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## How Prepared Were Schools and Teachers for Remote Teaching and Learning?

*Improving Learning Experiences Online Using Evidence from TIMSS 2019*

### SUMMARY

Before school closures due to the COVID-19 pandemic, the frequency with which teachers used computer activities to teach a class varied across education systems. However, many teachers across the board reported the need for professional development to teach using technical devices. Using results from TIMSS (Trends in International Mathematics and Science Study) 2019, this brief examines schools' and teachers' readiness for remote teaching, learning and opportunities available to improve the delivery of remote learning experiences online.

### IMPLICATIONS

- Education systems should recognize the level of readiness of teachers and schools when providing remote teaching and learning online before the COVID-19 pandemic to address potential gaps in educational quality resulting from the disruption period.
- There is a need for continued teacher training in information and computer literacy to foster confidence in remote teaching and enhance their use of digital devices for teaching and learning.
- Schools need to be equipped with the essential resources that are necessary to provide education remotely online.
- With data from TIMSS 2019 and the upcoming TIMSS 2023 cycle, schools' and teachers' readiness for remote teaching online prior to the pandemic can be compared with (changes in) the teaching, learning situations, and outcomes after the COVID-19 disruption.

International Association for the Evaluation of Educational Achievement (IEA), Amsterdam.

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## INTRODUCTION

Among many other areas of life, the education sector was majorly affected by the COVID-19 pandemic leading to school closures. Overnight, parents, students, teachers, and schools were confronted with the challenges of remote teaching and learning, where possible, provided online. The successful accommodation of these changes is not solely dependent on parents and students, nor the home environment for learning. The readiness of schools to deliver remote learning online—including school resources such as the availability of technological equipment, a sufficient infrastructure, teachers capable appropriate remote online teaching—is an important factor to tackle.

Recent studies on the impact of the COVID-19 pandemic on education such as IEA’s REDS (Responses to Educational Disruption Survey) emphasize the role of schools and teachers in successfully implementing and conducting remote teaching and learning online. Analyzing cross-country data from 11 education systems across the globe, REDS found that schools lack an overall readiness to accommodate remote online learning. Teachers reported the need to narrow the content of their teaching during school closures to the core aspects of the curriculum, and that they felt increasingly troubled by managing disadvantaged students in remote learning situations. This is most concerning, given that the study attests

students of a lower socioeconomic status to be particularly affected by the effects of the pandemic (Meinck et al., 2022). Furthermore, forced changes to education systems around the globe due to the pandemic—such as school closures—have been associated with a decrease in student achievement (Hammerstein et al., 2021), confirming policymakers’ and educators’ concerns of the pandemic’s diminishing effect on student learning.

Aiming at adding to these findings, we utilize data from the 2019 cycle of IEA’s TIMSS to identify potential indicators that highlight schools’ and teachers’ readiness for remote learning online prior to the pandemic. We focus on teachers’ self-reported capacities to use digital devices for teaching and learning, and on schools’ preparedness for the technological support of remote teaching and learning online. Furthermore, we associate some of those indicators with student achievement, and conduct analyses across the 72 education systems in total including benchmarking for TIMSS 2019, providing substantial cross-country comparisons to get a bigger picture of the topic. Lastly, we intend to show how TIMSS data can be used for the purpose of pinpointing opportunities to improve schools’ and teachers’ readiness for remote teaching and learning online.



## DATA & ANALYSIS

Conducted every four years since 1995, TIMSS is administered to fourth- and eighth-grade students in school.<sup>1</sup> In 2019, 72 (including benchmarking) education systems from around the globe participated in the study. Although TIMSS primarily aims to investigate student performance in mathematics and science internationally, it also bears the potential to monitor the readiness of schools and teachers for remote learning, with the following items:

### **Teachers' readiness to use digital devices for teaching**

Teachers' computer activities to support learning in mathematics lessons: We assume that teachers who are more experienced in the usage of a computer in on-site classrooms are more likely to successfully implement remote learning situations, given the exceeding level of experience.

Teachers' needs for professional development on integrating technology into mathematics: We assume that teachers who indicated the need for professional development on the integration of technologies into mathematics lessons are

possibly lacking competencies in that regard, yet reflect and show a willingness to improve their knowledge and skills.

### **Schools' readiness to support online teaching and learning**

Schools' usage of an online learning management system: We assume that the availability of an online learning management system is a valuable prerequisite for the quick implementation of remote learning situations. Having a respective system at hand prior to the pandemic potentially contributed to a smoother transition, securing the continuation of effective schooling.

We apply basic statistical methods using the IEA International Database Analyzer to provide results for fourth and eighth grades,<sup>2</sup> whereas descriptive statistics are provided for all items.<sup>3</sup> The schools' usage of an online learning management system is furthermore associated with student achievement in mathematics. Due to the specific TIMSS data structure, results including teacher characteristics are always reported at the student level.



<sup>1</sup> In 1999, TIMSS was only administered to eighth grade students.

<sup>2</sup> The IDB Analyzer is an SPSS-based tool for the analysis of large-scale assessment data, such as TIMSS, PIRLS, TALIS, ICCS, ICILS and PISA. The IDB Analyzer ensures the obtainment of correct standard errors by using weights and accounting for the nested structure of the data. For more information visit: <https://www.iea.nl/data-tools>.

<sup>3</sup> Some of the results presented here originate from the international results on mathematics and science. However, table formats are transported into figures, simplifying the overview of patterns across countries. Furthermore, we focus on one aspect specifically, aiming at interpreting respective indicators through the lens of baseline indicators for remote teaching and learning.

## RESULTS

### Computer activities used by teachers to support learning in mathematics lessons

On average, most students across all education systems are taught by teachers who never or almost never conduct computer activities in class to enhance learning during mathematics lessons. Taking a closer look, in almost half of the education systems, more than 75% of the students have their mathematics teachers reporting that they never or almost never conduct computer activities during mathematics lessons. On the contrary, only 12 education systems in the fourth grade and seven education systems in the eighth grade

have more than 50% of their students taught by teachers who carry out computer activities during mathematics lessons at least once or twice a month. In general, results show that students are rarely taught by teachers who conduct computer activities during mathematics lessons at least once or twice a week. The Netherlands and the United States are exceptional in that regard, where more than a third of fourth-grade students are taught by teachers who carry out computer activities during mathematics lessons almost daily. At eighth grade, New Zealand and Australia show over 50% of students taught by teachers who conduct computer activities at least once or twice a week during mathematics lessons.

Figure 1.1: Percentage of fourth-grade students by frequency of their mathematics teachers doing computer activities for the whole class to enhance learning during mathematics lessons

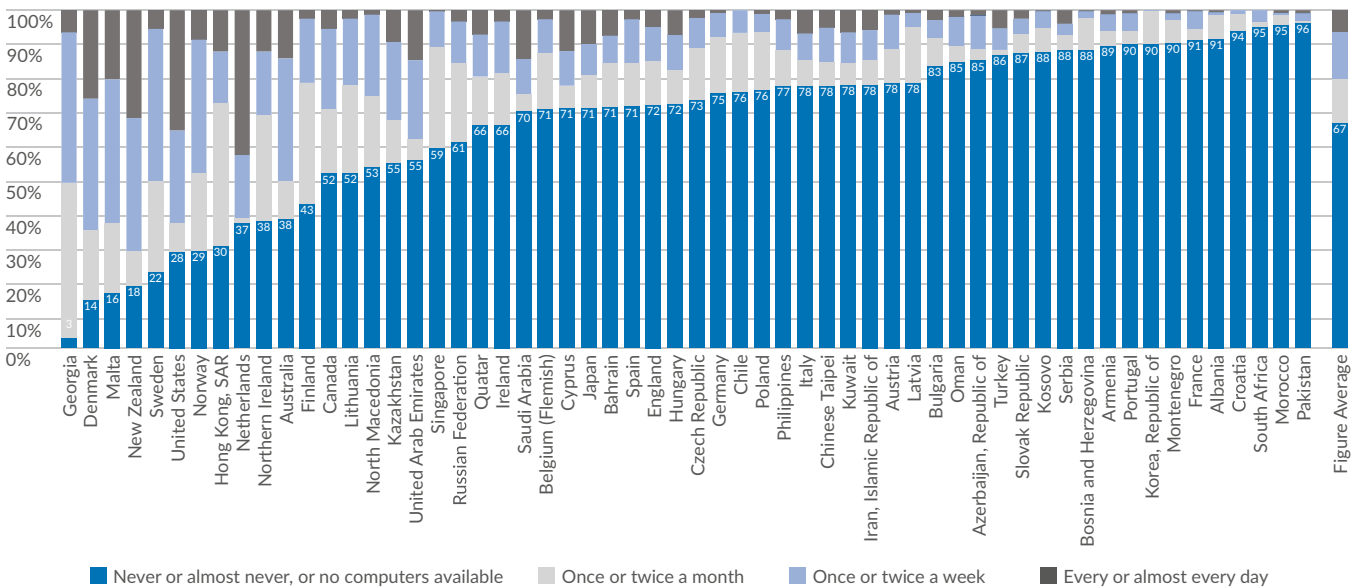
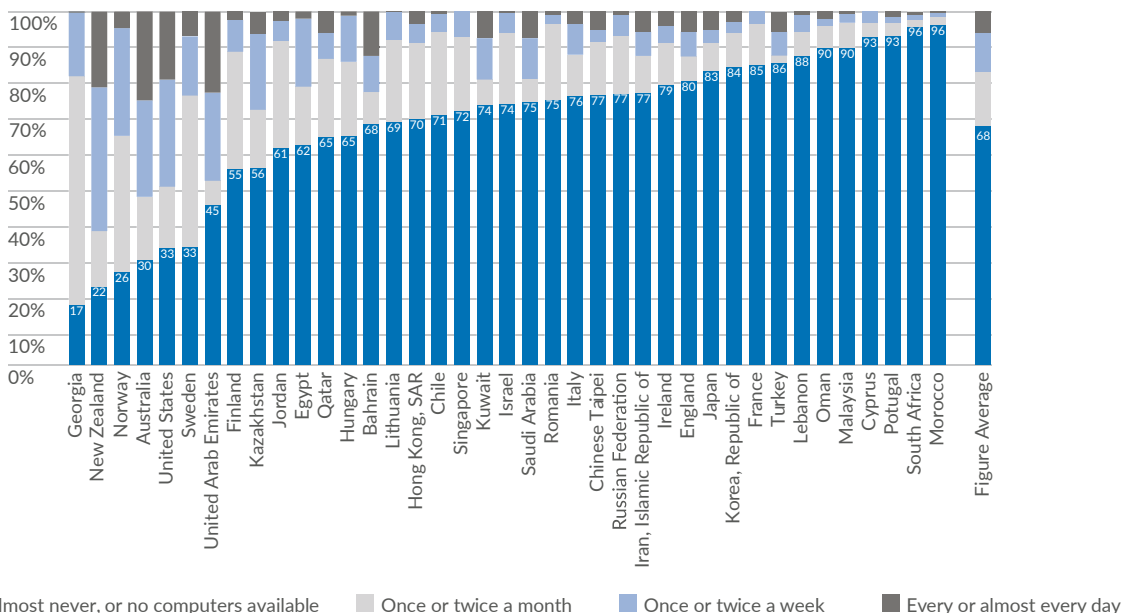


Figure 1.2: Percentage of eighth-grade students by frequency of their mathematics teachers doing computer activities for the whole class to enhance learning during mathematics lessons

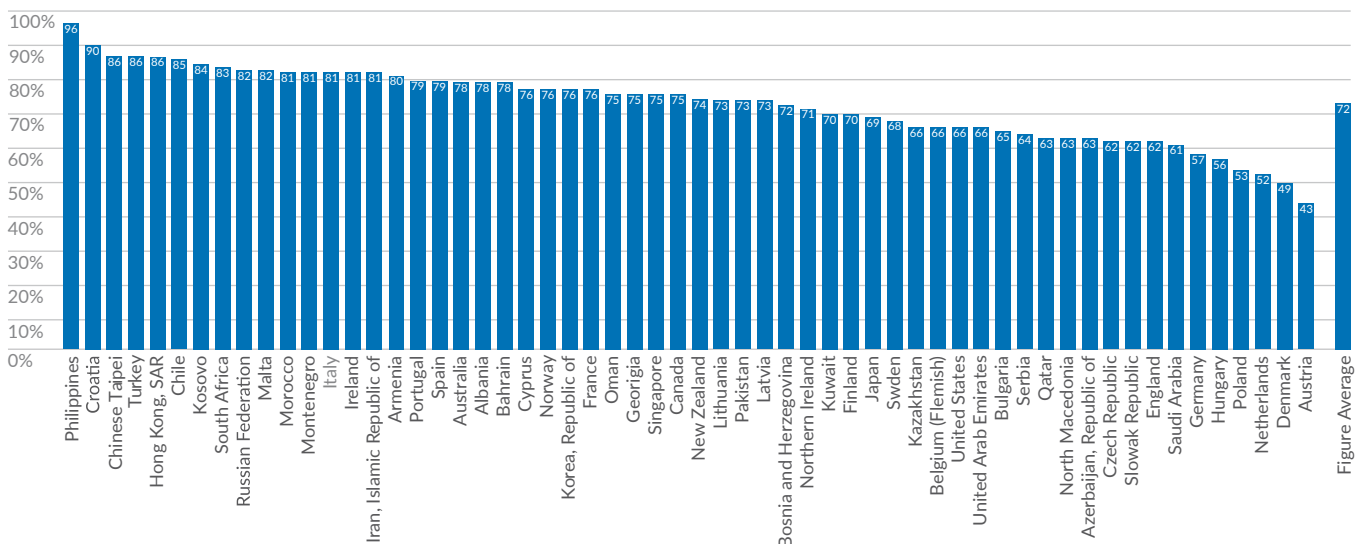


**Teacher-reported needs for professional development on integrating technology into mathematics**

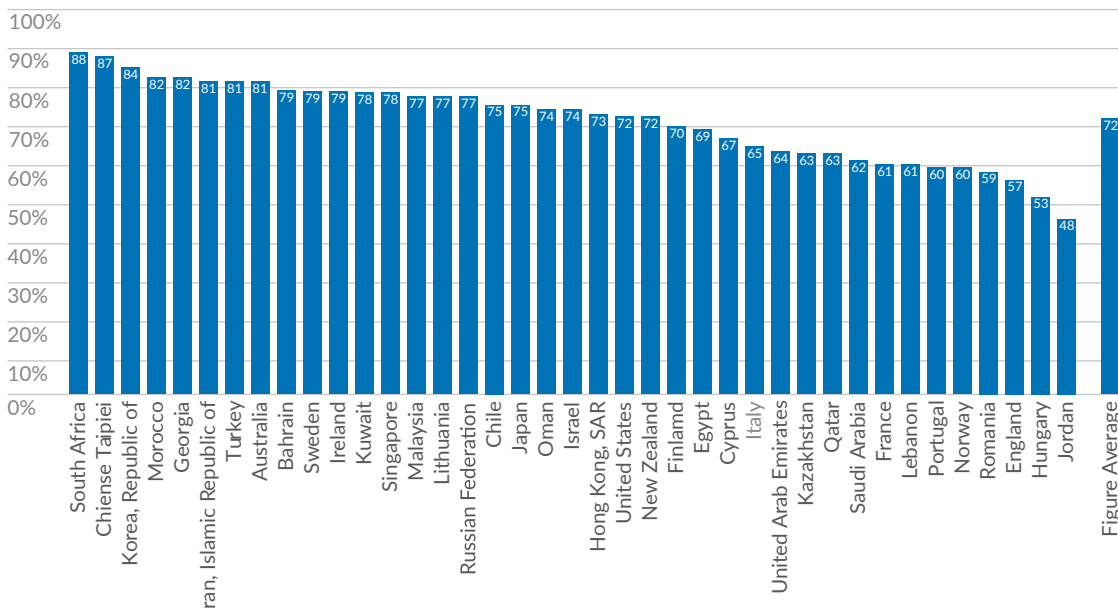
More than two thirds of the students across all participating education systems at both fourth and eighth grades are taught by teachers who indicate the need for professional development on integrating technology into mathematics instruction. In all education systems but Austria and Denmark (fourth grade), and Jordan (grade eight), more than half of the

students have teachers indicating the need for professional development on integrating technology into mathematics instruction. Relatively high percentages of students with teachers expressing a need for professional development can also be found in some of the countries where students report that they are more frequently taught by teachers who make use of computers in mathematics lessons, for example in Hong Kong and Malta for the fourth grade, and in Georgia and Sweden for the eighth grade.

**Figure 2.1: Percentage of fourth-grade students taught by teachers who indicate the need for professional development on integrating technology into mathematics instruction**



**Figure 2.2: Percentage of eighth-grade students taught by teachers who indicate the need for professional development on integrating technology into mathematics instruction**



These results match the findings presented in Figures 1.1 and 1.2 on teachers' computer activities to support learning in mathematics lessons, namely, that the majority of students across all education systems are taught by teachers who never or almost never do computer activities for the whole class to enhance learning during mathematics lessons. Presumably, teachers refrain from using technologies because they lack the knowledge on how to integrate them effectively.

Overall, results on teachers' readiness to use digital devices for teaching draws the picture that most teachers felt unprepared back in 2019 for the requirements of remote online teaching.

### Schools' usage of an online learning management system

In 2019, shortly before the pandemic, in approximately two-thirds of the education systems participating in TIMSS 2019, at least 50% of the schools used an online learning management system when providing education to fourth-grade students. In the eighth grade, the ratio was even larger. In 19 education systems participating in the fourth-grade assessment, and in 21 education systems from the eighth-grade assessment, more than three-quarters of the schools were using an online management system for learning. In Denmark and Singapore (fourth grade), and Lithuania, Singapore, and Sweden (eighth grade) all schools were using an online management system for learning.

Figure 3.1: Percentage of schools that use an online learning management system in the fourth grade

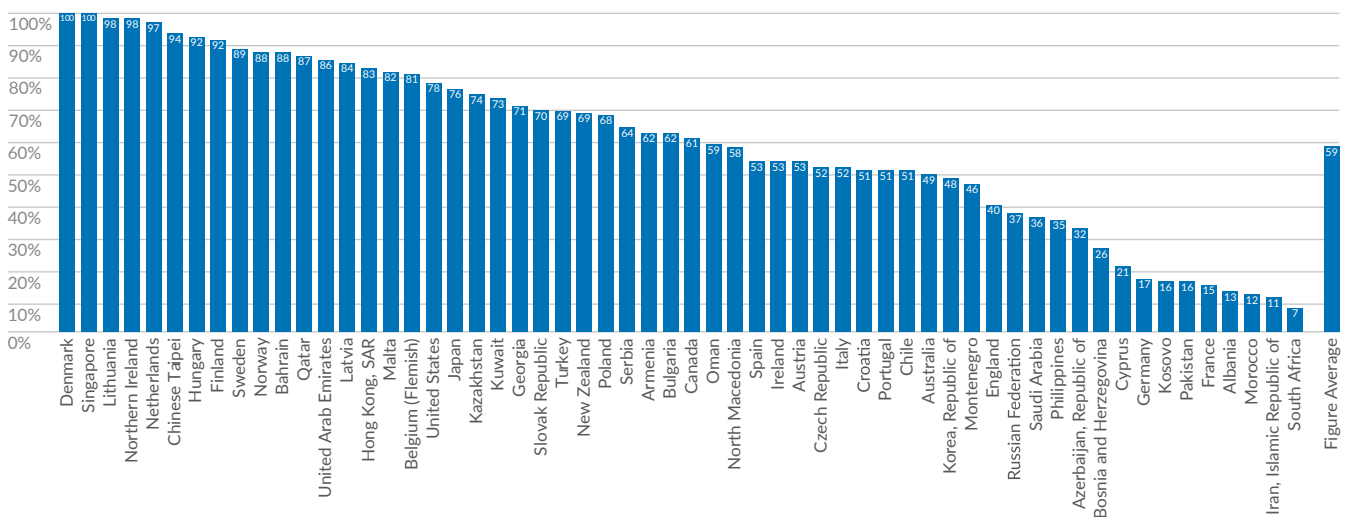
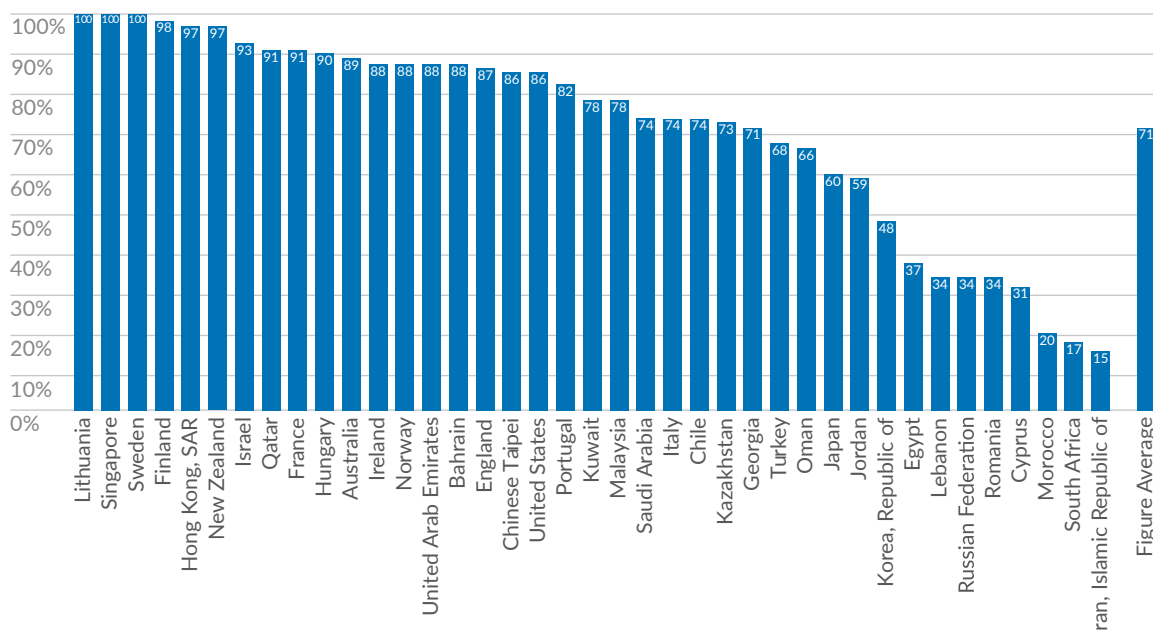
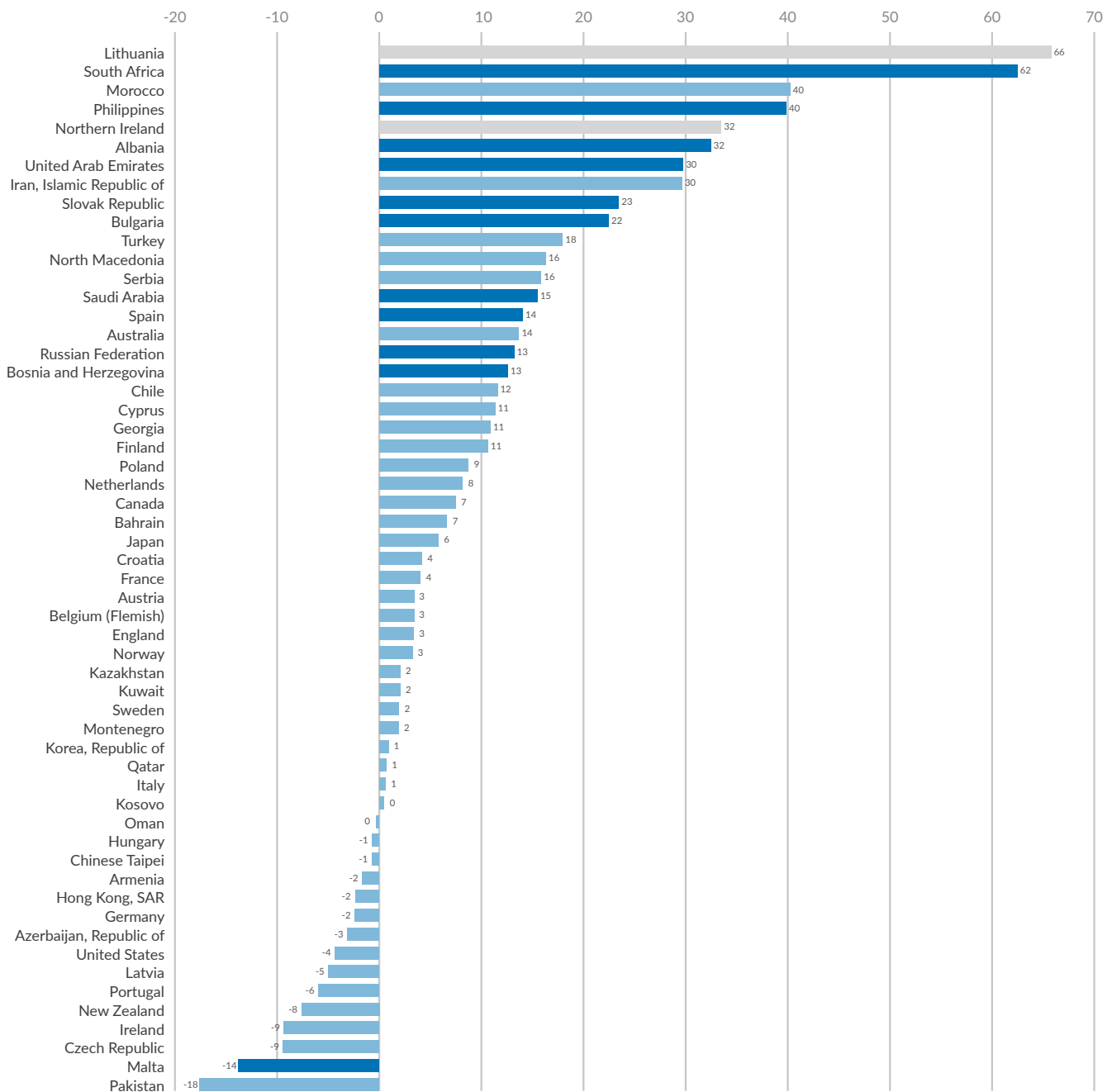


Figure 3.2: Percentage of schools that use an online learning management system in the eighth grade



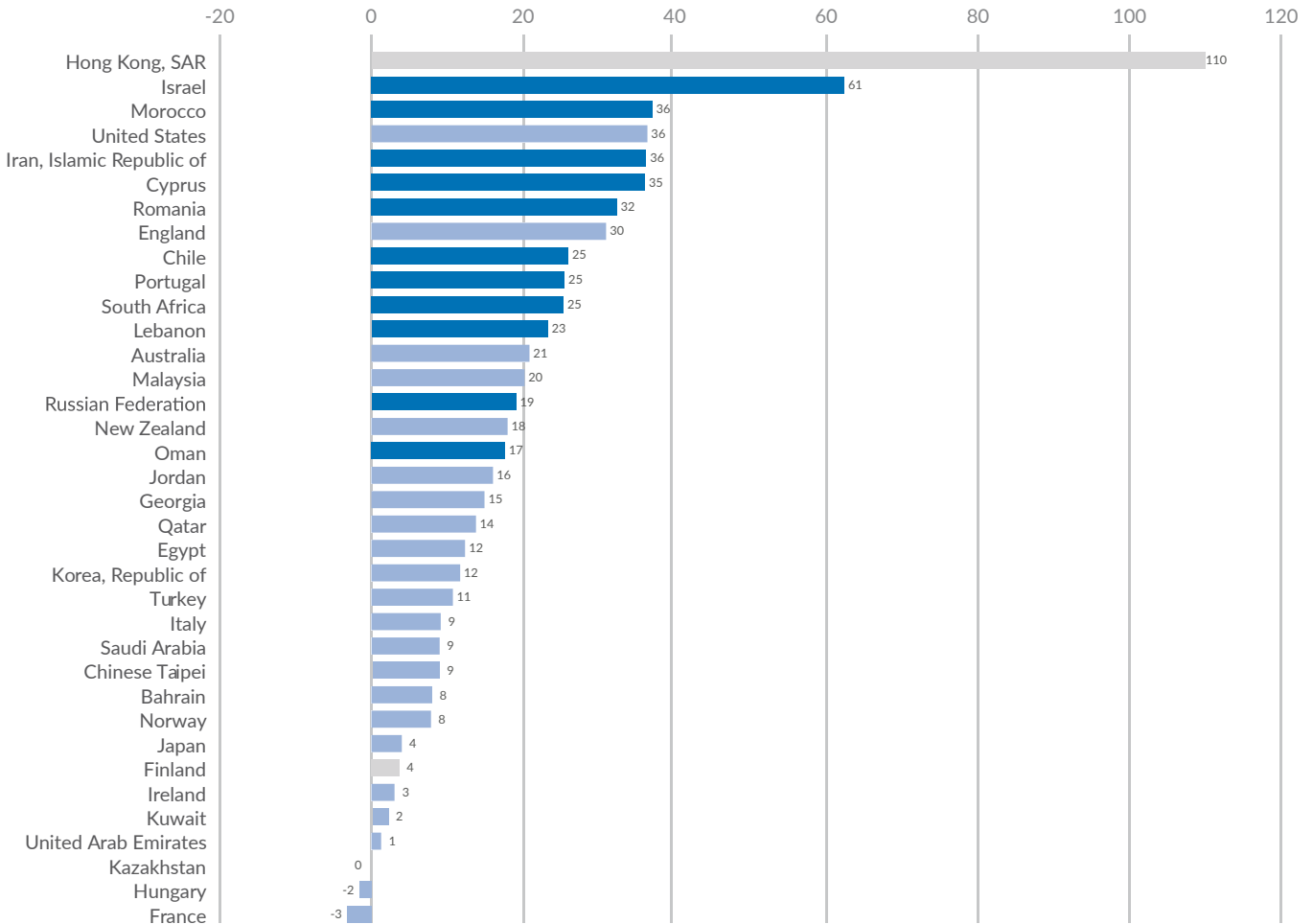
Schools' usage of an online learning management system is associated with student achievement in 11 education systems in both the fourth-grade and the eighth-grade assessments. We find outstanding results when looking at the differences between students' average performance in mathematics in schools with and without an online learning management system. In South Africa (fourth grade) and Israel (eighth grade), there is a 60-point high-achieving score point difference in schools that used an online learning management system. Malta is the only education systems where fourth-grade students in schools with an online learning management system score lower compared to their peers in schools without such a system.

Figure 4.1: Difference in mean student mathematics achievement in fourth grade between students at schools using and not using an online learning management system



Notes: Dark blue shading indicates significant differences; light blue indicates no significant differences; gray shading indicates education systems with too few schools not using an online learning management system..

Figure 4.2: Difference in mean student mathematics achievement in eighth grade between students at schools using and not using an online learning management system



**Notes:** Dark blue shading indicates significant differences; light blue indicates no significant differences; gray shading indicates education systems with too few schools not using an online learning management system..

When accounting for the composition of the student body in the schools regarding the socioeconomic status of their families, the association of an online learning management system with student achievement in mathematics disappears in about half of the countries that showed a bivariate association. Before the pandemic, the use of an online learning management system did not impact student mathematic achievement. It will be interesting to see if that was different when schools closed during the pandemic.



## DISCUSSION & CONCLUSION

Results of our analyses show that, prior to the pandemic, education systems differed regarding the frequency of students being taught by teachers who enhance learning for the whole class via computer activities during mathematics lessons. This might have been because schools did not have the necessary resources, such as computers or computer rooms for shared use.

However, it may also be that teachers lacked the necessary skills for and knowledge of using computers for teaching. Results of our analyses show that, across all education systems, many teachers also reported the need for professional development in using technologies for teaching mathematics. On that note, we also refer to the results of ICILS (International Computer and Information Literacy Study) 2018, showing that it is not enough to simply provide more technological devices. Teachers also need support in the usage of information and computer technologies in the classroom, given that they tend to use respective technologies more often when they feel confident in doing so (IEA, 2019). Policymakers should explore options to support teachers and enhance their skills and knowledge of using computer technologies during lessons.

Results show that many schools used online learning management systems before the pandemic. However, in almost all countries there was no association between the usage of an online learning management system and student mathematics achievement. Using this as a baseline, future research could investigate if during (and after) the pandemic schools' preparedness for remote teaching and learning online made (or will make) a difference regarding student learning outcomes.

Adding to findings from studies such as REDS, our analyses provide insights into the readiness of teachers and schools for remote teaching and learning prior to the pandemic in primary and secondary schools in 60+ education systems. Given that remote teaching and learning online will continue to play an important role in the future, enhancing the ability of schools, teachers, and students to accommodate respective learning environments will remain a crucial task for education systems around the globe. We show that TIMSS can provide valuable insights into the current strengths and weaknesses of education systems and highlight areas that are potentially relevant for the accommodation of remote teaching and learning online.

The upcoming cycle of TIMSS 2023 will allow further investigation into the topic. TIMSS is a trend study, and exploring the development of schools' and teachers' readiness for remote teaching and learning online at the education system level is possible. For instance, trend analyses could reveal whether education systems that conducted more computer activities in mathematics lessons—or with more schools already equipped with the systems necessary for remote teaching prior to the pandemic—benefit from more effective remote learning environments during the pandemic. In terms of teachers' need for professional development on integrating technology into mathematics lessons, it will be interesting to see whether this will have been prioritized by teachers, schools, and governments in order to foster teachers' capability to implement and run effective remote classrooms by 2023. Finally, the indicators for schools' and teachers' readiness to use digital devices for teaching could be associated with trends in student mathematics achievement. It may provide feedback for policymakers and educators on the pandemic's impact on student learning to see where appropriate and remedial measures are needed.

## ABOUT THE AUTHORS

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Falk Brese is a Research Analyst at IEA's RandA (Research and Analysis Unit). His research interests are in social inequalities and migration, the transition of research results from reporting to policy implementation, and ILSA (international large-scale assessments) methodology. He has worked at IEA since 2000 and has ample experience with the implementation of ILSAs and analyzing respective data. He has a background in political science with a focus on policy formation and implementation.

### NADINE TWELE

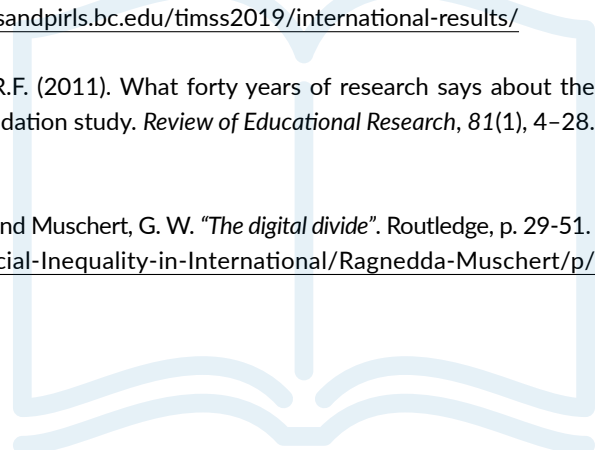


Nadine Twele is a former research analyst at IEA's RandA. She is familiar with the particularities of international large-scale assessments and how to address them. Her research interests are in educational decision making and inequality research with focus on disadvantaged societal groups. After completing her PhD on PIRLS data at the University of Hamburg, Nadine coordinates social youth work in municipal governance since 2022.



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