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Policy Brief

Is the use of ICT in the classroom associated with student achievement in Arab countries participating in TIMSS at Grade 8?

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Summary

Computers have become more and more widespread in schools and more frequently used in the instruction process. Although the physical availability of computers in the classroom is an important requisite, it is not the only factor influencing educational outcomes. This policy brief provides evidence of the relationship between teachers' emphasis on using computer software in eighth-grade mathematics and science instruction and student achievement in the Arab education systems participating in TIMSS 2011. Our analyses show that, in general, emphasis on the use of computer software for instruction is associated with student achievement in mathematics and science. This association is positive for some education systems and negative for others; however, negative associations disappear when the analysis takes into account the extent to which adequate support for teachers in integrating the use of computers into their teaching activities is provided. Additionally, we found that students of teachers who had participated in professional development activities related to the integration of technologies performed significantly better in about half of the education systems and in both of the subject areas (mathematics and science) analyzed.

Policy implications

According to the results of our analyses, we conclude that:

- 1. Promoting the use of ICT for instruction is not always sufficient to enhance academic achievement. In some education systems a greater emphasis on the use of computer software for instruction is associated with significantly higher student achievement, while in others it is associated with significantly lower student achievement. This result points out the importance of paying close attention to the processes of integrat-ing these technologies into teacher practice.
- 2. Adequate support for teachers could contribute to making ICT an effective teaching tool. The negative associations between the emphasis on the use of computers for instruction and student achievement become insignificant when the adequacy of the support teachers receive for integrating ICT into instruction is taken into account. This suggests that providing adequate support for teachers could help them use ICT in a more effec-tive way.
- 3. Regular training in using ICT could also help teachers to increase their classroom teaching efficacy. According to our analyses, on average, students of teachers who participated in professional development activities related to the use of ICT performed significantly better in about half of the education systems analyzed; in only one country were the results significantly worse.

Introduction

The use of information and communication technology (ICT) permeates every aspect of life today. Computers have become more affordable, more powerful, and more convenient to use in addressing complex tasks in a short time and with greater accuracy. During the past decades, education has likewise turned to computer technologies in order to aid the instruction process, thus widening the range of available techniques for quality teaching. Of course, technology cannot substitute for teaching quality, but it can enhance it (Page & Christian, 2012).

The utilization of computer technology in instruction provokes student enthusiasm, motivates learning, and allows students to study at their own pace, offering them a wide range of information on various topics and expanded learning opportunities. Computer programs, and even games, can facilitate students' understanding of concepts and problems through the visualization of ideas and transference of information into symbol systems. Although not always consistent, results from previous studies have shown that the use of computers in the classroom has an impact on student learning (Mullis, Martin, Ruddock, O'Sullivan, & Preuschoff, 2009); however, the availability of computers in the classroom is only a precondition for effective learning—the effective use of such technology in teaching depends to a large extent on the adequacy of a teacher's training in its use, technical and pedagogical support, and the availability of appropriate software consistent with the curriculum (Bang & Luft, 2013).

This policy brief seeks to explore the relationship between the use of computer software in classroom instruction and outcomes of student learning in mathematics and science, using Trends in International Mathematics and Science Study (TIMSS) 2011 data on Grade 8 students and their teachers in mathematics and science. The three main questions we address are:

1. What is the association between student achievement and the teachers' extent to which teachers use computer software for instruction in mathematics and science?

2. Does this association change after controlling for teacher perception as to adequacy of support on integrating the technologies into teaching activities?

3. Is teacher professional development in integrating ICT into classroom instruction for mathematics and science associated with student achievement?



Data and Measures

To explore the association between ICT use and student achievement in mathematics and science, this policy brief uses data from the latest cycle of Trends in International Mathematics and Science Study (TIMSS), conducted in 2011 by the International Association for the Evaluation of Educational Achievement (IEA). TIMSS is an international study that assesses mathematics and science achievement of students in Grades 4 and 8. In addition, the study collects background information on students, their teachers and principals, and their schools. This policy brief uses data obtained from Grade 8 students and their mathematics and science teachers.

The measures used are on student achievement in the two subjects, the extent to which teachers utilize computer software for instruction (as reported by them), teachers' perception of the adequacy of support they receive for integrating computers into mathematics and science instruction, and teachers' participation in professional development on integrating ICT into their subject areas in the two years preceding the survey. The question on the extent of using computer software in instruction of the subject has three response categories: basis for instruction, supplement, and not used. The question on teachers' perception as to the adequacy of the support they receive in integrating computers into instruction in their subject has four categories, ranging from "agree a lot" to "disagree a lot." The question on teachers' receipt of professional development training in integrating information technologies into their instruction is a yes-no question.

The policy brief uses data from 13 Arab education systems participating in TIMSS 2011 at the Grade 8 level: Bahrain, Jordan, Lebanon, Morocco, Oman, Palestinian National Authority, Qatar, Saudi Arabia, Arab Republic of Syria, Tunisia, United Arab Emirates, United Arab Emirates (Abu Dhabi) and United Arab Emirates (Dubai).

What is the association between student achievement in mathematics and science and the extent to which teachers use computer software for instruction?

The availability of computers in the classroom is only the first prerequisite for the use of ICT in instruction—relevant software as well as teachers capable of using it are also essential. The latter criterion is especially important—a teacher must maintain competencies in the subject areas being taught; ICT competencies are complementary, thus integration of ICT into their teaching may be a challenge (Varma, Husic, & Linn, 2008).

To address this issue, we conducted an analysis where we divided students into three groups according to the level of emphasis their teachers gave to the use of computer software for instruction. We then calculated the average mathematics and science performance of students for each of these three groups within each education system.

Figures 1 and 2 show the average Grade 8 student mathematics and science achievement scores for students with teachers who do not use computer software for instruction (red dots), those who use computer software as a supplement for instruction (yellow dots), and those who use computer software as a basis for instruction (green dots). The achievement scores are on



Source: International Organization for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2011

the horizontal axis and the colored dots represent the average achievement in the subject according to teacher emphasis (basis for instruction, supplement, not used) on the use of computer software in the instruction. The education systems where differences in achievement depending on the emphasis of computer software use are statistically significant are flagged with an asterisk. The figures presented show two things¹:

First, in Oman, Morocco, Saudi Arabia, Bahrain, and Lebanon, the mathematics achievement of students taught by teachers who use computer software for instruction is significantly higher than the achievement of their peers whose teachers do not use software for instruction. The same results are observed for the use of software for science instruction in Morocco, Oman, Lebanon, Palestinian National Authority, and Tunisia. The largest difference can be found in Oman, where the difference in science achievement between students taught by teachers not using computer software for instruction and those whose teachers use it as the basis for instruction is 59 score points (more than one half of a standard deviation on the achievement scale).

Second, contrary to the results described above, in Qatar, United Arab Emirates, and Abu Dhabi, students taught by teachers who do not use software in their mathematics instruction demonstrated significantly higher mathematics achievement compared to those whose teachers use it as a supplement or as a basis for instruction. The same is found for science achievement in Qatar, Bahrain, United Arab Emirates, Abu Dhabi, and Dubai.

This latter finding might seem surprising at first; however, previous research has shown that the availability of ICT in the classroom per se does not guarantee improvements in student achievement. Teachers' preparedness to use ICT and the support they receive in doing so are key factors for the successful implementation of ICT in the classroom. As Bang & Luft (2013) point out, the way technologies are used by science teachers, for example, often depends on (among other things) their understanding of the role of the technology and their knowledge on how it can enhance the teaching process. The integration



Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2011

of technology into the learning environment cannot stand alone: it must be linked to the learning and sociocultural environments (Page & Christian, 2012). A lack of experience in integrating ICT into instruction and aligning the available technology to the curriculum are other factors, along with difficulty in learning how to use the tools themselves (Varma et al., 2008).

Along these lines, we decided to investigate the role of support teachers receive in integrating ICT into their teaching activities. To do so, we turned to those education systems from the previous analyses where we found a negative association between an emphasis on the use of computer software and student achievement. We then explored this association while controlling for teachers' perception of the adequacy of support in integrating ICT into their teaching practices. The results show that when teachers share the same perception of the adequacy of the support they receive, no differences in student achievement related to teacher emphasis on using computer software can be found².

What are the differences in student achievement depending on the professional development of their teachers in the integration of ICT into subject instruction?

Along with the immediate support in integrating information technologies into instruction, the overall preparedness of

teachers in using ICT in classroom instruction may also be an important factor for the effective use of the technol-

¹ The mathematics achievement results for Tunisia, Palestinian National Authority, and Bahrain, as well as the science achievement results for Tunisia and Bahrain, should be considered with caution due to the very unequal sizes of the groups teachers fall into.

² We also decided to test the relationship between achievement and use of computer software by the students' teachers after controlling for students' computer use at home and school; however, these two variables did not change the relationship.

ogies in their work. While the availability of computers and computer software in the classroom, as well as support for their implementation, are important preconditions, if the teachers lack core competencies in using these rapidly changing technologies, they may not be able to utilize them in an effective manner. achievement of students whose teachers either did or did not receive professional development in integrating ICT within their subject areas in the past two years prior to testing. The following two tables present differences in achievement in mathematics and science for these two groups of students.

We tested the differences in mathematics and science



Source: International Organization for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2011



Source: International Organization for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2011

As the results in the figures show, for both mathematics and science the differences are statistically significant in about half of the educational systems analyzed: seven for mathematics and six for science. The largest significant difference in mathematics is in Bahrain (37 score points), and in science in Oman (40 score points). These differ-ences, found in nearly half of the countries (six in mathematics and five in science), indicate a positive association between the teachers' training in integrating ICT and student achievement. One peculiar finding is that negative, and significant, differences have been found in Qatar for both subjects (22 and 36 points respectively). In other words, in Qatar, students taught by mathematics and science teachers who received professional development in integrating ICT into the subject tended to perform lower in mathematics and science as compared to students taught by teachers who did not.

The general results in most of the educational systems analyzed are in line with Sorensen, Twidle, Childs and Godwin (2007), who pointed out that those teachers who were trained on using technology in their teacher preparation program were able to use these means in a more substantive and meaningful manner; nonetheless, new (science) teachers relied on the more basic and limited tools in their work that they had learned in their teacher preparation program, regardless of the availability of software and equipment in the schools (Bang & Luft, 2013).

It is possible that teacher professional development on integrating information technologies is related to some underlying characteristic of the individual schools, such as the availability of resources or a school's socioeconomic status. In a separate analysis, we tested whether undergoing professional development in the field in the last two years is related to the availability of school resources and a school's socioeconomic status in terms of student intake, as reported by school principals. No consistent patterns were found, either in mathematics or science. The only exception is Saudi Arabia: the lesser the shortage of school resources, the higher the percentage of teachers taking professional development tends to be. The same applies to the percentage of students coming from disadvantaged homes. In all other countries these two factors are not related to the percentage of teachers who took professional development on integrating ICT into their subject.



Conclusions and policy implications

- 1. The use of computer software in classroom instruction is associated with student achievement.
- Our results show that for most of the education systems we analyzed there are differences in the students' mathematics and science Grade 8 achievement associated with the emphasis their teachers give to the use of ICT in the classroom; however, the results do not always show a positive relationship: in some education systems, the higher the emphasis the teachers put on using computer software, the lower the achievement tends to be. This result suggests that the frequency with which computers are used for instruction might not be the only important factor in the relationship between ICT and student achievement.
- 2. Adequate support for teachers in integrating computers into their practices could contribute to making ICT an effective teaching aid.
- While the use of ICT in general, and computer software in particular, may open a wide range of new opportunities, in some education systems teachers need more support on the use of these rich means. Therefore, it is worth conducting further research on other possible factors such as support for integrating ICT into teacher practice. Our analyses show that when teachers' perception

of the adequacy of support for integrating ICT into the subject instruction is taken into account, the negative differences in students' mathematics and science achievement associated with teachers giving more or less emphasis to the use of computer software become statistically insignificant.

- 3. Opportunities for professional development in integrating information technology into teacher practices are important.
- As discussed above, patterns relating the use of computer software in the classroom to student achievement have been found, but also an association between the support teachers receive for ICT integration and student achievement. Given the rapid and continuous development of these technologies, more frequent professional development opportunities could help improve teaching practices, and, in turn, student achievement. As our analyses show, in about half of the education systems we examined, students whose teachers participated in professional development in integrating ICT performed significantly higher than students whose teachers did not participate in such training.

References

Bang, E., & Luft, J. A. (2013). Secondary Science Teachers' Use of Technology in the Classroom during Their First 5 Years. Journal of Digital Learning in Teacher Education (International Society for Technology in Education), 29(4), 118–126.

Mullis, I. V. S., Martin, M. O., Ruddock, G. J., O'Sullivan, C. Y., & Preuschoff, C. (2009). TIMSS 2011 Assessment Framework. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College, Lynch School of Education.

Page, T., & Christian, B. (2012). Computer Technology in the Geography Classroom: Quality Teaching and Learning. TEACH Journal of Christian Education, 3(2).

Sorensen, P., Twidle, J., Childs, A., & Godwin, J. (2007). The Use of the Internet in Science Teaching: A longitudinal study of developments in use by student-teachers in England. International Journal of Science Education, 29(13), 1605–1627.

Varma, K., Husic, F., & Linn, M. C. (2008). Targeted Support for Using Technology-Enhanced Science Inquiry Modules. Journal of Science Education and Technology, 17(4), 341–356.



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The Arab League Educational, Cultural and Scientific Organization (ALECSO) is a specialized inter-governmental agency headquartered in Tunis, essentially concerned with the development and coordination of educational, cultural and scientific activities in the Arab World, and the development of regional and international cooperation in these fields. ALECSO has several missions to carry out in the education field, to support Arab countries member of the LAS in the development of human resources, the modernization of the educational systems, as well as to promote the Arabic language and the Arab-Islamic culture both within and outside the Arab world.

The Arab Regional Agenda on Improving Education Quality (ARAIEQ) is one of ALECSO's major education initiatives, aiming to improve the quality and relevance of education services in the region through regional collaboration. Launched in 2012 with the support of the World Bank, ARAIEQ includes five pillars :

- Arab Program on Education Evaluation and Policy Analysis (APEEPA) hosted by UNESCO's regional bureau in Beirut, who initiated the preparation of these policy briefs, in coordination with IEA.

- The Arab Program on Teacher Policies and Teacher Professional Development (APTP), based at the Queen Rania Teachers Academy (QRTA) in Amman, Jordan.

- The Arab Program on Curriculum Innovation, Qualifications, and ICTs in Education (APIQIT) hosted by the National Center for Education Technologies (CNTE) in Tunis, Tunisia.

- The Arab Program on Early Childhood Development (APECD), hosted by the regional NGO based in Beirut "Arab Resource Collective (ARC).

- The Arab Program on Entrepreneurship Education and Innovation (APEEI), hosted by the regional NGO Injaz El Arab based in Amman.

The present policy brief aims to propose some issues and recommendations about the analysis of TIMSS results , with regard to the pillar above on Curriculum Innovation, Qualifications, and ICTs in Education (APIQIT).

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