estonia	For all classes	47.6	2.9	525	3.4
	For some classes	44.8	2.8	515	3.0
	Not for any classes	7.6	1.1	522	8.6
Finland	For all classes	51.7	2.9	515	2.8
	For some classes	37.2	3.2	521	3.0
	Not for any classes	*11.1*	*2.3*	*524*	*3.2*
France	For all classes	67.6	3.1	504	4.0
	For some classes	22.6	2.8	465	10.2
	Not for any classes	*9.7*	*2.0*	*508*	*17.0*
United Kingdom	For all classes	*5.4*	*1.4*	*534*	*12.6*
	For some classes	14.0	2.0	488	7.1
	Not for any classes	80.6	2.2	494	4.7
Greece	For all classes	63.7	4.1	452	3.8
	For some classes	*18.8*	*3.4*	*459*	*9.1*
	Not for any classes	*17.5*	*3.0*	*447*	*8.2*
Croatia	For all classes	39.3	3.6	470	8.2
	For some classes	47.2	3.8	466	5.4
	Not for any classes	*13.4*	*2.8*	*490*	*11.0*
Hungary	For all classes	55.9	4.0	479	5.5
	For some classes	33.8	3.7	481	9.1
	Not for any classes	*10.3*	*2.4*	*459*	*19.1*
Ireland	For all classes	18.7	3.0	497	7.2
	For some classes	41.6	3.8	504	4.6
	Not for any classes	39.7	4.1	504	4.9

[106] When estimates are unreliable, they are not reported and the corresponding cells include an *. Estimates that should be interpreted with caution are presented in italic.

MS		Students in schools where the principal reported teachers use pedagogy suitable for students with heterogeneous abilities, in Mathematics classes			
		% of students	S.E.	Mathematics mean	S.E.
Italy	For all classes	44.9	2.2	484	4.0
	For some classes	41.2	2.1	488	3.8
	Not for any classes	13.9	1.6	490	7.5
Lithuania	For all classes	48.7	3.4	479	4.7
	For some classes	25.3	3.4	493	6.0
	Not for any classes	26.0	2.8	469	5.4
Luxembourg	For all classes	44.4	0.1	513	1.5
	For some classes	39.3	0.1	472	1.6
	Not for any classes	16.3	0.1	465	2.5
Latvia	For all classes	41.7	3.7	490	4.6
	For some classes	53.0	3.8	491	3.5
	Not for any classes	*	*	*	*
Netherlands	For all classes	38.9	4.2	532	7.9
	For some classes	34.9	3.7	512	10.6
	Not for any classes	26.2	4.2	520	11.9
Poland	For all classes	63.2	4.4	518	5.5
	For some classes	*13.1*	*2.9*	*501*	*8.3*
	Not for any classes	23.7	3.7	522	5.3
Portugal	For all classes	60.9	4.0	495	5.5
	For some classes	32.3	3.8	478	7.0
	Not for any classes	*	*	*	*
Romania	For all classes	33.1	3.7	454	6.6
	For some classes	52.3	3.8	440	5.3
	Not for any classes	*14.6*	*2.5*	*439*	*11.4*
Slovak Republic	For all classes	55.9	4.1	490	6.7
	For some classes	25.7	3.2	466	8.7
	Not for any classes	*18.3*	*3.4*	*479*	*13.1*
Slovenia	For all classes	27.3	0.7	505	2.7
	For some classes	64.3	0.7	506	1.7
	Not for any classes	8.4	0.4	482	4.3
Sweden	For all classes	55.9	4.0	476	3.3
	For some classes	33.8	3.3	481	4.5
	Not for any classes	*10.3*	*2.3*	*482*	*11.0*
EU 26 average	For all classes	45.6	0.7	496	1.1
	For some classes	36.9	0.6	488	1.3
	Not for any classes	17.5	0.5	489	2.4

Table 3. Distribution by answer category of school principals' views on ability grouping index within schools for the EU MS[107]

MS		Students in schools where principal reported on ability grouping within schools: % of students	S.E.	Mathematics mean	S.E.
Austria	No ability grouping between any classes	71.9	2.3	529	3.7
	One of these forms of ability grouping between classes for some classes	14.7	2.3	467	11.8
	One of these forms of ability grouping for all classes	13.4	1.8	435	11.2
Belgium	No ability grouping between any classes	20.6	2.9	520	9.0
	One of these forms of ability grouping between classes for some classes	57.0	3.1	521	4.9
	One of these forms of ability grouping for all classes	22.4	2.7	497	10.5
Bulgaria	No ability grouping between any classes	*6.9*	*2.1*	*459*	*21.2*
	One of these forms of ability grouping between classes for some classes	62.6	4.1	435	6.1
	One of these forms of ability grouping for all classes	30.5	3.6	451	8.5
Czech Republic	No ability grouping between any classes	*58.8*	*4.2*	*506*	*5.5*
	One of these forms of ability grouping between classes for some classes	30.6	3.7	495	8.4
	One of these forms of ability grouping for all classes	10.6	2.7	464	16.0
Germany	No ability grouping between any classes	31.9	3.1	543	6.8
	One of these forms of ability grouping between classes for some classes	32.9	3.4	523	8.3
	One of these forms of ability grouping for all classes	35.3	3.0	482	7.4
Denmark	No ability grouping between any classes	24.1	3.2	505	4.7
	One of these forms of ability grouping between classes for some classes	58.0	3.8	497	3.2
	One of these forms of ability grouping for all classes	17.9	2.8	508	8.1
Spain	No ability grouping between any classes	*7.6*	*1.6*	*496*	*7.4*
	One of these forms of ability grouping between classes for some classes	43.8	2.8	486	3.4
	One of these forms of ability grouping for all classes	48.6	2.9	481	2.6
Estonia	No ability grouping between any classes	*10.9*	*2.1*	*517*	*7.9*
	One of these forms of ability grouping between classes for some classes	61.1	2.9	523	2.5
	One of these forms of ability grouping for all classes	28.0	2.6	516	3.9
Finland	No ability grouping between any classes	35.5	3.5	523	2.7
	One of these forms of ability grouping between classes for some classes	46.4	3.8	517	2.5
	One of these forms of ability grouping for all classes	18.0	2.5	513	6.0

[107] When estimates are unreliable, they are not reported and the corresponding cells include an *. Estimates that should be interpreted with caution are presented in italic.

		Students in schools where principal reported on ability grouping within schools			
MS		% of students	S.E.	Mathematics mean	S.E.
France	No ability grouping between any classes	43.8	3.5	509	6.1
	One of these forms of ability grouping between classes for some classes	31.4	3.2	480	8.8
	One of these forms of ability grouping for all classes	24.8	3.3	489	11.1
United Kingdom	No ability grouping between any classes	*	*	*	*1
	One of these forms of ability grouping between classes for some classes	37.1	3.4	498	8.2
	One of these forms of ability grouping for all classes	62.2	3.5	494	3.7
Greece	No ability grouping between any classes	81.4	3.2	459	3.0
	One of these forms of ability grouping between classes for some classes	*11.3*	*3.2*	*421*	*10.2*
	One of these forms of ability grouping for all classes	*7.3*	*1.8*	*444*	*21.3*
Croatia	No ability grouping between any classes	*8.0*	*2.4*	*504*	*19.0*
	One of these forms of ability grouping between classes for some classes	37.8	3.9	469	6.4
	One of these forms of ability grouping for all classes	54.2	4.2	467	6.7
Hungary	No ability grouping between any classes	23.3	2.9	470	8.5
	One of these forms of ability grouping between classes for some classes	31.2	3.8	499	10.6
	One of these forms of ability grouping for all classes	45.5	3.8	467	6.2
Ireland	No ability grouping between any classes	*	*	*	*
	One of these forms of ability grouping between classes for some classes	40.2	4.0	498	4.5
	One of these forms of ability grouping for all classes	59.0	4.0	506	3.9
Italy	No ability grouping between any classes	24.1	1.7	501	6.2
	One of these forms of ability grouping between classes for some classes	48.7	1.9	489	2.9
	One of these forms of ability grouping for all classes	27.3	1.9	471	5.5
Lithuania	No ability grouping between any classes	15.9	2.8	485	9.4
	One of these forms of ability grouping between classes for some classes	24.7	3.0	486	7.1
	One of these forms of ability grouping for all classes	59.4	3.4	476	3.8
Luxembourg	No ability grouping between any classes	32.1	0.1	522	1.8
	One of these forms of ability grouping between classes for some classes	41.4	0.1	467	1.5
	One of these forms of ability grouping for all classes	26.5	0.1	485	1.8
Latvia	No ability grouping between any classes	*17.8*	*3.0*	*491*	*8.2*
	One of these forms of ability grouping between classes for some classes	46.1	3.9	489	4.6
	One of these forms of ability grouping for all classes	36.1	3.3	492	4.7

MS		Students in schools where principal reported on ability grouping within schools: % of students	S.E.	Mathematics mean	S.E.
Netherlands	No ability grouping between any classes	*6.4*	*1.7*	*540*	*10.1*
	One of these forms of ability grouping between classes for some classes	39.0	4.6	525	8.5
	One of these forms of ability grouping for all classes	54.6	4.9	516	7.8
Poland	No ability grouping between any classes	42.4	4.1	513	5.1
	One of these forms of ability grouping between classes for some classes	*19.3*	*3.5*	*511*	*7.0*
	One of these forms of ability grouping for all classes	38.3	4.3	524	7.9
Portugal	No ability grouping between any classes	38.3	4.1	513	5.2
	One of these forms of ability grouping between classes for some classes	38.1	3.7	466	5.9
	One of these forms of ability grouping for all classes	23.6	3.5	477	9.1
Romania	No ability grouping between any classes	*9.7*	*2.2*	*452*	*15.6*
	One of these forms of ability grouping between classes for some classes	44.3	3.6	442	5.8
	One of these forms of ability grouping for all classes	45.9	3.5	445	6.4
Slovak Republic	No ability grouping between any classes	28.4	3.3	493	9.0
	One of these forms of ability grouping between classes for some classes	39.1	3.3	487	7.6
	One of these forms of ability grouping for all classes	32.5	2.9	464	9.6
Slovenia	No ability grouping between any classes	50.5	0.7	499	1.6
	One of these forms of ability grouping between classes for some classes	42.1	0.7	511	1.8
	One of these forms of ability grouping for all classes	7.4	0.9	493	9.8
Sweden	No ability grouping between any classes	*15.7*	*2.8*	*472*	*6.6*
	One of these forms of ability grouping between classes for some classes	27.8	3.3	479	5.8
	One of these forms of ability grouping for all classes	56.5	3.3	480	3.1
EU 26 average	No ability grouping between any classes	27.2	0.5	499	1.8
	One of these forms of ability grouping between classes for some classes	38.7	0.7	488	1.3
	One of these forms of ability grouping for all classes	34.1	0.6	482	1.7

Table 4.1. School principals' views on teacher focus index for EU MS (left part of graph 4)

MS	Index of teacher focus: Mean index	S.E.	Variability in the index (Standard deviation)	S.E.
Austria	-0.57	0.08	1.03	0.07
Belgium	-0.60	0.06	0.91	0.05
Bulgaria	0.66	0.06	0.86	0.04
Czech Republic	-0.22	0.05	0.92	0.05
Germany	-0.53	0.06	0.80	0.05
Denmark	0.15	0.05	0.85	0.03
Spain	-0.11	0.07	1.03	0.04
Estonia	0.38	0.06	0.98	0.04
Finland	-0.17	0.05	0.83	0.04
France	-0.75	0.08	1.02	0.05
United Kingdom	0.07	0.07	0.95	0.05
Greece	0.05	0.07	0.98	0.04
Croatia	-0.19	0.08	0.97	0.05
Hungary	0.04	0.09	0.97	0.05
Ireland	0.21	0.09	1.02	0.06
Italy	-0.46	0.04	0.92	0.03
Lithuania	0.80	0.06	1.01	0.04
Luxembourg	-0.49	0.00	0.81	0.00
Latvia	0.56	0.06	0.85	0.04
Netherlands	-0.64	0.07	0.85	0.06
Poland	0.46	0.06	0.80	0.04
Portugal	-0.01	0.08	0.92	0.05
Romania	0.66	0.07	0.80	0.04
Slovak Republic	-0.01	0.05	0.72	0.04
Slovenia	-0.20	0.01	1.03	0.01
Sweden	0.05	0.06	0.95	0.05
EU 26 average	-0.03	0.01	0.92	0.01

Table 4.2. School principals' views on the teachers trying new methods, social development and adapt standards, for EU MS[108] (right part of graph 4)

	Students in schools where principal reported that teachers are interested in trying new methods and teaching practices				**Students in schools where principal reported that the social and emotional development of the students is as important as their acquisition of mathematical skills and knowledge in Mathematics classes**				**Students in schools where principal reported there is a consensus among teachers that it is best to adapt academic standards to the students' levels and needs**			
MS	Strongly agree	S.E.	Agree	S.E.	Strongly agree	S.E.	Agree	S.E.	Strongly agree	S.E.	Agree	S.E.
Austria	28.3	3.6	53.1	4.6	*18.6*	*3.4*	40.5	4.2	*	*	31.4	3.7
Belgium	12.8	2.1	66.6	2.6	*9.4*	*1.8*	48.1	3.1	*6.1*	*1.6*	37.0	3.0
Bulgaria	*38.1*	*3.7*	55.6	3.4	37.0	3.2	55.7	3.3	43.6	3.3	48.3	3.5
Croatia	13.8	2.7	69.6	3.5	*14.0*	*2.9*	50.3	4.3	*14.7*	*2.8*	65.9	3.8
Czech Republic	23.8	2.7	67.6	3.5	12.1	1.9	62.0	3.5	*10.0*	*1.8*	45.0	3.9
Denmark	22.5	2.8	64.6	3.7	14.9	2.4	56.3	3.7	34.6	3.1	56.9	3.4
Estonia	28.5	2.6	61	2.9	26.9	2.8	55.8	3.1	35.1	2.6	55.1	2.7
Finland	20.7	2.7	65.2	3.4	*6.3*	*1.5*	51.5	3.4	*15.3*	*2.7*	69.4	3.2
France	*14.7*	*2.6*	51.9	3.8	*5.2*	*1.5*	41.8	3.2	*7.8*	*1.9*	38.0	3.4
Germany	*13.1*	*2.5*	71.4	3.6	*17.0*	*2.9*	59.1	3.4	*4.9*	*1.6*	24.9	3.0
Greece	20.2	2.7	54.4	3.4	28.3	3.5	54.5	3.9	24.5	3.9	49.4	4.2
Hungary	26	3.6	63.5	3.8	*15.6*	*2.9*	54.0	3.8	26.6	3.8	48.7	3.5
Ireland	39.8	4	50.2	4.2	20.9	3.2	55.6	4.3	25.2	3.5	53.4	4.0
Italy	12.7	1.5	60.9	2.4	12.4	1.4	48.0	2.1	7.9	1.1	50.5	2.2
Latvia	46.2	3.8	53.5	3.8	27.2	3.1	65.1	3.4	27.2	3.5	61.5	3.6
Lithuania	39.7	3.7	56	3.9	51.2	3.4	39.8	3.8	49.5	3.1	40.6	3.2
Luxembourg	37.9	0.1	48.2	0.1	1.2	0.0	60.1	0.1	3.7	0.0	25.1	0.1
Netherlands	*	*	45.7	4.4	*	*	48.2	5.0	*16.2*	*2.9*	61.9	3.9
Poland	23.2	3.6	65.6	3.8	31.8	4.0	65.1	4.0	33.6	3.7	61.6	3.7
Portugal	32.3	3.8	58	4	*16.5*	*3.6*	55.8	4.1	*13.7*	*3.3*	58.0	4.3
Romania	36.7	3.5	59.5	3.4	38.4	4.1	56.4	4.0	39.2	3.9	53.0	3.8
Slovak Republic	26	2.6	68.4	2.8	*13.8*	*2.5*	69.4	3.2	*8.9*	*1.8*	62.4	3.8
Slovenia	22.9	0.6	55.8	0.7	13.8	0.4	57.1	0.6	14.3	0.3	52.4	0.6
Spain	17.6	2.4	62	2.6	19.4	2.5	50.5	2.7	18.0	2.3	56.5	2.7
Sweden	23.4	2.9	63.6	3.6	*17.5*	*3.0*	49.4	3.8	24.6	3.1	62.1	3.4
United Kingdom	37	3.3	52.9	3.3	15.0	2.4	51.9	3.3	28.9	2.9	45.1	2.9
EU 26 average	25.5	0.6	59.4	0.7	18.7	0.5	53.9	0.7	20.7	0.5	50.5	0.7

[108] When estimates are unreliable, they are not reported and the corresponding cells include an *. Estimates that should be interpreted with caution are presented in italic.

Table 5. Distribution by answer category of school principals' views of variable measuring teachers' intentions – stay with well-known methods for the EU MS[109]

MS		Students in schools where the principal reported teachers stay with well-known methods			
		% of students	S.E.	Mathematics mean	S.E.
Austria	Strongly agree	*	*	*	*
	Agree	35.2	3.7	503	8.0
	Disagree	52.5	4.2	509	5.2
	Strongly disagree	*10.6*	*2.7*	*508*	*11.2*
Belgium	Strongly agree	*6.7*	*1.3*	*494*	*17.1*
	Agree	54.9	2.8	522	4.8
	Disagree	37.5	2.7	514	7.0
	Strongly disagree	*	*	*	*
Bulgaria	Strongly agree	*22.9*	*3.2*	*436*	*11.0*
	Agree	62.2	3.7	436	5.5
	Disagree	*14.9*	*2.9*	*455*	*13.5*
	Strongly disagree				
Czech Republic	Strongly agree	*6.2*	*1.8*	*500*	*14.4*
	Agree	51.9	3.7	498	5.7
	Disagree	40.1	3.6	499	6.8
	Strongly disagree	*1.8*	*0.6*	*537*	*16.6*
Germany	Strongly agree	*	*	*	*
	Agree	30.7	3.3	502	8.4
	Disagree	59.7	3.5	517	5.7
	Strongly disagree	*7.1*	*2.0*	*557*	*14.7*
Denmark	Strongly agree	*	*	*	*
	Agree	56.7	3.4	502	3.5
	Disagree	37.5	3.4	501	3.8
	Strongly disagree	*	*	*	*
Spain	Strongly agree	*7.9*	*1.4*	*500*	*8.1*
	Agree	52.9	2.7	481	3.1
	Disagree	38.2	2.5	487	2.5
	Strongly disagree	*	*	*	*
Estonia	Strongly agree	19.0	1.9	516	4.0
	Agree	73.3	2.4	521	2.5
	Disagree	7.2	1.6	526	8.5
	Strongly disagree	*0.6*	*0.1*	*530*	*12.5*
Finland	Strongly agree	*	*	*	*
	Agree	33.1	2.9	519	3.0
	Disagree	60.0	3.2	517	2.8
	Strongly disagree	*	*	*	*
France	Strongly agree	18.2	2.6	507	12.9
	Agree	61.0	3.8	502	4.6
	Disagree	18.1	2.6	473	13.8
	Strongly disagree	*	*	*	*
United Kingdom	Strongly agree	*8.0*	*2.0*	*513*	*11.4*
	Agree	37.4	3.2	507	5.5
	Disagree	48.7	3.4	483	6.5
	Strongly disagree	*5.9*	*1.5*	*501*	*10.9*
Greece	Strongly agree	*13.4*	*2.8*	*463*	*11.3*
	Agree	59.4	4.1	449	3.7
	Disagree	26.1	4.1	455	8.2
	Strongly disagree	*	*	*	*

[109] When estimates are unreliable, they are not reported and the corresponding cells include an *. Estimates that should be interpreted with caution are presented in italic.

		Students in schools where the principal reported teachers stay with well-known methods			
MS		% of students	S.E.	Mathematics mean	S.E.
Croatia	Strongly agree	*5.8*	*1.8*	*457*	*17.5*
	Agree	50.8	4.0	471	4.9
	Disagree	41.2	3.9	475	8.4
	Strongly disagree	*	*	*	*
Hungary	Strongly agree	27.4	3.6	475	10.4
	Agree	62.2	4.0	482	6.6
	Disagree	*10.4*	*2.7*	*463*	*14.6*
	Strongly disagree				
Ireland	Strongly agree	*11.7*	*2.4*	*504*	*5.3*
	Agree	32.9	3.6	507	4.6
	Disagree	50.3	4.0	499	4.2
	Strongly disagree	*5.1*	*1.7*	*508*	*10.4*
Italy	Strongly agree	17.3	1.5	491	6.8
	Agree	58.7	1.9	485	2.9
	Disagree	23.5	1.8	492	5.5
	Strongly disagree	v	*	*	*
Lithuania	Strongly agree	*15.1*	*2.7*	*480*	*8.1*
	Agree	56.5	3.4	481	4.3
	Disagree	21.3	2.7	476	5.7
	Strongly disagree	*7.1*	*1.8*	*468*	*14.2*
Luxembourg	Strongly agree	16.0	0.1	462	2.6
	Agree	60.0	0.1	505	1.4
	Disagree	24.0	0.1	479	1.9
	Strongly disagree				
Latvia	Strongly agree	*8.1*	*2.1*	*479*	*12.5*
	Agree	51.4	3.6	487	4.3
	Disagree	37.6	3.7	489	4.6
	Strongly disagree	*	*	*	*
Netherlands	Strongly agree	*10.9*	*2.7*	*536*	*16.2*
	Agree	54.1	4.2	528	6.3
	Disagree	35.0	4.0	511	10.9
	Strongly disagree				
Poland	Strongly agree	*	*	*	*
	Agree	31.0	4.1	514	5.7
	Disagree	57.4	4.4	516	3.9
	Strongly disagree	*7.1*	*2.2*	*559*	*20.6*
Portugal	Strongly agree	*9.3*	*2.4*	*494*	*16.1*
	Agree	53.3	4.2	488	5.6
	Disagree	34.2	3.8	482	6.6
	Strongly disagree	*	*	*	*
Romania	Strongly agree	21.3	3.2	435	8.7
	Agree	54.9	3.9	452	5.3
	Disagree	23.8	3.2	436	9.0
	Strongly disagree				
Slovak Republic	Strongly agree	*	*	*	*
	Agree	42.6	3.4	474	7.2
	Disagree	51.0	3.8	490	6.5
	Strongly disagree	*	*	*	*
Slovenia	Strongly agree	18.4	0.6	479	2.8
	Agree	57.5	0.7	514	1.9
	Disagree	24.2	0.6	496	3.0
	Strongly disagree				

		Students in schools where the principal reported teachers stay with well-known methods			
MS		% of students	S.E.	Mathematics mean	S.E.
Sweden	Strongly agree	*5.5*	*1.6*	*509*	*11.8*
	Agree	43.4	3.8	477	3.6
	Disagree	47.6	4.0	477	3.7
	Strongly disagree	*	*	*	*
EU 26 average	Strongly agree	11.1	0.4	489	2.6
	Agree	50.7	0.7	493	1.0
	Disagree	35.5	0.6	489	1.5
	Strongly disagree	2.7	0.3	496	4.6

Table 6. Students report on opportunities to learn Mathematics tasks and concepts for EU MS

MS	Index of experience with applied mathematical tasks				Index of experience with pure mathematical tasks				Index of familiarity with Mathematics Concepts			
	Mean index	S.E.	Variability in the index (Standard deviation)	S.E.	Mean index	S.E.	Variability in the index (Standard deviation)	S.E.	Mean index	S.E.	Variability in the index (Standard deviation)	S.E.
Austria	-0.03	0.02	0.88	0.02	-0.03	0.02	1.10	0.02	-0.13	0.02	0.84	0.03
Belgium	-0.23	0.01	0.95	0.02	-0.09	0.02	1.15	0.01	0.13	0.02	0.99	0.02
Bulgaria	0.00	0.02	1.07	0.02	0.06	0.03	0.95	0.02	0.34	0.03	1.17	0.03
Czech Republic	-0.25	0.02	0.87	0.02	-0.09	0.03	0.97	0.02	0.18	0.02	0.74	0.03
Germany	0.06	0.02	0.88	0.02	0.13	0.02	0.92	0.02	-0.03	0.02	0.88	0.03
Denmark	0.27	0.02	0.98	0.02	-0.37	0.02	1.04	0.01	-0.09	0.02	0.82	0.03
Spain	0.17	0.01	0.87	0.02	0.27	0.01	0.83	0.01	0.25	0.02	1.05	0.02
Estonia	0.07	0.02	0.82	0.02	0.03	0.02	0.94	0.02	0.38	0.01	0.72	0.02
Finland	0.23	0.02	0.85	0.02	0.00	0.02	0.90	0.01	-0.37	0.01	0.75	0.03
France	-0.05	0.02	0.92	0.02	0.02	0.02	1.05	0.02	0.08	0.02	0.80	0.03
United Kingdom	0.03	0.02	0.94	0.02	0.02	0.02	0.99	0.01	-0.29	0.02	0.89	0.02
Greece	-0.41	0.02	1.08	0.02	0.05	0.02	1.04	0.02	0.42	0.02	1.06	0.04
Croatia	-0.04	0.02	0.96	0.02	0.19	0.02	0.87	0.02	0.34	0.02	0.88	0.02
Hungary	0.11	0.02	0.98	0.03	0.14	0.02	0.90	0.02	0.32	0.03	0.89	0.06
Ireland	0.14	0.02	0.86	0.02	0.14	0.02	0.95	0.02	-0.46	0.02	0.94	0.03
Italy	-0.42	0.01	0.92	0.01	0.22	0.01	0.92	0.01	0.33	0.02	0.93	0.01
Lithuania	0.19	0.02	0.87	0.02	0.13	0.02	0.84	0.01	-0.07	0.02	0.73	0.02
Luxembourg	-0.28	0.02	1.04	0.02	-0.25	0.02	1.15	0.01	-0.25	0.02	1.10	0.03
Latvia	0.02	0.02	0.84	0.02	-0.01	0.02	0.87	0.02	0.45	0.02	0.73	0.02
Netherlands	0.22	0.02	0.94	0.02	-0.01	0.03	1.04	0.02	-0.42	0.03	0.89	0.03
Poland	0.48	0.02	0.86	0.02	0.09	0.02	0.81	0.01	0.30	0.02	0.81	0.03
Portugal	-0.37	0.02	1.11	0.03	-0.35	0.03	1.15	0.02	0.14	0.03	0.88	0.03
Romania	0.10	0.02	1.02	0.02	-0.07	0.03	0.95	0.01	0.49	0.04	1.14	0.03
Slovak Republic	0.05	0.02	0.93	0.02	-0.11	0.02	0.91	0.02	-0.07	0.02	0.82	0.04
Slovenia	0.04	0.02	0.97	0.02	0.20	0.02	0.87	0.01	0.36	0.01	0.89	0.03
Sweden	0.33	0.02	1.01	0.02	-0.25	0.02	0.96	0.01	-1.31	0.03	1.07	0.03
EU 26 average	0.02	0.00	0.94	0.00	0.00	0.00	0.96	0.00	0.04	0.00	0.90	0.01

Table 7. Students report on teaching practices in Mathematics classes for EU MS

MS	Index of teacher-directed instruction				Index of teachers' student orientation				Index of teachers' use of formative assessment and feedback			
	Mean index	S.E.	Variability in the index (Standard deviation)	S.E.	Mean index	S.E.	Variability in the index (Standard deviation)	S.E.	Mean index	S.E.	Variability in the index (Standard deviation)	S.E.
Austria	-0.10	0.02	0.93	0.02	-0.27	0.02	1.00	0.01	0.05	0.02	0.93	0.02
Belgium	-0.10	0.02	0.95	0.02	-0.26	0.02	0.98	0.01	-0.11	0.02	0.93	0.01
Bulgaria	0.55	0.03	1.05	0.02	0.70	0.03	1.06	0.02	0.75	0.02	1.01	0.02
Czech Republic	0.13	0.03	0.90	0.02	0.05	0.02	0.84	0.02	-0.14	0.02	0.88	0.02
Germany	-0.05	0.02	0.88	0.02	-0.05	0.02	0.94	0.01	-0.09	0.02	0.91	0.01
Denmark	-0.29	0.02	0.86	0.02	0.19	0.02	0.78	0.01	-0.10	0.02	0.87	0.01
Spain	-0.13	0.02	0.99	0.01	-0.14	0.02	1.05	0.01	-0.06	0.02	1.07	0.01
Estonia	-0.16	0.02	0.86	0.02	-0.14	0.02	0.86	0.01	-0.07	0.02	0.84	0.02
Finland	-0.12	0.02	0.88	0.01	-0.06	0.02	0.81	0.01	-0.17	0.02	0.91	0.01
France	-0.05	0.03	1.07	0.02	-0.40	0.02	0.94	0.01	-0.10	0.02	0.93	0.01
United Kingdom	0.15	0.02	0.94	0.01	0.02	0.02	0.91	0.01	0.33	0.02	0.95	0.01
Greece	0.21	0.02	1.04	0.02	-0.16	0.03	1.14	0.02	-0.05	0.02	1.06	0.02
Croatia	0.06	0.02	0.98	0.02	-0.37	0.03	1.00	0.02	0.07	0.02	0.85	0.02
Hungary	-0.01	0.03	0.97	0.03	-0.41	0.03	1.01	0.02	0.01	0.03	0.94	0.02
Ireland	-0.08	0.02	0.98	0.02	-0.58	0.03	0.94	0.01	-0.07	0.02	0.93	0.01
Italy	-0.16	0.02	0.98	0.01	-0.03	0.01	0.90	0.01	0.16	0.01	0.96	0.01
Lithuania	0.15	0.02	0.90	0.02	0.19	0.03	0.94	0.02	0.01	0.03	1.00	0.02
Luxembourg	-0.12	0.02	1.07	0.02	-0.24	0.02	1.11	0.01	-0.15	0.02	1.03	0.02
Latvia	0.25	0.03	0.89	0.03	0.24	0.03	0.85	0.02	0.11	0.02	0.84	0.02
Netherlands	-0.12	0.03	0.97	0.02	-0.07	0.03	1.04	0.02	-0.07	0.03	0.88	0.02
Poland	-0.22	0.02	0.94	0.02	-0.10	0.03	0.98	0.02	-0.05	0.02	0.92	0.02
Portugal	0.27	0.03	1.06	0.02	0.24	0.04	1.15	0.02	0.31	0.03	1.13	0.02
Romania	0.26	0.03	1.08	0.02	0.41	0.04	1.15	0.02	0.36	0.03	1.02	0.02
Slovak Republic	-0.04	0.02	0.94	0.02	0.07	0.03	0.99	0.02	0.16	0.02	0.93	0.01
Slovenia	0.10	0.02	0.99	0.01	-0.30	0.02	1.08	0.01	0.01	0.02	0.90	0.02
Sweden	-0.04	0.02	0.99	0.02	0.44	0.02	0.85	0.02	0.07	0.02	0.98	0.02
EU 26 average	0.01	0.00	0.97	0.00	-0.04	0.01	0.97	0.00	0.04	0.00	0.95	0.00

Table 8. Students report on teaching quality for EU MS

	Index of disciplinary climate				Index of teacher support				Index of teachers' use of cognitive activation strategies			
MS	Mean index	S.E.	Variability in the index (Standard deviation)	S.E.	Mean index	S.E.	Variability in the index (Standard deviation)	S.E.	Mean index	S.E.	Variability in the index (Standard deviation)	S.E.
Austria	0.21	0.03	1.08	0.02	-0.46	0.03	0.99	0.02	-0.10	0.02	0.90	0.02
Belgium	0.04	0.03	1.04	0.01	-0.14	0.02	0.97	0.01	-0.19	0.02	0.98	0.02
Bulgaria	-0.20	0.03	0.91	0.01	0.22	0.03	0.96	0.02	0.53	0.03	1.13	0.03
Czech Republic	0.10	0.04	1.09	0.02	-0.23	0.03	0.93	0.02	0.15	0.02	0.89	0.02
Germany	-0.02	0.02	1.02	0.01	-0.31	0.03	0.97	0.01	0.02	0.02	0.83	0.02
Denmark	-0.01	0.03	0.89	0.02	0.19	0.03	0.90	0.01	-0.03	0.02	0.77	0.01
Spain	-0.04	0.02	1.03	0.01	0.12	0.02	1.04	0.01	0.10	0.02	1.00	0.02
Estonia	0.20	0.03	0.96	0.01	-0.11	0.02	0.85	0.01	-0.06	0.02	0.82	0.02
Finland	-0.33	0.02	0.86	0.01	0.16	0.02	0.90	0.01	-0.06	0.02	0.89	0.02
France	-0.29	0.03	1.05	0.01	-0.23	0.03	0.99	0.01	-0.07	0.02	0.87	0.02
United Kingdom	0.15	0.02	1.07	0.01	0.34	0.02	0.95	0.01	0.34	0.02	1.00	0.02
Greece	-0.24	0.03	0.90	0.02	-0.16	0.02	0.92	0.02	0.08	0.02	0.98	0.03
Croatia	-0.12	0.03	1.02	0.01	-0.35	0.03	0.92	0.01	-0.14	0.02	0.91	0.02
Hungary	0.05	0.04	1.02	0.02	-0.20	0.04	0.98	0.02	-0.08	0.03	0.88	0.03
Ireland	0.13	0.03	1.10	0.02	0.08	0.02	1.04	0.01	0.13	0.02	1.00	0.02
Italy	-0.04	0.02	0.99	0.01	-0.19	0.02	0.95	0.01	-0.10	0.02	0.90	0.01
Lithuania	0.28	0.03	1.06	0.01	0.05	0.02	0.87	0.02	0.08	0.02	0.87	0.02
Luxembourg	-0.02	0.02	1.09	0.01	-0.39	0.02	1.10	0.01	-0.09	0.02	1.05	0.02
Latvia	0.08	0.04	0.95	0.02	0.06	0.03	0.83	0.03	0.07	0.02	0.74	0.02
Netherlands	-0.16	0.03	0.92	0.02	-0.45	0.03	0.89	0.02	-0.21	0.03	0.98	0.02
Poland	0.08	0.04	1.05	0.02	-0.26	0.03	0.98	0.01	0.05	0.02	0.91	0.02
Portugal	0.00	0.03	0.97	0.01	0.44	0.03	1.00	0.01	0.38	0.03	1.14	0.02
Romania	0.01	0.04	1.00	0.01	0.13	0.02	0.90	0.01	0.24	0.02	0.94	0.02
Slovak Republic	-0.13	0.03	0.93	0.02	-0.15	0.03	0.95	0.02	-0.18	0.02	0.85	0.02
Slovenia	0.06	0.02	1.04	0.01	-0.37	0.02	0.90	0.01	-0.03	0.02	0.84	0.02
Sweden	-0.20	0.03	0.89	0.01	0.23	0.03	1.02	0.01	-0.22	0.02	1.04	0.02
EU 26 average	-0.02	0.01	1.00	0.00	-0.08	0.00	0.95	0.00	0.02	0.00	0.93	0.00

Table 9. Students views on use of ICT in Mathematics classes for the EU MS

MS	Index of ICT use in Mathematics classes			
	Mean index	S.E.	Variability in the index (Standard deviation)	S.E.
Austria	0.01	0.02	0.90	0.01
Belgium	-0.13	0.02	0.87	0.01
Czech Republic	-0.19	0.02	0.89	0.02
Germany	-0.17	0.02	0.86	0.01
Denmark	0.72	0.04	1.17	0.01
Spain	-0.06	0.02	1.00	0.01
Estonia	0.15	0.02	0.95	0.01
Finland	-0.33	0.01	0.76	0.01
Greece	0.01	0.02	1.02	0.01
Croatia	-0.18	0.02	0.93	0.02
Hungary	-0.13	0.02	0.96	0.02
Ireland	-0.15	0.02	0.85	0.02
Italy	0.08	0.02	1.01	0.01
Latvia	0.06	0.03	0.99	0.02
Netherlands	-0.09	0.02	0.87	0.02
Poland	-0.24	0.03	0.91	0.02
Portugal	0.13	0.03	1.05	0.02
Slovak Republic	-0.04	0.03	1.01	0.01
Slovenia	-0.05	0.01	0.98	0.01
Sweden	-0.22	0.02	0.94	0.02
EU 21 average	-0.04	0.01	0.95	0.00

Table 10. Distribution of school principals' views on teacher peer review for EU MS[110]

MS		Students in schools where the principal reported teacher peer review (of lesson plans, assessment instruments, lessons)			
		% of students	SE	Mean	SE
Austria	Yes	78.6	3.4	505	3.5
	No	21.4	3.4	512	10.6
Belgium	Yes	76.3	2.4	527	3.5
	No	23.7	2.4	489	8.8
Bulgaria	Yes	29.4	3.7	469	10.6
	No	70.6	3.7	426	5.5
Czech Republic	Yes	66.6	3.7	503	4.5
	No	33.4	3.7	494	7.4
Germany	Yes	44.6	3.0	512	7.0
	No	55.4	3.0	516	5.4
Denmark	Yes	40.9	3.6	497	4.1
	No	59.1	3.6	502	3.6
Spain	Yes	21.9	2.2	490	4.2
	No	78.1	2.2	483	2.3
Estonia	Yes	48.8	2.7	518	3.1
	No	51.2	2.7	522	2.7
Finland	Yes	19.1	2.9	523	3.1
	No	80.9	2.9	518	2.3
France	Yes	42.5	3.5	501	6.3
	No	57.5	3.5	496	5.8
United Kingdom	Yes	92.9	1.5	492	3.9
	No	*7.1*	*1.5*	*530*	*11.8*
Greece	Yes	26.0	3.5	461	6.9
	No	74.0	3.5	451	3.8
Croatia	Yes	62.0	3.7	477	5.4
	No	38.0	3.7	461	6.2
Hungary	Yes	74.5	3.1	481	4.2
	No	25.5	3.1	473	11.1
Ireland	Yes	33.7	3.6	506	5.7
	No	66.3	3.6	500	2.8
Italy	Yes	87.4	1.7	488	2.5
	No	12.6	1.7	479	6.5
Lithuania	Yes	74.7	3.1	480	3.3
	No	25.3	3.1	473	5.7
Luxembourg	Yes	63.3	0.1	494	1.0
	No	36.7	0.1	488	1.6
Latvia	Yes	89.3	2.3	488	2.7
	No	*10.7*	*2.3*	*493*	*10.5*
Netherlands	Yes	54.0	4.6	520	7.8
	No	46.0	4.6	526	7.9
Poland	Yes	64.4	4.0	514	4.1
	No	35.6	4.0	524	7.1
Portugal	Yes	71.3	4.6	487	4.9
	No	28.7	4.6	484	8.9
Romania	Yes	69.4	3.1	445	4.1
	No	30.6	3.1	446	8.3

110 When estimates are unreliable, they are not reported and the corresponding cells include an *. Estimates that should be interpreted with caution are presented in italic.

MS		Students in schools where the principal reported teacher peer review (of lesson plans, assessment instruments, lessons)			
		% of students	SE	Mean	SE
Austria	Yes	78.6	3.4	505	3.5
	No	21.4	3.4	512	10.6
Slovak Republic	Yes	84.2	3.0	479	4.9
	No	*15.8*	*3.0*	*493*	*14.7*
Slovenia	Yes	62.4	0.8	514	1.6
	No	37.6	0.8	486	2.1
Sweden	Yes	58.7	3.7	479	3.2
	No	41.3	3.7	478	4.1
26 EU average	Yes	59.1	0.6	494	1.0
	No	40.9	0.6	490	1.43

Table 11.1. School principals' views of teacher morale for the EU MS (left part of graph 11)

	Index of teacher morale			
MS	Mean index	S.E.	Variability in the index (Standard deviation)	S.E.
Austria	0.54	0.07	0.81	0.54
Belgium	-0.27	0.06	0.90	-0.27
Bulgaria	0.21	0.07	0.88	0.21
Czech Republic	-0.10	0.05	0.78	-0.10
Germany	0.01	0.06	0.92	0.01
Denmark	0.40	0.06	0.92	0.40
Spain	-0.43	0.05	0.98	-0.43
Estonia	0.05	0.05	0.87	0.05
Finland	0.33	0.06	0.83	0.33
France	-0.39	0.07	0.98	-0.39
United Kingdom	0.45	0.06	0.92	0.45
Greece	-0.41	0.09	1.09	-0.41
Croatia	-0.29	0.07	0.92	-0.29
Hungary	-0.02	0.07	0.90	-0.02
Ireland	0.49	0.08	0.96	0.49
Italy	-0.60	0.03	0.92	-0.60
Lithuania	0.34	0.06	0.83	0.34
Luxembourg	0.00	0.00	0.76	0.00
Latvia	0.09	0.06	0.78	0.09
Netherlands	-0.19	0.07	0.85	-0.19
Poland	-0.14	0.08	0.90	-0.14
Portugal	-0.17	0.08	0.98	-0.17
Romania	-0.04	0.07	0.87	-0.04
Slovak Republic	-0.27	0.06	0.84	-0.27
Slovenia	-0.18	0.01	0.89	-0.18
Sweden	0.39	0.07	0.87	0.39
EU 26 average	-0.01	0.01	0.89	-0.01

Table 11.2. School principals' views of teacher morale for the EU MS[111] (right part of graph 11)

	Students in schools where principal reported that the morale of teachers in this school is high				**Students in schools where principal reported that teachers work with enthusiasm**				**Students in schools where principal reported teachers take pride in the school**				**Students in schools where principal reported teachers value academic achievement**			
MS	Strongly agree	S.E.	Agree	S.E.	Strongly agree	S.E.	Agree	S.E.	Strongly agree	S.E.	Agree	S.E.	Strongly agree	S.E.	Agree	S.E.
Austria	56	4.4	43.9	4.4	51.2	4.2	48.8	4.2	53.6	4.2	44.4	4.1	64.7	4.4	34	4.5
Belgium	18.4	2.4	70.3	2.5	20.8	2.7	74.5	3.1	29	3.1	65.5	2.9	34.7	3.1	59.9	3.3
Bulgaria	56.4	3.6	43.1	3.6	28.4	3.3	65.6	3.2	54.5	4	42.4	3.8	38.8	3.5	54.3	3.4
Czech Republic	33.1	3	66.5	3	8.7	2	83.3	2.6	26.6	3.3	71	3.2	46.2	3.7	53.6	3.7
Germany	34.3	3.2	62.4	3.4	38.7	3.5	60.4	3.5	34.5	3.6	58.5	4	35.8	3.4	60	3.7
Denmark	53.8	3.3	44.9	3.3	57	3.5	42.4	3.5	51.1	3.5	45.3	3.7	46.5	3.9	52.9	3.8
Spain	13.8	1.8	62.5	2.8	15.2	1.8	70.2	2.9	30	2.4	64.3	2.5	41.4	2.5	52.5	2.5
Estonia	36.6	3.2	61.5	3.2	22.1	2.3	74.1	2.4	33.6	2.3	61	2.5	51.6	2.8	48	2.8
Finland	59.6	3.2	39.6	3.2	29	3.2	68	3.2	37.9	3.3	55.9	3.5	68.2	3.1	31.5	3.1
France	14.5	2.3	65.3	3.4	15.2	2.4	71.3	3.2	36.3	3.2	58	3.5	34.1	3	57.7	3.2
United Kingdom	31.1	2.9	59.7	3.2	50.5	3.2	47.6	3.5	65.2	3.2	33.2	3.1	77.5	2.9	22.5	2.9
Greece	24.5	3.2	59	3.8	19.3	2.8	64.6	4	35.4	4	50.1	4.4	30.8	3.7	61	4.1
Croatia	31.5	3.8	61.6	3.9	13.2	2.6	76.1	3.3	27.2	3.5	68.9	3.7	27.5	3.6	67.4	3.7
Hungary	30	3.5	66.5	3.7	17.8	3	69.8	3.4	37.3	4.1	58	4.2	58.9	3.8	40.1	3.9
Ireland	47.1	3.8	46.4	3.5	55.4	3.9	41.1	3.7	62.8	4	36	3.9	65.1	3.6	34.9	3.6
Italy	9.5	1.3	63.6	1.9	8.6	1.2	71.2	1.8	23.7	1.7	68.1	1.8	35.1	1.9	61.5	2
Lithuania	50.8	3.3	48.2	3.2	19.6	2.9	75.2	3.1	56.3	3.6	40.8	3.6	70	3.2	27.8	3.1
Luxembourg	28.3	0.1	68.9	0.1	17.3	0.1	82.7	0.1	33.3	0.1	62.8	0.1	49.9	0.1	50.1	0.1
Latvia	37.1	3.6	62.9	3.6	22.3	2.8	75.9	3	43.3	3.7	56.2	3.6	38	3.6	60.8	3.7
Netherlands	29.1	3.9	68.3	3.9	20	3.8	80	3.8	26	3.7	70	3.9	30.7	3.8	64.2	3.9
Poland	15.3	3	70.8	4.1	23.4	3.7	73.1	3.9	27.2	3.8	72	3.9	52.5	4.1	46	4.2
Portugal	16.7	3.3	59.6	4.2	16.5	2.7	72.7	3.7	36.7	3.8	59.7	3.9	62.9	4.5	36.8	4.5
Romania	30.7	3.7	63.7	4	18.9	3.2	70.7	3.7	44.7	4.2	51.2	4.2	41.4	4.2	55.3	4.1
Slovak Republic	33.7	3.6	64.2	3.6	5.4	1.5	79.9	3	24.7	3.2	71.8	3.3	34.2	3.5	63.5	3.6
Slovenia	12.7	0.4	77.1	0.6	16.6	0.8	77.4	0.9	32.8	0.9	61.4	0.9	51.8	0.7	46.7	0.7
Sweden	60.9	3.6	36	3.3	35.6	3.5	61.4	3.5	42.1	3.4	51.8	3.3	69.8	3.4	30.2	3.4
EU 26 average	33.3	0.6	59.1	0.7	24.9	0.6	68.4	0.6	38.7	0.7	56.9	0.7	48.4	0.7	34	4.5

[111] When estimates are unreliable, they are not reported and the corresponding cells include an *. Estimates that should be interpreted with caution are presented in italic.

Table 12. School principals' views on consensus among Mathematics teachers that academic achievement must be kept as high as possible for EU MS[112]

MS		Students in schools where the principal reported that there is a consensus among Mathematics teachers that academic achievement must be kept as high as possible			
		% of students	S.E.	Mathematics mean	S.E.
.Austria	Strongly agree	39.4	4.2	521	6.5
	Agree	48.0	3.9	501	5.9
	Disagree	*10.0*	*2.5*	*495*	*17.3*
	Strongly disagree	*	*	*	*
Belgium	Strongly agree	23.4	2.5	537	7.4
	Agree	59.9	2.8	522	4.6
	Disagree	16.2	1.9	469	10.6
	Strongly disagree	*	*	*	*
Bulgaria	Strongly agree	32.8	3.4	475	9.5
	Agree	49.1	3.6	422	5.7
	Disagree	16.5	2.7	427	7.7
	Strongly disagree	*	*	*	*
Czech Republic	Strongly agree	41.7	3.7	522	5.2
	Agree	53.3	3.7	488	6.4
	Disagree	*5.0*	*1.4*	*449*	*19.7*
	Strongly disagree				
Germany	Strongly agree	35.2	3.6	512	7.4
	Agree	53.3	4.0	519	5.5
	Disagree	*10.9*	*2.2*	*498*	*19.2*
	Strongly disagree	*	*	*	*
Denmark	Strongly agree	60.7	3.5	503	3.1
	Agree	38.1	3.5	497	4.3
	Disagree	*	*	*	*
	Strongly disagree				
Spain	Strongly agree	50.8	3.2	488	2.9
	Agree	43.1	3.0	481	4.0
	Disagree	6.1	0.9	479	7.4
	Strongly disagree	*	*	*	*
Estonia	Strongly agree	44.8	2.8	523	3.0
	Agree	50.4	2.8	518	3.3
	Disagree	*4.7*	*1.1*	*520*	*9.6*
	Strongly disagree				
Finland	Strongly agree	38.0	3.2	524	2.6
	Agree	51.8	3.5	516	3.0
	Disagree	*9.6*	*1.9*	*507*	*6.2*
	Strongly disagree	*	*	*	*
France	Strongly agree	34.2	2.9	527	6.7
	Agree	55.3	3.2	488	5.5
	Disagree	*10.5*	*2.1*	*446*	*12.3*
	Strongly disagree				
United Kingdom	Strongly agree	74.4	2.8	500	4.8
	Agree	25.2	2.8	480	7.8
	Disagree	*0.5*	*0.1*	*438*	*12.1*
	Strongly disagree				

[112] When estimates are unreliable, they are not reported and the corresponding cells include an *. Estimates that should be interpreted with caution are presented in italic.

MS		Students in schools where the principal reported that there is a consensus among Mathematics teachers that academic achievement must be kept as high as possible			
		% of students	S.E.	Mathematics mean	S.E.
Greece	Strongly agree	38.6	3.2	465	4.9
	Agree	51.7	3.7	447	4.3
	Disagree	*9.6*	*2.3*	*437*	*13.1*
	Strongly disagree	*	*	*	*
Croatia	Strongly agree	25.1	3.7	474	8.2
	Agree	62.1	4.1	471	5.4
	Disagree	*11.7*	*2.5*	*467*	*10.1*
	Strongly disagree	*	*	*	*
Hungary	Strongly agree	41.6	3.8	494	7.4
	Agree	51.7	4.0	473	6.3
	Disagree	*6.7*	*1.8*	*420*	*14.9*
	Strongly disagree				
Ireland	Strongly agree	64.5	3.9	507	3.3
	Agree	35.4	3.9	494	5.0
	Disagree	*	*	*	*
	Strongly disagree				
Italy	Strongly agree	29.3	1.8	509	5.0
	Agree	58.9	2.0	484	2.8
	Disagree	11.3	1.3	451	5.1
	Strongly disagree	*	*	*	*
Lithuania	Strongly agree	64.9	3.0	487	3.6
	Agree	31.2	3.0	463	5.4
	Disagree	*4.0*	*1.3*	*469*	*20.3*
	Strongly disagree				
Luxembourg	Strongly agree	42.5	0.1	519	1.7
	Agree	56.7	0.1	472	1.5
	Disagree	0.8	0.0	462	10.5
	Strongly disagree				
Latvia	Strongly agree	39.8	3.3	496	4.9
	Agree	52.7	3.5	486	4.0
	Disagree	*6.8*	*1.6*	*471*	*11.8*
	Strongly disagree	*	*	*	*
Netherlands	Strongly agree	37.2	4.3	544	8.8
	Agree	60.0	4.3	507	6.8
	Disagree	*	*	*	*
	Strongly disagree				
Poland	Strongly agree	53.0	4.1	529	5.4
	Agree	43.5	4.0	504	4.5
	Disagree	*3.6*	*1.1*	*509*	*14.2*
	Strongly disagree				
Portugal	Strongly agree	46.7	4.2	493	5.6
	Agree	46.8	4.5	482	6.8
	Disagree	*6.5*	*2.1*	*478*	*9.8*
	Strongly disagree				
Romania	Strongly agree	37.3	3.9	456	7.7
	Agree	57.4	3.8	438	4.7
	Disagree	*5.3*	*1.7*	*429*	*14.4*
	Strongly disagree				
Slovak Republic	Strongly agree	19.6	2.6	480	12.5
	Agree	66.7	3.4	487	5.6
	Disagree	*13.1*	*2.8*	*455*	*14.8*
	Strongly disagree	*	*	*	*

		Students in schools where the principal reported that there is a consensus among Mathematics teachers that academic achievement must be kept as high as possible			
MS		% of students	S.E.	Mathematics mean	S.E.
Slovenia	Strongly agree	41.7	0.7	517	2.6
	Agree	54.6	0.7	492	1.6
	Disagree	3.7	0.3	513	6.9
	Strongly disagree				
Sweden	Strongly agree	26.3	3.3	489	5.3
	Agree	50.4	3.7	478	3.4
	Disagree	22.3	3.1	469	5.6
	Strongly disagree	*	*	*	*
EU 26 average	Strongly agree	41.7	0.6	504	1.2
	Agree	50.3	0.7	485	1.0
	Disagree	7.7	0.4	472	2.4
	Strongly disagree	*0.4*	*0.1*	*472*	*5.9*

Table 13.1. Indexes of student related aspects of school climate for EU MS (left part of graph 13)

	Index of student climate			
MS	Mean index	S.E.	Variability in the index (Standard deviation)	S.E.
Austria	-0.30	0.08	0.95	0.06
Belgium	-0.08	0.06	1.04	0.05
Bulgaria	0.12	0.10	1.24	0.06
Czech Republic	0.20	0.06	0.96	0.05
Germany	-0.18	0.04	0.69	0.03
Denmark	0.07	0.07	0.91	0.06
Spain	0.19	0.05	0.96	0.04
Estonia	-0.05	0.05	0.88	0.03
Finland	-0.50	0.04	0.65	0.03
France	0.01	0.06	1.01	0.05
United Kingdom	0.40	0.06	0.91	0.05
Greece	0.03	0.08	1.05	0.07
Croatia	-0.53	0.07	0.96	0.06
Hungary	0.13	0.05	1.04	0.06
Ireland	-0.09	0.06	0.91	0.06
Italy	0.01	0.04	0.94	0.03
Lithuania	0.27	0.05	0.80	0.06
Luxembourg	-0.27	0.00	0.67	0.00
Latvia	-0.19	0.06	0.89	0.04
Netherlands	-0.40	0.05	0.70	0.04
Poland	0.05	0.06	0.84	0.04
Portugal	-0.14	0.09	1.07	0.06
Romania	0.60	0.07	0.93	0.05
Slovak Republic	-0.22	0.06	0.85	0.05
Slovenia	-0.38	0.01	0.80	0.01
Sweden	-0.19	0.05	0.81	0.05
EU 26 average	-0.06	0.01	0.90	0.01

Table 13.2. Indexes teacher related aspects of school climate for EU MS (right part of graph 13)

	Index of teacher climate			
MS	Mean index	S.E.	Variability in the index (Standard deviation)	S.E.
Austria	-0.16	0.07	0.88	0.05
Belgium	-0.26	0.05	0.83	0.04
Bulgaria	0.37	0.10	1.33	0.05
Czech Republic	0.19	0.05	0.81	0.04
Germany	-0.31	0.05	0.71	0.06
Denmark	0.13	0.06	0.94	0.05
Spain	-0.19	0.05	0.94	0.05
Estonia	0.14	0.05	0.89	0.04
Finland	-0.08	0.05	0.78	0.03
France	-0.17	0.06	0.88	0.06
United Kingdom	0.38	0.07	1.05	0.05
Greece	-0.16	0.09	1.19	0.07
Croatia	-0.31	0.08	0.87	0.05
Hungary	0.37	0.07	0.89	0.06
Ireland	0.10	0.08	0.99	0.07
Italy	-0.29	0.04	0.95	0.04
Lithuania	0.54	0.05	0.76	0.04
Luxembourg	-0.29	0.00	0.73	0.00
Latvia	0.13	0.07	0.89	0.05
Netherlands	-0.85	0.04	0.53	0.04
Poland	0.47	0.06	0.86	0.04
Portugal	0.11	0.09	0.95	0.07
Romania	0.58	0.08	0.99	0.05
Slovak Republic	0.04	0.06	0.76	0.04
Slovenia	-0.08	0.01	0.92	0.01
Sweden	-0.09	0.07	1.02	0.07
EU 26 average	0.01	0.01	0.90	0.01

Table 14. Multilevel analysis of teaching practices and school learning environment on students' Mathematics achievement[113]

	Model (1)		**Model (2)**		**Model (3)[114]**	
	Coef.	**SE**	**Coef.**	**SE**	**Coef.**	**SE**
Fixed Part						
Const	485.06	4.65	484.97	10.15	474.86	9.66
Student characteristics						
Gender			**15.73**	1.61	**22.14**	1.86
ESCS (Socio-economic Status)			**17.64**	1.56	**11.62**	1.52
Immigration background			**-12.36**	2.29	**-10.79**	3.10
School/classroom characteristics						
Class size			0.35	0.23	0.09	0.14
Diverse ethnic backgrounds			**-5.29**	1.11	**-3.60**	1.09
School average of ESCS			**61.25**	5.32	**44.43**	5.29
School funding (private vs public)			-3.98	4.13	-1.68	4.11
School size			**0.02**	0.01	0.01	0.00
Student-teacher relations			**2.13**	0.86	0.47	0.95
Ability grouping in Mathematics classes					**3.22**	**1.02**
ICT use in Mathematics lessons					**-8.80**	**1.22**
Opportunities to learn						
Experience with applied mathematical tasks					**-2.99**	**0.87**
Experience with pure mathematical tasks					**9.97**	**0.94**
Familiarity with Mathematics concepts					**26.34**	**2.52**
Teaching practices						
Teacher-directed Instruction					**-3.35**	**1.16**
Formative Assessment					**-6.45**	**1.32**
Student Orientation					**-12.81**	**0.72**
Teacher quality						
Disciplinary climate					**6.40**	**0.66**
Teacher support					**3.99**	**1.14**
Cognitive activation in Mathematics lessons					**7.05**	**0.76**
Country characteristics						
Country average of ESCS			-9.42	17.58	24.32	16.86
Random part						
Country level	544.02	147.67	337.55	86.26	282.28	113.13
School/classroom level	3346.30	378.55	1194.74	110.65	832.59	94.09
Student level	5001.33	844.03	4636.15	783.84	3602.15	750.15
Deviance	2312989		1276437		449396.8	
AIC	2312990		1276449		449419.8	

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a) Model 1 includes 193,038 students, 7,602 schools and 26 countries.
b) Missing values were excluded from the analysis.
c) The variance components' model was applied to the data and the model was then estimated using iterative generalized least squares (IGLS) (Goldestein, 1986).
d) The computational component was generated using MLWin 2.31 software (Rabash, Steele, Browne, & Goldstein, 2013). The bottom-up procedure, the deviance (De leeuw and Meijer, 2008) and the Akaike's information criteria (AIC) (Akaike, 1981) were used to decide which variables to include in the model and multicollinearity was checked.
e) Values that are statistically significant at the 5% level ($p < 0.05$) are in bold.

114 The reduction of the deviance and of the AIC index reveals the superiority of the model (3) and corroborates that this model is the best-fit model to explain the students' performance in EU MS.

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Abstract

This report offers a detailed description of teaching practices at the primary and secondary school levels and it explores some relationships between teaching practices and other factors such as student achievement and class size. The latest data from several large-scale assessments in education is used for these purposes, namely TIMSS & PIRLS 2011, PISA 2012 and TALIS 2013. The focus of the report is on the mapping of the frequency of different teaching practices across European Member States (EU MS) at ISCED levels 1 and 2 as measured in TIMSS/PIRLS at the fourth grade level, in PISA for 15-year olds and in TALIS for teachers in ISCED level 2.

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