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Teaching Mathematics for Peace

Mathematics education is important to me, but I consider the quest for peace to be my vocation. The mathematics education context is one in which I can work at bringing peace to my world. I recognize that my goal of a peaceful world is unlikely to be attained in my lifetime. Perhaps it is the mathematician in me that is content to approach the inaccessible, the infinite.

The idea of relating the teaching of mathematics to an interest in peace is a strange one to many people. I can tell by the looks on the faces of those with whom I share my passions. To them, mathematics is culturally and socially neutral, sterile. I am quite familiar with this view of mathematics. It describes my own attitude when I started my mathematics teaching career.

In my first five years of classroom teaching in Alberta, I strived to be a caring presence in my classrooms. I listened to my students and tried to help them understand both their world and their mathematics – separately. I saw myself as a peacemaker who happened to be teaching mathematics, which was for me a neutral subject, unconnected with my students' experience outside the classroom. I disagreed with other mathematics teachers who constantly reminded their pupils that mathematics is the most useful of the subjects. Perhaps elementary and junior high mathematics is used in the "real" world, but high school mathematics seems quite foreign to the experience of most adults. For me the value of the subject was to be found only in its parallels to outside experience, not with its connection to the outside.

My recent experiences with the new Alberta mathematics curriculum, in juxtaposition with my experiences teaching mathematics in rural Swaziland for the previous two and a half years, sparked my interest in the connections between mathematics and society. I realized that methods and values in the mathematics classroom were connected to methods and values of the outside world. I also began to see that mathematics is often both implicated in violence and used in the name of peace.

D'Ambrosio (1994) notes the importance of mathematics in this century's enormous technological advances.

> Humanity has seen the smallest reaches of imagination and talks about reaching the boundaries of the universe. And yet, this same century has shown us a despicable human behavior. … Much of this paradox has to do with an absence of reflections and considerations of values in academics, particularly in the scientific disciplines, both in research and in education. (p. 443)

I support his conclusion that more reflection is needed in and about the classroom. The reason I share my thoughts regarding peace and mathematics education is to prompt such reflection. In this paper, I will ask some simple questions that have no simple answers. However, I assert that the consideration of these questions can be a potent beginning for thoughtful adjustments to teaching practice.

What is peace?

Before thinking about how we might structure mathematics classroom experiences to promote peace, it is important to ask what we might mean by peace. The word *peace* can be used to describe vastly different things.

After two airplanes were flown into New York's World Trade Centre towers on September 11, 2001, I heard a radio reporter on the scene exclaim in panic: "The worst thing is

that no one knows what will happen next." I wondered when anyone knows what will happen next. In the following days I reflected on the ways I can live in an unpredictable world.

One approach to my complex existence in an unpredictable world is to try to control the environment, to build a network of security. With this approach, I decide how a "peaceful" world should look and then try to structure it so. This approach equates peace with *security*. Wars against terrorism and jihads against infidels are extreme examples of this approach.

An opposite approach to the same world is to try to be aware of the complexity and changeability of the world and to find my place within it. This approach focuses on awareness and equates peace with *harmony*. With the former approach I try to tune the world to match the standard I have in mind. With the latter approach I try to attune myself to the world and find a place in its symphony.

Securing a Right World – Mathpower

How would mathematics pedagogy look if we were to try to *secure* a peaceful world? The security approach embodies teleological ethics, in which the ends justify the means. Mathematics and other tools are important in proportion to their utility for pursuing the end in mind. Although applied mathematics is favoured with this view, pure mathematics may still be valued in recognition of its history in which applications have been found after the development of the mathematics.

If we think that the ends justify the means, then we will be more interested in the answer to a question than in the process of arriving at the answer. Multiple choice and numeric response examinations embody such values. Students' "right answers" are credited no matter how they are found. Our interest in the mathematics class would be to train students to use technology and knowledge efficiently and powerfully. Words that relate to effectiveness and power would appear in our scoring rubrics and in our classroom resources and decorations.

Indeed, mathematics provides tools that can be used to solve problems in our world. Problem solving has long been an important part of mathematics pedagogy. What if we used our mathematical word problems to ask students to make calculations about fair wealth distribution or efficient structuring of peacekeeping forces? Gerofsky (1996), in her exploration of mathematical word problems, questions this and other expectations of word problems:

> The claim that word problems are for practicing real-life problem solving skills is a weak one, … unlike real-life situational problems, no extraneous information may be introduced. (p. 41)

Still, word problems that express an interest in a peaceful world are preferable to missile trajectory calculations, for instance.

I suggest it is important that we keep our students aware that their word problem contexts are unrealistically simple. When they have real problems to address outside of the mathematics classroom, we would *expect* them to consider all the related information. If they select a few numbers that relate to the situation and simply manipulate them using mathematical algorithms, it is likely that they will exacerbate the problem rather than solve it.

Mathematics may provide helpful tools for solving local and global problems, but there are also other good tools. An important part of wisdom is to have a diversity of tools available and to use them appropriately.

Building Awareness – Critical Mathematics and Ethnomathematics

How would mathematics pedagogy look if we were most interested in finding our fit with the world? With an interest in *harmony*, we would look at our place in an interconnected system. Potential for building awareness would be the standard by which we evaluate mathematical

tasks. There are two recent movements in mathematics education scholarship that prescribe more awareness – ethnomathematics and critical mathematics education.

Ethnomathematics describes an interest in the mathematical activity of diverse cultural groups. It can be incorporated into the curriculum in a number of ways, including the use of mathematically rich artefacts from other cultures as starting points for mathematical discussion or tasks. It seems to me that an assumption behind this movement is that awareness of other cultures' processes helps us see our place in the world. The web page of the International Study Group on Ethnomathematics can be found at http://www.rpi.edu/~eglash/isgem.htm.

Critical mathematics education describes a wide array of activities and reflections that uncover mathematics education's assumptions and values. For example, Borba and Skovsmose (1997) criticize the typical fixation on single right answers in mathematics classrooms. They call it "the ideology of certainty" and wonder about how it prepares students to think about problems outside the classroom. Borba and Skovsmose suggest that mathematical tasks be structured in such a way as to make a variety of approaches viable and a diversity of answers correct.

With their approach, it is the teacher who is involved in critical thinking. Their apparent assumption is similar to mine in this paper – that students will benefit from having teachers who are more aware of the connections between mathematics and society. D'Ambrosio (1998) suggests that teachers engage *students* in critical dialogue about the connections between mathematics and their world.

> I propose questions as "What do you think of [a current event or a philosophical question]?", let some discussion follow and then come with another question "What does mathematics have to do with this?" (p. 72)

Thoughtful Action – a Middle Way

The two views of peace that I have described so far are quite polar. I put myself somewhere in the middle between these two approaches to peace, closer to the harmony end of the spectrum. Although I consider it necessary to be aware of my place and the interconnectedness of things in the constantly changing, complex world, I still need to act – I need to live. If I spend all my time merely noticing, I cannot participate. Somewhere in between the two extremes of thoughtless action and detached analysis there is a place for thoughtful action. I suggest that a degree of engagement with the world is necessary for more thorough understanding, for higher awareness.

I consider three planes of thoughtfulness. While engaged in mathematical activity, students can be mindful of the connection between different forms of mathematical thinking, the importance of their individual choices within their activity, and the connections between generalizations and the particular cases to which they relate.

Mathematics curriculum is typically fragmented, as it divides mathematical activity into pure and applied streams, into broad categories within these streams (e.g. geometry, algebra), into smaller categories within each broad category (e.g. within algebra there are equations, factoring, etc.), and within these narrower categories into concepts (e.g. within factoring there are differences of squares, second-degree trinomials, etc.).

When students are given a problem, they are expected to classify it according to known types. In doing this, they ignore the people and places involved. After classification, they follow a standardized procedure designed for problems of that particular category. Only one result is acceptable. By drawing boundaries between "classes" of problems and between "useful" information and "extraneous" information, students are encultured to ignore the

interconnectedness of mathematics and to ignore the connections between problems and their mathematical or real-life contexts.

Alternatively, we can open up possibilities for connection-making within mathematics by presenting students with open-ended questions and problems, giving no clue as to how they might be answered. These tasks could be given as part of formal assignments or informally in class discussion. Either way, students would need to consider the breadth of their mathematical experiences to find some mathematical knowledge that might apply. They would then need to decide how it applies and how they can know if they are applying it correctly.

Besides opening up the possibility for seeing connections within mathematics, such tasks can help students develop ownership of their mathematical ideas. The mathematician is connected to the mathematics. As students listen to each other's mathematical ideas or look at each other's mathematical writing, they can be directed to see a diversity of viable approaches and forms of presentation. With this realization they may see that the form of mathematics is closely connected to the humans who construct it in response to particular problems.

Although the connection between mathematicians and their mathematics grounds the discipline in particular contexts, generalization is at the heart of mathematical processes. Generalizations can, however, be grounded in context for students. As we direct students to make generalizations, they can become aware of the limitations of generalization as well as the power of generalization. When I simply present a rule for my students to *use*, they struggle with its application. They wonder when and how to use the rule. By contrast, if they are engaged in the activity of *constructing* rules, they are more likely to see the connections between general rules and the contexts from which they were born or in which they may apply.

Skovsmose (2000) describes how traditions of activity in mathematics classrooms format society by providing a framework for solving problems in the world outside the classroom. It is my hope that mathematics classrooms can format the world for peace by establishing traditions of classroom mathematics activity that can be characterized as thoughtful action.

Conclusion – Doing Good

In my first year of teaching, a grade 11 student asked me, "Did I do good on yesterday's math test?" I responded playfully: "No. Doing good is feeding the hungry, clothing the naked, healing the sick, bringing hope to the poor. You did none of that on this test. You did, however, do well. You got 87%." This little experience has prompted me to wonder how I, as a mathematics teacher, can do some good for my students and for my world – how I can be an agent for peace. As a teacher it is my responsibility to set tasks for my students in such a way that if they follow my instructions well they will be doing something good.

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