



Professional learning for math teachers is a plus for students

WHAT THE STUDY SAYS

Using 4th- and 8th-grade mathematics data from 2003, 2007, and 2011 Third International Mathematics and Science Study (TIMSS) assessments, researchers conducted a cross-national empirical study to examine teacher participation in professional development and its impact on student achievement. They conclude that, although 4th- and 8th-grade students in the United States had more access to teachers who participated in professional learning than similar students in other countries, one-third to one-half of 4th graders were taught by teachers who had no professional development in mathematics. They also conclude that teachers' participation in professional development was positively associated with student achievement.

Study description

Despite an increased emphasis on the importance of professional learning and federal guidelines defining levels of investment in it for various federally

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At a glance

An international comparison study based on TIMSS data over multiple years demonstrates that professional learning for teachers of 4th- and 8th-grade mathematics is associated with increased student achievement.

THE STUDY

Liang, G., Zhang, Y., Huang, H., Shi, S., & Qiao, Z. (2015). Professional development and student achievement: International evidence from the TIMSS data. *Journal of Postdoctoral Research*, 3(2), 17-31. Available at www.postdocjournal.com/file_journal/767_55399091.pdf.

funded initiatives, empirical research on the impact of professional learning on student achievement continues to be limited. This study is a multinational empirical study using data collected over an eight-year period to examine more closely the impact of professional learning on student achievement. It focused specifically on six areas of professional learning in mathematics: math content, math pedagogy, math curriculum, integrating information technology into math, math assessment, and improving students' critical thinking or problem-solving skills.

Questions

The research study focused on two questions:

1. How does the percentage of students whose teachers participated in math professional development compare with other countries around the world from 2003 to 2011?

2. How are the national levels of students' access to teachers who have participated in professional development associated with national math achievement?

Methodology

Researchers used both student achievement and teacher self-reports about their participation in professional learning from the 2003, 2007, and 2011 Third International Mathematics and Science Study to answer the two research questions. Data from the teacher survey about their educational backgrounds, contexts, curricular content, and instruction provide their perceptions and permit comparative analyses about trends in student achievement related to multiple factors. Since 2003, the numbers of countries participating in TIMSS has been growing steadily. In 2003, 26 countries participated in the 4th-grade study and 28 countries participated in the

WHAT THIS MEANS FOR PRACTITIONERS

This multinational, comparative, empirical study examining data across eight years provides evidence of the positive association between teacher professional development in six areas related to mathematics and students' mathematics achievement on an international assessment.

The research study affirms what is outlined in the Outcomes standard of Learning Forward's Standards for Professional Learning — content-focused professional learning is a powerful vehicle for promoting student learning. These findings, when coupled with other research studies, emphasize the importance of linking the content of professional learning to specific outcomes for students, ensuring depth of teacher content knowledge and content-specific pedagogy, knowledge of curriculum, assessment practices, and technology integration into the content.

Further, it suggests that professional learning leaders, practitioners, decision makers, and policymakers have a responsibility for monitoring alignment between the content of professional learning and discipline-specific knowledge and pedagogy. The study, as researchers note, supports the implementation of policies, advocacy, and practices for professional learning as a vehicle for improving student achievement and supporting educational reform.

8th-grade study. In 2011, 52 countries participated in the 4th-grade assessment and 45 countries participated in the 8th-grade one.

Because TIMSS uses a two-stage stratified cluster sampling design of classrooms, students who were taught by teachers with specific attributes are the unit of analysis in this research study as well. The teacher questionnaire asks teachers to respond to a question about their participation in professional development in the past two years in each of the six focus areas. Teacher responses were coded as yes or no.

National mean math scores for 4th- and 8th-grade students were used as the measure of math achievement. Researchers used UNESCO Institute for Statistics data from the time periods of each of the three administrations of TIMSS about gross domestic product (GDP) per capita and education expenditure as a percentage of GDP as control variables.

Analysis

Researchers calculated Pearson's correlation coefficients between national mean math achievement and students' access to teachers who participated in professional development. They subsequently conducted multiple regressions using as the dependent

variable math achievement of a country for a specific grade level and as the independent variable the percentage of students whose teachers had professional development in one of the six focus areas. The analyses compared students in the United States, in TIMSS countries, in high-income OECD countries, and in G8 countries.

Results

Researchers present the percentage of students in 4th and 8th grade by their teachers' participation in math professional development that focused in the six areas in the past two years from 2003 to 2011. Overall, there is a larger percentage of students in the U.S. whose teachers participated in math professional development in all areas than in other countries. For example, teachers of 73% of 8th-grade students in the U.S. — compared to 54% of students in TIMSS countries, 52% of students in high-income OECD countries, and 54% of students in G8 countries — participated in professional development in math content in 2011.

Areas where the percentage of U.S. students whose teachers participated in professional development is substantially larger (two-thirds or more compared to one-half or less) than in other countries include math content

(4th and 8th grade), math curriculum (4th and 8th grade), and integrating information technology into math (8th grade). The data indicate that, despite the large percentage of students whose teachers participate in mathematics professional development in the U.S. and other countries, nearly a quarter to a half of students do not have access to teachers with professional development in some areas and the percentage of 8th-grade U.S. students declined in all areas between 2003 and 2011.

Overall, students' math achievement is moderately or significantly associated with professional development in four areas, including math content, math pedagogy, math curriculum, and integrating information technology into math. For example, the correlation coefficients between 4th-grade students' math achievement and teachers' professional development in math content are statistically significant at 0.05 or higher in 2003 and 2007 and for the pooled data. For 4th-grade students, 22 of the 23 coefficients are both positive and significant. For 8th-grade students, 17 of 24 coefficients are positive and significant.

Based on the positive association between student math achievement and teacher professional development,

researchers conducted a series of multiple regression models. The regressions indicate that, after controlling for GDP and educational expenditure, there is a statistically significant association in 2007 in five of the six professional development areas for 4th-grade students (math content, pedagogy, curriculum, integrating technology, and improving critical thinking and problem-solving skills); in 2011 in one area; and in five areas for simple pooled data.

For example, in 2007, an increase of 1.9 points in national mean math score is associated with one percentage point increase in the proportion of 4th-grade students whose teachers participate in professional development

in math content. For 8th-grade students, the positive and statistically significant associations occur in 2007 in four of the five areas (math content, pedagogy, curriculum, and integrating technology); in 2011 in math pedagogy; and in pooled data in math content, pedagogy, curriculum, integrating technology, and critical thinking and problem solving skills.

For 8th-grade students, a one percentage point increase in access to teachers with professional development in math content, pedagogy, curriculum, and integration of technology increases the national mean math achievement score by an average of 1.04, 1.24, 0.93, and 1.07 points respectively.

Limitations

The researchers note several limitations. Teacher responses about their participation in professional development are self-reported and self-determined as simple yes or no without reference to the amount or quality of professional development and without explanation to guide teachers' responses. A common limitation of research in professional learning is the lack of common definitions of constructs related to professional learning nationally or internationally. In addition, the context in which professional learning occurs varies greatly across countries. ■

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