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It is quite popular these days to talk about mathematics as a tool that allows us to solve problems. This can be a powerful image, for we typically think of tools in a positive light. Tools enable us to do things we couldn't do otherwise; they empower us to accomplish our goals. However, we also tend to have another image of a tool–tools are neutral. Thus, whether we choose to use a hammer to build or to tear down is up to us and has nothing to do with the concept of hammer. Of all the tools in our bag, mathematics is often perceived as the most neutral of all. Learning mathematics is taken as an ethically neutral process which simply allows us to accomplish independently chosen goals. This paper challenges that view, arguing against the very possibility of a neutral tool. It is argued that all of our teaching, including teaching mathematics, involves ethical choices and thus that, as mathematics educators, every decision we make in the mathematics classroom is made in an ethical and political context.

The Neutrality of Tools

In some ways, this paper is an extension of an argument made recently by Robert Boody. In relation to the claim that computers are a neutral tool in the classroom, he states:

> The problem with this view is that the kinds of tools we have available also shape how we see our world, including what problems to work on and how to solve them. The old saying that "to a person with a hammer, everything begins to look like a nail" is not far off. Another way to put it is that tools (like every other way we articulate our world) both reveal and conceal. Simply put, a hammer reveals aspects of the world amenable to hammering, but tends to conceal things we might glue, sew, or something else entirely. The tools help structure our world. (1993, p. 25)

The argument in this paper is that the ways in which tools "help structure our world" are directly related to the ways in which we structure the tool. For one unfamiliar with our cultural uses of a hammer, merely having the object, a hammer, present will not make everything look "like a nail." It is only because we construct our understanding of a hammer as a tool in the service of building that hammers elicit nails. Had we lived in a culture where hammers were used as projectiles, hammer holders would perceive targets rather than nails. I make a similar argument for mathematics. Mathematics is a tool and mathematics does help structure our world. But we have options in the ways we construct our mathematics. Perhaps more importantly, as educators we have options in the ways we create the cultural/educational setting in which our students construct their mathematics and thus in the ways they structure their world.

The argument begins with an analogy, and the tool I have chosen for that analogy is a gun. The analogy is appropriate, I believe, not only because of the increasing attention being paid to guns in our national dialogues, but also because I would expect that many of those who might argue against the neutrality of guns might still tend to see mathematics as a neutral subject.

Let us imagine two situations:

> First, imagine a family living in a middle class community where there has recently been a high level of crime, some of it violent. We could characterize this community by saying that there is a rampant fear of crime. Imagine a child in this community growing up in a

household where the parents have installed extensive alarm systems, where they won't allow the child outside alone, where both parents might be taking self-defense courses which include training in the use of guns for self protection, and where, despite abhorrence of the idea, guns are kept in various strategic places around the house because, so the child is told, we must be ready to protect ourselves against those who want the things we have worked so hard to get.

Now imagine a rural family living in a remote mountain area. In this family, wild game provides a substantial and important part of the family's diet, and hunting is a direct means of providing family sustenance. Thus, for a child to see a parent heading to the woods in the morning with a gun is a signal for celebration, for it often means that good eating and good spirits will accompany the evening meal.

The question is this: Is a gun the same thing for both of these children?

The National Rifle Association would have us believe that it is. For them, guns don't kill people, people kill people. I think that many of us, however, despite recognizing that there are certain things which we would all label as "guns," would have a hard time saying that the concept of gun is the same for these two children.

But is this not equally true for the tool, mathematics?

Let us first be clear that, like hammers and guns, there are certain things that most of us in a given culture at a given time will call mathematics. Thus, if we see someone count out five objects, or hear someone say that $y=x^2$ represents a parabola, or watch someone construct a graph of the relationship between position and time, we will agree that that is mathematics. In a Vygotskian framework, these various mathematical representations would be called socio-historic tools. These tools exist in the space between individuals, that is in the rules and language of the culture. I think we would agree that it is an important educational activity for students to learn the mathematical rules and language of their culture, for that is part of the process of learning to function as a social being and to communicate effectively with others.

I would suggest, however, that to confine our definition of mathematics to these socio-historical tools is to reduce it to nothing more than a set of symbols with rules for their manipulation. Things become tools for us only when we use them as tools, and the type of tool they become depends on the way they are used. Ernst von Glasersfeld (1994) calls tools mental constructs which are viable within the experiential world of the individual. Within this view, problems, or what Confrey (1991) has called the "problematic," are also constructed by the individual. Tools become viable, that is meaningful or of value, when they are useful in resolving these problems. Thus, the construction of problems and the viability of tools are, for an individual, inseparable.

We feel appalled when we read of paramilitary groups teaching children to use guns by shooting at targets shaped like humans. Likewise, if a school taught the concept of hammer by having our children break the glass out of junked automobiles, we would be upset. In themselves, neither of these acts is necessarily harmful, and one could argue that each is effective in teaching the use of the particular tool. Our displeasure, I would suggest, comes from a sense that the concepts of these tools which the children construct are inseparable from the contexts in which the tools are used. Their viability or meaning or value is directly related to the problematic situations in which we place the children as they construct their use.

The Neutrality of Mathematics

I suggest that we should be likewise appalled when we see mathematics being taught through problems that are self-serving, competitive and/or socially or environmentally destructive. Although such problems occasionally appear in curricular materials, often the message is much more subtle, as authors often, in good faith, attempt to create situations that feel neutral. However,

in the introduction to her book, *Relearning Mathematics*, Marilyn Frankenstein (1989) suggests that what seems "neutral" often masks a non-neutral support for the status quo:

> Most schooling and daily life bombard us with messages supporting the status quo. Even trivial math applications, like finding the totals from a grocery bill, carry the non-neutral hidden message that it's natural to distribute food according to individual payment. Even traditional maths courses which provide no real-life data carry the non-neutral hidden message that learning maths is separate from helping people understand and control the world. (p. 5)

As an example, let me take a single statement from an article in the first issue of a new NCTM journal, *Mathamatics Teaching in the Middle School*, which describes an interesting method for teaching probability. To introduce the article, four situations are described. The fourth is given below followed by the opening sentence of the discussion:[1]

> "My mathematics teacher might collect homework today; should I do it?" Every day each of us must make choices like those described above. The choices we make are based on the chance that certain events might occur. (Brutlag, 1994, p. 28)

In many ways this example seems innocuous enough, something teachers and students may joke about.[2] But there are, I would argue, several messages in such a problem. First is the suggestion, in the closing sentence, that mathematics provides the primary, if not sole, criteria by which we should make such a decision. Second is the suggestion that one does what one can get away with.[3] Both of these are closely related to how we construct our ethical relationships with others. To imply, as is too often done in our teaching, that personal decisions about what is to be valued can be resolved through quantitative criteria alone goes directly against notions of commitment, caring, and duty to others. It is tied closely to the myth of a rational morality which feminist authors such as Carol Gilligan (1982) and Nel Noddings (1984) have challenged.

This is, of course, just one example and to criticize it may seem the height of political correctness. However, it is not the particular example that is the issue. Rather, the problem is in our tendency to treat such examples as if the mathematics is a separable and amoral activity, a neutral tool which simply provides a means for finding out the "truth" about patterns and relationships. We may teach mathematics any way we want. How our students choose to use it is not our concern. To me, this sounds very much like the National Rifle Association's claim that it is not guns that kill people, it's people that kill people.

Suppose then, that we eliminate all objectionable problem contexts. Is it possible to teach neutral mathematics? My answer to that is a clear no–we cannot escape our responsibilities as educators so easily. Knowledge is never value free. To teach mathematics as if it were neutral is to make an ethical and political decision, for in fact it promotes a view that knowledge and the use of knowledge can be discussed as if they were two separate issues. This view allows the chemist, for example, to disavow any responsibility for the fact that his research results were used tc produce a new lethal weapon. This separation between knowledge and its use is related to what Donald Schon (1990) has called the separation between "knowledge and action" and contributes to what Schon calls "a growing skepticism in whether professional knowledge is beneficient ... a growing suspicion that scientific knowledge actually produces social problems."

Conclusions

What I am suggesting is that mathematical knowledge is inseparable from the contexts and situations in which it is constructed. We help our students create mathematics by helping them

form the problematic situations in which the tool is useful. This is an argument, for example, that we emphasize cooperative learning in the classroom not simply because it enhances results on tests or because it promotes desired socialization, but because it helps our students construct a mathematics that is viable in attaining their goals within a cooperative social framework. Likewise, it is an argument that we use problems like many of those used by Marilyn Frankenstein (1989)[4] not only because it helps students understand the oppressive conditions in which many live but also because it helps them construct a tool that is viable in their efforts to change those conditions. Finally, there is a certain recursiveness here also. If we ignore the ethical setting of our mathematics teaching and treat mathematics as if it were neutral, we ultimately attract to the field of mathematics those individuals who are themselves comfortable with such a view. Given the increasing status of those who succeed in academic mathematics, we may be directly supporting the development of a more rationalist/technicist society. Robert Boody (1993) describes the "technological mindset" as efficient in solving a given problem, but:

> The problem is that the focus is only on this given problem; it does not ask if it is a good problem to solve, or if there is another way to view the entire situation. (p. 24)

To promote a view of mathematics as a neutral tool may be to promote a society more concerned with efficiency and technology than with human values and creating a just and caring society.

Notes

[1] By using this example, I do not mean to criticize Brutlag or his article. In fact he presents an intriguing activity ("SKUNK") in the article that could lead to some wonderful classroom discussions and investigations in the area of probability.

[3] Although for some, such problems may take on a deeper significance–adding to their conviction that mathematics is not for them.

[3] There is also an educational message here regarding the implied value of doing homework. But that is not as relevant to this article.

[4] Here is one example from her textbook:
"Write the numbers in each of the following sentences in words, as whole numbers:
(a) According to the Children's Defense Fund, in 1976 there were 1.3 million children under 17 who had never visited a doctor.
(b) In 1979, IBM had a military contract for $552.6 million, which represented about 2/100 of IBM's total sales." (Frankenstein, 1989, p. 125)

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