▲ Up, Down, Sideways: Difficulties of a Daughter and Dad in Learning Mathematics

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Introduction

One of the complex routines that comprise the teaching profession is the communication between the school and the home. This article, drawing on contemporary research and personal anecdote, will provide mathematics educators with further insight into some common perceptions held by parents[1], and strategies for more effectively communicating and working with these important stakeholders to increase the overall quality of students' mathematics experience.

As a mathematics educator who was very interested in the Esso Family Math Program[2], I had asked the organizers about the possibility of participating in one of the local groups with my 4-year-old daughter. We were welcomed and encouraged to attend, and I was also asked if I would consider keeping a brief reflective journal throughout the six sessions, as a form of ongoing research. Having been regularly involved in educational research, I had no qualms about this request and looked forward to recording impressions of the program as Clara and I experienced it together. What I did not expect was my own emotional response, as a parent (and teacher), to the vignette which I will describe shortly. My feelings that night, and throughout the program as I had more time to think about this and other incidents, have helped me to reconsider the nature and importance of risk-taking and mistake-making, and how these two activities relate to the teaching and learning of mathematics.

The Teacher-Parent Connection

Research conducted throughout the past few decades has shown that parental involvement in children's schooling is one of the most important factors regarding academic success (*Expert Panel on Early Math in Ontario, 2003*, pages 17-18). While many of these studies have focused primarily on the mother's influence, a recent study by Flouri and Buchanan (2004, page 150) found that the father's, involvement also has a significant long-term effect in a child's school achievement. Encouraging both mothers and fathers to take active roles in their children's learning is therefore an important goal for all teachers. However, certain formidable obstacles exist in this undertaking.

In many parents' minds, mathematics is still predominantly regarded as the memorization of number facts and related computational skills (Onslow, Edmunds, Adams, Waters, & Chapple, 2002, page 7). Moreover, many parents are unfamiliar, and therefore rather uncomfortable with the content of today's standards-based, K-8 mathematics curriculum (e.g., new topics such as probability and statistics). Even when parents earnestly want to assist their children with homework assignments, many are unsure how to do so (Whiteford, 1998, pages 65-66); and they may be rather uneasy with the multiple teaching and learning strategies that are now used in many mathematics classrooms (Bay-Williams & Meyer, 2003, pages 54-55; *Expert Panel on Student Success in Ontario, 2004*, page 80). For example, they may not easily relate to elements of cooperative group work, increased communication and problem solving, the use of manipulatives and technology, and varied assessment, since their own mathematics education likely did not include any or many of these components. This is not to say that these strategies and resources are always used properly, or that they guarantee successful learning (see for example, "Concrete Materials", *Consortium of Ontario School Boards, 2003*, Section 1,

[1] *While home support may include parents, guardians, and/or other caregivers, the author has used the term "parent" throughout for clarity.*

[2] *The Esso Family Math Project is a "community-based program for families who would like their children to experience success in math, yet who may find it difficult to obtain help in facilitating their children's mathematical development." The author would like to thank Dr. Barry Onslow, the FM Project Director, for his valued input on this paper, and the many members of the FM team for their encouragement regarding our FM experience. For more information and excellent resources, visit their website at: http://www.edu.uwo.ca/essofamilymath/ .*

page 29). The quality of instruction will largely depend, as always, on the quality of the instructor.

Clearly, facilitating a positive home-school connection between teachers and parents represents a meaningful yet difficult task. What, then, can teachers do to bridge this gap in such a way as to encourage and educate parents, thereby supporting student learning? Fortunately, a growing body of qualitative research is emerging in this area. Drawing from a series of case studies, Anderson (1998, page 336) suggests that teachers should: acknowledge and validate parental contributions and reduce their claim to authority; ask parents to think about what sorts of mathematical activities they already take part in at home with their children; ensure, as much as possible, that materials flow from home to school and vice versa, and should extract important general principles and specific mathematical strategies from the literature and from conversations with parents about student learning and progress.

In an attempt to assist parents, teachers have successfully implemented various ideas and programs such as colourful information booklets regarding mathematics; regular math problems featured in school newsletters; web-based calendars and resources; take-home math practice bags; math music CDs and videos; games and puzzles; math walks or field trips; children's books that have mathematical connections; inviting parents to attend class as observers or assistants, and parent/family math nights and programs (Colgan, 2002; Kloosterman, 1998; Onslow, Edmunds, Chapple et al., 2002; Ontario Ministry of Education, 2003; Peressini, 1998). These initiatives and innovative resources have been shown to assist parents in becoming more involved in their children's learning. But perhaps even more crucial for this home-school connection to be effective is that teachers communicate to parents how their children must be allowed to *regularly struggle with math problems* in order to develop as learners.

Risk-Taking and Mistake-Making

The National Council of Teachers of Mathematics clearly emphasized in their *Principles and Standards* document that "effective mathematics teaching requires understanding what students know and need to learn and then *challenging* and supporting them to learn it well" (2000, page 16, emphasis added). Students of mathematics must be adequately challenged in day-to-day learning activities. It is only in this way that children will be able to grapple with, what Piaget referred to as, "disequilibrium" or "cognitive dissonance", and in so doing, reinforce existing neural connections and also develop new connections and deeper mathematical understanding. Martinez and Martinez (2003, pages 29-30) likewise discuss the recognition, and powerful potential, of "eustress" (good stress) - as opposed to "distress" - in helping children learn mathematics. Chatterley and Peck (1995) describe how even the most well-intentioned teacher can rob students of mathematical learning: "If we understand the process necessary to provide the referents within the minds of our students, we will cease to mentally cripple them by being overly kind and sympathetic and by helping too much and often far too soon" (page 436).

Notwithstanding the need for adequate challenge, teachers need to explain to parents that they not overly swamp their children with learning tasks that are too far above, or ahead of them (Turner & Meyer, 2004, page 312). Tomlinson (2001) notes that "when a student continues to work on understandings and skills already mastered, little if any new learning takes place. On the other hand, if tasks are far ahead of a student's current point of mastery, frustration results and learning does not" (page 8). Both extremes are obviously to be avoided - the secret, therefore, lies in finding the right combination of, what I like to refer to as, *applied mystery and mastery*.

The Russian psychologist, Lev Vygotsky (1930/1978), developed an insightful educational theory which he referred to as the Zone of Proximal Development (ZPD) - the difference between the learner's capacity to solve problems on his/her own, and his/her capacity to solve them with external support. According to this theory, the teacher's or parent's role is to provide appropriate instructional *scaffolding* and relational support in order to maximize student achievement within his/her ZPD. Adequate and appropriate scaffolding allows teachers and parents to extend and maximize the degree of challenge for children, while still encouraging them to take risks and to learn new concepts through their initial and important failures.

The following real-life vignette provides insight into one parent's perspective, and might assist teachers in their attempts to communicate these realities and related strategies to parents.

Vignette: Up, Down, Sideways

As Clara and I walked into the public library, there was a sense of excitement and anticipation as we looked around the room of new faces. We found two empty chairs at one of the side tables and introduced ourselves to the other children and adults already seated next to

us. We both noticed the many interesting books, posters, and manipulatives to be found around the space, and therefore became curious to know just what kind of experiences were in store for us. After about ten minutes, the leader invited us to come up and take some pizza, drinks, and dessert. Following dinner, everyone was formally welcomed and then the leader began the program with various planned activities. At one point during the evening, the children were all asked to come forward and sit on the carpet in front of the leader, so as to share their understandings of patterning.

> ***Leader:*** *Alright now, boys and girls, let's have a look at these bears and see if we can't find a pattern. Notice that the first bear is standing straight with his head up and feet down. But look, the second bear is upside down with his head at the bottom and feet at the top. And who can describe the third bear?*
>
> ***Kulchurika:*** *It's laying down, sort of - sideways, like.*
>
> ***Leader:*** *Okay, right. So, let's say it together while I point to each of the eight bears - Up, down, sideways, up, down, sideways, up, down - who thinks they know what bear would come next if this pattern continues? Yes, Clara?*
>
> ***Clara:*** (hand held high, with much enthusiasm) *Up?!*
>
> ***Leader:*** *Well, that's a good suggestion, Clara. Let's look at the pattern again to check your answer. Say it with me - up, down, sideways, up, down, sideways, up, down, up - does that seem right, do you think?* (Brief pause - Clara shakes her head, knowing there's a problem. She does not offer a correction, but looks back at me with confused, anxious, and saddened eyes.) *Does anyone else have another idea?*
>
> ***Aize:*** *I think it's supposed to be sideways.* (They recite it together, as a group, trying this new idea.)
>
> ***Leader:*** *Well, what does everyone think?* (general affirmation) *Yes, I think we've discovered the pattern!*

Discussion: Conceptual and Perceptual Difficulties

Clara was not unlike other students of the same age in terms of conceptual difficulties experienced throughout the Family Math program. Referring back to my journal notes, I see that she not only struggled with the bear orientations (patterning), but also with the conservation of length (the misinterpretation of "spread-out" counters being of *greater number* than "closely-aligned" ones) and capacity (the possibility of shorter, but wider, containers holding more water than taller ones): and a general difficulty in estimating objects exceeding the number 10. All of these quite normal conceptual challenges were eventually understood as her mathematical thinking developed through time and with practice, and I should note that Clara has enjoyed and excelled in mathematics in formalized schooling. What's important here, though, is not her eventual understanding of concepts, but the actual fact that she was allowed, and encouraged, to *struggle* with challenging mathematics in a caring environment, such as that provided by the Family Math leader that evening.

Let's return again to the bear patterning incident described in the vignette. Given that it is a relatively rare occurrence for an adult to be observing his/her own child volunteer an answer during a public forum, perhaps I should not be all that concerned about my reaction. However, I wonder if it is not somehow connected to a significant commentary on parental involvement in general. At that particular moment - when Clara offered an incorrect response and then looked back at me - although I felt very confident with the curriculum and reform-oriented strategies, and supported by leaders and volunteers that night, it was my reaction as a parent to her first public, academic "failure", which really quite surprised me. I realized that even with all of my mathematical training and background, along with my years of teaching and learning experiences, my initial and automatic response was still to feel somewhat embarrassed - to look on the error with disappointment and perhaps judgment, rather than view it as an *opportunity for growth and new learning*. As a mathematics instructor, I had not responded in this way with hundreds of students over the years, when they had volunteered incorrect answers in my classrooms. And yet, with my own child, my *affective*, or emotional, response seemed to have overcome my well-reasoned and academically-seasoned *reflective* one. While I did not mention any of this initial reaction to Clara, and even though we worked on patterning together (at her request) throughout the coming week until that particular aspect was well understood, this personal revelation both bothered and intrigued me. I had been confronted with a form of parental pride which, while often being a strong and healthy emotion, in this instance was found to conflict with clear thinking about thinking - a strange case of *virtuous vice*.

Most importantly, perhaps, I must now ask myself the following question: Would I have allowed Clara to struggle with the mathematics and to wrestle with her own *cognitive dissonance* if the two of us had been

working on her mathematics homework together (e.g., not corrected her immediately, but rather listened and asked good questions to help her clarify her own thinking)? Quite often, it is this sort of cognitive tension, so very necessary for learning, which can be, and often is, avoided by parents, and even by some teachers, who do not understand the educational benefits of students taking risks and making mistakes.

Conclusion: Understanding Patterns in Math and Mind

In retrospect, Clara most likely wanted to please her father, gain affirmation from the Family Math leader, and be accepted by the other children that evening - one could argue that these are quite natural feelings. But more than this, I wonder if she just really wanted to understand the mathematics - to solve the puzzle before her. Perhaps it was this curiosity that originally drove her hand up, or later, drove her to practice until she more fully understood this new piece of math curriculum.

What if the leader had disregarded her answer completely or worse yet, commented on its lack of correctness in jest? What if the parent she glanced back at had not forced a smile and been quite so successful in masking his inner disappointment? What if the very first time she dared to take a public risk in a mathematics learning environment, she met with blatant disapproval or even ridicule? Would she ever have tried again? On the other hand, if Clara is daily encouraged to take risks in solving problems, by both her teacher at school and by her caregivers at home, she is far more likely to take further risks, to communicate her ideas to others, to develop deeper understandings of key concepts, and to simply enjoy the wonders of mathematics.

Dad has since learned to welcome risk-taking during shared mathematics times and to anticipate Clara's, and his own, initial errors with more of an attitude of enthusiasm. He's tried his best to convey this to his daughter by listening more carefully, asking good questions, and appreciating all of Clara's answers, since her incorrect answers often convey more information about her actual mathematical understanding than do her correct ones. More than anything, perhaps, he's learned that one can always be proud of a brave attempt and a willingness to continually learn from one's mistakes.

As teachers, we can share these types of stories with parents, making them aware that it is natural for them to want to shield their children from frustration and errors. By doing so, we help parents to recognize the tangible benefits that arise from children taking risks and persevering with a difficult concept or problem. Teachers and parents have the exciting opportunity and responsibility to translate these simple aphorisms into successful teaching and learning experiences for all children.

References

Anderson, A. G. (1998). Parents as partners: Supporting children's mathematics learning prior to school. *Teaching Children Mathematics, 4*(6), 331-337.

Bay-Williams, J. M., & Meyer, M. R. (2003). Help! Parents and standards-based mathematics. *Principal Leadership, 3*(7), 54-60.

Chatterley, L., & Peck, D. (1995). We're crippling our kids with kindness!! *Journal of Mathematical Behavior, 14*(4), 429-436.

Colgan, L. (2002). Mathematics at home. *Ontario Mathematics Gazette, 41*(1), 12-15.

Consortium of Ontario School Boards. (2003). *Targeted implementation and planning supports: Grades 7, 8, and 9 Applied mathematics.* Toronto, ON: Queen's Printer for Ontario. Retrieved July 15, 2005, from http://www.curriculum.org/occ/tips/index.shtml

Expert Panel on Early Math in Ontario. (2003). Early math strategy: The report of the expert panel on early math in Ontario. Toronto, ON: Ontario Ministry of Education. Retrieved July 15, 2005, from http://www.edu.gov.on. ca/eng/document/reports/math/index.html

Expert Panel on Student Success in Ontario. (2004). *Leading math success: Mathematical literacy, Grades 7-12: The report of the expert panel on student success in Ontario.* Toronto, ON: Ontario Ministry of Education. Retrieved July 15, 2005, from http://www.edu.gov.on.ca/eng/document/reports/numeracy/index.html

Flouri, E., & Buchanan, A. (2004). Early father's and mother's involvement and child's later educational outcomes. *British Journal of Educational Psychology, 74,* 141-153.

Kloosterman, P. (1998). Parent involvement in elementary problem solving. *School Science and Mathematics, 98*(4), 205-210.

Martinez, J. G. R., & Martinez, N. C. (2003). Raising middle school math standards without raising anxiety. *Middle School Journal. 34*(4), 27-35.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics.* Reston, VA.

Onslow, B., Edmunds, G., Adams, L., Waters, J., & Chapple, N. (2002). Children and their parents: Learning math together and having fun. *Child & Family, 6*(1), 6-14.

Onslow, B., Edmunds, G., Chapple, N., Forsythe, J., Burakari-Adera, R., & Waters, J. (2002). Parents: The logical link for supporting children's mathematical understanding (Part 1). *Ontario Mathematics Gazette, 40*(4), 27-31.

Ontario Ministry of Education. (2003). *Helping your child learn math: A parent's guide - The Ontario early math strategy.* Toronto, ON: Author. Retrieved July 15, 2005, from http://www.edu.gov.on.ca /eng/document/brochure/earlymath/index.html

Peressini, D. D. (1998). The portrayal of parents in the school mathematics reform literature: Locating the context for parental involvement. *Journal for Research in Mathematics Education, 29*(5), 555-582.

Tomlinson, C. A. (2001). *How to differentiate instruction in mixed-ability classrooms (2nd ed.).* Alexandria, VA: Association for Supervision and Curriculum Development.

Turner, J. C., & Meyer, D. K. (2004). A classroom perspective on the principle of moderate challenge in mathematics. *The Journal of Educational Research, 97*(6), 311-318.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press. (Original work published 1930.)

Whiteford, T. (1998). Math for moms and dads. *Educational Leadership, 55*(8), 64-66. ▲

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▲ Table of Contents

Up Front

Regular Features

Special Features

Articles

Notices

Advertisements