

## The Effect of Subject-Specific Teacher Qualifications on Student Science Achievement

Vera Freundl, Pietro Sancassani

### Key Messages

- Students perform 3.5% of a standard deviation higher in science subjects in which their teachers hold a subject-specific qualification, an effect roughly equivalent to a 2 hour-increase in weekly instruction time.
- The results were obtained from a 30-country international setting.
- The effect is larger for female students, especially when taught by female teachers, and for students from a lower socioeconomic background.
- The effect is also larger for developing and lower-performing countries.
- Increased confidence to teach science explains 20% of the effect of subject-specific teacher qualifications.



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# The Effect of Subject-Specific Teacher Qualifications on Student Science Achievement

Vera Freundl, Pietro Sancassani\*

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What makes a good teacher? This is one of the central questions in the economics of education. General teacher qualifications, such as education level or advanced degrees, tend to be poor predictors of teacher quality.<sup>1</sup> Instead, some studies have shown that subject-specific qualifications predict teacher quality better.<sup>2</sup> However, the vast majority of such studies are based on data from the United States. It is therefore unclear to what extent the findings can be generalized to other nations, as teacher education programs vary widely across countries.<sup>3</sup> The lack of international evidence is particularly problematic for developing economies, which would arguably benefit most from improving student achievement (Hanushek and Woessmann 2015).

## New International Evidence on Teachers' Subject-Specific Qualifications

This policy brief summarizes the results from a recently published paper (Sancassani, 2023), which analyses the impact of teachers' subject-specific qualifications on students' science achievement in an international context. The paper uses data from the *Trends in Mathematics and Science Study 2015* (TIMSS 2015), an international large-scale assessment of students' achievement. TIMSS includes information on subject-specific teacher qualifications and on student test scores in four science subjects: biology, chemistry, physics, and earth science.

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<sup>1</sup> Hanushek (1986), Rivkin, Hanushek, and Kain (2005), Clotfelter, Ladd, and Vigdor (2007), Buddin and Zamarro (2009), Staiger and Rockoff (2010), Ladd and Sorensen (2015).

<sup>2</sup> For example, Monk and King (1994), Goldhaber and Brewer (1997, 2000), Croninger et al. (2007), Clotfelter, Ladd, and Vigdor (2010).

<sup>3</sup> Blömeke, Kaiser, and Lehmann (2010), Tatto et al. (2012).

The paper focuses on 8<sup>th</sup>-grade students in 30 countries where science is taught as an integrated subject (Figure 1), namely where the same teacher teaches all four science subjects. The survey's questionnaire collects information on whether teachers hold subject-specific qualifications in each of the four science subjects.

**Figure 1**  
**Countries Analyzed**

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Note: The map shows the countries that are part of the analysis.  
For the full list of countries, see Sancassani (2023).

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## **Analysis of the Impact of Subject-Specific Teacher Qualifications on Student Test Scores**

It is often difficult to estimate the impact of teacher qualifications on student performance. Unobservable characteristics of students and teachers can bias the estimates if they are not taken into account. To overcome such issues, the study leverages the availability of student test scores and subject-specific teacher qualifications in the four science subjects for each student and teacher. This allows the estimation of a model that accounts for unobserved student and teacher characteristics that do not vary across the four science subjects, which constitute the most serious threats from an econometric standpoint. The resulting estimates will therefore not be biased by the fact that, for example, more motivated or higher-ability students might be more likely to be taught by teachers who hold subject-specific qualifications.

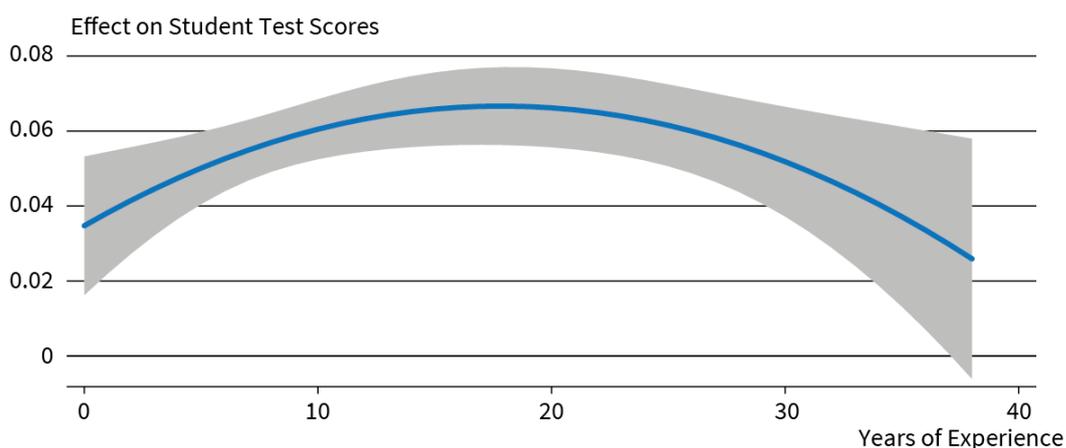
## **Subject-Specific Teacher Qualifications Matter for Students' Science Achievement**

The study finds that subject-specific teacher qualifications positively affect student test scores. Students perform 3.5% of a standard deviation higher in science subjects in

which their teachers hold a subject-specific qualification. This effect is equivalent to an increase in instruction time of slightly more than 2 hours per week compared to instruction by a teacher without subject-specific qualifications. Further, it can be calculated that each student would gain approximately USD6,825 more in cumulative lifetime income from being taught by a teacher with subject-specific qualifications in a single grade. The study also shows that 20% of the effect can be explained by teachers feeling more confident to teach science subjects in which they hold a subject-specific qualification.

With respect to teachers' experience, the impact of subject-specific teacher qualifications on student test scores increases as teachers gain more experience and it peaks at mid-career, at about 18 years of experience. While remaining positive, the effect declines slightly thereafter (Figure 2).

**Figure 2**  
**Effect of Subject-Specific Teacher Qualifications on Student Test Scores**



Note: The figure shows the effect of subject-specific teacher qualifications on students' test scores along teacher's years of experience with 95% confidence interval.

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## Larger Effect for Female and Disadvantaged Students

Further analyses show that female students benefit more than male students from being taught by teachers with subject-specific qualifications. The effect for female students is even larger if the teachers are also female. A possible explanation for this is that female students might be more confident in learning science subjects if the role model they are exposed to is also a female. Hence, these results support the existence of a role-model effect of teachers already observed in the literature (e.g., Dee 2005, Paredes 2014).

Interestingly, the impact of subject-specific teacher qualifications is also larger for students from lower socio-economic backgrounds. This has important equity implications, as it suggests that teachers with subject-specific qualifications might help to improve the outcomes of students from the most disadvantaged backgrounds.

## **Larger Effect in Developing and Low-Performing Countries**

The paper also finds that the impact of subject-specific teacher qualifications varies across groups of countries. In particular, the effect is larger in developing countries and in countries that fall below the median science performance. Since most of the literature in the field of teacher characteristics and student outcomes focuses on the United States, these results suggest that teacher qualifications might have an even greater impact on student test scores on a global scale than the literature currently suggests.

## **Policy Implications**

In light of the study's findings, countries worldwide should promote teachers' acquisition of subject-specific qualifications by, for example, raising the standards required to become science teachers. This appears to be especially important for female students, who have long been underrepresented in STEM subjects, and for students from disadvantaged backgrounds, who tend to lag behind their more affluent peers in terms of educational achievement. Further, results from this paper suggest that students in developing and lower-performing countries benefit the most from being taught by such teachers. Hence, encouraging teachers to acquire subject-specific qualifications can help increase the equity and efficiency of educational systems around the world.

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