Untangling the Math Debate

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Abstract

The question of how best to teach mathematics has been up for debate for decades. Traditionalists push for a back-to-basics type education, while reformers seek to teach students for understanding. At the same time, many teachers are dealing with their own feelings of anxiety about math. While it often appears that this debate must end in an either-or solution, perhaps the best way forward would be to seek a balanced solution. Teachers could be supported through this process of change with a combination of quality professional development and opportunities to engage in professional learning communities. Finding a way to strike a balance and end this debate will give teachers the opportunity to provide their students with a comprehensive mathematics education.

Over the last several decades, the question about how to teach mathematics best has been debated heatedly (Hattie et al., 2017). The debate, dubbed the math wars (Schoenfeld, 2004), is the argument between two seemingly polarized sides on how mathematics should be taught. On one side are the traditionalists, who promote a back-to-basics education (Ansari, 2016; Urback, 2017). On the other side of the debate are the reformers, who advocate building understanding of concepts (Ansari, 2016). Further complicating the debate is that many teachers, particularly in primary grades, deal with math anxiety (Gonzalez-DeHass, Furner, Vasquez-Colina, & Morris, 2017) and low self-efficacy in teaching mathematics (Novak & Tassell, 2017). While what is portrayed in the press appears to be an either-or (procedural versus conceptual understanding) scenario, perhaps the best way forward would be to seek a balanced approach to mathematics education (National Council of Teachers of Mathematics [NCTM], 2014).

Ways to support teachers in finding an increased sense of confidence could be found through quality professional development (Thames & Ball, 2010), and developing professional learning communities that promote a focused culture of learning (DuFour, 2004). Change, while necessary, can be difficult; however, there are solutions to help ease the process.

The Math Wars – Trying To Swing the Pendulum

The math wars debate is one that seems to pit traditional back-to-basics curriculum against building understanding of mathematical concepts, leaving anxious educators in the middle, lacking confidence in their ability to support their students. Frequent news reports on the topic of mathematics education broadcast falling test scores (Aumel & Hirshfield, 2018), and claim that the curriculum and discovery learning are the culprits (Urback, 2017). Discovery learning is a phrase often used by the media, yet by their own admission it “is a term rarely uttered by anyone within the education system and does not appear anywhere in [the] math curriculum” (Flanagan, 2018, para. 18). Despite the reports, Canadian students are among the top ten countries assessed on the recent PISA assessment, and students in all provinces, except Saskatchewan, “performed at or above the OECD average” in 2015 (O’Grady, Deussing, Scerbina, Fung, & Muhe, 2015, p. 35). Manitoba’s students do have a lot of room for growth, because they scored well below the Canadian average in mathematics on the recent PCAP in 2016 (O’Grady, Fung, Servage, & Khan, 2018). It is important to remember, however, that the focus of the PISA and PCAP is directly linked not to a particular curriculum, but rather to the way students apply their knowledge (Ansari, 2016). The question of where the issue lies, and how to solve it, is not as simple as demanding a changed curriculum.

How to teach specific curricular outcomes is part of the debate, with each group trying to push the pendulum of educational methods to their side. The media frequently highlight those advocating for a back-to-basics approach that involves rote memorization and learning procedures (Anderssen, 2018). However, the current research into mathematics education shows that students learn best through a combination of teaching strategies that depend on the student, the student's prior knowledge, and the learning goal (Hattie et al., 2017). Students learn curricular outcomes best through non-traditional methods (such as an increased focus on student discourse and collaboration), by building both conceptual understanding and procedural fluency (NCTM, 2014; Rittle-Johnson, Schneider, & Star, 2015) in a differentiated manner (Hattie et al., 2017). This means that students need fluency (flexibility in seeing relationships and strategy use) as well as mastery of basic math facts, not just memorization (Kling & Bay-Williams, 2015). They need to know both how to perform procedures and why they work (Rittle-Johnson et al., 2015). In other words, what students need is a balance of basic skills and understanding, not the either-or scenario often given. While how students learn best is indicated in the research, for teachers to know how to facilitate this learning can seem daunting and complicated, particularly in light of their own feelings and experiences with math.

Many elementary school teachers report high math anxiety, negative feelings toward mathematics, and low self-efficacy when it comes to teaching mathematics (Knaus, 2017; Novak & Tassell, 2017). Multiple studies have shown that teachers pass down these attitudes and beliefs to their students, causing poor achievement in the next generation (Chang, 2015; Gonzalez-DeHass et al., 2017). When students have math anxiety, it affects their working memory and can lead to avoidance of math (Ramirez, Chang, Maloney, Levine, & Beilock, 2016). Preservice teachers who have had math anxiety in the past have stated concerns about their ability to teach new concepts and strategies (Stoehr, 2017). Comparatively, teachers with high self-efficacy in teaching mathematics are more likely to be willing to try new or different teaching approaches, and are willing to use multiple teaching strategies (Chang, 2015). Perhaps this anxiety is why teachers who are not comfortable with mathematics revert to teaching the way they learned, through lecture-style teaching and worksheet practice. The math debate is not just news fodder for a polarizing story, pitting traditionalist against reformer; the consequences are far reaching because they impact teachers, and as a result students, in terms of their feelings about and confidence with mathematics.

Moving Forward by Striking a Balance

Rather than trying to push the pendulum in one direction or the other, supporting teachers through professional development and professional learning communities to strike the right balance between procedure and understanding is perhaps the best thing that educational leaders can do (Anderssen, 2018; Ansari, 2016). One of the biggest challenges at the heart of this debate is that teachers are trying to change the system that they themselves learned from (Zager, 2017). While discovery learning does not exist in the curriculum, inquiry-based learning does (NCTM, 2014). Unlike the free-for-all that discovery learning is portrayed to be, inquiry-based learning relies on a teacher who knows the curriculum thoroughly, has a strong sense of students' learning goals, and is capable of guiding his/her students to a deeper understanding of mathematical concepts (Zager, 2017). A balance of building conceptual understanding, along with learning procedural skills and developing mathematical accuracy and fluency, makes for a rigorous math education (Hattie et al., 2017). Teachers, who usually have learned in a more traditional way, including memorizing facts and formulas, sometimes have difficulty developing the kind of mathematics knowledge for teaching that is required to provide this balanced, rigorous type of mathematics experience (Hill & Ball, 2004).

Supporting teachers to make the shift in their own understanding and professional practice through professional development is an ongoing process. Changing teachers' beliefs about mathematics, and their own self-efficacy in teaching it, takes time (Knaus, 2017). Engaging in

continuing professional development targeted at understanding the mathematical content for teaching is one solution for improvement (Hill & Ball, 2004). Learning through professional development is common practice throughout the teaching profession. Ensuring that the focus of professional development is on making connections between teaching practice and understanding math content for teaching is key (Cueto, Leon, Sorto, & Miranda, 2017). There is an important difference between understanding math content knowledge as computational ability and understanding the content as it is used for teaching (Hill & Ball, 2004). This distinction is important for professional development facilitators to understand, because mathematics teachers also need the latter type of learning in order to be successful at improving student achievement (Thames & Ball, 2010). For example, when teachers participate in learning opportunities that provide time for them to explore concepts by using manipulatives and pictorial representations, they develop a deeper understanding of the content they need to teach and they increase their confidence (Vinson, 2001). While student learning results from many factors, including the teacher's knowledge of and responsiveness to his/her students' learning needs (Hattie et al., 2017), the teacher's own understanding of mathematical content for teaching is a critical piece for success (Hill & Ball, 2004).

Engaging in collaborative professional learning and dialogue can be a good step in the right direction to reducing math anxiety and increasing self-efficacy (Chang, 2015). Positive feelings about the subject can be transmitted from teachers to their students (Allen & Schnell, 2016). In the same way that teachers work to break concepts down into manageable chunks of information for students to learn and understand, leaders need to think about how to facilitate change in a meaningful, manageable way. Providing opportunities for teachers to explore the mathematical content they are expected to teach, and helping them to make connections between curricular goals and teaching practice, are crucial (NCTM, 2014). Giving teachers time to engage in reasoning, and determining why particular procedures work, are part of finding balance (Hill & Ball, 2004).

Another important shift is to change the culture of our schools from one of teaching in isolation to one of professional learning communities that engage in pedagogical dialogue (NCTM, 2014) and focus on learning goals (DuFour, 2004). In the past, teaching has been an isolated profession; teaching typically happened behind closed doors (Admiraal, Lockhorst, & van der Pol, 2012). Part of being a professional is viewing oneself as a lifelong learner and seeking to learn and improve one's practice (NCTM, 2014). When teachers collaborate in order to shift the focus from what they are teaching to how students are learning (DuFour, 2004), they can focus on the mathematical content as students might learn it. An effective school culture is one that has a shared belief in its own efficacy, collective responsibility to students' learning, and confidence in the ability to improve (NCTM, 2014).

Administrators play a key role in setting the culture of learning in a school. When the message sent by administrators is one of support and understanding, the culture and focus of a school can improve (Marynowski, 2016). Administrators can also build culture by supporting meaningful professional development that builds teachers' understanding of curricula (Admiraal et al., 2012; NCTM, 2014). This shift in culture to one of collaborative practice and goals (Admiraal et al., 2012; DuFour, 2004) provides opportunity for professional dialogue that can build some of the mathematical content for teaching that educators may be missing. Perhaps if teachers no longer feel as though they are in the middle of a tug of war, but rather feel supported through a culture of professional development and dialogue, they will have the confidence to move forward with providing the balanced mathematics education that students need.

Conclusion

The debate about mathematics education continues, with no easy solution. Teachers are on the receiving end of conflicting information. The traditionalists, via the media, are demanding

traditional teaching methods and curriculum (Urback, 2017). On the other side are those who promote building conceptual understanding (Ansari, 2016). Compounding this confusion are teachers' own negative feelings about mathematics and a lack of self-efficacy (Gonzalez-DeHass et al., 2017). Having the courage to learn and move forward with a balanced approach can be a challenge, but one that is achievable. Ongoing, quality professional development could be one solution to improving both teachers' knowledge about math education (Thames & Ball, 2010) and their self-efficacy (Knaus, 2017). Providing teachers with opportunities to engage in discussion and collaborative work is another possible solution (DuFour, 2004). One thing is clear, though: if the stakeholders in this debate do not strive to work together and find a balance, it will be the students who continue to miss out on a comprehensive mathematics education.

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