

Beyond Numeracy: Values in the Mathematics Classroom

Gail FitzSimons

Monash University

<gail.fitzsimons@education.monash.edu.au>

Alan Bishop

Monash University

<alan.bishop@education.monash.edu.au>

Wee Tiong Seah

Monash University

<weetiong.seah@education.monash.edu.au>

Philip Clarkson

Australian Catholic University

<p.clarkson@patrick.acu.edu.au>

In this paper we report on findings from classroom observations of a series of government, Catholic, and independent, primary and secondary, co-educational and single-sex schools. Analyses based upon pre- and post-lesson interviews together with videotaped lesson observations reveal that intended values may or may not be nominated explicitly by individual teachers. In turn, these may be observed as explicitly taught, implicitly taught, or not at all. This suggests that there are tensions between intended and implemented values.

Introduction

Values are an inherent part of the educational process at all levels, from the systemic, institutional macro-level, through the meso-level of curriculum development and management, to the micro-level of classroom interactions (Le Métails, 1997). At the micro-level they play a major role in establishing a sense of personal and social identity for the student. In mathematics classroom sessions, as in all teaching, values are a crucial component of the classroom affective environment, and thus are a crucial influence on the ways students choose to engage (or not) with mathematics. This issue is further compounded by the extent of teachers' awareness of values ascribed to the particular discipline, the values carried by their own selection from the available pedagogical repertoire, and their consciousness or otherwise of imposing their own personal values (Pritchard & Buckland, 1986).

As discussed by Clarkson, Bishop, FitzSimons, and Seah (2000), the three-year *Values and Mathematics Project* (VAMP) began in 1999, with the organisation of a teacher focus group and a series of professional development sessions. During these, mathematics teachers (primary and secondary) were encouraged to discuss both the actual and intended values, that were part of their teaching of mathematics. The purpose of these discussions was to identify and understand the positions taken by mathematics teachers on value issues. These discussions also helped in the formulation of survey questions, and to identify teachers who would be willing to participate further in the project. The greatest difficulty faced by the project team was the recruitment of practising teachers, due primarily to anxieties about having their value positions on mathematics analysed.

Clarifying Teachers' Intended and Implemented Values

In the first stage of the research, knowledge gained from the focus group phase of the study was used to create questionnaires. These were disseminated to mathematics teachers across Victoria in order to explore in detail the values held and taught by respondents. The results from the survey indicate that primary teachers, at least, consider values teaching an important part of mathematics education. They generally prefer mathematics' logical and creative aspects over its societal gatekeeping role. Pedagogically, they prefer

process/understanding over product/result, with testing preferred least. The surveys indicated the considerable influence of the teacher's own personal value framework, but perceived inconsistencies in the results suggest the possibility of competing sets of values, heavily dependent on context. The results also strongly indicated the absence of a common language within mathematics education with which to discuss values, retarding progress towards teacher awareness and control. (See FitzSimons, Seah, Bishop, & Clarkson, 2000, for further details in relation to the survey data.)

The emphasis in the most recent phase of the research has been on working with eight volunteer teachers to clarify the relationships between their intended and implemented values. Throughout this process, teachers were encouraged to identify the role that values teaching plays in their classrooms, and how they were implementing these.

To clarify the 'implemented values,' classroom observations took place during three mathematics lessons. These lessons were videotaped with the researcher taking field notes of critical incidents and decision points. Following each classroom observation, an interview was held in which the observer suggested, using video clips as prompts, a description of the classroom which highlighted those values that were perceived as being implemented, and the behaviours associated with them. The focus of the interview was on the comparisons between the 'intended values' planned by the teacher, and the 'implemented values' noted by the observer. The interview continued until consensus was arrived at between the teacher and observer concerning the values taught in the lesson.

Findings from the Research

Table 1

Categories of Intended and Implemented Values Observed

		Implemented/Observed		
		Taught Explicitly	Taught Implicitly	Not Observed
Intended/ Nominated	Nominated Explicitly	Co-operation (Anna)	Self-esteem (Ben)	Creativity (Colin)
	Not nominated	Individual differences (Diane)	Inclusiveness (Edward)	—

In this section we draw upon the data from recent fieldwork of case studies in primary and secondary classrooms in order to illustrate the tensions teachers experience between intended and implemented values when teaching mathematics — an overview of which is provided by Table 1. An important point was whether the teachers nominated particular values to be taught, or not, contrasted with whether they were observed to be teaching these explicitly or implicitly. In some cases, values were nominated but were not observed being taught. In the following sections, examples are presented of teachers' actions corresponding to five of the six cells in Table 1. The sixth cell is clearly empty, being values which were neither nominated nor observed.

Nominated Explicitly/ Taught Explicitly

The following is an example of a teacher explicitly nominating a value which was then observed to be explicitly taught in the classroom. Anna was a Grade 1/2 classroom teacher in an outer suburban, middle class, co-educational Catholic school. In the pre-lesson

interview, she nominated the value of the children *working co-operatively* in small groups. She mentioned that some children find it difficult to select themselves into a group (for example, when she says: “make a group of five”) due to their difficulty in counting and also for developmental reasons. She felt that students should be respected if they choose not to work in groups; that teachers need to weigh up the situation. From past experience she knows that lessons can be “sabotaged” by behavioural issues in co-operation.

Observation of the class revealed that Anna discussed the task at hand (measurement of students’ heights with unmarked paper strips), including relevant vocabulary for comparison of heights. Time was given over to have the students form small groups of various sizes, including “one.” After students had made groups of five, she asked each group to nominate one member as leader/reporter. She then spent time discussing the processes of election, particularly as one student appeared to have usurped control of his group. Students then carried out the task of measuring each other’s heights by marking a strip of paper with a coloured pen. It became apparent that one group of five boys was having trouble co-operating — it seemed they were in dispute over who was taller than whom. Following the measuring, the whole group reassembled to discuss group co-operation and the difficulties encountered.

In the post-lesson interview, Anna observed that co-operation and small group work

... probably took up far more time than I had expected — it’s what happens.

She continued that, when children choose their own groups,

you’ve got all those power relationships, whereas with the ‘table groups’ [teacher-selected groups] ... you probably get more ‘on-task’. But I can’t rescue you [the children] from that all the time. You have to be able to experience that stuff, you know.

Co-operative group work is an integral part of Anna’s teaching in every subject area, not just mathematics. It appeared that other classes at this age-level operate similarly, and this may be a reflection of the ethos of the school which has a general *Value of the Fortnight* programme in operation. The relative time spent in this lesson on co-operation compared to the actual task of measurement reflects the importance placed by Anna upon this particular value.

Nominated Explicitly/ Taught Implicitly

This category pertains to values which were explicitly nominated by a teacher, but which were implicitly taught in class. The following example illustrates this.

Ben has nine years of secondary mathematics teaching experience. He was head of the mathematics department in an independent boys’ secondary college in an affluent inner, south-eastern suburb of Melbourne.

The class observed was a small, Year 11 Further Mathematics class. He had chosen to teach this class of ten ‘under-achieving’ boys

partly to challenge myself to do something with the boys, and partly because I know that I could relate well with them.

A value which Ben explicitly nominated to emphasise with his students was student *self-worth/self-esteem* — one of two main values identified in the school’s philosophy. Especially with this class,

the thing that I will really try to push is to – hopefully – get them to build their self-esteem up. Anybody who gets anything, even if it is not even close, will get a really huge pat at the back. That

will really pump them up because they have had so many years of failure, of not doing well, getting poor results in tests, they really need building up, attended to.

Over the three lessons observed, it became evident that the value of *self-esteem* was often emphasised, although its portrayal was implicit in his behaviour; that is, Ben neither introduced nor discussed the value with the students. As an example, one of the ways in which Ben picked students to answer a particular question in class was to ‘target’ those whom he believed might know the answer, but were too shy to speak out. Giving these students opportunities to demonstrate to themselves (and to the class) that they could ‘do it right’, Ben felt, would be good for these students’ self-esteem.

Another notable illustration took place when the students were having an in-class test. Ben moved amongst the students, commenting to individuals that they were doing particular questions well, and/or that their solutions were looking really good. For him, these personal remarks were good for the students’ self-esteem. In fact, for a few students, he went so far as to tell them that “this is the formula”, so that these students might taste success. However, in relation to the situation being an assessment, Ben confessed that he did not really feel comfortable with such an act (perhaps suggesting an unresolved conflict between competing values).

Ben felt that the value could be successfully portrayed without his stating it explicitly to the students. In fact, to do so might remind students that their self-esteem was low. Ben’s top priority in this regard was to provide as many opportunities as possible for the students to personally taste success. In his assessment, Ben felt that his effort with this class over the last nine months had been rewarded. One particular example was a student named Ron:

Ron in front was fantastic. He worked today. And, he would never, ever, at the start of the year, have said anything that might contradict what I was saying just because he had a different way of doing the same question. He would sit there, with his head down, and never said anything. Now he is confident enough to say this is how he did it, and it is okay, and that is really good for him.

Nominated Explicitly/ Not Observed

In this category, values were nominated but were not observed in the actions of the teacher concerned. An example of such values (non-)portrayal was provided by Colin.

Colin taught Year 7 mathematics in a state secondary college in a large country town 200km north of Melbourne. According to Colin, the large bulk of students in his school came from middle- and upper-class families.

Colin was a chemist in the local dairy centre before entering the teaching profession 14 years ago. Amongst the values he nominated and personally embraced was the value of *creativity* in doing mathematics. In his response to a hypothetical contextualised situation, in which he was asked if he would adhere to curriculum guidelines and thus show linkages amongst different mathematical topics, Colin remarked that the underlying value guiding his actions would be that which reflected creativity:

looking for and at alternative solutions.

However, the promotion of this value was not observed during the researcher’s visits to the class. Moreover, Colin was aware of this. According to him, the reality of the class prevented him from portraying the value of *creativity*: few students normally responded to his invitation. At the same time, Colin had to consider the less able students in the class too so that they would not get confused in the process.

Thus, Colin neither encouraged nor discouraged students to come up with alternative solutions. Colin felt that although he would compliment any student who provided an alternative solution, he was concerned that the weaker students did not get confused and lose interest in the context of a general discussion in class. For him, it was a difficult situation usually: there appeared to be an internal, personal tension between the values of *creativity* and *confidence* and, as far as the three lessons observed were concerned, the latter seemed to have prevailed.

Not Nominated/ Taught Explicitly

The following is an example of where the teacher did not nominate or make explicit that she was going to teach a certain value in the following lesson, but nevertheless did teach that value explicitly in the classroom.

Diane was an experienced primary teacher with a composite Grade 3/4 class in a Catholic school, located in small country town. In the preliminary interview she emphasised and nominated values of: (a) relating the mathematics to real-life, (b) strength of character, and (c) co-operation. During the lesson on making three-dimensional shapes, however, one value that was observed being taught and also frequently explicitly addressed was *individual differences*. Despite not having nominated this value, she was continually celebrating individual differences in the lesson:

... remember the Lego activity? Who did it one way, who did it another? What works for one doesn't work for another ...

In some way this was linked with other implicit ideas she had about mathematical creativity:

I hope I'm not going to get all cubes! ... Well done Mary, no-one's made that shape before!

In discussion after the lesson it was clear that Diane realised that this was explicit values teaching that she was doing. She also agreed that it was an important value for her:

... they all get the same answer but there are different ways ... I need them to know that it doesn't matter which way you do it you come to the same conclusion ... to make them realise that there isn't a set pattern, and maths is the place to do it ... It doesn't matter which way you do it, its correct if it works for you. ... We all see things differently ... but what comes from the parents is the one right answer (meaning also one right way!)

It was unclear why she had not explicitly nominated this value in her pre-lesson interview. One interpretation might be that it is such an integral part of her teaching that she didn't even recognise it as being important.

However, in the subsequent observed lesson, Diane decided to explicitly nominate *individual differences*, and in this case she was looking for students' ways of estimating the results of calculations. As she said in the pre-lesson interview:

What I'm looking for (today) is what sort of strategies they use ... I'll be trying to make them realise that everyone's going to use different types of strategies.... So what sort of strategies they use for estimating.

Again in this lesson phrases such as the following appeared:

Good ... any other way? Each of you might do it differently...Did anyone else get anything different?

Not Nominated/ Taught Implicitly

The following is an example of a teacher failing to nominate particular values in the pre-lesson interview, but nevertheless teaching them, albeit implicitly.

Edward is an experienced teacher, with tertiary mathematics education lecturing experience, teaching in a substantial, private, co-educational secondary school in a regional city. The class observed was a year 8 class, described as a ‘mixed ability’ group, with 11 girls and 7 boys. In the initial interview, Edward made the strong point that the value that he would be emphasising, as he did in all his teaching, was the *development of the individual and valuing the individual*.

The topic to be studied by the observed class was Chance and Data: Comparison of world times in athletics for men and women. In the pre-lesson interview Edward identified the following values that he intended to teach in this lesson: (a) *co-operation* – sharing of ideas for growth, (b) *valuing the individual* by taking “this” approach to teaching, (c) showing *mathematics as a tool* – utilitarian, (d) clear *communication* through (i) effectiveness of graphing, (ii) verbal communication in small groups, and (iii) written summaries by students, and (e) a systematic approach – logic.

There were other values that seem to be taught through the lesson, which were not planned:

- *Clarifying – verbal communication*
- *Encouraging participation*
- *Inclusiveness*
- *Understanding*
- *Managerial control*

The first became evident through Edward’s frequent questioning that focused on the students having to clarify exactly what they were saying to him on a one-to-one basis, or when responding in a whole class situation. This was slightly different and in addition to the notion of communication that Edward had planned to teach. There was a pattern to the questioning and asking students to respond that seemed to the observer to be a valuing of *understanding, encouraging, and including*. Edward agreed with this observation in the post-lesson interview. He explained that he did not attempt to close off the lesson at the point that was planned, but was content to let the students continue on — since they had not been able to progress as fast as was anticipated.

Hence *closure or tying off the loose ends quickly or sticking to time* was subordinated to *understanding*, and so forth. *Managerial control* seemed to reside very much with Edward, although in a non-threatening, benevolent, relaxed manner. To some extent this would be expected in this school, but only recognised by Edward when raised as a possibility by the observer. It is probably the style that Edward has used for so long — as was the case with Diane, above, it is in fact integral to Edward in his role as a teacher.

Discussion

The last section demonstrated that not only are different values being taught in the mathematics classroom, but these values may also be categorised according to the degree of teacher awareness of their own intentions to teach particular values, as well as according to the degree of teacher explicitness in teaching them. Nevertheless, it appears from the examples above that regardless of teacher intention and of the ways in which the values

were implemented, all the teacher participants (except Colin, of course) felt that their respective values identified in the previous section were taught effectively.

None of the teacher participants portrayed their values in any one of the five ways consistently during the lessons observed. Nor were they expected to. It was not clear, however, why some intended values were not nominated explicitly by the teachers concerned. The most likely interpretation is that such values were so much a part of a teacher concerned (such as Anna and Diane) that the teacher had not assumed it necessary to mention them at all. That was why, perhaps, in Diane's case, she nominated the value *individual differences* in the next lesson observed.

The examples in the last section also exemplified some of the factors influencing the implementation (or not) of intended values, and whether the teaching was to be carried out explicitly. There were influences at the institutional macro-level (Anna & Ben), at the institutional micro-level of classroom interactions (Ben & Colin), and even at the individual level of trying to resolve personally-held competing values (Edward, Ben, & Colin). The remaining data in our fieldwork suggests the possible influence of other factors too, such as socio-cultural and systemic.

Of particular interest is the instance where a teacher explicitly nominated an intended value, but did not teach it in class, such as Colin and his valuing of *creativity*. A possible reason for this could be teacher lack of time, a situation which might have its root in any level of context. However, if the reality of the classroom was the determining factor, then there are serious questions indeed regarding teacher satisfaction and sense of fulfillment in these instances.

One may infer from the data in the previous section that female and/or primary school teacher participants portrayed values explicitly, whereas the male and/or secondary school teachers would either portray values implicitly or choose not to teach selected values. This is, however, incidental. After all, the same teachers were all observed to teach values associated with multiple cells in Table 1, and the values listed in Table 1 are not the only values associated with each individual teacher.

Conclusion

As noted in the introduction, values play a major role in establishing a sense of personal and social identity for the student, particularly in the mathematics classroom, crucially influencing the ways students choose to engage (or not) with mathematics. The examples given in this paper highlight the range of factors, often competing and sometimes conflicting, that a teacher must deal with in the moment-by-moment classroom interactions. They must negotiate a satisfactory balance between promoting the perceived values of the discipline of mathematics (as outlined by Bishop, 1988, for example), the values embedded in the principles of mathematics education to which they adhere, carried by their own selection from the available pedagogical repertoire and, finally, the general educational values common to classes at that particular level of education. This issue is further compounded by the extent of teachers' consciousness or otherwise of imposing their own personal values (Pritchard & Buckland, 1986).

Although numeracy is often regarded as a set of skills and knowledges needed for participation in work and life, the teaching of values in mathematics education goes beyond the cognitive domain, to encompass the affective domain, and even the embodied, enactive domain — as in the case of practical activities or the physical formation of students into small groups. The data collected from interviews and classroom observations in this project

highlight some of the many tensions teachers experience in attempting to resolve often-conflicting value-laden situations. (For a discussion of broader issues concerning values in (vocational) mathematics education, see FitzSimons, 1999.)

This paper has focused on an analysis of the relations between intended and implemented values in mathematics classrooms. The next phase of our research will be to ask teachers to nominate values not currently being taught but which they would like to implement. In this way, we will attempt to ascertain even more clearly the extent to which teachers can gain control over their values teaching.

References

- Bishop, A. J. (1988). *Mathematical enculturation: A cultural perspective on mathematics education*. Dordrecht: Kluwer Academic Publishers.
- Clarkson, P. C., Bishop, A. J., FitzSimons, G. E., & Seah, W. T. (2000). Challenges and constraints in researching values. In J. Bana & A. Chapman (Eds.), *Mathematics education beyond 2000. Proceedings of the 23rd Annual Conference of the Mathematics Education Research Group of Australasia* (Vol. I), (pp. 188-195). Perth: Mathematics Education Research Group of Australasia.
- FitzSimons, G. E. (1999). Values, vocational education and mathematics: Linking research with practice. In *Changing practice through research: Changing research through practice. Proceedings of the 7th Annual International Conference on Post-Compulsory Education and Training* (Vol. 3), (pp. 11-21). Brisbane: Centre for Learning and Work Research, Griffith University. [available from the World Wide Web: <http://www.education.monash.edu.au/projects/vamp/>]
- FitzSimons, G. E., Seah, W. T., Bishop, A. J., & Clarkson, P. C. (2000). Conceptions of values and mathematics education held by Australian primary teachers: Preliminary findings from VAMP. In W.-S. Horng & F.-L. Lin (Eds.), *Proceedings of the HPM 2000 conference, History in mathematics education: Challenges for the new millennium* (Vol. II), (pp. 163-171). Taipei: National Taiwan Normal University.
- Le Métails, J. (1997). *Values and aims underlying curriculum and assessment*. (International Review of Curriculum and Assessment Frameworks Paper 1). London: School Curriculum and Assessment Authority.
- Pritchard, A. J., & Buckland, D. J. (1986). *Leisure, values and biology teaching*. (Science and Technology Education, Document Series No. 22) Paris: UNESCO.