

VALUES, MATHEMATICS AND SOCIETY: MAKING THE CONNECTIONS

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School mathematics is intimately linked to the society in which it is taught. Whether we are preparing students for meaningful life in the society or for productive contribution in the workplace, relevant societal values are involved. On the other hand, the notion of school mathematics as value-laden is increasingly recognised. Yet, from the work of the 'Values And Mathematics Project', it is clear that there is little explicit discussion in the classroom of values and their role in relating mathematics to society. This paper aims to address this, and suggests how connections amongst values, mathematics and society may be made.

Mathematics and Society

School mathematics is intimately related to the society in which it is taught. Teaching mathematics for numeracy further reinforces this connection. Reflecting this at the academic level, there are educational meetings like the series of 'Mathematics Education and Society' conferences, and there are also mathematics education conferences with themes such as 'Valuing Mathematics in Society', 'Mathematics Education in the South Pacific' and 'Mathematics Education for a Knowledge-based Era'.

Many nations' mathematics curriculum statements establish the link between learning mathematics and living in the society. In Victoria, the 'Curriculum and Standards Framework' for mathematics starts off by highlighting the role of mathematics in the Australian society:

Mathematics pervades all aspects of our lives — as citizens, in our homes and in the workplace. It has applications in all human activities, crossing cultural and linguistic boundaries to provide a universal way of solving problems [C]ompetence in mathematics enhances both our understanding of the world and the quality of participation in Australian society. (Board of Studies Victoria, 2000, p. 5)

The cover designs/illustrations of many mathematics textbooks in and out of Australia also emphasise the value of mathematics in society. Some of the textbook titles make explicit the relationship of mathematics in society. In fact, if we are to pick up any country's mathematics textbook, we will likely become unfamiliar with the way in which mathematical content is presented, and/or with the context of parts of the text. The experience of some American students with mathematics textbooks imported from Singapore is a case in point (Viadero, 2000).

This link between mathematics and society may be interpreted as referring to the applicability of mathematical concepts and skills in everyday life and in the workplace. There is also another perspective to this link, one which is relatively more implicit and less known. This other perspective perceives the relating of society to school mathematics through its values. In other words, school mathematics is structured and delivered in such a way as to portray the values of the society in which it is delivered. Unfortunately, as the authors and their colleagues have found through the 'Values and Mathematics Project', many teachers of mathematics find it difficult to think about values in relation to their pedagogical repertoire because there was hitherto little professional development support in terms of conceptualising and talking about values. As a result, there is little explicit teaching and discussion of values in the mathematics classroom. In this regard, this paper aims to bring to the fore the connections amongst values, mathematics and society.

This relationship amongst values, mathematics and society has also been found to be the source of cognitive dissonance amongst immigrant teachers of mathematics in Victoria (Seah, 2002). Even though (or perhaps because) the immigrant teachers were experienced teachers of mathematics in their respective home countries, their respective socialisation experiences in the Australian mathematics classroom are not short of value differences. Although the mathematical aspect of the teaching content is similar across the home countries and Australia, these teachers encounter value differences which are grounded in the ways with which mathematics as a discipline is perceived in Australia, and with which pedagogies differ (e.g. teacher-centred versus student-centred teaching). The role of the society in shaping these different perceptions and practice is evident.

Values related to Mathematics and Mathematics Education

In effect, the nature of education has always been value-laden. "The school, like the government, is an institution with a basic function of maintaining and transmitting some, but not all, of the consensual values of the society" (Kohlberg, 1981). Traditionally, school mathematics has often been spared from scrutiny with regards to its role in values portrayal, perhaps because mathematical concepts are similar across geographical borders. Promoted by such research movements as ethnomathematics from the 1980s onwards, there was an increasingly recognised view that mathematics — and school mathematics — is not culture-free. If we agree that cultures are sustained and cultures develop through their own customised systems of values, then it is reasonable to say that school mathematics is not value-free either. "School mathematics is mathematics as it is conceptualised, represented, structured, and sequenced to share with the next generation through the formal schooling experience" (Schmidt, McKnight, Valverde, Houang, & Wiley, 1997, p. 4).

While it is comparatively easy for us to conceptualise and talk about values in the society, it is not as evident what values in mathematics and in mathematics education are all about. Are we talking about designing the context of mathematical problems to incorporate societal/cultural values, such that students are not only doing mathematics, but are also given the opportunities to discern the 'moral behind the story'? What are values in the mathematics classroom?

"Values in mathematics education are the deep affective qualities which education aims to foster through the school subject of mathematics" (Bishop, FitzSimons, Seah, & Clarkson, 1999, p. 1). The most internalised variable in the affective domain of the Taxonomy of Educational Objectives (Krathwohl, Bloom, & Masia, 1964) is 'characterisation (by value or value complex)'. The valuing process involves (1) choosing freely, from alternatives, and after thoughtful consideration of the consequences of each element, (2) prizing, and affirming to others, and (3) acting with the choice, and acting repeatedly in some pattern of life (Raths, Harmin, & Simon, 1987). As a result of this process, value indicators such as attitudes and beliefs may evolve into values (Raths et al., 1987).

Values can thus be considered as being at one end of a continuum of affective variables such as emotions, attitudes and beliefs. Generally, emotions and attitudes may be separated from beliefs and values by what McLeod (1992) calls 'response stability', in the sense that we would expect an individual's beliefs and values to be relatively less susceptible to change. Indeed, values may be so stable within an individual that "the internalization and the organization processes [involved] reach a point where the individual responds very consistently to value-laden situations with an interrelated set of values, a structure, a view of the world" (Krathwohl et al., 1964, p. 35). In an attempt to better 'see' what values 'look like', Seah (in press) compares beliefs and values using evidences from research literature and teacher feedback, arriving at the two different but related domains of differences as shown in Table 1:

Table 1: Possible ways of differentiating beliefs from values

	Belief	Value
It is about the degree to which something is true	... important
It exists in a context	... in the absence of any context

Table 2 provides some examples of beliefs. For each belief, the *possible* value(s) associated with it is/are suggested. This contrast between beliefs and values will not only clarify the distinction suggested in Table 1, but more importantly, it is hoped that a clearer idea of what values in the mathematics classroom are is facilitated. Of course, although each belief may be associated with the value(s) suggested, the absence of any belief in any individual does not imply necessarily the absence of the associated value(s) in that individual.

Table 2: Examples of beliefs and corresponding values

Belief	Value(s)
Mathematical proofs need to be taught to students.	Rationalism
What is important in mathematics has been and will be shown by mathematicians.	Mystery
All that matters in mathematics is getting the right answer(s), nevermind the methods used.	Product Control
Mathematics assessment should focus on multiple-choice and short-answer questions.	Product Efficiency
Full marks should be awarded for correct method shown, even if the numerical value is wrong.	Process
What is learnt in school mathematics is relevant to life and work.	Relevance
The new Maths Methods (CAS) is what school mathematics should be about.	Relevance Technology
School mathematics is about understanding and learning ideas.	Concept
The role of the mathematics teacher is to teach concepts and demonstrate associated skills.	Authority
School mathematics provides us with tools for successful problem-solving.	Tool
As a teacher, I believe that student group work is essential in their mathematics learning experience.	Communication Cooperation
Students in my class are free to work with the manipulatives at any time.	Responsibility Connection

Values drive decisions (FitzSimons, Bishop, Seah, & Clarkson, 2001) and actions (Krathwohl et al., 1964; Raths et al., 1987). This is significant for us as teachers of mathematics in at least two ways. Firstly, an awareness of what the implicit and explicit values underlying the content of curriculum statements and textbooks are (being both decisions and actions of education administrators and textbook writers) empowers us to relay, mediate or reject these values in our interactions with our students in the mathematics classroom. Secondly, a better understanding of our own values relating to mathematics and mathematics education, and indeed to education in general as well, will better inform our decisions and actions in our professional practice in the mathematics classroom.

Bishop (1996) classifies these values into mathematical, mathematics educational, and general educational. In particular, mathematical values relate to qualities of the discipline of mathematics to which we attribute worth and importance. Bishop (1988; 2001) suggests three complementary pairs of these, i.e. rationalism and objectism, control and progress, mystery and openness, and some of these are evident in Table 2. Mathematics educational values, on the other hand, "are specifically associated with the norms of the institutions within which mathematics education is formally conducted" (Bishop, 1996, p. 20), and include the norms and practice of teachers in the mathematics classroom. Values like 'authority', 'technology' and 'tool' in Table 2 exemplify these values portrayed by teachers, schools and education boards. The third category of values, i.e. general educational values, is related to "the general educational and socialising demands of society" (Bishop, 1996, p. 20). The values of 'communication' and 'responsibility' are certainly two of those falling into this category.

Incorporating Values in Our Teaching Practice

Attempts to establish connections amongst values, math and society necessarily present us with the question of *what* or *whose* values to portray. Generally, these are values identifiable with the Australian culture and society, such as 'individual differences' and 'a fair go' portrayed by two teachers in the 'Values and Mathematics Project' (FitzSimons et al., 2001). These values are also embedded in national symbols such as the national anthem, which may include 'hardwork' ("Beneath our radiant Southern Cross, we'll toil with hearts and hands") and 'multiculturalism' ("For those who've come across the seas, we've boundless plains to share"). They may also be discerned from national and state curriculum statements. Examples of the latter are 'communication' and 'technology' (Board of Studies Victoria, 2000). There are also values specific to the respective states and territories, as well as values relevant to individual schools and even classes! Does the community within which your school is situated subscribe to any community value(s)? Does your school articulate particular religious or societal values? In fact, many schools have explicit statements of core, shared values in their mission statements. How do we teach these through our mathematics lessons?

Indeed, how can values be incorporated in our mathematics teaching practice other than through deliberate attempts in including the 'moral behind the story' in the context of questions? In effect, we are already involved with the teaching of values through different aspects of our professional practice! These may be evident in various aspects of our work, from curriculum planning, lesson planning (including choice of resources), lesson execution, student arrangement, assigning of student work, to assessment. The challenge for us teachers is how we may more explicitly relate values, mathematics and society together. Another challenge is with regards to possible conflicts of cultural perceptions with students from other cultures (e.g. American, Asian and Middle East cultures). That said, specific ways of incorporating values in classroom practice very much depend on the kind(s) of values intended for transmission. The following is an example which teachers are welcomed to consider and to try out in their classrooms.

A hypothetical example

Amongst the values Lauren subscribes to are 'listening', 'cooperation', 'openness' and 'communication'. She considers these to be some of the important values students need to learn through mathematics and other subjects for the modern-day workplace and for constructive relationships with others in the society. With regards to her latter consideration, Lauren feels that these are four of the values contributing to the 'social capital' (Fukuyama, 1999) of a community. Lauren's pedagogical practice includes student group discussion / investigative work, which is often followed by group submission of reports or assignments. While she recognises that this form of instruction provides many opportunities for the identified values to be portrayed, Lauren wishes to make this portrayal much more explicit than in its current form. She reflects on the composition of the student groupings, and decides that by changing the group member make-up once a term, she will further facilitate her teaching of the four values, especially since she deliberately alternates between mixed- and equivalent-ability groupings, as well as groupings by gender and by ethnicity. The underlying rationale is to provide students with sufficient time to learn to be open to, listen to, communicate with, and work constructively with peers, yet giving them the opportunities to work with as many of their peers as possible.

Lauren also re-assesses the reporting requirements for her group activities. She rationalises that if she expects groups to select a representative to present a verbal report each, she will also be further facilitating student internalisation of three of the values, i.e. 'listening', 'openness' and 'communication'. Further, she will also be emphasising different aspects of these values. For example, student valuing of 'communication' takes on a different dimension in the context of oral presentations, as considerations like public speaking protocol come into play. Lauren also reminds herself that one particular immigrant student had come from a culture which does not value excessive public talk, and that she has to provide this student with ample opportunities to appreciate the importance of appropriate and open elaboration and justification in the local society.

Additionally, Lauren is aware that her role as facilitator of student construction of knowledge will be an even more proactive and important one. She will not only be ensuring that group members cooperate amongst themselves; she will also be verbalising the associated value more explicitly, perhaps through the awarding of a praise for particular students or groups who do well in this aspect. She will not only listen to student discussion as they work through given tasks; she will also model the posing of questions to challenge student assumptions, so that all of them learn to value the importance of 'openness' in mathematics, in mathematics education and in the society.

Conclusion

While the notion of school mathematics being as value-laden as any other school subject is increasingly being recognised, this paper aims to extend that notion to explore the important role played by values in relating mathematics to society, and in educating the students for life and work in the society. Although mathematical concepts and skills may not change significantly over time, the ways in which these are structured into the curriculum, and the ways in which these are interpreted and taught in the mathematics classroom can both be tailored according to the current societal demands and projected trends. As a result, the utility and relevance of school mathematics may be experienced by all, especially by the students themselves! Our role as teachers in this endeavour is a crucial one indeed.

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The URL of the 'Values And Mathematics Project' is www.education.monash.edu.au/projects/vamp/