Mathematics Best Practice
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EDPB 506 Section 2
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What is my understanding of how to best teach math? Research must support my view of the important aspects of math education. Where am I coming from as an elementary generalist classroom teacher?

Upon completing this semester and attending 5 workshops at the BC NW Math conference, my understanding of the "Psychology of Math" has significantly shifted.

I come to this subject with much personal anxiety about Mathematics that is rooted in a long history of regurgitating information that was not fully understood or relevant to me. I succeeded in high school mathematics, completing Algebra & Geometry and Calculus up to my OAC (Ontario Academic Credit) year, but despite my ability to perform to standards of that level, my foundation was and is, weak in mathematics. I do not know if that is because I started French Immersion in grade 4, creating a significant shift toward language acquisition, with math being taught to me suddenly in French, or for other reasons. My perception of lack of competence in math has been part of the reason it took me 10 years to actually begin this BEd program, being one of the core pre-requisites of the Elementary program. On pages 66-67 in our textbook, Marian Small explores ways for both students and teachers to diminish anxiety around Math. She advises that using manipulatives, taking the time to ensure that math "makes sense", and being prepared etc., will help to reduce anxiety.

As an adult learning math for Elementary Education using new techniques and strategies, I have begun to see patterns emerging that I have otherwise never known. The language is becoming "unlocked", and I am now seeing things in a new way. I am at the very beginning of this journey, and worry that I do not have the expert skills needed to teach math to my students. What gives me confidence is that I have a lot of life experience with many relevant life skills, I am a life long learner who seeks innovative and creative ways through problems and I have a strong desire to learn and succeed.

What has become clear to me through studying mathematics this semester, and through attending the Math conference in Victoria, is that parallel learning can be supported in an elementary classroom, and that learning rooted in innovation and creativity is precisely what students need to feel a sense of empowerment and exploration (and therefore relevance and understanding) as they begin to apply mathematics in the classroom.

This approach to teaching mathematics will foster the development of multiple intelligences and varying learning styles to be maximized as children work through classroom activities and problems. Having my own challenges in math may make me a better teacher, because I will more personally understand the work that goes into making these patterns come alive, bringing a necessary compassion and perspective to students who struggle with this learning. In addition to this, for students who would benefit from enrichment activities, having a strong "toolbox" and being able to use stations and additional resources, will allow me to meet the learning needs of all my students.

Children begin learning math well before school starts. Their confidence declines as they enter school and subsequently move through the grade levels of mathematics. This perception of competence from grade 1 to grade 12 is explored in Bergin and Bergin's text, Child and Adolescent Development. Using work done by Jacobs et al. (2002), we see that in a longitudinal study of perceptions of self-competence and task values using Hierarchical Linear Modeling, student's self-perceptions of competence and subjective task values declined as children got older and that the gender differences between boys and

girls did not systematically increase with age. Using the graph below, you will notice significant decline in both male and female perceptions of Math Competence from grade 1 through grade 12.

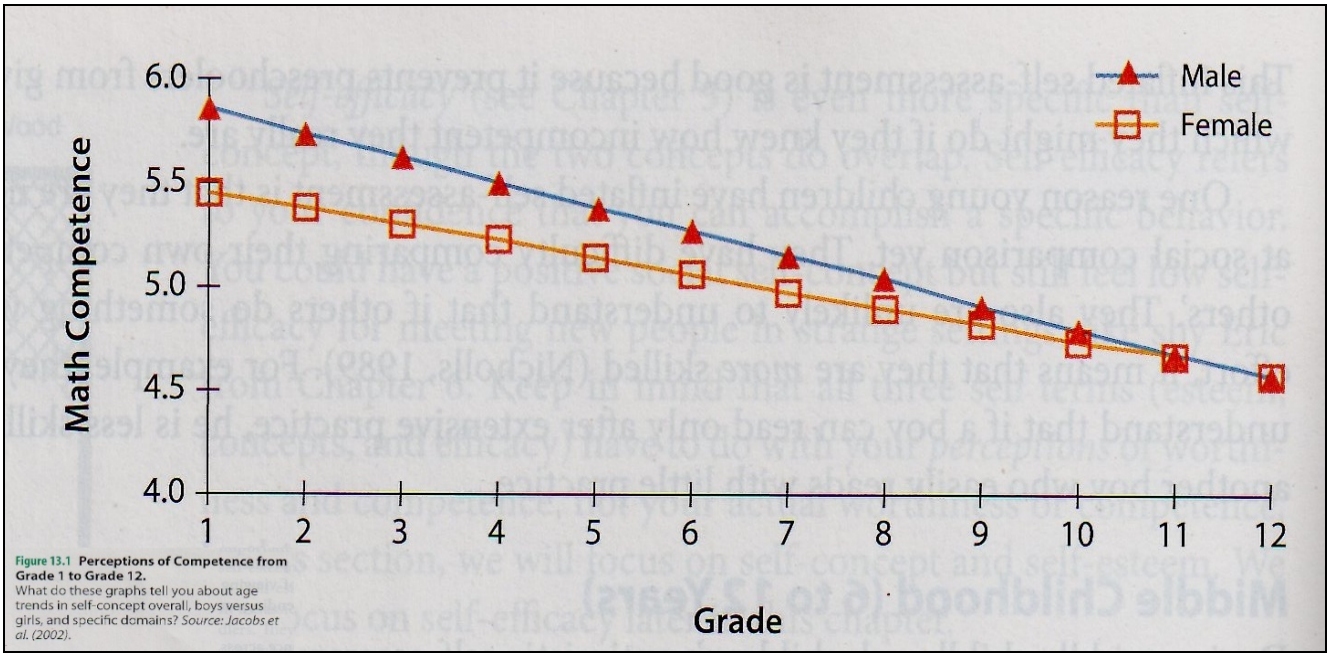

Figure 13.1 Perceptions of Competence from Grade 1 to Grade 12.
What do these graphs tell you about age trends in self-concept overall, boys versus girls, and specific domains? *Source: Jacobs et al. (2002).*

The American Psychological Association stated in 2007 that:

- Researchers have found that preschool children often have some idea of quantitative concepts like addition and subtraction, but it is not clear yet if this predicts later math achievement.
- Older children appear to have a harder time learning some math concepts than others; for example, fractions are particularly difficult, even when children already understand part-whole relationships. Small-scale laboratory research shows promise in looking at alternative teaching strategies to address this, but additional work is needed to translate these findings into education practice.
- Recent work has uncovered the origins of early individual differences in math competence by examining the kinds of math input children are exposed to at preschool. Studies show that lower socioeconomic status (SES) children are often exposed to far less math talk, which may explain some of the achievement gap in math when children enter school.

Coming from the discipline of Fine Arts with years of work in the fields of Outdoor Recreation and Experiential Education, I am naturally skeptical of any system that does not celebrate diversity, alternative perspectives, different modes of learning, and integrated/creative problem solving using the whole brain, for every child. Regardless of SES, and pre-math exposure, there is still ample opportunity at the Elementary level, and as an elementary generalist classroom teacher, to expose students to holistic learning styles that integrate strengths and build on prior knowledge. That is why I am comforted and inspired by the workshops I attended at the NW Math Conference. Each of these workshops used creativity, kinesthetic learning, music, and dance or movement in some form as a means to teach mathematics.

This makes sense to me...*Why*? Because when you are moving and playing, you are having FUN. When you are having fun, learning happens without you even noticing it, and it is not a chore. You desire for more and it reinforces what you know in ways that are positive and encouraging, building greater confidence. This principle does not only apply to mathematics. What makes this approach to learning absolutely essential to Math, is that it is a different kind of approach that deconstructs what math has been to us (as teachers) for years. There is no way to fall back to our "old ways" as teachers (ie. how

we were taught), when you are scaffolding the subject in a completely re-invented way. Using manipulatives, and exploring alternative methods of delivery like dance/movement and brain-based strategies, working in small groups, and listening to music etc., seem like good ways to move forward in the curriculum, *however*…

What troubles me is the branding and marketing of some of these resources, and the commercialization of teaching techniques, that may or may not be scientifically supported, but sold and used Internationally in classrooms everywhere due to their excellent marketing. When I first learned about "Brain Gym®", I was pretty excited. It made sense to me on an emotional level and I was ready to adopt it. My critical inquiry and research brain on the other hand, when faced with writing this paper, waded into the depths of controversy and quickly realized that there is inadequate research as to the efficacy of these techniques. Spaulding, Mostert and Beam, in their article *Is Brain Gym® an Effective Educational Intervention?*, 2010, conclude the following:

> No studies adequately described the nature of services provided in comparison conditions. Moreover, selected data analysis procedures were far from sound; no intervention effects were measured beyond an immediate post-test, and effect size statistics demonstrating the magnitude of treatment effects were not provided. Given the fact that there are no *high* quality or even *acceptable* studies validating the program, there is insufficient evidence (see Gersten et al., 2005) to conclude that BGI is an effective intervention…There is certainly great potential for improving teacher instruction and student learning through a better scientific understanding of how the brain functions (Ansari, 2008; Goswami, 2006) and how a technology-rich society may be changing the way the brain develops (Wolfe & Brandt, 1998). However, programs appearing to be founded on principles of brain-science, particularly BGI, should not be given a free pass solely based on claims of being "brain-based," but instead should be subject to the same standard of empiricism and scrutiny as other educational research.

Does this mean that the techniques are wrong or that they could hurt students? Probably not, though it does suggest BGI is not worth significant investment beyond just being a way to learn kinesthetically, or to implement as body breaks or to try out in Phys. Ed. class. Regardless of scientific data, there is still the place in me that intrinsically knows, that for some students, movement, and for all students, learning by doing, is the best way to understand the world (and that includes *you*, Math…).

So, moving on from products, and moving into theories, let's look at Piaget's theory of Cognitive Development and Math. Bergin and Bergin (pg. 162), say that:

> Constructivism is probably the most popular approach in mathematics education…A constructivist teacher emphasizes hands-on tools to illuminate concepts. This involves direct manipulation of materials relevant to math whenever possible and emphasis on student-initiated problem-solving activities…**Research suggests that accurate pictures, like diagrams and graphs, may promote math more than manipulatives**, even in young children…Asking children to explain their strategy is important. Explainers learned more regardless of instructional approach. This suggests the instructional approach may not matter as much as getting children to actively process the strategy.

And yet, in Marian Small's book (pg. 4), she advocates that the use of manipulative materials is essential to developing mathematical understanding based on research that was done in the 60's, 70's and 80's.

Vygotsky's Sociocultural Theory and Math take social interaction and cultural transmissions in to consideration as important sources of knowledge, advocating cooperative learning in the classroom, linking that to greater math achievement.

All of these theories and strategies agree that **the full development of mathematical ability requires social interaction – "Opportunities to use and observe strategies, and receive scaffolding from experts…Children should talk about how they solved a problem because they learn by reasoning about a problem and explaining to others why it is right"** (Bergin and Bergin, pg. 163).

I don't believe these theories are wrong, despite their minor conflicts. As a more visual learner myself, I do believe in using manipulative materials, but in this research what I understand the most, is that the process of how a strategy is implemented must be discussed socially (cooperative learning) in order for a student to fully internalize the learning.

So now that we have considered some theory, I want to discuss strategies that use dance, song, and play. From the workshops I attended at the conference, to our classes, and to my own learning, these elements are what I have gleaned the most inspiration from, and why I am excited for math now.

Did you know that Hip Hop is the music of Mathematics? Mary Jo Fulmer and Kim Sutton think so, and they used music throughout their presentations, mostly hip-hop, probably for it's sweet 4/4 beats.

Through these workshops, I learned that Math can be creative, kinesthetic, inspiring, and fun, and that as an elementary generalist classroom teacher, there are many resources available to me to help support my journey into mathematics that will help me to make it so. Language, dance, art and math can all be integrated to support a whole experience for students. The approaches I saw are supported by Bandura's theory of Social Learning, Piaget's Cognitive Developmental Theory, and Vygotsky's Sociocultural theory.

This active learning that engages both sides of the brain and considers a number of learning styles supports the development of multiple intelligences and brain development/processing. When children have the opportunity to engage in healthy physical activity, they experience reduced production of cortisol, secreted due to stress, and have an easier time understanding and interpreting information, integrating the parts into the whole.

Already in my grade 3 practicum, I have implemented some of Mary-Jo Fulmer's skip counting to hip hop activities, played music, had the students cheering about how much they loved math as they moved their bodies, and activated their whole brains by crossing their midline, increasing their spatial sense and positional vocabulary along the way. While skip count dancing, I could quickly assess who knew their numbers and who did not, where further learning needs to happen, and what students are confident with. It was fun, and it created a sense of community and light heartedness. We laughed, and sang, and shook our bodies. We progressed from there to stations, and the class, though unfamiliar with group work with this teacher, were concentrated and willing, filled with excitement and joy as they practiced what they knew, and challenged themselves with new ideas. This fills my bucket up, when I can see them all inspired and engaged, and I know that is how I want to continue to teach…

In conclusion, I would like to highlight that my understanding of the "Psychology of Math", as I said in the introduction, has shifted significantly. All of the courses we have taken this semester, particularly Child and Youth Development, Social Studies (critical inquiry), and Math (in the classroom, text, and through the professional development opportunity of the NW Math conference), for the purposes of this reflection, have all come together here to influence how I will go about teaching. The amount of information that has gone into considering what is right and good and true for me to teach who I am,

with authenticity, is remarkable to me, having been fairly certain before entering the program, and I am grateful to have the opportunity to summarize it, to solidify it here, as it has helped me tremendously to integrate all of this learning, and piece it together meaningfully, and powerfully, adding to my toolbox this element of hope about math and my future with it by my side. This is my understanding of how to best teach mathematics.

Sources:

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8. Williams, Mara Rose. "Elementary school teachers put math into motion", 2000. Elementary school teachers put math into motion Charleston Gazette (West Virginia) December 15, 2000, Friday

BCAMT Workshops:

- Elementary Keynote Speaker: **Catherine Twomey Fosnot**, *Classrooms where all students bloom: The role of context, community and conferring.*
- **Marion Small**: Cultivating Creativity in the Math Classroom gr. 5-8, *Fostering creativity in mathematics teaching will also foster deeper understanding and more student success.*
- **Mary Jo Fulmer**: Monkay Math gr. K-3, *Use movement, dance, songs and games to teach numeracy concepts, marrying brain based learning research and dance therapy with foundational math skills.* website: http://www.dancingintheaisles.com,
- **Wendy Hill**: The Learning Carpet, Let's get physical…Math on the floor Gr. 3-5, *'Learn by Doing': Mapping, language and number concepts, patterns, shapes, measurements and data management all on a 100 square floor grid.*
- **Kim Sutton**: Motivate Elementary Math Gr. K-5, *Use motivational strategies for Elementary Mathematicians that empower all students.* Website: http://www.creativemathematics.com/learn/