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Policy Brief

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Is teacher experience associated with mathematics achievement?

Summary

There is general agreement that teacher quality provides an added value to effective education; hence, in recent years, organizations such as IEA, UNESCO, and OECD, as well as governments around the world, have shown an increased interest in areas related to teachers and teacher policy.

Previous research has shown that teacher experience plays an important role in determining student achievement, particularly in the first years of teaching. In this policy brief we contribute to the debate on the relationship between number of years of teaching experience and student achievement by using international comparative data to address two questions: first, whether teacher experience is associated with student mathematics achievement of fourth graders; and second, how this association changes when other teacher characteristics are taken into account.

Policy implications

Our results suggest that:

1. There is no simple, universal relationship between teacher experience and student achievement. In many education systems the students of more experienced teachers achieve better than the students of less experienced teachers; however, in other systems the opposite pattern was found.
2. Country-specific characteristics are relevant. The factors associated with teacher experience vary across education systems, with no clear pattern among all TIMSS countries.
3. Teachers' level of formal education may have an impact on the relationship between student achievement and teacher experience. Our analyses suggest that in recent years many educational systems have put more emphasis on teacher qualifications by employing those with higher levels of educational attainment, yet at the same time, in most countries teachers with higher formal qualifications tend to have shorter careers in teaching.
4. Policies related to teacher experience should be designed to take into account the characteristics of each education system. When it comes to policies related to teacher experience, there is no single solution applicable to all educational systems. Policies aimed at maximizing returns on additional years of teacher experience should consider the particularities of teacher career trajectories in the various education systems.

Introduction

In recent years, many national governments have shown, through their participation in initiatives coordinated by supranational organizations, an increased interest in questions related to teachers and teacher policy. For example, in 2013, the European Commission published Supporting Teacher Educators for Better Learning Outcomes, a report prepared by a group of experts designated by 26 European countries[1]. In 2012, UNESCO launched the initiative Strategy on Teachers 2012–2015 (UNESCO, 2012). In 2011, with the support of the World Bank, the Arab League Educational, Cultural, and Scientific Organization launched the Arab Regional Agenda for Improving Education Quality[2], with teacher policies as one of its five regional programs.

One of the key findings of the body of research known as Educational Effectiveness is the importance of classroom and teacher characteristics as predictors of student achievement (Muijs et al., 2014). Specific teaching approaches have also been found to contribute significantly to learning. Based on a synthesis of over 800 meta-analyses relating to achievement, Hattie (2009) points out the importance of factors such as establishing clear learning intentions and success criteria, a classroom environment that tolerates errors, and tasks for students that are challenging but commensurate with their abilities.

This work focuses solely on number of years of teaching experience and its relationship to selected teacher characteristics. We concentrate on years of teaching experience because some authors (e.g., Rice, 2010) view it as one of the most important factors in personnel policies affecting teachers and schools: It drives teacher transfer policies, and is often considered a major source of inequality across schools. The importance of teacher experience is based on the premise that students taught by more experienced teachers tend to have higher academic achievement.

A considerable number of studies have already shown that additional years of teaching are related to increased student achievement, particularly in the first years of teaching (e.g., Clotfelter, Ladd, & Vigdor, 2007; Croninger, Rice, Rathbun, & Nishio, 2007; Rowan, Correnti, & Miller, 2002); however, the same body of research suggests that there is no simple, universal relationship between these variables. The studies indicate that the impact of teacher experience on student achievement is difficult to examine, as teacher policy in this respect varies according to the context. For example, in one approach more experienced teachers may be assigned to students of higher ability and with fewer discipline problems; however, in another approach the opposite might be the case (Mullis, Martin, Foy, & Drucker, 2012).

This policy brief contributes to the debate on the relationship between teacher experience as measured by years of teaching and student achievement in fourth-grade mathematics by using international comparative data to address two questions:

- Is teacher experience associated with student mathematics achievement of fourth graders in the education systems analyzed?

- How does this association change when other teacher characteristics are taken into account?

Data

In order to answer these questions we used the IEA's Trends in International Mathematics and Science Study (TIMSS) 2011 Grade 4 database. In addition to academic achievement data, TIMSS 2011 collects data on a rich array of contextual information through student, home, teacher, school, and curriculum questionnaires. In this policy brief, our main analysis variables were: years of teaching experience (as reported by teachers) and student mathematics achievement scores. We used information from the 55 education systems that administered TIMSS in 2011.

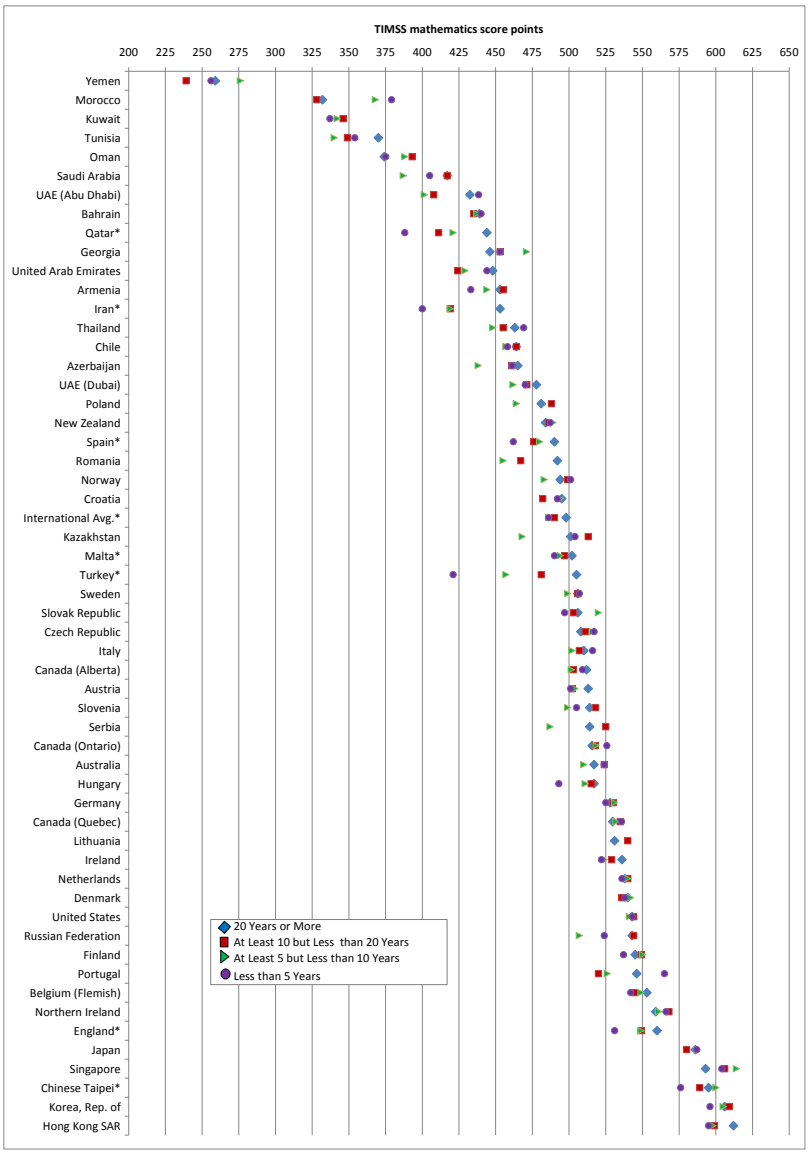
1 http://ec.europa.eu/education/policy/school/doc/support-teacher-educators_en.pdf
2 http://go.worldbank.org/DWK0YI8JX0

Is teacher experience associated with student achievement?

Figure 1 presents the average mathematics achievement scores of students as broken down by teachers' reported years of teaching experience for the 55 education systems analyzed. As can be observed, on average, there is a pattern suggesting that students taught by teachers with more teaching experience tend to have higher achievement scores. In 20 education systems, the students of teachers with 20 or more years' experience had the highest average achievement. Across all education systems, the students of teachers with less than five years of teaching experience achieved an average of 486 score points in Grade 4 mathematics, while the students of teachers with 20 or more years of experience achieved an average of 498 score points[3]. The largest difference between these two groups was found in Turkey, where students of teachers with less than 5 years of experience achieved an average of 84 score points less than students of teachers with at least 20 years of experience. The difference between the student achievement of teachers with 20 or more years of experience and those of teachers with less than five years of experience turned out to be significant for seven educational systems (Turkey, Iran, Qatar, Chinese Taipei, Spain, England, and Malta), as well as for the international average.

This pattern, however, was not evident in all education systems. As can be observed in Figure 1, in 13 education systems the highest average achievement corresponds to students of teachers with 5 or less years of experience; in 10 education systems it corresponds to students of teachers with at least 5 but less than 10 years' experience; and in 12 education systems, the students of teachers with at least 10 but less than 20 years of experience were the ones who had the highest average achievement. For none of these groups, however, were the differences statistically significant.

Figure 1: Average Grade 4 mathematics achievement scores of students, broken down by teachers' years of teaching experience and education system: TIMSS 2011



Note: * Statistically significant differences between student achievement of teachers with 20 or more years of experience and those of teachers with less than 5 years of experience ($p < 0.05$).

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

3 TIMSS scores are reported on a theoretical scale that ranges from 0 to 1,000, with an international mean of 500 and a standard deviation of 100.

What student, teacher, and school characteristics are associated with teacher experience?

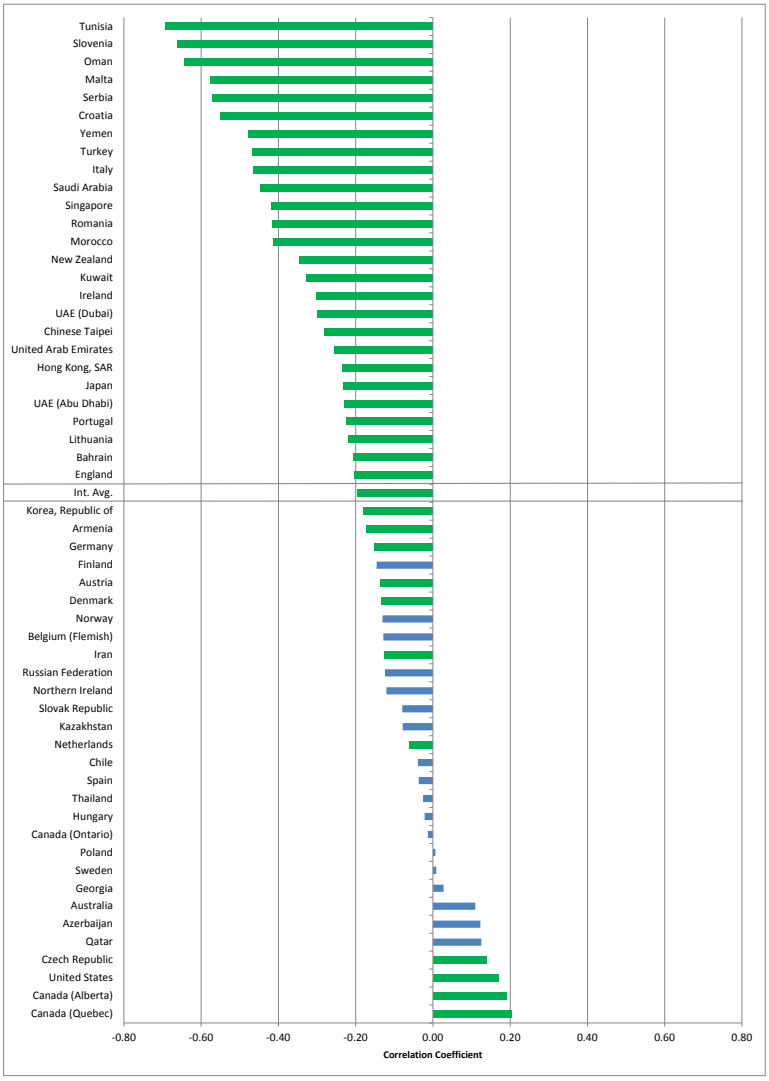
We know from the literature that the relationship between teacher experience and student achievement is not a simple one and can be affected by diverse factors. For this reason, we decided to look for other factors and conditions associated with teacher experience in the 55 TIMSS 2011 education systems. We explored the relationship between teacher experience and several school, teacher, and student characteristics. From the set of characteristics at the school level we chose: school climate, school resources, and school size; at the teacher level: teacher level of education and teacher career satisfaction; and for students: student socioeconomic status and student motivation. We found statistically significant associations between teacher experience and many of these variables; however, different relationships were found to be significant in different education systems, and relationships indicating a positive, linear relationship in some education systems were often found to be negative in others.

These mixed patterns may reflect the various teacher policies that different education systems have in place regarding years of teaching experience. Some education systems may assign experienced teachers to more challenging schools, while others may do exactly the opposite. For example, in our analyses (not reported here), we found that:

In Lithuania and Northern Ireland, there is a significant negative association between teacher years of experience and the socioeconomic status of their students[4]. This association suggests that in these countries, students with higher socioeconomic status tend to be taught by less experienced teachers. In contrast, in Slovenia, Chinese Taipei, Romania, Spain, Qatar, and Oman, the students with lower socioeconomic status tend to be taught by teachers with less years of experience.

In Malta, Iran, Romania, Morocco, Qatar, and Chinese Taipei, there is a negative and significant association between teacher years of experience and the population size of the city, town, or area where the school is located. This association indicates that in these countries, students who attend school in more populated (urban) areas tend to be taught by teachers with less experience. This pattern is reversed in Finland, Italy, Sweden, Austria, and Ireland, where students who study in less populated (rural) areas are the ones who tend to be taught by teachers with less experience.

Figure 2: Correlation between number of years of teaching experience and teachers' attained level of formal education for each education system: TIMSS 2011 Grade 4



Note: Green bars indicate a statistically significant correlation coefficient ($p < 0.05$).
Source: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2011.

In Malta, Germany, Austria, Ireland, Northern Ireland, Italy, Azerbaijan, Finland, Poland, Portugal, and Croatia, there is a significant negative association between teacher experience and teacher career satisfaction. This association suggests that in these countries, the teachers who teach mathematics to fourth grade students are more satisfied with their jobs when they are less experienced. In contrast, in Hungary, Abu Dhabi, Singapore, the Russian Federation, Oman, and the United Arab Emirates, the more experienced teachers are the ones who are more satisfied.

The most consistent pattern among the variables analyzed, however, was the relationship between teachers' years of experience and their

4 The information about socioeconomic background was collected from student responses to questions concerning availability of home resources (number of books and number of home study supports) and parent responses to questions on the number of children's books in the home, parental level of education, and parental occupation.

level of formal education; Figure 2 shows the correlation between these two variables for the 55 education systems analyzed.[5]

The graph shows a general pattern which supports a hypothesis of a negative association between years of teaching experience and teachers' attained level of formal education across the majority of the 55 education systems (correlation coefficients range from −0.7 in Tunisia to 0.2 in Quebec). The correlation coefficients are statistically significant in 37 education systems. Of these 37, the relationship is negative in 33 education systems and positive in the remaining four. In education systems where the relationship is negative, teachers who teach mathematics to Grade 4 students tend to have fewer years of teaching experience but higher levels of educational attainment. The tendency is the opposite in the four education systems with a positive and significant correlation coefficient.

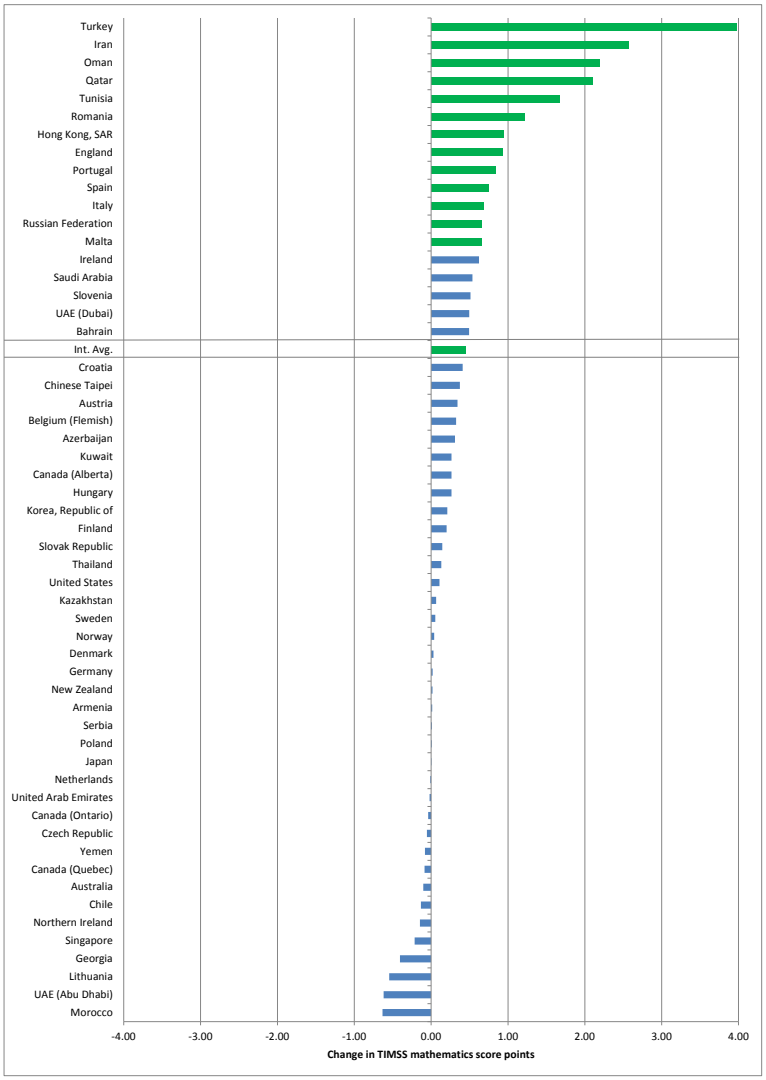
Does the relationship between teacher experience and student achievement change when the teacher's level of formal education is taken into account?

In the first section of this brief, we concluded that the relationship between teacher experience and student achievement is not a simple one. In Figure 1 we presented data indicating that, on average, across the 55 education systems, teacher years of experience are positively associated with grade 4 student mathematics achievement. But we also showed that this pattern is not shared across all education systems analyzed.

Because the association of teacher years of experience with student achievement can be affected by various factors, we investigated the relationship between several student, teacher, and school characteristics and the number of years of experience of mathematics teachers of TIMSS 2011 fourth graders. Our results indicated that the characteristic most consistently associated with teacher years of experience was the teacher's attained level of formal education.

In Figure 3 we show the association between teachers' years of experience and average grade 4 student mathematics achievement after taking into account differences in the teachers' levels of formal education. When doing these estimations we controlled for the

Figure 3: Expected change in the average mathematics achievement of Grade 4 students by education system for each additional year of teacher experience after controlling for teacher's level of formal education: TIMSS 2011



Note: The horizontal bars show the expected change in average achievement score points for each additional year of teacher experience.

Green bars indicate a statistically significant correlation coefficient ($p < 0.05$).

Source: IEA, Trends in International Mathematics and Science Study (TIMSS) 2011.

5 Correlation is a measure of the strength of the relationship between two quantities (variables): in this case, teachers' years of experience and teachers' highest level of formal education (both reported by the teachers themselves). A correlation is expressed by means of a correlation coefficient—a statistic with absolute values ranging from zero to one, where zero indicates no observable relationship, and one indicates a perfect relationship. A correlation is positive if high values of one variable are associated with high values of the other variable; for example, if teachers with more years of experience report having higher levels of formal education. A correlation is negative when high values of one variable are associated with low values of the other; for example, if teachers with more years of experience report having attained lower levels of formal education.

teacher's level of formal education (self-reported). In other words, we compared students as if they were taught by teachers with the same level of formal education and the only thing that changed was the number of years of teaching experience of their teachers.

We found a positive and statistically significant association between teacher experience and student average mathematics achievement in 13 of the 55 education systems, and a negative and significant association in none. Of the statistically significant relationships, the test score gain associated with each additional year of teaching ranged from 0.7 in Malta to 3.9 score points in Turkey.

Conclusions

1. ***There is no simple, universal relationship between teacher experience and student achievement.***

   Our results show that more is not always better. Teachers with similar years of teaching experience may have different backgrounds and be allocated to student populations in different ways in different countries; however, in many countries, in agreement with the research literature, students of more experienced teachers show higher achievement than students of less experienced teachers (in some countries, however, the opposite pattern is found).

2. ***Country-specific characteristics are relevant.***

   Our results showed that the number of years of teaching experience is associated with different factors in different countries. For example, we found significant associations between teachers' years of experience and student socioeconomic background, population density of the city or town where the school is located, and the level of teachers' job satisfaction. However, the relationship between teachers' years of experience and these factors was positive in some education systems and negative in others.

3. ***Teachers' level of formal education may have an impact on the relationship between student achievement and teacher experience.***

   Our analyses indicate that in most of the 55 education systems examined, teachers' attained level of formal education is negatively associated with years of teaching experience. Furthermore, when assuming the same level of formal education for all teachers, the negative associations between teacher experience and student achievement found in a number of educational systems disappeared. This suggests that in recent years, many education systems may have put more emphasis on teacher qualifications by employing those with higher levels of educational attainment.

4. ***Policies related to teacher experience should be designed to take into account the characteristics of each education system.***

   The results of our analyses suggest that when it comes to policies related to teacher experience, there is no one-size-fits-all solution. Teachers' career trajectories differ by country. For example, in some countries experienced teachers are more satisfied with their jobs than new teachers; in other countries, the opposite is true. In some education systems more experienced teachers gravitate to socially disadvantaged students in urban schools, and in others the more experienced teachers tend to be assigned to schools in well-off neighborhoods in rural areas. Therefore, policies aimed at maximizing returns on additional years of teacher experience should consider the particularities of teacher career trajectories in the various education systems and focus on assigning teachers in such a way that the highest overall gain in achievement is obtained.

As mentioned above, the relationship between teacher experience and student achievement is not straightforward: In this policy brief, we explored the association between teachers' years of experience and student achievement while controlling for selected student, teacher, and school characteristics (e.g., student socioeconomic status, teacher's highest level of formal education attained, and the size of the city or town where the school is located). Nevertheless, it may be that other factors and mechanisms underpin the associations between these two variables. A combination of qualitative and quantitative research may help to unravel these relationships by capturing interactions between and among teachers and students that cannot be derived from analysis of large-scale international assessment data such as that collected by TIMSS. The data we analyzed and the statistical methods we used for our analyses have important limitations that need to be taken into account when assessing the utility of our findings.

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Copies of this publication can be obtained from:

The Secretariat
International Association for
the Evaluation of Educational Achievement
Herengracht 487
1017 BT Amsterdam
The Netherlands

IEA Data Processing and Research Center
Mexikoring 37
22297 Hamburg
Germany

By email:
department@iea.nl
mail@iea-dpc.de

Website:
www.iea.nl

This policy brief was produced with the collaboration of:

IEA Data Processing and Research Center
Research and Analysis Unit
Andrés Sandoval-Hernández
Katrin Jaschinski

Pennsylvania State University
College of Education
Pablo Fraser
Sakiko Ikoma

About the IEA

The International Association for the Evaluation of Educational Achievement, known as IEA, is an independent, international consortium of national research institutions and governmental agencies, with headquarters in Amsterdam. Its primary purpose is to conduct large-scale comparative studies of educational achievement with the aim of gaining more in-depth understanding of the effects of policies and practices within and across systems of education.

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