

Conceptions of Values and Mathematics Education held by Australian Primary Teachers¹: Preliminary Findings from VAMP

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Introduction

One of the underpinning beliefs of researchers in the Values and Mathematics Project (VAMP) is that making explicit the teaching of values will contribute positively to the mathematics education of the student. There is a burgeoning literature in adult mathematics education (see FitzSimons, & Godden, in press) which suggests that many people leave school holding negative beliefs and attitudes about the discipline of mathematics, the field of mathematics education, and their own sense of identity and agency with respect to learning and using mathematics. The long years of experience in classrooms are an important factor in this identity formation, together with influences from significant others and the mass media, for example. Thus, each mathematics lesson may be viewed (in the microcosm) as mathematics education history in the making, creating and recreating identities of people who interact with others, now and in the future.

As noted in Bishop, Clarkson, FitzSimons, and Seah (elsewhere in these proceedings), the VAMP project has conducted inservice workshops for primary (elementary) and secondary school teachers to inform and recruit participants. We have also advertised through the local mathematics teachers' association and the Catholic school system for interested people to complete a detailed questionnaire requiring about 30 minutes of their time. Challenges and difficulties found in the practical workings of this Project are discussed in Clarkson, Bishop, FitzSimons, and Seah (elsewhere in these proceedings). In this paper we will outline some of the findings from the Project so far, based on fieldnotes from the inservice workshops and analysis of questionnaires. Several themes are pursued, including teacher understanding/ opinions of: (a) values teaching in mathematics education, (b) institutional or socio-cultural influences, and (c) mathematical and mathematics educational values; in addition, we are interested in the extent to which teachers exercise control over values portrayal.

Values Teaching in Mathematics Education

One of the foremost questions to be addressed is whether teachers actually see a place for values teaching in mathematics education. By expressing an interest in being involved in this project, respondents have tacitly indicated support for the concept. However, while there was agreement or strong agreement by many with the statement: "There is a place in mathematics teaching for the teaching of values," a number of responses made us question whether this statement was interpreted descriptively or normatively – these interpretations will be clarified in subsequent interviews.

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The Project's homepage can be found at [<http://www.education.monash.edu.au/projects/vamp/>]

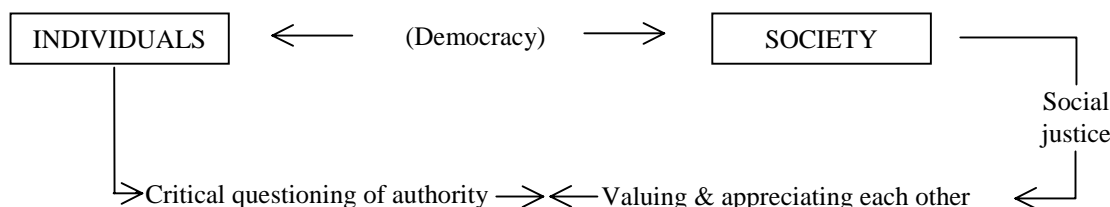
Another area of interest was the relationship in values teaching between mathematical and personal, social or moral values in the relative emphasis placed upon these two categories by teachers. Once again there were a diversity of responses with some teachers placing personal values ahead of mathematical values, others *vice versa*, and still others advocating a blend. Within the first category, there were distinctions made between individual and social goals:

Personal growth shouldn't be at the expense of social/moral responsibility.

There must be a balance between social justice and individual growth.

To the respondent making the last comment, attempts to achieve this balance have been the source of tensions in the society with regards to interpersonal relationships. He represented this situation with a sketch which is reproduced in Figure 1:

Figure 1
Tensions in interpersonal relationships resulting from a balanced development of social justice and individual growth.



There was generally strong support for using current social issues (e.g., gambling) to promote discussion of values in mathematics, but not at the expense of causing disharmony within the community. Most advocated working in co-operation with parents through explanation and discussion where sensitive issues are concerned, in order to promote open and honest discussion with students. However there was a warning from one experienced teacher:

While there is a place for a serious discussion of social issues formally and as they arise, it seems pointless to introduce vexatious debate when it is not necessary.

While teachers were concerned that the teaching of mathematics should attempt to meet the immediate personal learning needs (including learning to think for themselves) and future aspirations of their students, some were willing to critique the institutions of mathematics and mathematics education in the classroom. They suggested, for example, that there could be discussion of the personal and social empowerment aspects of mathematics. There could be discussion of the value of mathematics throughout history and across cultures, emphasising its creativity. There could be discussion to transform the social expectations arising from the compulsory nature of mathematics education into personal satisfaction for their students, at the same time helping students to critique these social expectations. Further to this the suggestion was made to encourage children to question importance of *all* subjects, list their responses on board and have a class discussion. That is, to treat students' questions, mathematical and meta-mathematical, with respect.

Institutional and Socio-Cultural Influences

As has become apparent, the teaching of values in mathematics cannot be considered in isolation; it must be situated within broader contexts. These were discussed analytically under five broad headings in Bishop, Clarkson, FitzSimons, and Seah (1999): (a) socio-historic knowledge, (b) socio-cultural practice, (c) the community of practice in the classroom, (d) the microgenetic development of the student, and (e) the ontogenetic development of students and teachers. Clearly there are expectations of each other on the part of teachers and students (e.g., Brousseau, 1997), as well as from the school, the family, the local community, and society at large including government, business and industry. Between teachers and students there are questions of mutual respect (behavioural and intellectual), and behavioural norms unique to each classroom if not the entire school. The ability of any teacher to conduct whole-class discussion, small-group work, problem solving activities, investigations, and so forth is constrained explicitly or implicitly by the ecology of the classroom situated within a range of influences such as those listed here. Other pragmatic constraints faced by teachers are the time available within what are often termed 'overcrowded curricula' linked to the pervasive influence of external tests or examinations, and even the structure of the timetable itself.

The results from questions aimed at influences on the portrayal of values in mathematics teaching were as follows. The teacher's personal value framework rated consistently highly, sometimes in concert with religious/spiritual values but sometimes these were diametrically opposed with the latter ranked last or near last. Although it was generally agreed that curricular resources (e.g. curriculum guides, textbooks, etc.) portrayed values, there was an equivocal response to the degree of influence exerted by the kind(s) of pupils in the particular class, the school ethos and culture, and the particular topic being taught. That is, some teachers claimed to portray values consistently across classes, topics, or both whereas others stressed the need to respond to different students' needs. An example of the dilemmas in making generalizations here is given by the following comment:

The kind of students I have in my classes does not change the values I portray . I consider it important to provide a realistic consistent modelling of my own values, especially to the low socio economic students I teach who express cynicism concerning and often feel betrayed by teacher "masks."

Here are the words of a teacher who expressed a concern for a particular group of students, yet who maintained a consistency of values portrayal. This is another area where follow-up interviews may help us to gain a deeper understanding of values teaching in mathematics.

Teachers' views on mathematical and mathematics educational values

As is discussed above, the teacher respondents felt that there is a place for values teaching in mathematics lessons. Regarding the subject of school mathematics and its teaching, most of them also thought that it was important to portray these two aspects as value-laden. These values would pertain to mathematics content and mathematics pedagogy, or to use Bishop's (1996) terms, these are the mathematical and mathematics educational values respectively. It is an aim of the Values And Mathematics Project to specifically investigate these values which are unique to the mathematics classroom, as distinct from the general educational values such as obedience and graciousness. At the

same time, there is an acknowledgement too that there are overlaps between and amongst these categories, such as the value of creativity.

One of the questionnaire items attempted to find out the relative importance teachers placed on mathematical values. Among the questionnaire returns, it was noted that these teachers of mathematics generally preferred to portray mathematical values associated with logical thinking and creativity. In contrast, the value related to the role of mathematics as a gate-keeper to societal upward mobility was the least preferred for nearly all of the teacher respondents. This is in spite of the requirement in Australia that a pass in at least one mathematics subject be attained as a criteria for tertiary entry applications. At this stage, one possibility to account for this is that at the primary level, the aims and foci of mathematics teaching are more broadly defined. Another possibility is socio-cultural in nature; unlike many Asian cultures, a good career with a comfortable remuneration does not necessarily require a tertiary academic qualification. Other personal skills are often equally valued in the society as well.

When a student asks for reasons why mathematics is taught and studied in school, the teacher's response often reveals --- and contributes to an inculcation of --- values related to the subject of mathematics. Amongst the responses received, there was a majority which emphasised the complementary values of control and progress (Bishop, 1988):

Mathematics is part of our everyday experiences and sophisticated mathematics helps people to explain their environment and and [sic] aspects associated with living such as trends

Mathematics is an area we need to cope with [in] our everyday life. We need it to exist as a whole person who can manage life

Understanding mathematics and having mathematical skills is personally and socially empowering.

As for mathematics educational values, the responses indicated a strong preference for values associated with problem-solving and investigations. These values embody non-standard ways of doing mathematics. They emphasise process/understanding over product/result, a statement which nearly all the teacher respondents agree to. These teaching methods, together with the next highly-ranked value associated with small-group work, were also reflected in the resounding endorsement of teacher encouragement for student alternative solutions and/or justifications. At the other extreme, testing is a teaching style which most respondents ranked last amongst different ways of teaching mathematics.

Teacher control over values portrayal

While the above provide the Values And Mathematics Project with a first glimpse into teacher awareness of values teaching in mathematics education, institutional and socio-cultural influences underpinning such values teaching, and the nature of mathematics content and pedagogical values held by primary school teachers of mathematics in Australia, the Project is also interested in investigating the relationship of these self-professed values with values which are actually portrayed in the mathematics class. This concern arose from documented inconsistencies between teacher beliefs and subsequent actions (Sosniak, Ethington, & Varelas, 1991; Thompson, 1992; Tirta Gondoseputro, 1999). It is envisaged that a better understanding of this relationship

arising from the different sources and analyses of data collection later on in this Project will provide us with clues to exploring the possibility of explicit teacher control over the representation of selected values in class.

While a rich description of this relationship between belief and practice may be obtained from the next phase of the Project, that is, lesson observations and personal interviews with the teacher participants, the questionnaire items were also designed to reveal aspects of any such correspondence as observation and discussion points. This was initially planned for by eliciting teacher conscious reflection (e.g., through ranking preferred and portrayed values).

A section of the questionnaire consisted of items with contextualized classroom situations. It asked for teachers' open-ended feedback regarding (a) their response to each situation, (b) the contextual factors guiding their respective responses, and (c) the underlying values underpinning their actions. The items in this section were intended to complement cross-item instrument reliability checks. However, while responses to context-free items in the other sections demonstrate reliability of these items, for some respondents such consistencies broke down between these items and items in the contextualized section.

In other words, inconsistencies between respondent self-professed values and values underlying responsive actions to hypothetical classroom situations (Bishop & Whitfield, 1972) or critical incidents (Tripp, 1993) provided another (unintended) source of checking for teacher control over their values portrayal in the primary mathematics classroom. A distinction between this source and the purposeful inclusion of teacher reflection items is that the former tapped into teacher subconscious preference for selected values given hypothetical contexts. In fact, one or more of the contexts might have even been experienced personally by some of the respondents before, in which case their responses to these incidents might actually reflect their recollections of their own reactions to the respective situations!

The teachers' indication has been that the kinds of values being represented were influenced predominantly by their own personal value framework. Then, it may be expected that with such personal involvement, preferred values were translated into portrayed ones in the classroom. In the case of mathematical values (Table 1), this expectation held true for the highest-ranked value corresponding to logical thinking, that is, rationalism (Bishop, 1988), as well as to the two lowest-ranked values which corresponded to mathematics improving one's career prospects, and to beauty. The value of creativity, in particular, appeared to be under-emphasised despite strong teacher intentions.

Table 1
Comparison of descriptors associated with preferred and portrayed mathematical values

Preferred	Portrayed
1. Logical thinking (1.3)	1. Logical thinking (1.6)
2. Creativity (2.2)	2. Systematic working (2.3)
3. Systematic working (2.5)	3. Puzzling (2.7)
4. Puzzling (2.8)	4. Creativity (2.8)
5. Beauty (3.9)	5. Beauty (4.6)
6. Improving career prospects (5.8)	6. Improving career prospects (5.8)

Note. Average rankings are denoted in brackets.

As for values related to teacher pedagogical practices, the initial analysis of questionnaire data showed that values related to problem-solving, investigations and small-group work were both highly preferred and portrayed in the classroom, although the relative emphases amongst these three activities were different in practice (Table 2). Testing/assessment was also least preferred and least emphasised amongst the list of teaching activities. As much as teachers might not subscribe to direct instructions in the classroom, the reality and practical constraints appeared to make it a more-commonly used teaching style than desired. Nevertheless, and perhaps of the nature of primary mathematics curriculum, teachers were still able to engage in pedagogical activities which promote cooperative and other social skills, creative thinking and non-standard solutions as represented by the top three activities in Table 2.

Table 2
Comparison of activities associated with preferred and portrayed mathematics educational values

Preferred	Portrayed
1. Problem-solving (1.5)	1. Small-group work (2.3)
2. Investigations (2.4)	2. Problem-solving (2.5)
3. Small-group work (2.6)	Investigations (2.5)
4. Self-paced learning (4.2)	4. Direct instruction (3.3)
5. Direct instruction(4.5)	5. Self-paced learning (4.5)
Team teaching (4.5)	6. Team teaching (5.0)
7. Testing (5.9)	7. Testing (5.1)

Note. Average rankings are denoted in brackets.

At this preliminary stage of analysis, there is no evidence of interaction between the extent to which preferred and portrayed values match and the factors influencing value portrayal for any individual teacher. It will be certainly worthwhile to investigate the strength of this relationship once more questionnaires are returned and a more detailed analysis of the data are carried out.

What are some of the perceived inconsistencies between teacher professed values and values underlying teacher responses to hypothetical classroom incidents? For one respondent who placed the least emphasis on portraying mathematics achievement as improving career prospects, her action in response to the context given in Figure 2 below would be informed by

an overriding value ... [which is] that my students need to understand and enjoy mathematics if they are to achieve the positions in society to which they aspire

The teacher's use of the term 'overriding' will be picked up again at the end of this paper.

Figure 2
Contextualized item C1

It is the first lesson with your class in the new school year. One pupil raises his/her hand and asks you why pupils have to study mathematics in school.

In a similar case, another teacher respondent claimed that the values she subscribed to and subsequently portrayed in practice were all related to the nature of school mathematics itself, such as rationalism, creativity, mystery and aesthetics. In fact, she ranked all these values equally high, and the only value she singled out for a lower

emphasis was that of mathematics achievement improving students' career prospects. This teacher's response to the situation outlined in Figure 2 was to

be honest and say the system requires it, their parents and future employers expect it ... [guided by the value that mathematical skills are both] personally and socially empowering.

In other words, there was also an emphasis on the utilitarian value of school mathematics, despite her earlier response otherwise.

Figure 3
Contextualized item C4

As part of classroom activity, you plan to make use of some 'Tattslotto' information you have collected. Your co-ordinator warns you against doing this because of the sensitivity to gambling of the school parents.

Note. 'Tattslotto' is one of the publicly televised games of chance popular in Australia.

The contextualized situation in Figure 3 was included in the questionnaire. All except one teacher expressed ways of conducting the planned discussion, most with suggestions of accommodating the parents' concerns. This one teacher had in the previous sections of the questionnaire ranked her personal value framework as constituting the prime influencing factor for the kinds of values she portrayed in her class. She had also agreed emphatically that there is a place in mathematics teaching for the teaching of values. Yet, this teacher's response to the parents' concerns would be to

change the type of activity while maintaining the same teaching goal.[After all,] there is more than one way to present any material.

Has the personal value framework which was supposedly so influential to this teacher been overtaken by her concern for parents' opinions, even though she saw the opportunities here

for a serious discussion of social issues?

At the time of responding to the questionnaire, this teacher has already accumulated 32 years of service in the education sector, several of which involved leadership roles within educational administration agencies. Yet, implicit in these comments was that for her, the teaching goal for the 'Tattslotto' activity appeared to be related to some mathematical topic, such as probability and statistics, rather than also values related to the demystification of social activities in which mathematics plays a critical role, and for which participants should be able to make informed judgements.

Another discrepancy between stated values and contextualized values arose from the relative importance teachers placed on values related to the subject and values related to students' personal growth and social development. A teacher respondent who made a clear distinction between these two categories of values had emphasised the former. However, when asked for his responses to three hypothetical students who preferred to work individually rather than in a group, his response was to reject students' suggestions, as he felt

there is [sic] values and ideas that are important in group work.

To him, these values were related to learning to work together and to accepting peers' ideas. These guiding values are clearly related to student personal and social development, rather than to values related to mathematics which he ranked highly.

Conclusion

This paper outlines some of the preliminary findings from our interactions with teachers with regard to values teaching in mathematics education. One striking observation has been that *in the context of mathematics education*, teachers are generally left in need of a common language with which values may be discussed. Without this common language, it will remain elusive for teachers to become more aware of, and to review, their own values as portrayed in the mathematics classroom. There are certainly implications here for a contribution towards greater mathematics excellence from the affective, if not the cognitive, perspective of education.

The use of the term 'overriding value' by one teacher respondent brought into question the ranking of values in terms of personal importance. Another teacher hinted at this too when he commented that the ranking items

are very difficult questions to answer, especially by putting numbers in boxes.

Values as deeply internalised affective constructs may well exist together within each of us without necessarily being in a hierarchical relationship. The context in any given critical incident then leads us to view the particular situation with our internal and invisible pair of value lenses, and here clearly the notion of competing values may be of relevance.

Our project itself cannot claim to be outside of the sphere of influence on teachers, as the words of this response to the questionnaire reflect:

I have never thought of mathematics as promoting values before and concepts of beauty and future careers relating to maths are hard to include in my thinking when I work with young children.

Clearly, we still have a long way to go. We hope this preliminary presentation will stimulate further reflection and help us to arrive at an initial conception of values in mathematics education held by teachers in Australia.

References

- Bishop, A. J. (1988). *Mathematical enculturation: A cultural perspective on mathematics education*. Dordrecht, The Netherlands: Kluwer Academic Publishers.
- Bishop, A. J. (1996, June 3-7). *How should mathematics teaching in modern societies relate to cultural values --- some preliminary questions*. Paper presented at the Seventh Southeast Asian Conference on Mathematics Education, Hanoi, Vietnam.
- Bishop, A. J., Clarkson, P. C., FitzSimons, G. E., & Seah, W. T. (2000). Why study values in mathematics teaching: Contextualising the VAMP project. In *Proceedings of the History and Pedagogy of Mathematics Conference*. Taipei, Republic of China.
- Bishop, A. J., Clarkson, P. C., FitzSimons, G. E., & Seah, W. T. (1999). *Values in Mathematics Education: Making Values Teaching Explicit in the Mathematics Classroom*. Paper presented at 1999 Australian Association for Research in Education Annual Conference. [World Wide Web: <http://www.swin.edu.au/aare/>].

- Bishop, A. J., & Whitfield, R. C. (1972). *Situations in teaching*. Berkshire, England: McGraw-Hill.
- Brousseau, G. (1997). *Theory of didactical situations in mathematics. (Didactique des mathématiques, 1970-1990)*. (N. Balacheff, M. Cooper, R. Sutherland & V. Warfield, Eds. & Trans.) Dordrecht: Kluwer Academic Publishers.
- Clarkson, P. C., Bishop, A. J., FitzSimons, G. E., & Seah, W. T. (2000). Methodology challenges and constraints in the VAMP Project. In *Proceedings of the History and Pedagogy of Mathematics Conference*. Taipei, Republic of China.
- FitzSimons, G. E., & Godden, G. L. (in press). Review of literature on adults learning mathematics. In D. Coben, J. O'Donoghue, & G. E. FitzSimons (Eds.), *Perspectives on adults learning mathematics: Research and practice*. Dordrecht: Kluwer Academic Publishers.
- Sosniak, L. A., Ethington, C. A., & Varelas, M. (1991). Teaching mathematics without a coherent point of view: Findings from the IEA Second International Mathematics Study. *Journal of Curriculum Studies*, 23(2), 119-131.
- Thompson, A. G. (1992). Teachers' beliefs and conceptions: A synthesis of the research. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 127-146). New York: Macmillan.
- Tirta Gondoseputro, T. (1999). The cross-cultural perspective of teachers' beliefs and their influence on teaching practices: A case study of two teachers teaching secondary mathematics in Australia and Indonesia. In J. M. Truran & K. M. Truran (Eds.), *Making the difference: Proceedings of the Twenty-second Annual Conference of The Mathematics Education Research Group of Australasia Incorporated* (pp. 494-501). Sydney, Australia: The Mathematics Education Research Group of Australasia Incorporated.
- Tripp, D. (1993). *Critical incidents in teaching: Developing professional judgement*. London: Routledge.

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