

UPPER ELEMENTARY TEACHERS' MATHEMATICS RELATED ANXIETIES AND THEIR EFFECTS ON THEIR TEACHING*

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This paper is related to a study of grade 5-8 teachers' math-related anxieties and attitudes, their impact on their teaching practices, and how these teachers can be helped in dealing with their anxieties and improving their teaching. Following initial teacher interviews, the teachers will participate in a series of "Math Empowerment" workshops that will utilize a holistic approach, including a lot of math work along with activities for emotional, psychological and social support. This paper reports the findings of the first phase of the study, consisting of initial teacher interviews. Teachers' various types of anxiety are described and illustrated, along with their own schooling experiences that gave rise to these anxieties, as well as their current teaching challenges and coping strategies in dealing with these challenges.

Introduction

It has been established that pre-service, and in-service elementary teachers frequently exhibit math dislike and/or anxiety (Bush, 1990; Hembree, 1990; Trice, A. D., & Ogden, E. D. (1986-1987). Furthermore, there have been numerous claims that these teachers inadvertently pass on their negative attitudes towards math to their students (e.g. Bulham & Young, 1982; Karp, 1991, Martinez, 1987, Widmer & Chavez, 1978) although these claims have not been supported by all studies (Bush, 1991; Swetman, 1994). Recent math reforms have added new dimensions in teachers' math-related fears: the need to teach a new curriculum, including new educational philosophies and approaches to learning and teaching math that teachers may have never been exposed to (Battista, 1992). Province-wide testing has been recently introduced in Ontario, and the threat of teacher testing is looming.

This paper deals with an ongoing project consisting of a qualitative study of a group of 12 upper elementary (grade 5-8) Ontario teachers who experience significant math-related anxieties and feelings of inadequacy. The purpose of the study is twofold: (a) to gain a better understanding of these teachers' math-related anxieties, attitudes and beliefs, and their effects on their math teaching, (b) through conducting a series of workshops for these teachers, to explore a holistic approach to helping these teachers in dealing with their anxieties and improving their math teaching.

This paper reports on some initial findings of the study based on teacher interviews conducted so far. Teachers' math-related anxieties and attitudes, classroom teaching challenges and coping strategies will be described. Since the data collection and initial analysis for the whole study will be completed by the early summer, some findings from the later stages of the project will also be included in the conference presentation.

*This research was supported in part by a grant from the Imperial Oil Centre for Studies in Science, Mathematics and Technology Education, The Ontario Institute for Studies in Education of the University of Toronto (OISE/UT), Toronto.

Theoretical and Empirical Background

The problem of "math anxiety" came to the fore in the early 1970's (e.g. Fennema, 1974; Tobias, 1976; 1978). Earlier research on gender issues indicated that females are more likely to develop math anxiety than males (e.g. . Fennema & Sherman, 1976; Tobias, 1976; Zaslavsky, 1994). Moreover, math anxiety was shown to relate inversely to math performance and bound directly to avoidance of the subject (Hembree, 1990; Ho, et al., 2000). It was also shown that students who were exposed to traditional math instruction reported more math anxiety than those who were exposed to alternative emphasizing problem solving and discussion of students' own informal strategies (Newstead, 1995; 1998). Math anxiety was often considered as a subject-specific manifestation of the test anxiety construct. Since math anxiety lacked its own theoretical construct, researchers applied models of test anxiety theory to math anxiety (Humbree, 1990; Bandalos, Yates & Thorndike-Christ, 1995; Ho & al. 2000). More recently, however, researchers identified other components of math anxiety besides test anxiety, such as problem solving anxiety, abstraction anxiety, or fear of the public aspects of doing math in the classroom (Newstead, 1998; McLeod, 1992; Hembrees, 1990; Brown & Gray, 1992).

There has also been much research on other aspects of affect, such as attitudes toward, and beliefs about math (e.g. Thompson, 1992; Battista, 1994; Ma and Kishor, 1997; a Gierl & Bisanz, 1994; Hannula, 1998; McLeod, 1992). A number of researchers have been exploring the whole array of affect in mathematics, including attitudes, beliefs and emotions (DeBellis & Goldin, 1997; McLeod, 1989). Particularly, in recent years there has been discussion of the unstable nature of some of these constructs and their dependence on the context in which they are observed. For instance, Tirosh (1993) uses the term: "specific affects" to describe students' emotions, attitudes and beliefs as they react to specific mathematical situations, activities or topics. With regards to attitudes, it has been suggested that they are unstable and unreliable and are strongly influenced by the specific conditions in which they are observed or perceived (Gellert, 2001, Martino & Zan, 2001; Ruffell, Mason & Allen, 1998). The approach used in this study is based on the above distinctions and we will also deal with particular manifestations of affect as they arise in specific situations.

Methodology

This is a qualitative case study of the group of teachers that will participate in the workshop series. We also hope to conduct individual case studies with two of the teacher participants. Data collection has already started with the teacher interviews, and will continue throughout the duration of the workshops and in the final teacher interviews following the workshops. Participants consist of 12 grade 5-8 classroom teachers who have self-identified as having math related anxieties.

Following the initial interviews (half which have already taken place), these teachers will participate in a series of seven "math empowerment" workshops during February and March of 2002. The workshops will utilize a holistic approach, including a focus

on math learning and teaching approaches, combined with activities for emotional, psychological and social support. Constructivist principles (Confrey, 1990) and the NCTM Principles and Standards (2000) will guide the math learning component. Workshops will include small group work on various math tasks and problems, sharing and discussion, along with group reflection, journal writing, guided visualization and relaxation activities (Tobias, 1978; 1989; Eisenberg, 1992; Martinez, 1987; Zaslavsky, 1994). The workshops will provide a safe and supportive environment to help participants feel secure and free to take risks. Participants will be also able to interact via email or phone with each other and with the researcher at any time in-between workshops, so they can feel fully supported in-between workshops..

Data Collection: Besides the initial and final interviews, data will also be collected during the workshops and will include:(i) Samples of participants' work on math tasks during the workshops;(ii) Samples of participants' reflections written during the workshops; (iii) Transcripts of 5-6 recorded discussions involving participants working in small groups; (iv) Questionnaires to be administered three times during the workshop series; and (v) Field notes taken by the researcher and research assistant during workshops and interviews.

Initial Findings and Discussion

The findings reported here are based on transcripts of the interviews with six of the teachers. The interviews were semi-structured and lasted 40-65 minutes. The findings will be discussed according to the main themes that arose in the interviews.

Participants' Difficulties During Their Own Schooling: In one of the interview questions participants were asked to recall their elementary and secondary school experiences in math. Four of them experienced problems with math in elementary school, and all of them had problems in high-school. When asked about how she felt about math in elementary school, Sarah, a young grade 6 teacher, talked about the many tears she had shed about math during that period, and described her difficulties and how she came to hate math:

- Do you remember if you had any specific difficulties when learning math?
- *Um, Yeah, multiplication especially. It was really difficult for me, all through public school and even into high school.*
- When would that have started?
- *Grade 4! [big laugh from Sarah]. And I, I really remember it. And it wasn't until actually I started teaching multiplication when somebody told me it was repeated addition, I never understood what I was doing.*
- Sarah!
- *And, all the way through public school I remember I hated it. And I have memories of doing "mental math." I always hated that. And when teachers go around, and they ask you, you do it in order?*
- Yes.
- *And I would sit going, "Oh, please, what question?" and I would there and count backwards to see which one I was going to get.*

- Oh my!
- *And I remember I finally got one right one day, and my teacher went, “Look everybody, Sarah FINALLY got one right!” And it was that comment that threw me off for the rest of my life. I hated it since then.*

For Sarah, the above incident has made a lasting impact and set the stage for the development of her math anxiety.

Participants' Math Teachers' Teaching Styles: When asked about the teaching styles of their teachers in both elementary and secondary school, participants described them as very traditional and textbook-based. One participant talked about her frustration when she wanted to know *why* things were to be done in a certain way, but nobody could tell her:

I remember them placing more emphasis on skills and procedures. That's what I remember. If they did something other, you know, I don't want to take credit away from them because they may have, but I remember the procedures and the skills being very specific, our homework being very specific in that way – you have to do this and this in order to get that answer. And the problem that I had at the time when I had homework, I would often ask my brother to help me, I have an older brother, and the thing that I always asked was “Why?” I remember this very clearly, as I was asking him, “Well why do you do that?” And he would say “This then this, make this.” “Why?” And nobody answered why and it bothered me. I wanted to know why because it made no sense to me. That this and this would equal, that.

Another young participant stated that the teachers' 'drill and kill' approach made math a boring and meaningless subject for her. This is how she kept herself busy during math lessons:

- *...But, especially Gr. 11 I wasn't with it at all. Gr. 10, I spaced out in class. I actually, I used to write songs about math. [laughter]*
- Do you have any of them still?
- *I do.*
- You'll have to bring them to the workshops.
- *I have this whole series – The Pythagorean Song Series.*
- Really?
- *Oh yeah, about like, “Pythagorus, I love your root hypotonous...” I made like whole songs and poems and stuff. [laughter] That's what I did in math.*

Not surprisingly, research has shown that teachers who identify their own math teachers as having stressed computation and drill are more likely to be math anxious than teachers whose math teachers had stressed understanding (Carroll, Widmer and Chavez, 1979; Hembree, 1990).

Participants' Teaching Styles and Classroom Challenges

The teachers had a lot to say about how their limited math knowledge impaired their teaching and expressed concern about not giving their students the right skills they would need later. A grade 7 teacher who is also a music specialist said:

- *...I just teach from the textbook and I don't do that in any other subject... but I just feel like.. I don't know it so I guess I just decided to do it, exactly following the prescription...*
- That's quite common.
- *Yeah...It's just like playing a musical instrument, I understand that you need to read the notes, you need your fingering, you need the sound of it in your head, so you need all these different components so then I can break it down and teach each of these components... With the math, I just don't know what to teach first, I don't know what the smallest stuff is.. so I just follow the book..*

Another participant reflects on the impact of her negative school experiences on her teaching:

- After having described your math history, can you sort of pinpoint where your anxiety comes from?
- *Yes, I almost think it's lack of support during my whole math career...because....I think it's not being able to extend my knowledge of math.... I have the basics but I can't extend it..*
- Do you feel you are stunted somehow?
- *In some ways, yeah, .. I mean, ..you know, even in my own classroom in teaching math I find it difficult to bring them beyond the basics....how do you extend that knowledge and some of these kids have some pretty interesting questions that I'm stuck because I have the basic knowledge but find it difficult to extend it...*

As is typical for math anxious people, the two teachers cited above are unable to experience any creativity when it comes to math. They seem to lack the relational (or conceptual) understanding required in order to be creative. (Skemp, 1978)

Teachers' Coping Strategies:

The same teacher cited above then went on to describe her ways of coping with her teaching challenges:

- *... I now have to do a lot of extra work for myself; in order to walk into the math class prepared I practically do the homework myself in order to make sure I know exactly ..*
- How much time you spend preparing for a math class?
- *Probably around a good hour for each math class, plus marking, ...so that I make sure that I can answer even their basic questions...and you know, I have some pretty bright students in my class.. but you know, I also depend on a lot of the bright students in my class because they often see, ...and are able to explain things sometimes better than I can...or in a different way, at the kids level...*

Interestingly, over-preparing for lessons and doing all the exercises ahead of time has been mentioned in the literature as a strategy that helped teachers compensate for their anxieties (Martinez, 1987).

All of the interviewees discussed their worries about being asked difficult questions in class that they were unable to answer, or being asked to solve a new problem unlike the ones in the text. In the excerpt above the teacher describes a common coping strategy for dealing with such situations: asking for help from the bright students in the class. A couple of other participants reported using similar strategies and were able to ask for help from their brightest students. But some of the participants had a problem with admitting to their class they did not know how to solve a problem. One of the teachers stated that "*I am the teacher, so I am expected to know the answer*". He would not admit to his grade 8 class that he did not know the solution to a problem and found other ways of getting by. Sometimes he would pretend he knew the solution but asked one or two of the bright students to solve the problem on the blackboard. At other times he would shift to another activity and seek help from his colleagues after class.

Various Types of Math-Related Anxiety:

As seen above, these teachers reported a number of different types of math-related anxieties, from the "classical" math anxiety (or "mathophobia" defined by the early researchers (Lazarus, 1974; Tobias, 1978) to more specific anxieties in relation to specific topics, activities or teaching situations. By far the most dreaded teaching situation for all participants was being asked a difficult question in class that they could not answer. Teachers devised a variety of coping strategies for dealing with such occurrences, as was discussed above.

When asked which math strands or topics they felt the most apprehensive about, the teachers varied quite a bit in their responses. Some mentioned geometry as a difficult topic, while others were pleased to report they found geometry easy because they could "see it". Measurement was considered "manageable" by most of them. Yet nearly all of the teachers mentioned algebra as a topic they were most apprehensive about, obviously because of its abstract nature, and had difficulty explaining it to their students. *Abstraction anxiety* has been a focus of some research (e.g. Brown & Gray, 1992).

Problem solving anxiety (McLeod & Adams, 1989) was by far the most dominant within this group and manifested in participants' fear of being asked to solve an unfamiliar problem in front of their class. It was also the reason why some participants reported solving all the relevant textbook problems prior to class. The last question in the interview was aimed at assessing teachers' degree of problem solving anxiety and whether they would exhibit resourcefulness and optimism, or feel helpless and hopeless, when faced with a non-routine math problem. The question asked:

- Suppose I were to give you an open-ended, non-traditional math problem to solve right now. What would be your immediate reaction? How would you feel about being given this problem to solve? – (Probe as necessary: identify emotion, identify bodily reactions) - Would you attempt to solve the problem?

Here is a grade 7 teacher's response to this question:

- Suppose I were to give you an open-ended, non-routine math problem... (teacher tightens up in her chair, looking very nervous).... Just SUPPOSE I were to give you a math problem, I am NOT actually giving you one! - How would you react? - What would you do?
- *Just you saying that is making my stomach go in a big knot... Oh, I just hope she's not going to ask me a math problem...*
- Would you try to solve it?
- *No way!* (appears to be frightened)

This response demonstrates this teacher's *learned helplessness* when it comes to math problem solving. Learned helplessness happens when a person has experienced repeated failures in the past and believes that whatever their effort in the future, the outcome for them will not change. It's a feeling of loss of control. (Gentile and Monaco, 1986).

There was one more participant who exhibited learned helplessness when answering this question. The other four participants replied that they might feel somewhat uneasy but would go ahead and try to solve the problem. It could very well be that some of the more severe cases of math anxiety are indeed related to learned helplessness. This phenomenon deserves further study.

In conclusion, this was an initial report on some of the early findings in our project. We are looking forward to starting the workshop series where we hope to gain a much deeper and richer understanding of the participants' cognitive and affective responses to doing math tasks and their progress in trying to deal with their math anxieties.

References

- Battista, M. T. (1994). Teacher Beliefs and the Reform Movement in Mathematics Education. In *Phi Delta Kappan*, February 1994, pp. 462-470.
- Bulmahn, B. J. & Young, D. M. (1982). On the Transmission of Mathematics Anxiety. In *Arithmetic Teacher*, Volume 30(3), November 1982, pp. 55-56.
- Brown M. A. & Gray, M. W. (1992). Mathematics Test, Numerical, and Abstraction Anxieties and their Relation to Elementary Teachers' Views on Preparing Students for the Study of Algebra. In *School Science and Mathematics*, Volume 92(2), February 1992, pp. 69-73.
- Bush, W. S. (1989). Mathematics Anxiety in Upper Elementary School Teachers. In *School Science and Mathematics*, Volume 89(6), October 1989, pp. 499-509.
- Bush, W. S. (1991). Factors Related to Changes in Elementary Students' Mathematics Anxiety. In *Focus on Learning Problems in Mathematics*, Volume 13(2), Spring Edition 1991, pp. 33-42.
- Confrey, J. (1990). What Constructivism Implies for Teaching. *Journal for Research in Mathematics Education Monograph*, 4, 107-122.
- DeBellis, V. A. & Goldin, G. A. (1997). The Affective Domain in Mathematical Problem-Solving. In *Proceedings of the 21st Conference of the International Group for the Psychology of Mathematics Education*, Volume 2, pp. 209-216.
- Di Martino, P. & Zan, R. (2001). Attitude Toward Mathematics: Some Theoretical Issues. In *Proceedings of the 25th Conference of the International Group for the Psychology of Mathematics Education*, Volume 3, pp. 351-358.

- Eisenberg, M. (1992). Compassionate Math. In *Journal of Humanistic Education and Development*, Volume 30, June 1992, pp. 157-166.
- Fennema, E. (1974). Sex Differences in Mathematics Learning: Why??? In *The Elementary School Journal*, Volume 75(3), pp. 183-189.
- Fennema, E. & Sherman, J. (1977). Sex-Related Differences in Mathematics achievement, spatial Visualization and Affective Factors. In *American Educational Research Journal*, Volume 14(1), pp. 51-77. (a)
- Gellert, U. (2001). Research Attitudes in Mathematics Education: A Discursive Perspective. In *Proceedings of the 25th Conference of the International Group for the Psychology of Mathematics Education*, Volume 3, pp. 33-40.
- Gentile, R. J. and Monaco, N. M. (1986). Learned Helplessness in Mathematics: What Educators Should Know. In *Journal of Mathematical Behavior* 5, 159-178.
- Gierl, M. J & Bisanz, J. Anxieties and Attitudes Related to Mathematics in Grades 3 and 6. In *Journal of Experimental Education*, Volume 63(2), pp. 139-158.
- Hannula, M. (1998). The case of Rita: "Maybe I started to like math more". In *Proceedings of the 22nd Conference of the International Group for the Psychology of Mathematics Education*, Volume 3, pp. 33-40.
- Hembree, R. (1990). The Nature, Effects, and Relief of Mathematics Anxiety. In *Journal for Research in Mathematics Education*, Volume 21(1), pp. 33-46.
- Ho, Hsiu-Zu et al. (2000). The Affective and Cognitive Dimensions of Math Anxiety: A Cross-National Study. In *Journal for Research in Mathematics Education*, Volume 31(3). May, 2000.
- Karp, K. S. (1991). Elementary School Teachers' Attitudes Toward Mathematics: The Impact on Students' Autonomous Learning Skills. In *School Science and Mathematics*, Volume 91(6). October, 1991.
- Lazarus, M. (1974). Mathophobia: Some Personal Speculations. In *National Elementary Principal*, Volume 53, pp. 16-22.
- Ma, X. & Kishor, N. (1997). Assessing the Relationship Between Attitude Toward Mathematics and Achievement in Mathematics: A Meta-Analysis. *Journal for Research in Mathematics Education*, 28, 26-47.
- Martinez, J. G. R. (1987). Preventing Math Anxiety: A Prescription. In *Academic Therapy*, Volume 23(2), November 1987, pp. 117-125.
- McLeod, D. B. (1989) Beliefs, attitudes, and emotions: New views of affect in mathematics education. In McLeod & Adams (Eds.) op. cit., 245-258. - (1992). Research on affect in mathematics education: A reconceptualization. In D. Grouws (Ed.), *Handbook of research on mathematics teaching and learning*. NY: Macmillan, 575-596.
- McLeod D.B., & Adams, V. M., Eds. (1989). *Affect and Mathematical Problem Solving: A new perspective*. NY: Springer-Verlag.
- Newstead, K. (1998). Aspects of Children's Mathematics Anxiety. In *Educational Studies in Mathematics*, Volume 36, pp. 53-71.
- Norwood, K. S. (1994). The Effect of Instructional Approach on Mathematics Anxiety and Achievement. In *School Science and Mathematics*, Volume 94, pp. 248-254.
- Swetman, D. L. (1994). Fourth Grade Math: The Beginning of the End? In *Reading Improvement*, Volume 31(3), pp. 173-176.
- Tobias, S. (1978). *Overcoming Math Anxiety*. New York: W. W. Norton & Co., Inc.
- Tobias, S. (1989). Teaching to learn science and mathematics. In: Connolly, P. & Vilardi, T. (Eds.). (1989). *Writing to learn mathematics and science*. New York, NY: Teachers College Press.
- Trice, A. D., & Ogden, E. D. (1986-1987). Correlates of Mathematics Anxiety in First-Year Elementary School Teachers. *Educational Research Quarterly*, 11(3), 2-4.
- Widmer, C. C. & Chavez, A. (1978). Math anxiety and Elementary School Teachers. In *Education*, Volume 102(3), Spring 1978, pp. 272-276
- Zaslavsky, C. (1994). *Fear of Math*. New Brunswick, N.J.: Rutgers University Press.