Twisting, Stretching, and Bending: A Case for Flexibility in Today's Model of Mathematics Education

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Note from the Author

The presenters' question was made up of many parts. I felt that choosing one part would help me to focus my paper on an argument as well as write about something meaningful for me.

The entire question that the presenters provided is given below, and the ***bolded*** question is that which I have chosen to answer. My subject specific modification of the question is in ***red***.

Presenter's Guiding Question for Week 4

Describe similarities and differences between schools today and early schools such as Dame Schools, Latin Grammar Schools or the Franklin Academy?

How did these schools meet the needs of their charges and what may have been lacking?

How have these schools influenced our current model of education?

How does our current model of** mathematics **education meet the needs of our students and how is it lacking?

Modern mathematics education literature shows a continual mention of, and often a response to, the "traditional" way of teaching the subject (Wood, 2001, 110). This method of teaching mathematics is aptly dubbed "mathematics from above" by El-Kafafi, who describes it as learning "through reception of information, absorption of facts and reproduction" (Siham El-Kafafi, 2011, 45). Hence, teachers are viewed "as experts in the field whose job is to transmit those facts to the students … through the rote-learning method" (Siham El-Kafafi, 2011, 45). This is often the method that people think of and refer to when criticism is given for mathematics education. Our more contemporary position on numeracy education, or as El-Kafafi calls "mathematics from below," sees learners "using and understanding mathematics to make sense of the real world and acknowledging numeracy as a social activity," which is a much more student-centered, progressivist, and constructivist approach (Henson, 2010, 4 and 109; Siham El-Kafafi, 2011, 46). While many members of the public would disagree, I would argue that our current model of mathematics education is one of "mathematics from below." This view is justified by the large amount of research that has been done in the last thirty years in education in general (Henson, 2010, 130), and specifically in the last twenty to devise and execute many context-based mathematics curricula driven by higher order thinking that are currently in practice in many parts of North America (Meyer, Dekker, & Querelle, 2001, 522). The purpose of this paper is to discuss the ways our current model of mathematics education meets, and does not meet, the needs of our students.

On the whole, our current model of mathematics education encourages teachers to use research to inform their practice. Many mathematics teachers, whether through academic reading, workshop attendance, or social networking and web 2.0 technologies, work to improve their practice by trialing a wide variety of techniques (Campbell, Shaing, Hui-Yin Hsu, Duffy, & Wolf, 2010; Healy & Hoyles, 1999; Mishra & Koehler, 2007; Tomlinson, 2001). The availability of such rich pedagogical knowledge, and the support that schools provide encourage teachers' experimentation with this knowledge and, thus, the improvement of their teaching practice. In addition, a growing number of teachers conduct their own research in their classrooms using action research techniques (Henson, 2010, 130). Many researchers, such as Ginsburg, advocate for clinical interview processes to be used in formative assessment (Ginsburg, 2009, 113), and significant research has identified ways to avoid some of the pitfalls of this and other interview and observation techniques (Koichu & Harel, 2007, 350). Combine the focus of many curricula on the aforementioned "mathematics from below," student-centered approach with the plethora of pedagogical research distributed through now ubiquitous technologies, and we have a growing professional development model that will help mathematics teachers meet students' needs in an ever changing world.

A formidable challenge to this aim of teachers to assist students is the issue of "math phobia," or "math anxiety." A common problem in mathematics education in North America, "math phobia" is defined as a feeling of stress and lack of confidence when working in mathematical situations (Stuart, 2000, 331). This affects many children and adults and is currently the topic of much research in the contexts of elementary school teaching (Siham El-Kafafi, 2011), special education (Humphrey & Hourcade, 2010), and pre-service teacher preparation (Gresham, 2007; McGlynn-Stewart, 2010). "Math phobia" has been attributed to such factors as peer and teacher attitudes towards gender and ethnicity, and family and peer attitudes towards the subject itself (Stuart, 2000, 331). Studies in student motivation have shown that the strongest motivating factor for persistence in learning is understanding (Miller, as quoted in Siham El-Kafafi, 2011, 44). Yet, elementary teachers are subject generalists (Robitaille &

Dirks, 1982, 10), many of whom doubt their ability to teach successfully for mathematical understanding, and many more in a "mathematics from below" constructivist manner (McGlynn-Stewart, 2010, 175). In addition, the many differences between the informal mathematics people do in their everyday lives and "school mathematics" can't be ruled out as another cause here (Robitaille & Dirks, 1982, 3; Siham El-Kafafi, 2011, 41). It seems our current model of mathematics education has played an unfortunate role in the widespread development of this negative perception. However, "math phobia" is reinforced much more strongly outside of school through what Papert has identified as a more general fear of learning: "our children grow up in a culture permeated with the idea that there are 'smart people' and 'dumb people.' …There are people who are 'good at math' and people who 'can't do math.' Everything is set up for children to attribute their first unsuccessful or unpleasant learning experiences to their own disabilities" (Papert, 1980, 43). The pervasiveness of this general perception in North American culture means that students are entering classrooms at earlier and earlier stages in their lives with preconceived notions of what their learning journey will entail, and thus, it is less appropriate for total fault to be placed on our current model of mathematics education. However, we can say with certainty that mathematics educators have an important role to play in instilling a love of the wonder, power and beauty of mathematics in students, and in showing parents ways to reinforce and model positive attitudes to the subject at home.

In order for educators to take this role of advocacy for mathematics education, they need to understand the crisis of faith in mathematics as a subject and of teachers in general that has been popularized in politics and the media in recent decades. Regardless of the progress that has been made in mathematics education, we are still feeling the aftershocks of people's reactions to their own unpleasant experiences with mathematics, whether due to mathematics education itself or general cultural influences mentioned previously. As Papert claims, "deficiency becomes identity" (Papert, 1980, 42). Negative experiences that are collectively reinforced determine the popular idea of what "mathematics education" is, and this is what is being responded to in public discourse at present. The impact teachers can have on this perception is marred by this, and the "crisis in education" that is also part of this discourse. For nearly three decades, the public has gotten used to seeing "educational reforms that display little confidence in the ability of public school teachers to provide intellectual and moral leadership for [America's] youth" (Giroux, 1988, 121). For example, Darling-Hammond, Wise, and Klein contend that the professionalization of teachers in Ontario that commenced in the late 1990s was based on the premise that teachers lacked skills and approaches to prepare students for the global economy (as quoted in Mawhinney, 1998, 40). It is difficult for teachers to have an impact if their credibility is reduced in the public eye. In addition, perception is an unpredictable and often illogical animal that is nearly impossible to control and direct. Still, change is possible and educators must try.

Hope for change can be found in the metaphor of flexibility, and firstly, by "twisting" to examine many different sources of inspiration, such as the learning that takes place in early childhood. While many people have had negative experiences in mathematical situations, Piaget's experiments showed that mathematical learning takes place naturally and results in perfectly coherent theories of the world that are usually expressed using different mathematics than that which is generally accepted in adult culture, but are no less mathematical in nature (Piaget, 1953, 74). This is "a learning process that has many features schools should envy: It is effective (all the children get there), it is inexpensive (it seems to require neither teacher nor curriculum development), and it is humane (the children seem to do it in a carefree spirit without explicit external rewards or punishments)" (Papert, 1980, 42). It seems the theme of this

Piagetian learning, as Papert calls it, is one of flexibility. Children learn innately through free exploration centered on their personal interests without any pre-determination of what particular lesson will be learned in that moment. We can take our cue from this naturally progressivist process. Design thinking invites teachers to take a similarly flexible and reflective view of their practice, and thus offers them a powerful way to conceptualize their work (Brown, 2009, 16). One could argue that there are many restrictions on teacher freedoms due the plethora of administrative structures at various levels of our school systems. However, design thinking is about taking an experimental, collective approach, and embracing constraints rather than thinking of them as limitations, a creative method that can help some teachers "stretch" the limist of their classroom practice (Brown, 2009, 16-17). The simple act of a change in some teachers' perception from a framework of impediment to the idea of possibility can be a powerful positive force in enhancing the planning of learning experiences that take place in their classroom. Teachers should also work to harness the power of children's natural problem solving ability: "when children's intuitions are respected and valued, …they naturally pick up more advanced ways of solving problems" (Jung, Kloosterman, & McMullen, 2007, 55). It may seem obvious to point this out, but if teachers focus more on what students have to offer rather than on what students "got wrong," as can be an unintended tendency, teachers can facilitate more positive and more powerful learning experiences. Outside of the classroom, teachers need to "bend" rules: continue to suggest solutions and advocate for changes to problems that they see in our model of mathematics education. Teachers have a natural position of leadership within a school and any form of leadership is sustainable if it is "activist" in nature (Hargreaves & Fink, 2004, 12). Teachers can be "activist" in the way they resist issues harmful to education structures, such as the influence of high stakes testing in schools or the aforementioned self-reinforcing culture of fear of learning mathematics, in order to bring more flexibility to the classroom in the interests of student learning. Teachers need to remain agents of change both in and out of their classrooms in order for our model of mathematics education to continue to be refined. Many improvements have already been made and continue to be made to the focus of curricula and to teacher professional development, and great strides are being made by teachers to make more positive classroom culture for students susceptible to "math phobia." A flexible approach where teachers "twist" to see many perspectives, "stretch" the limits – their own as well as those of their students – and "bend" the rules hindering flexibility is necessary to continue to hone our current model of mathematics education.

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