

## Why study values in mathematics teaching: contextualising the VAMP project <sup>1</sup>?

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### 1. Teachers' decisions and values

Imagine that you are a Grade 4 mathematics teacher. It is the first day back after the Christmas holiday, and you are talking with your class before getting down to work. You ask if anyone had any 'mathematical' presents. One boy says that he had been given a mathematical game from his uncle's country. He says it is very interesting, it has many variations, and he asks if he can show the class how it is played.

What would you do? Would you let him show the class and see what develops? Would you say something like: "Well that would be nice, but we don't have time now to do it, maybe later" or maybe: "Excellent, show me after the class, and I'll decide then if we can play it."

Are mathematical games a part of your teaching ideas? Would this game fit within your curriculum? Does that matter? In any case, you would probably make your choice in the way that you normally do, and not think much more about it. But the fact remains that you must make a choice, and that choice depends on your values.

Here is another example. This happened to me many years ago, and I remember it well. You are studying fractions with a lively class of 12 year old students, and you ask them to suggest a fraction that lies between one half and three-quarters. One particularly eager student offers the answer "two-thirds". When you ask how she knows that it lies between the other two fractions, she answers: "Well you can see that on the top the numbers go 1,2,3 and on the bottom they go 2,3,4. On the top, the 2 is between the 1 and the 3, and on the bottom, the 3 lies between the 2 and the 4, so therefore two thirds must be between the other two fractions!"

It is certainly an interesting answer but what would your decision be? Would you say: "No, that's not the right reason." Or: "Yes, very interesting but I don't think that'll work for any two fractions." Or: "That's a nice explanation. Let's see whether it will be true for any two fractions."

Finally, consider this situation: As the teacher of a grade 6 class, you ask your students to think of a mathematical problem that can be linked with a photograph of a woman selling produce at a rural market. Miguel, a student volunteering a response, suggests this is a trick! He states, "There is no mathematics problem here. The woman has never been to school and she does not know any mathematics."

How would you react to Miguel? And what would you do if all the class agreed with Miguel? Or suppose only the boys in the class agreed with him, what would you do? Whatever your decisions, what you do is dependent on your values, and through the choices you make you are also shaping the values of your students.

All teachers must make decisions in situations like these, and the decisions reveal the teachers' values. Unfortunately we know very little about values in mathematics teaching, except that they are present. That is the main reason why we began a research project on this topic.

### 2. Mathematics, Culture, and Values

Human beings everywhere and throughout time have used mathematics (Bishop,1988). The mathematics typically can be observed as behaviours illustrating the following six 'universal' activities (i.e. every cultural group does them): counting, measuring, locating, designing, explaining, and playing. These behaviors are reflective of the culture of the people demonstrating them and are inexorably influenced by what that cultural group values.

Sadly, little is known or has been written about the values which mathematics teachers think they are imparting, or how successful they are in imparting them. In our research, the Values in Mathematics Project, (<http://www.education.monash.edu.au/projects/vamp>) several colleagues and myself are examining teachers' awareness of what values they teach in their mathematics classrooms, how this takes place, and perhaps most importantly, what values are students learning from their mathematics teachers.

We now understand that all teachers teach values but that most values teaching and learning in mathematics classes happens implicitly. A number of teachers who believe that mathematics learning has value for their students, may have never considered the particular values they are imparting. The values taught, whether explicitly or more likely implicitly, seem to depend heavily on one's personal set of values as a person and as a teacher.

One thing is clear, teaching values isn't like teaching fractions. There are no right answers for one thing. You may be an expert on fractions, but it is not possible to be an expert on values. However understanding more about values is in our view the key to generating more possibilities for improving mathematics teaching.

Current developmental policies in many national programs are focused on improving the achievement outcomes of students, and although their statements of intent often mention the encouragement of 'desirable' values, the curriculum prescriptions which follow have little to say about their development. For example, the Goals of the Australian school mathematics curriculum have been described as follows (Australian Education Council, 1991):

*As a result of learning mathematics in school all students should:*

- *realise that mathematics is relevant to them personally and to their community;*
- *gain pleasure from mathematics and appreciate its fascination and power;*
- *realise that mathematics is an activity requiring the observation, representation and application of patterns;*
- *acquire the mathematical knowledge, ways of thinking and confidence to use mathematics to:*
  - *conduct everyday affairs such as monetary exchanges, planning and organising events, and measuring;*
  - *make individual and collaborative decisions at the personal, civic and vocational levels;*
  - *engage in the mathematical study needed for further education and employment;*
- *develop skills in presenting and interpreting mathematical arguments;*
- *possess sufficient command of mathematical expressions, representations and technology to:*
  - *interpret information (e.g. from a court case, or a media report) in which mathematics is used;*

- *continue to learn mathematics independently and collaboratively;*
- *communicate mathematically to a range of audiences; and*
- *appreciate:*
  - *that mathematics is a dynamic field with its roots in many cultures; and*
  - *its relationship to social and technological change.*

It is clear from these statements, which are typical of educational goal statements, even if in this case they are more progressive than usual, firstly that valuing has entered into their choice. Secondly they all contain implications for values teaching and for cultivating what we might term 'mathematically informed valuing'.

Also there is now a great variety of proposals from research, and ideas for improving mathematics teaching being generated internationally. In particular in the areas of information technology (see Noss and Hoyles, 1996), ethnomathematics (see Barton, 1996, Gerdes, 1995) and critical mathematics education (see Skovsmose, 1994), the role of mathematics teachers is being critically examined. What is of special interest about these kinds of developments however is that there is a strong concern both to question, and also to try to change, the values currently being taught.

### **3. Socio-Cultural Values in Mathematics Teaching**

We believe that it is essential to consider cultural values in mathematics within the whole socio-cultural framework of education and schooling. Culture has been defined as an organised system of values which are transmitted to its members both formally and informally, (McConatha & Schnell, 1995, p. 81). Mathematics education as cultural induction has been well researched over the last twenty years (Bishop, 1988), and it is clear from this research that values are an integral part of any mathematics teaching.

Values exist throughout all levels of human relationships. At the individual level, learners have their own preferences and abilities, that predispose them to value certain activities more than others. In the classroom there are values inherent in the negotiation of meanings between teacher and students, and between the students themselves. At the institutional level we enter the political world of any organisation in which issues, both deep and superficial, engage everyone in value arguments about priorities in determining local curricula, schedules, teaching approaches, etc. The larger political scene is at the societal level, where the powerful institutions of any society with their own values determine national and state priorities in terms of the mathematics curriculum and teacher preparation requirements. Finally, at the cultural level, the very sources of knowledge, beliefs, and language, influence our values in mathematics education. Further, different cultures will influence values in different ways. Cultures don't share all the same values.

A socio-cultural perspective on values is crucial to understanding their role in mathematics education because valuing is done by people. The symbols, practices, and products of mathematical activity don't have any values in or of themselves. It is people, and the institutions of which they are a part, who place value on them. The research and writing on socio-cultural aspects of mathematics education (e.g. Davis and Hersh, 1981 and 1986; Joseph, 1991; Wilson, 1986) make this abundantly clear.

### **4. Mathematical values**

After examining the research literature in preparation for the empirical part of the Values in Mathematics Project, our initial analyses reveal that there are two main kinds of values which teachers seek to convey: the general and the mathematical. For example, when a teacher admonishes a student for cheating in an examination, the values of 'honesty' and 'good behavior' derive from the general socialising demands of society. In this case, the values are not especially concerned with, or particularly fostered by, the teaching of mathematics. However when we think about the three incidents previously described, we very soon get into mathematical values. In Bishop (1988, 1991), I argued that the values associated with what can be called Western mathematics could be described as follows:

*Rationalism* - The main value that people think about with mathematics I call rationalism. It involves ideas such as logical, and hypothetical, reasoning, and if you value this idea, then for example in the second incident above with the fractions you would want the class to explore the generality of the student's conjecture.

*Objectism* - Mathematics involves ideas such as symbolising, and concretising, and I refer to this value as 'objectism'. Mathematicians throughout its history have created symbols and other forms of representation, and have then treated those symbols as the source for the next level of abstraction. Encouraging your students to search for different ways to symbolise and represent ideas, and then to compare their symbols for conciseness and efficiency, is a good way to encourage this value.

*Control* - The value of 'control' is another one of which most people are very conscious. It involves aspects such as having rules, being able to predict, and being able to apply the ideas to situations in the environment. It is one of the main reasons that people like mathematics. It has right answers that can always be checked. The woman selling in the street market in the third incident above will value the control she can exert over her profit and the quantities of her goods.

*Progress* - The complementary value to 'control' is one that I call 'progress'. Because mathematics can feel like such secure knowledge, mathematicians feel able to explore and progress ideas. This value is involved in ideas such as abstracting and generalising, which is how mathematics grows. Questions like: "Can you make up another problem that uses the same information but is more complicated?" or "Can you suggest a generalisation that is true for all those examples?" are good tasks for encouraging that value.

*Openness* - I call another familiar value 'openness' because mathematicians believe in the public verification of their ideas by proofs and demonstrations. Asking students to explain their ideas to the whole class is good practice for developing the openness value.

*Mystery* - 'Mystery' is the final value I will describe. Anyone who has ever explored a mathematical problem or investigated a puzzle, knows how mystifying, wonderful, and surprising mathematics can be. For example, I still think it is surprising that the ratio of circumference to diameter is always the same for any sized circle (Pi is the ratio). And mathematics is full of these mysteries! Did you know for example that if you take any Pythagorean triple like 3,4,5 or 5,12,13 and multiply the 3 numbers together, the result is always a multiple of 60! Isn't that surprising? And why should it be 60? (90 might in some way seem to be a more 'logical' answer!)

It seems from the research literature that over the last centuries these six values have been fostered by mathematicians working in the Western culture, and it is these values that teachers are probably also promoting when they teach mathematics. Of course they may promote some more than others, so perhaps teacher in-service activities could help teachers develop ways to promote all of them.

Then they would be encouraging their students to be thoroughly mathematical, in a Western cultural sense.

However, we have also recognised that culture is a strong determinant of mathematical values, and research shows us that not all cultures share the same basic values. So it is likely that mathematics teachers working in different cultures will impart different sets of values to their students, even if they are teaching to the same basic mathematics curriculum. This is one reason why we are very interested in this collaborative research project with our Taiwan colleagues.

#### **4. The VAMP research project**

In 1999 the ARC began funding our three year research project which had the following goals:

1. To investigate and document mathematics teachers' understanding of their own intended and implemented values.
2. To investigate the extent to which mathematics teachers can gain control over their own values teaching.
3. To increase the possibilities for more effective mathematics teaching through values education of teachers, and of teachers in training.

As we have said above, there is little knowledge about how aware teachers are of their own value positions, about how these affect their teaching, and about how their teaching thereby develops certain values in their students. Initial teacher education and in-service professional development need this kind of research basis in order to help change the situation. But doing this research is far from easy, for all kinds of reasons (see Clarkson, Bishop, FitzSimons and Seah, 2000, this volume). We believe that the key to making development of values teaching possible is to investigate teachers' understanding of their own values. For Goal 1 we intend to study both teachers' intentions, and their actual teaching behaviours. Values teaching happens both implicitly and explicitly and there is not necessarily a one-to-one correspondence between what is intended and what occurs.

To begin this research we ran a series of inservice workshops with teachers which enabled us to gain some initial insights into the kinds of values teachers were considering. As a result of these workshops, we have developed a detailed questionnaire which we are giving to about 30 volunteer mathematics teachers in Victoria. Preliminary results from this questionnaire will be presented in another paper at this conference, by FitzSimons, Seah, Bishop and Clarkson (2000, this volume). The questionnaire will also be used to identify the teachers who would be willing to participate further in the research and whose views about values are sufficiently, and interestingly, different.

As we say in Goal 2 above, we wish to have a direct effect on the teachers in the project, and in an overt way. This project is not just a study of teachers' existing values, it is concerned with change, and with the way in which awareness and understanding of their own values teaching enable teachers to further develop their own teaching.

The first approach for this intervention phase of the project will be to work with approximately 20 selected volunteer teachers, to clarify via initial interviews their 'intended values', and through classroom observation and post-observation interviews, the ways in which they implement these in the classroom. Through this process, teachers will be encouraged to identify the role that they want

values teaching to play in their classrooms, and to identify in which areas they are achieving what they want, and in which areas they desire change.

Bearing in mind the possible relationship between beliefs and values, we will then build on the insights so far gained to focus on whether teachers can change a 'held belief' into an 'implemented value' observable in their classroom. This is a crucial phase from a theoretical perspective. Following a number of group discussions with the 20 teachers, a joint plan will be devised to attempt to implement certain specified values different from those normally emphasised by the teachers. The principle aim of the group discussion sessions is for the teachers to be able to support each other during what could be a challenging experimental period.

The joint plan will be implemented over a similar three-week observational period to that used in the first approach. The researchers' tasks will be to observe and document the extent to which the implementation takes place. Following the observations and teacher interviews, further group discussions will be held. The teachers will be asked to keep journals with weekly entries and these journals will be particularly important documents for analysis and discussion during this phase.

It is our contention that improving and making values teaching more explicit in mathematics classrooms will make mathematics learning more effective. Hence the third goal above. We anticipate that we will be generating in-service activities for teachers, based around the following kinds of topics. The interest and concern is not with the particular choices the teachers might make but with the values underlying their decisions'

#### *Planning your curriculum for the year:*

Should I emphasise breadth or depth in the topics? What out-of-school visits should I include? How should my math curriculum link with those in science, language, art, etc.? What big ideas should I focus on this year? What curriculum choices should I offer my students?

#### *Choosing textbooks/electronic teaching aids*

What do I expect from a good textbook? What extra materials should I prepare? How much calculator use would be desirable for my Grade 4 class? How should I tap into the math resources on the Internet? (Textbooks can also be considered to be carriers and shapers of values. They are in effect 'text teachers' and are certainly written by people interested in developing certain values.)

#### *Planning lessons*

How much choice of activities should I give my students? How much routine practice is important for them? How much group work do I want to build in? How detailed should my planning be?

#### *Planning and setting assessment tasks, mark schemes*

How many multi-digit multiplication problems are sufficient? Should I allow calculator use? Should students mark their own assignments?

#### *Setting homework*

Is my homework always 'after the lesson' type rather than 'before the lesson'? Should I encourage parents to help as much as possible? Should I let my students cooperate with their homework assignments?

#### *Grouping students in class*

Should I encourage friendship groupings by letting my students work with their friends? Should I mix the non-English speakers with the first language English speakers?

Through activities based around questions such as these, it is our hope that we shall be able to make mathematics teachers not only more aware of the different values that they are teaching, but also that they will be more in control of their own values teaching. By this means we intend teachers to develop a greater range of teaching techniques, and to be able to offer a more rounded mathematical education to all their students.

### Note

The 'Values and Mathematics Project' (VAMP) is a three-year (1999-2001) Australia Research Council funded project jointly conducted by Monash University and the Australian Catholic University.

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<sup>i</sup> The 'Values and Mathematics Project' is supported by a Australian Research Council Large Grant. The Project's homepage can be found at [<http://www.education.monash.edu.au/projects/vamp/>].