FOSTERING STUDENTS’ DISPOSITION TOWARDS MATHEMATICS: A CASE FROM A CANADIAN UNIVERSITY

SITISOFE ENYONAM ANKU
Nanyang Technological University
National Institute of Education
School of Science
469 Bukit Timah Road
Singapore 259756

To meet the challenge of getting students who have had traumatic experiences studying mathematics at the high school to develop confidence in themselves and study mathematics again, a 12-week mathematics course that emphasized concept development through the use of multiple activities was developed for prospective student teachers in a Canadian university. Students actively participated in the classes by verbalizing, clarifying, and justifying their thinking through small group discussions. While students felt before the course that mathematics was daunting and mainly abstract, they felt after the class that mathematics could be fun, meaningful, and applicable to many aspects of their family lives.

One of several factors that affect students’ learning of mathematics is their disposition towards mathematics. As used here, mathematical disposition means “a tendency to think and act in positive ways” (National Council of Teachers of Mathematics, 1989, p. 233). This tendency is reflected by students’ interest and confidence in doing mathematics, willingness to explore alternatives and persevere while solving mathematical problems, and the willingness to reflect on their own thinking while they learn mathematics (NCTM, 1989; Schmalz, 1989).

One way to encourage students’ interest and help them gain the confidence to do mathematics is to develop mathematical concepts from real-life experiences of people and other subject disciplines (Nunes, Schielmann, & Carraher, 1993) or via problem solving (Lester, Masingila, Mau, Lambdin, Pereira dos Santos, & Raymond, 1994). Getting students interested in doing mathematics also involves creating a non-threatening classroom environment where students are encouraged to share their ideas and have those ideas respected (NCTM, 1991).

The author’s belief in fostering students’ disposition toward mathematics learning through connecting mathematical concepts with real-life situations and through encouraging student discourse in the mathematics classroom formed the cornerstone of a 12-week course he designed for students preparing to enter a primary teacher education program in a Canadian university.

Even though this course might raise several interesting issues, the major focus of this article is to document the variety of classroom activities students of the course engaged in and how these activities impacted on the students’ disposition towards mathematics. A brief description of the course and the students’ background is also provided. Finally, some observations from the course and challenges the course posed for the instructor and the students are shared with readers.

The Course

This was an introductory course in mathematics offered in this university’s preservice elementary teacher education program. The
Table 1
Words describing what mathematics meant to the students of this class before the course.

<table>
<thead>
<tr>
<th>Anxiety</th>
<th>Fear</th>
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<tr>
<td>Frustration</td>
<td>Scary</td>
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<tr>
<td>Intimidation</td>
<td>Pain</td>
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<tr>
<td>Stress</td>
<td>Hurts the brain</td>
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<tr>
<td>Confusion</td>
<td>Abstract</td>
</tr>
<tr>
<td>Frightening</td>
<td>Difficult</td>
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<tr>
<td>Panic</td>
<td>Sense of uncertainty</td>
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<tr>
<td>Chore</td>
<td>Obscure</td>
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<tr>
<td>Terrifying</td>
<td>Blurry</td>
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<tr>
<td>Foreboding black hole</td>
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</table>

Table 2
What mathematics meant to Jane before the course.

The word mathematics tends to throw me into a panic and then I settle down into a sense of uncertainty—figures, adding, subtracting, multiplying and dividing and from there I draw a blank. My approach this time is not to panic as quickly and open myself and mind to learning exactly what mathematics is, because to be perfectly honest I don’t believe I know what it means. I believe it doesn’t have to be as daunting as people tend to make it out to be.

covered topics in algebra, arithmetic, geometry, probability, and statistics.

The Students
The 30 students for the course came with varying backgrounds. All of them had first degrees but in different subject disciplines like English, French, Geography, History, and Physics. The last time they took a mathematics course ranged from two to eight years. For several years, many had postponed entry into the preservice program because they dreaded taking this course.

The Classes
Easing student anxiety
It is my experience that many students enter their first mathematics classes with some anxiety, so the first day of class was used to ease the apparent anxiety among the students. They were asked to introduce themselves, talk about their background, and make known their expectations from the course. The instructor shared with the students his expectations that they take the responsibility of doing and understanding mathematics themselves. They were to work in small groups of between 3 and 5, share their ideas, and justify their thinking. Their inputs would be valued and respected. The instructor’s responsibility was to provide them with a variety of activities and a non-threatening classroom environment that would enable them to do and understand mathematics on their own. There was a brief history of the development of mathematics, with particular emphasis on the topics to be covered during the course.
First class quiz

The first quiz was for students to respond to the question “What does mathematics mean to you?” The indication from the responses was that over 90% of the students had developed negative attitudes towards the learning of mathematics, especially from their experience learning mathematics in the high school. Majority claimed not to have done well in mathematics while they were in the high school. A summary of the different negative words used is provided in Table 1.

Two typical responses by Jane and Joan (pseudonyms) are provided in Tables 2 and 3 respectively.

Concept development

On the first day of class, it was stated that emphasis was to be placed on conceptual understanding of the topics to be covered. However, derivation of formulas was not neglected. As an example of developing concepts in geometry, students were asked to take turns in their groups and describe things in their sitting rooms, bedrooms, and kitchens. They were to group all things described using criteria of their choice. Eventually, the four basic geometric shapes (circles, triangles, squares, and rectangles) were identified by the students. Also, to develop concepts related to areas of plane figures and units of measurement, to derive some related formulas, and to establish some connection between geometry and arithmetic (and eventually algebra), students went through the following activities:

1. Find the area of a page in any book using 1 cm cubes or flats.
2. Find the area of the top of the table you are using now. Would you still use 1 cm cubes or flats? Explain.
3. Come up with a rule for finding other surfaces that look like the page and the table top. Explain any connection between this rule and any of the four operations you performed on the number system while learning arithmetic.
4. Conjecture from your activities a rule for finding the area of a triangle.

Also, the concept of the Pythagorean theorem was developed through a problem. Students were to suppose they were in a mall looking for an executive business bag to buy. The biggest bag has dimensions of 40 cm long by 20 cm wide by 25 cm deep. They have at home a half meter long umbrella which will have to fit into the bag purchased. Will the bag of the given dimensions be a good buy? (They have a pocket size calculator with them.) Having conceptually understood the problem as essentially finding the diagonal of the bag, a strategy for solving the problem was then gradually developed, leading to the familiar formula \( a^2 + b^2 = c^2 \). Students then explored some implications of the theorem by examining, for example, square roots and irrational numbers and then proofs by contradiction.

| Table 3 |
| What mathematics meant to Joan before the course. |

As far as I understand, mathematics is the study of numbers, equations and formulas. Having not understood grade 12 algebra, the thought of taking mathematics course is terrifying. So terrifying that I have postponed taking the course seven years since I have attended university. I hope the course will teach me what mathematics means and I will learn the bigger picture of math. For now math looks like a blurry bunch of symbols I don’t understand.
As another example, through many activities, students derived the formula for the area “A” of a circle as $A = \pi r^2$. Students made sense of the area formula as a product of $\pi r$ and $r$, which represent respectively two sides of a rectangular shape of the same area as that of the circle.

In fact, all relevant formulas were derived through hands-on students’ classroom activities, group work, and group discussions. Always, discussions started with very elementary concepts and moved on to more advanced ones. The transition turned out to be smooth for most students. Similar approaches were adopted for developing concepts related to arithmetic, algebra, probability, and statistics. Students were doing mathematics (Lampert, 1988) and understanding mathematics themselves (Schifter & Fosnot, 1993).

**Range of class activities**

The classes, each of two and half hours duration and occurring twice a week, covered a wide range of activities. There was a quiz each week and journal entries for each class. There were guidelines that students followed while making their journal entries. Specifically, students were to identify what mathematics topic/concept was discussed, what they understood, what they did not understand, what new strategies they learnt, professions where the concepts learnt could be applied, and then pass any other comments of their choice. The students were restricted to two pages for each entry. There was one take-home assignment each week, group investigations, group presentations, students constructing their own questions to demonstrate their understanding of concepts discussed, students providing criteria for judging the work of their peers, mid-term examination, and final examination. All their classroom activities, including class participation, were assessed and awarded marks (see Anku, 1995).

**Results**

On the final day of class for the course, the students were to respond to the same quiz they responded to on the first day of class. What does mathematics mean to you? The purpose was to compare student’s initial and final responses to see if there was any evidence of a shift in their disposition towards mathematics after the course. All the negative words used to describe mathematics had disappeared and all students in the class had something positive to say about mathematics; they had derived a new meaning for mathematics. (It is pertinent to add that all students passed the course.) The responses by Jane and Joan, reproduced in Tables 4 and 5 respectively, are typical of the class responses after the course.

**Usefulness of the Results**

Although this is a case (Merriam, 1991) in a classroom in a Canadian university, the results provide an indication that in a given classroom, students’ interest in learning mathematics can be rekindled. Also, establishing the relevance of mathematics to the daily life activities of people or developing mathematical concepts via problem solving can enhance students’ disposition towards mathematics. Students can be drawn into thinking and acting positively towards mathematics.

Students did not only “feel good” taking this course, they also passed the course and enrolled in the teacher education program of this university. Thus, by fostering students’ disposition towards mathematics, the students, many of whom had postponed for several years their desire to become teachers, were able to, once again, learn mathematics confidently and become successful at it. Furthermore, students’ negative perception of mathematics as only “straight division, addition, multiplication and subtraction” could shift to that of mathematics as “a broad study which encompasses many real life situations.”

It should be encouraging news for the math-
Table 4
What mathematics meant to Jane after the course.

At the beginning of the course I believe I said that mathematics meant fear, uncertainty and brought a sense of panic to the forefront. Although I still feel somewhat uncertain in different areas of mathematics, or the world of mathematics, it is less daunting and I do think I have learnt to appreciate it. The actual definition of mathematics no longer means straight division, addition, multiplication and subtraction to me but has a broader means as I now understand that it encompasses much of our everyday life in ways which I have not been aware. I hope that at some point I too will be able to say comfortably that I enjoy mathematics and it does not give me uneasy feeling in the pit of my stomach. I am getting further from that slowly but surely.

Table 5
What mathematics meant to Joan after the course.

Mathematics is a broad study which encompasses many real life situations. Math can be applied to many things I had never considered before. Mathematics to me means gaining a little bit better understanding of the world in general, understanding how things work and, learning how to solve problems that affect my life. With little knowledge about math I have opened new doors behind which I have discovered interesting solutions.

eematics education community that given a new impetus to mathematics teaching, many more students can be drawn back to study mathematics. However, there are many challenges posed for the mathematics teacher, the students, and institutions whose policies affect mathematics education. Some of these challenges are discussed next.

Challenges

Teacher challenges

There are enormous challenges awaiting any mathematics teacher who is to teach mathematics to students who find the subject so terrifying that they can postpone learning it for as many as seven years and deny themselves the opportunity to get into a profession they desire so much. Whatever students’ reasons are for “daring” to learn mathematics again, their fear of mathematics made the task of fostering their disposition towards the subject more formidable.

An early challenge is to convince the students that they too can become successful at doing and understanding mathematics. A motto developed for the course was that “Although mathematics produces formulas, no formula produces mathematicians.” This was referred to frequently to encourage the students to develop confidence in themselves and overcome myths and beliefs (Garofalo, 1989; Paulos, 1992) that inhibit their learning of mathematics.

Another challenge for the teacher is the provision of a variety of activities that will capture and sustain the interest of the students and at the same time be relevant as sources that can be used to meaningfully develop mathemati-
cal concepts. An adequate knowledge of the structure of mathematics and expertise in developing such activities are required of the teacher.

There is also a challenge for the teaching of more complex mathematics concepts in mathematics departments of universities. Can this approach, if adopted (or adapted), draw more students into studying higher mathematics? Intuitively, and from over 18 years of teaching mathematics to students at several levels, the answer to me is yes. What do you think?

**Student challenges**

For the students, a major challenge will be getting them to openly share and justify their thinking with their peers through discussions since many students perceive mathematics as only a computational activity by the individual (Nunes et al., 1993). Students will have to become convinced that their ideas are valued for them to open up and start sharing those ideas.

Another challenge for students is whether they will succeed this time if they adopt the **new** approach. An early experience of a better understanding of concepts that they have memorized but never understood should surely convince students to, at least, give it a try.

**Institutional challenges**

For institutions, accepting a flexibility of the mode of assessing students' competence becomes a major challenge. Are class activities valued and will they contribute to the final grading of students? Or should students sit for an end of course examination as the only source for determining their competence? Using multiple sources (NCTM, 1989; Stenmark, 1989) for gathering information on students' competence needs to be accorded an institutional recognition. For this course, the multiple sources used for assessing students (see Anku, 1995) was officially recognized by the university so students worked hard throughout the course knowing very well that all their classroom activities would be valued.

**Conclusion**

What has become clear from this class is that hope should not be lost on students who have had traumatic experiences learning mathematics previously. By the teacher creating a non-threatening classroom atmosphere and then helping students develop mathematical concepts through a variety of activities that are related to real life experiences of people (including students), students' interest can be rekindled and sustained. By actively participating in the class, students will then be doing and understanding mathematics themselves. Mathematics becomes meaningful to them and the students develop positive attitudes towards the subject. A tremendous amount of work is involved but the benefits for students and the mathematics education community, at least in terms of students thinking and acting positively about mathematics, make fostering students' disposition towards mathematics a worthwhile task to undertake.

**References**


Privatization of Higher Education Services: Propositional Pros and Cons

(Continued from page 579)

Conclusions

Privatization is taking place throughout the higher education community, especially within student services, but will it overtake the philosophy and mission of student development? Should higher education officials neglect their responsibility to consider all aspects of this shift then, higher education student development may change in ways unacceptable for such institutions. The propositions and concerns offered herein should be of primary concern to higher education administrators so as to not inhibit the mission of the university or college.

References


