Developing mathematics teacher confidence through increasing understanding of mathematics

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Dr. Jennifer Holm, from Wilfrid Laurier University, walks us through the importance of developing mathematics teacher confidence through increasing understanding of mathematics

Effective mathematics teaching requires mathematics teachers who have the confidence and knowledge to support all learners in developing an understanding of mathematics.

Concerns about the teaching and learning of mathematics have been ubiquitous in both the media and in ministries of education. In my research, I have focused on exploring why many mathematics teachers struggle with their own confidence in teaching the subject. A key issue I have identified is the widespread belief that the more mathematics a teacher knows, the more confident they will be in the classroom.

While a strong foundation in mathematics is certainly beneficial, this perspective oversimplifies the complex nature of teaching. Another assumption is the idea that just because a teacher has taken mathematics courses, they just need to learn about pedagogy to teach mathematics. There is more to effective mathematics instruction than just mastering content or taking general pedagogy courses – it requires a deeper, more specialized understanding of how to teach that content to diverse learners.

Research on increasing mathematics understanding

Shulman (1986) discussed that there is specialized knowledge that teachers need to be successful in teaching, which he termed “pedagogical content knowledge.” This knowledge would reflect something only a teacher would need to know to help them plan and execute lessons, but a student would not need or gather this knowledge. The faulty logic that many individuals possess is that if they have been students themselves, they can teach simply because they have observed teachers in their element. The issue with this belief is that teaching is a complex science, and many decisions go into every step a teacher takes, from what lesson to choose to what examples to provide to what questions to ask, and none of this may be obvious to a student who is trying to learn the content during the lesson.

There is also a need to disrupt current teaching practices in mathematics to support learners in being critical thinkers and supporting all learners. Ball and her colleagues (e.g., Ball et al., 2005; Ball et al., 2008) expanded on the initial ideas of Shulman and looked at mathematics specifically, terming this specialized knowledge as “mathematics knowledge for teaching.” This knowledge is something that a teacher would need to know about mathematics to support their teaching and includes knowledge of mathematics

content, teaching pedagogy, knowledge of students, and knowledge of curriculum trajectories. In my work, I have called this specialized knowledge “conceptual knowledge” to separate it from the “procedural knowledge” that many people have. This specialized knowledge is essential for teachers to have a flexible understanding of mathematics that would support students.

To give an example, consider how to solve 24 X 35. If you have strong procedural knowledge, you can correctly calculate the solution without using a calculator and may use any number of procedures (or formulas) to solve it. Conceptual knowledge (or mathematics knowledge for teaching) would mean that you could solve the problem in multiple ways, including using mental math or alternative methods; you could provide a model, possibly using manipulatives to show how and why the solution is correct; you could identify different ways students may have difficulties with the question; you could design different lessons with proper questioning to help students learn how to solve the problem and meet a variety of different learning needs of the students; you understand how a problem like this teaches students about the meaning of multiplication; and you can expand the understanding of multiplication from this problem into more complicated numbers and concepts, such as an understanding of fraction multiplication or algebra. A student needs to be able to solve the problem in an efficient way, and a teacher needs to support the student in gaining that knowledge.

Debate in mathematics education: How to effectively teach and support students

There is some debate currently in mathematics education about how to effectively teach and support students, with some individuals pushing that simply using direct instruction is most effective, while others are considering that students need opportunities to “play” with the mathematics with an effective teacher to learn to understand the concepts. In the end, the teacher needs to consider: do you want students to be able to calculate mathematical answers, or do you want them to build an understanding of the mathematics?

If the latter is the goal, then a variety of lessons needs to be employed, and the teacher needs a strong understanding of mathematics for teaching. It is relatively easy to take a teacher’s edition, directly share a problem with students, show them how to solve said problem, and then have students use the same solution method on similar problems. The amount of understanding needed would be minimal, and the focus would be on knowing the procedures required to solve the problems. Teaching in this way helps students understand that mathematics is about calculations.

On the other hand, giving students problems and then facilitating them to reason about and work through the problems using models and reasoning, would require a different set of skills as a teacher. In this case, students would learn that mathematics is about thinking, reasoning, and problem-solving.

We need a deeper understanding of mathematics for teachers

In my work, I have advocated for a deeper understanding of mathematics for teachers. To this end, I created Dr. Elle G. Brayic's Math Academy to host my online modules that work to support teachers in developing mathematics knowledge for teaching. For teachers to be confident in helping to facilitate students gain an understanding of mathematics that goes beyond calculations, teachers need to understand the mathematics themselves, and it is not something that they would necessarily gain from being mathematics students themselves.

This understanding of mathematics goes beyond just knowing how to calculate answers (as discussed earlier); instead, it focuses on how and why mathematics works. Current teachers' education programs and professional development must focus on supporting teachers in developing a stronger conceptual knowledge of mathematics.

This can and should also be studied in conjunction with pedagogical methods for teaching mathematics that support all learners in gaining an understanding of mathematics.

Today's workforce needs critical thinkers and problem solvers. Since we have the technology to do calculations, balancing a mathematical program that allows students to learn how to calculate answers and reason about mathematics is key. If this is to be the reality, then there needs to be a focus on supporting mathematics teachers in a better, stronger, more flexible conceptual understanding of mathematics.

References

- Ball, D. L., Hill, H. C., & Bass, H. (2005). Knowing mathematics for teaching: Who knows mathematics well enough to teach third grade, and how can we decide? American Educator, 29(1), 14, 16-17, 20-22, 43-46.
- Ball, D. L., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? Journal of Teacher Education, 59(5), 389-407.
- Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. Educational Researcher,15(2), 4-14.

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