Exploring Issues of Control Over

Values Teaching in the Mathematics Classroom

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In our previous AARE paper (Clarkson, Seah, Bishop, & FitzSimons, 2000), we discussed methodological challenges to researching values in the mathematics classroom. We have now collected data in this project from classroom observations. In analysing as case studies the teaching of eight teachers, we were able to categorise whether teachers did, or did not, nominate the values that were subsequently observed (or sometimes not observed). Where teachers were observed to teach the nominated values, a conscious decision by the teacher could have been made to address them explicitly (e.g., "today we are going to focus on co-operation …"), or implicitly (e.g., by rewarding co-operative behaviour without mentioning it explicitly). Of more interest in this paper is the converse: values that were not nominated by teachers but subsequently observed. Transcripts of data reveal that sometimes teachers were aware of the underlying values but, to the extent that they had internalised them, they had not considered them worthy of mention. At other times their responses appeared to indicate a measure of surprise. This paper will elaborate on how the project team approached the issues of control over the teaching of values, focusing especially on those not explicitly nominated.

Values in Mathematics Education

The notion of 'values' is not new in anthropology (e.g., Kluckhohn, 1962), organisational studies (e.g., Hall, 1994; Hofstede, 1997), philosophy (e.g., Rescher, 1969), psychology (e.g., Kohlberg, 1981; Krathwohl, Bloom, & Masia, 1964; Rokeach, 1973), and education (e.g., Halstead, 1996; Nixon, 1995; Raths, Harmin, & Simon, 1987). In the context of mathematics education, 'values' is a relatively new area of research interest. According to Chin, Leu, and Lin (2001), the values portrayed by teachers in mathematics classrooms are linked to their pedagogical identities. Seah and Bishop (2001) describe the values held by teachers as representing their 'cognitisation' of affective variables such as beliefs and attitudes, and the subsequent internalisation of these values into their respective affective-cognitive personal system. In the research study reported in this paper ¾ i.e. the 'Values And Mathematics Project' ¾ we propose values in mathematics education as the deep affective qualities which education aims to foster through the school subject of mathematics , and which are a crucial component of the mathematics classroom affective environment. While accepting that values, beliefs, and attitudes are dialectically related , our concern in this research study has been mainly with the values of mathematics, mathematics education, and education in general, rather than more global values such as social, ecological, moral and so forth ¾ although these are by no means incompatible, and indeed may influence teachers' personal value systems (Pritchard & Buckland, 1986).

Bishop (1996) categorises the values portrayed in the mathematics classroom into mathematical, mathematics educational, and general educational. Mathematical values relate to the epistemology of mathematics as a discipline, and Bishop (1988) proposes three complementary pairs of such values, i.e. rationalism - objectism, control - progress, mystery - openness. Mathematics educational values, on the other hand, are specifically associated with the institutional norms within which school mathematics is taught. Last but not least, general educational values pertain to values which are generally expected to be taught or inculcated in students by their teachers (of mathematics). Table 1 provides a list of examples of each of these three categories of values in mathematics education.

As Bishop, Clarkson, FitzSimons, and Seah (1999) note, there is little knowledge about what values teachers are teaching in mathematics classes, 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. Values are rarely considered in any discussions about mathematics teaching. It is a widespread misunderstanding that mathematics is the most value-free of all school subjects, not just among teachers but also among parents, university mathematicians and employers. Mathematics is just as much human and cultural knowledge as is any other field of knowledge; teachers inevitably teach values, and adults certainly express feelings, beliefs and values about mathematics which clearly relate to the mathematics teaching they experienced at school (FitzSimons, 1994). More fundamentally we believe that the quality of mathematics teaching would be improved if there were more understanding about values and their influences.

Table 1

Values in Mathematics Education

General meanings of 'value'	Mathematical values (Bishop, 1988)	Mathematics educational values
To value: • to command • to praise • to heed	Rationalism Objectivism Control	Accuracy Clarity Conjecturing

• to regard	Progress Mystery Openness	Consistency Creativity Effective organization Efficient working Enjoyment Flexibility Open mindedness Persistence Systematic working
A value is: • a standard • a thing regarded to have worth • a principle by which we live/act • a standard by which we judge what is important • something we aim for • qualities to which we conform		

It has long been recognised that teachers are continually making decisions in the classroom (Bishop, 1976) and that they are often in the position of having to judge between two or more competing values (Bishop, 1972). It is also recognised that there are differences between the values that are officially planned and those espoused by teachers (e.g., Lim & Ernest, 1997), as well as between teachers' espoused beliefs and their actual classroom practices (Lerman, 1998; Sosniak, Ethington, & Varelas, 1991) ¾ due in part to differential positionings as interview subjects and as teachers. In our previous AARE paper (Clarkson, Seah, Bishop, & FitzSimons, 2000) we outlined methodological issues encountered in researching the values in the mathematics classroom. One crucial area to emerge is finding a common language with which meaningful dialogue can occur.

Introduction to Research Study

The 'Values And Mathematics Project' (VAMP) is a three-year (1999-2001) mathematics educational research study supported by a grant from the Australian Research Council. The Project team has been disseminating its experiences and findings on an ongoing basis (e.g., Bishop, Clarkson, FitzSimons, & Seah, 1999; Bishop, FitzSimons, Seah, & Clarkson, 2001; Clarkson, Seah, Bishop, & FitzSimons, 2000). This paper reports on one recent phase of the research, whose emphasis 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. For each teacher participant, classroom observations took place during three mathematics lessons which 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

In analysing the data collected from the case studies of eight teachers, we were able to categorise whether teachers did, or did not, nominate the values that were subsequently observed (or sometimes not observed). Where teachers were observed to teach the nominated values, a conscious decision by the teacher could have been made to address them explicitly (e.g., "today we are going to focus on co-operation …"), or implicitly (e.g., by rewarding co-operative behaviour without mentioning it explicitly).

In Bishop, FitzSimons, Seah, and Clarkson (2001) we identified five classroom episodes to illustrate these categorisations. The first three were Anna, Ben, and Colin. Anna, a primary school teacher, nominated the value of the children *working co-operatively* in small groups, and was observed to implement this value. In fact, she indicated that this was a value that ran across all her teaching of the Grade 1/2 classes in this suburban Catholic school. Ben, a secondary mathematics teacher, nominated explicitly to emphasise the value of student *self-worth/self-esteem.* Over the three lessons observed, it became evident that this value was often emphasised, although its portrayal was implicit in his behaviour; that is, Ben neither introduced nor discussed the value with the students. Rather, he gave his Year 11 male, independent-school, students plentiful opportunities to demonstrate to themselves (and to the class) that they could 'do it right.' Colin, another secondary mathematics teacher from a large country town, nominated and personally embraced the value of *creativity* in doing mathematics. However, the promotion of this value was not observed during the researcher's visits to his Year 7 class. According to Colin, the reality of the class prevented him from portraying the value of *creativity*: few students normally responded to his invitation. 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.

Our major focus in this paper is the converse: values that were not nominated by teachers but subsequently observed. Transcripts of data reveal that sometimes teachers were aware of the underlying values but, to the extent that they had internalised them, they had not considered them worthy of mention. At other times their responses appeared to indicate a measure of surprise. The final two cases discussed in FitzSimons, Seah, Bishop, and Clarkson (in press) were Diane and Edward. Diane was an experienced primary teacher with a composite Grade 3/4 class in a Catholic school, located in a small country town. 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. 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. Finally, Edward an experienced teacher from a private, co-educational secondary school in a regional city, nominated the values of the *development of the individual* and *valuing the individual* in the pre-lesson interview, but failed to nominate the values of c*larifying – verbal communication, encouraging participation, inclusiveness, understanding,* and *managerial control.* Nevertheless, they were observed to be implemented, albeit implicitly. Further episodes drawn from observations made in the classrooms of Colin, Diane, and Edward will be given below, with elaboration on their teaching contexts.

Table 2 provides a framework which illustrates the tensions teachers experience between intended and implemented values when teaching mathematics. The sixth cell is clearly empty, being values which were neither nominated nor observed.

Table 2

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)	-

We now present a further 6 episodes from our case studies of teachers which exemplify the discrepant nominations/observations. The following is an example of a teacher nominating certain values which were observed in her actions, but not necessarily experienced by all members of the class. Rather, it appeared that some other values were over-riding those nominated.

Episode 1: Fay

Fay works in an outer western suburban, working class, primary, government school, composed of about 450 pupils of predominantly diverse ethnic minorities. On one particular day, the topic for this grade 5/6 composite class was fractions: revision of conversion to percentages and illustration of the terminology 'numerator' and 'denominator'. In her pre-lesson interview, Fay indicated that the values intended to be portrayed are ['as always']:

- to *have a go*
- to be *questioning*
- to be *open-ended*
- to be *inquiring*
- to *work things out*.

The subsequent classroom observation revealed that these values were implicitly taught; they were not the subject of discussion per se. There was high student involvement in the first revision segment, where students' ideas were built upon and praised. However, some students appeared not to be actively participating, but remained passive. The whole-class activity to illustrate the terminology ¾ 'numerator' and 'denominator' had the students separating into groups around the divisions of grade levels and of birthday months. Here students moved around the room according to the given rules, and Fay identified the fractional parts, writing them up on the board. Students' suggestions were listened to with respect, but the activity appeared to be substantially teacher-centred in terms of cognitive engagement. The class then resumed in direct instruction mode to practise the rules of the fractions game which was to follow. When the demonstration revealed an improper fraction, the rules were changed by Fay to accommodate the needs of the students for (only) proper fractions at this stage. Fay did not attempt to broaden the focus of the lesson to allow for the possibility of students *working things out* ¾ rather, the task was made more 'manageable'. After the small-group activity the class resumed in whole-group mode to discuss the results. Fay reinforced the point that "*not knowing is OK*." She praised two students' creativity in checking the unusual appearance of quarters by cutting up the shapes and fitting them together to make a whole. She also praised individual students' ways of working, and paid particular attention to 'special needs' students. The class concluded with a final revision, attending to words such as five-sixths, and the unusual shape for 1/4.

In the post-lesson interview the nominated values were discussed. Concerning the value of *having a go*, Fay conceded that, as the teacher, she needs time to consider the students' responses. She collects information on the students and decides what to do next. Today, for example, place-value was unintentionally drawn into the discussion, due to student difficulties over converting fractions to decimals and percentages. One implicit assumption of Fay's position (in common with many other teachers) appears that students need a certain base level of knowledge in order to *have a go*. Thus, Fay decided to scaffold students' responses to her initial question on converting fractions to decimals and percentages.

Concerning the value of *questioning*, Fay conceded that while the teacher is at the board the lesson is more teacher-centred than student-centred. But this second value was more in evidence during the small-group activity ¾ for example, when some students' raised the question of whether the unusual quarter shapes were really equal. Concerning the value of *working things out*, in the small-group activity, the English as a Second Language (ESL) students and struggling students received extra help, but the capable students were left to their own devices.

At first sight, it may be supposed that Fay was only partially successful in her implementation of the nominated values. However, the researcher believes that these nominated values reflect her intentions for the class as a whole. On the other hand, there were different values, not nominated, which over-rode those nominated in the case of individual students or groups of students. Taking account of her personal knowledge of the widely diverse immigrant population in her class, their individual levels of language and numeracy skills, and their personal circumstances (e.g., children who had recently experienced severe traumas in their country of origin), Fay had made these other values a priority. For example, she had decided not to push certain students beyond their cognitive and emotional limits in the quest for achieving her nominated (whole class) value goals. This is a value in itself ¾ *respect* for each learner and their *individual needs* ¾ but one so ingrained that it was not considered worthy of mention.

Episode 2: Diane

Diane is an experienced primary teacher with a composite Grade 3/4 class in a Catholic school, located in a small country town. For her, there is a place for values teaching in mathematics education, which would involve most importantly the promotion of desirable values for student growth and development. 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*.

However in her teaching it was clear that she was emphasising and indeed celebrating other values which related to the more mathematical values of *rationalism* and*openness*. For example, during the probability game with which the lesson began, she emphasised what she later referred to as 'clever guessing': "Keep track of the objects" "Put your thinking caps on." "Try to guess, to predict." She indicated that they would be expected to discuss openly their clever guessing. Again, the later work with house plans generated much explicit discussion about being able to communicate and explain to others: "You'll have to work together (with others) in the real world, to build your own house…"

Another example came from the discussion in preparation for the subsequent lesson. She said: "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 will they use for estimating?" And then "When we come back and discuss (at the end of the lesson) I want them to value everyone's opinion and accept that the way they did it was not wrong compared to the way someone else did it."

Although estimation was the topic, all the time she was emphasising the different strategies the students were using, and encouraging them to articulate those. She encouraged contributions from many children in the class, and supported them all in their attempts to articulate their procedures, strategies and explanations.

These mathematical values of *rationality* and *openness*,
embodying *communication* (explaining, justifying, etc.) and '*having a go*' had not been nominated by Diane. As with Fay, it appears that they were so ingrained in her teaching repertoire that they were not considered worthy of mention.

Episode 3: Colin (1)

Colin is the science coordinator and teaches mathematics and science in a government secondary school in rural Victoria. He had previously worked as a chemist in the local dairy centre before entering teaching fourteen years ago. Most of the 900 students in the school come from middle- and upper-class families. Nearly all students are ethnically Anglo-Saxon.

It is a routine in his Year 7 mathematics class that lessons begin with a short 'mental mathematics' activity. The questions are made up by Colin himself to help students 'stay in touch' with concepts taught previously. Colin has also found the exercise useful in settling the students down for class. It is noticed that 6 of the 9 questions posed during the first visit, all 8 questions in the second, and all 5 questions in the third visit were phrased either in question form (e.g., "what is ….", "how many ….") or in (mathematical) operational form (e.g., "12.5 times 0.5"). Thus, in all but 3 of the 22 questions, no imperative had been used. This is in contrast to the imperatives (e.g., "I want you ….") used whenever Colin issued instructions to students and whenever he sought to establish class discipline/control.

The use of imperatives in mathematics often highlights the nature of *control* through the discipline (see Seah & Bishop, 2000). The development of science through mathematical knowledge and skills has enabled us to predict and explain, and thus to control our environment and even fellow human beings, so much so that "when a natural disaster occurs …. there is a measure of annoyance, regret, and even guilt attached to our inability to control some of the forces of nature [with our mathematical knowledge]" . Imperatives signal the presence of power difference between the speaker and his audience. They serve to separate the haves from the haves-not of knowledge, the mathematician from the laymen, the teacher from his students. By phrasing the 'mental questions' in question form, however, there is almost a sense of Colin seeking advice or asking for assistance. This is not to say that the teacher positioned himself at the same level as his students; the asymmetrical relationship in the classroom still existed, but to a lesser extent compared to the alternative situation of teacher-know-it-all ordering his students to execute computations or solve questions without regard to student feelings. One may even say that Colin was emphasising the democratic nature of (mathematical) knowledge. After all, as noted above, he used imperatives effectively to gain control in the area of classroom management.

However, the de-emphasis on *control* (and the corresponding emphasis on *equality*) has been implicit. Neither did Colin nominate nor was he aware of the emphasis on *equality* of roles in doing/learning mathematics. When prompted during the interviews, Colin expressed his support for pedagogical aims of acting as facilitator of knowledge construction, rather than as gate-keeper to knowledge attainment. However, he did not see this value as being portrayed through his verbal discourse. In fact, he was not aware hitherto of his avoidance of imperatives in phrasing his mathematics questions. As he said in one post-lesson interview, "Well, I guess I haven't thought about that, to be honest!"

Episode 4: Colin (2)

This episode provides an example of Colin's implicit portrayal of mathematics as procedural, algorithmic, to be learned and used by following standard epistemological practice. That is, he appears to hold the value of mathematics as *progress* (see Bishop, 1988), as building on what is already known.

Although there exist many ways of introducing concepts, Colin chose to introduce concepts up front before further student learning activities were structured into his teaching practice. For example, in lesson 3 he wrote the following on the blackboard to introduce the topic of 'Circumference': "The perimeter of a circular object is called its circumference. Sometimes this can be measured, but at other times we need to calculate it." It was only after he had explained this statement to the students that a related investigative activity was introduced.

Indeed, after the 'mental mathematics' routine (see Episode 3 above), Colin usually began a lesson with a definition, proposition or hypothesis. Definitions represent accepted and established mathematical knowledge upon which learning activities designed to promote student knowledge extension or applications to mathematical problems are based. Hypotheses, on the other hand, usually lead on to student investigating/observing, recording, and calculating activities. Perhaps due to his academic and career background in science, such activities in hypothesis testing emphasise one major way through which scientific (and mathematical) knowledge has developed. In fact, the layouts of Colin's activity worksheet in lesson 2, and homework project handout in lesson 3, were very similar to school science laboratory work reports! Thus, new knowledge was portrayed as growing incrementally and cumulatively from previous knowledge, exemplifying the value of *progress*.

In the post-lesson interview, his response to a question on what he considered to be the message carried to this class was as follows:

> Well, I don't know, I didn't even think of that too much. I guess that's probably because of the way I teach science classes. You would start with a definition or a proposition, such as the rate at which a gas expands or the unit of the temperature. In this case, it is the circumference of a circle. You then test it to see what it is. So, I guess it's a way of enabling the kids having in their books some information of some theory, so they are not expected to ask later on in the chapter questions such as: "What is the circumference of the beaker?"

Thus, we have another example here in which a value is so internalised and so much characteristic of a teacher's professional practice that he may not perceive it as significant. Again, the issue which follows is the question of teacher ability to control the nature of portrayal of values, given that the teacher may not be aware of these being emphasised in the first place.

Episode 5: Edward (1)

As noted above, Edward is a very experienced secondary school teacher of mathematics. Part of one post-lesson interview focused on Edward not completing all of the content that he had planned in a particular lesson with a mixed-gender class of year 8 students.

Prior to this lesson Edward did not nominate *individual understanding* as a value to be emphasised. Nor did he actually nominate verbally the notion of *closure* of the lesson: that is, bringing the lesson to a point where students would have a final time for summarising what had taken place during the lesson and what had been learnt. However, in his written planning he had set out such a section in his notes; he had also nominated some time intervals for different sections of the lesson. Rather, it was observed that Edward was not adhering very closely to these suggested time intervals. Towards the end of the lesson Edward was clearly not worried about moving the class to a position where a summary statement could be made. It was this aspect of the lesson which was raised in the post-lesson interview:

> Interviewer: You didn't end up doing the graph and a final statement. ... the timing of the lesson seemed to be of the least importance than the communication, the understanding that was going on. That seemed to be of far more importance to you as the teacher than actually churning through what you had planned to get through.
>
> Edward: Yeah I think that's true. ... There's sort of a counter thing there. I'm not valuing closure which often worries me. I do value it, but I don't value it enough. I let other things take over or interfere so that I don't always achieve closure. ... So there's two values there, one value of tying things off, sort of coming to a conclusion, and the other of you know that valuing, exploring what we're doing.

This episode illustrates that encouraging the students to *understand* was a dominant value for Edward during this lesson, although he had not nominated it. He clearly let sections of the lesson run on so the students could continue to explore ideas. Interestingly, his enacting of this value brought about a conflict for him in relation to another important value of his ¾ that of *closure*. In this instance Edward seems to have decided upon one over the other, although his comments imply he is not always sure of his judgement.

Teachers like Edward may be better able to handle such judgements ¾ when there is a choice of enacting one value rather than another ¾ if they are helped to think more deeply about the process.

Episode 6: Edward (2)

In another post-lesson interview, the topic of homework was raised. The researcher noted that Edward had come back to it in class at least three times. He had emphasised to the students that it was important to do because it was going to be the basis for a classroom discussion ¾ for communication and sharing ideas, and so on. (It should be remembered that *communication* was one of Edward's nominated values.) Agreeing that doing homework was an important issue, Edward commented:

> Yeah, I guess it's the issue of being responsible for their own work out of class. You know, meeting commitments, that discipline, that self-discipline I guess. […] organisation, those sorts of things.

In the observed class Edward had reprimanded a student for failing to complete the homework and asked her to write out three times a reminder to get Mum or Dad to sign it. Edward then commented that this represented a change from his previous practice.

> There was a time I would have said "Do it fifty times", fifty lines […] But I thought about it, actually I’ve just this year started doing that. Last year I [...] got them to write ten lines and then twenty lines if they didn’t do it, and all of a sudden kids were up to a hundred lines and I thought "Oh this is stupid".

Our interpretation of this last quote is that Edward, in reflecting upon the change in his classroom management practice, is in the process of re-cognising a certain value ¾ shifting the *responsibility* (for completing homework in this case) from teacher to student and, in so doing, abrogating the powers of the teacher to demand meaningless busy-work as a form of punishment.

Discussion

The episodes above illustrate some of the variety of situations where the teaching of values in the mathematics classroom may be observed. These include, systemically: primary/secondary, government/independent/Catholic, and co-educational/single-sex school settings. The socio-economic contexts varied from wealthy to working class; suburban to regional to rural. The values observed were either nominated or not, and taught explicitly or implicitly. Teachers’ strategies for their implementation varied in terms of the prior decisions (if any) made at the lesson planning stage, the timing of the discussion (if any) of the value concerned, and the disruption (if any) to the classroom routine established by the teacher.

How should we interpret the failure by teachers to nominate values observed in mathematics classrooms? Are the teachers in control of their values teaching, to the extent that these values are internalised and characterised by the teaching, but taken for granted by the teacher? Or, is this omission an indication of the fact that the teacher concerned had not yet consciously made a commitment to that value, or was even unaware that this value might be classified as such? From our perspective, the self-selected nature of our sample teachers suggests that they are likely to be willing to receive and respond to values not currently considered as part of their teaching repertoire.

Could it be that there was a breakdown in communication between researcher and teacher, due to the lack of a shared discourse for the discussion of values in the mathematics classroom (see Clarkson, Seah, Bishop, & FitzSimons, 2000)? Could it be that the interpretation made by the researcher was actually a *mis*interpretation of the classroom episode? That is, was the issue simply one of lack of shared understandings between teacher and researcher?

Each of the case study teachers was experienced in classroom teaching. As researchers, we wondered whether their failure to nominate particular values may be attributable to their ignorance/lack of awareness of the values observed. In this case it may be considered that the particular values were not under the teacher’s control. On the other hand, it seemed likely that some of these values were so much an integral part of the teacher’s repertoire that they no longer were considered as worthy of mention. Is failure to nominate a value considered not to be affirming? Diane readily affirmed the value of individual differences once this was pointed out to her. Does it mean that the value is under control, or not? In fact, Diane was seen, in a class subsequent to the post-lesson interview, to make explicit the nomination and implementation of the value of individual differences (FitzSimons, Seah, Bishop, & Clarkson, in press).

The cognitive and affective domains of the two related taxonomies of educational objectives constructed by Bloom (Ed.) (1956), and by Krathwohl, Bloom, and Masia (1964), respectively, may contribute to our understanding of this dilemma. As experienced teachers, their cognitive domain skills of knowledge, comprehension, application, analysis and synthesis, and evaluation, would be well-honed ¾ although still subject to reflection and amelioration as new content and pedagogical knowledges become known and incorporated in their teaching. In the affective domain, the parallel and overlapping categories have been identified taxonomically as follows (Krathwohl, Bloom, & Masia, 1964):

1. The affective continuum begins with the individual's merely *Receiving* (1.0) the stimuli which initiate the affective behaviour, passively attending to it. It extends through his/her more actively attending to it, through willingly differentiating it and selectively attending to it.
2. The individual is perceived as *Responding* (2.0) to stimuli on request, willingly, and taking satisfaction in this responding.
3. The individual is described as *Valuing* (3.0) with increasing internalisation and consistency of behaviour; ranging from acceptance of, to preference for, to commitment to a certain value.
4. Successive internalisation of values and the emergence of more than one relevant value necessitates the *Organization* (4.0) of values into a system. This requires the *Conceptualization* (4.1) of each value responded to, and finally organising the value complex into a single whole.
5. Finally, *Characterization* (5.0) represents the point reached where an individual "responds very consistently to value-laden situations with an interrelated set of values, a structure, a view of the world" (p. 35). Ultimately, the characterisation by a value or value complex is reflected in an individual's consistent philosophy of life.

As noted by Raths, Harmin, and Simon (1987), the process of valuing requires choosing, freely, choosing from alternatives, choosing after thoughtful consideration of the consequences of each alternative, cherishing and being happy with the choice, enough to be willing to affirm the choice to others and to act upon the choices, repeatedly, persistently. Similarly at the higher levels of the Krathwohl, Bloom, and Masia (1964) taxonomy, the organisation of a value system, where more than one value is relevant (and may even be in conflict) requires the teacher to internalise the values held and to consciously weigh alternatives.

The episodes above, where observed values were not nominated, may be exemplars of the third level (i.e. valuing) in the affective domain of the taxonomy, where the value is accepted but not yet organised into a coherent system. On the other hand, as in several of the episodes, characterisation of a value or value complex tends to render it ¾ at least some of the time ¾ invisible to the teacher. Through the disruption arising from the interview situation, Edward was moved to reassess his values concerning *responsibility* for the homework set; he re-cognised a teaching strategy previously taken for granted. Similarly, Diane became cognisant of her valuing of*individual differences*. This conceptualisation and subsequent reorganisation of value systems by teachers ¾ by and for themselves ¾ is indeed one intended outcome of this project.

According to McLeod (1992), much of the research work relating to the affective domain has been conducted from a cognitive perspective ¾ that is, on beliefs, rather than attitudes and emotions. It is recognised that many, if not all, teacher education courses tend to focus exclusively on the cognitive domain: when the term 'Bloom's taxonomy' is used, it is taken as referring only to the educational objectives listed in Bloom (Ed.) (1956). In the affective domain, as in the cognitive domain, experienced teachers are likely to have well developed skills but, because they have never been challenged to interrogate these understandings, they have not developed the language to reflect upon them consciously or to discuss them. Thus, they are likely to remain at the subconscious level. One of the aims of the VAMP project is to raise this level of awareness, through the fostering of an appropriate lexicon.

Krathwohl (1994), himself, suggests that a future version of the taxonomy should attempt to overcome the division into cognitive, affective, and psychomotor domains, and to interrelate them ¾ perhaps even describing objectives in a multi-dimensional space. In the field of mathematics education, Hannula (2000) argues for a more comprehensive approach to research, as do adherents of enactivism (e.g., Gunn, in press; Reid, 1996). Following Krathwohl, our assertion is that the development and portrayal of values in the mathematics classroom (as elsewhere) must extend across both cognitive and affective domains, at least, rather than being divided arbitrarily.

Our challenge as researchers is, firstly, to try to locate the observed classroom episodes within this framework. Secondly, we wish to enable teachers to (re)conceptualise the range of values concerning, *inter alia*, the discipline of mathematics (e.g., Bishop, 1988) and the field of mathematics education (e.g., Seah & Bishop, 2000) that they wish to teach explicitly or to portray implicitly ¾ but to do so from a position of maximum understanding within their own particular educational context. That is, to gain control over the particular values that they have decided, consciously, to implement.

Conclusion

One of the ways we have conceptualised our role is as facilitators of professional development. That is, the teachers involved in this project are being made aware of a wider range of values, in both kind and number, in their own practice (current and potential) than they were previously. These include the values associated with the discipline of mathematics and those of mathematics education ¾ whether these values might be planned for explicitly or not, and whether they might be implemented explicitly or not. "I hadn't thought about it until you mentioned it" is a statement commonly heard by the research team. Our discussions are offering teachers a language with which to think about and to discuss values; we are witnessing an unfolding of subconscious thought processes. Professional development extends beyond conversations with researchers, though: through the acquisition of language and their developing conceptualisation of values, teachers are thereby enabled to explore these issues with colleagues.

In our discussion we considered various possible explanations for the failure by teachers to nominate certain values that were interpreted by observers as being portrayed, either explicitly or implicitly. Drawing on work over the last five decades by Benjamin Bloom and David Krathwohl, among others, we argued for the integration of cognitive and affective domains in the consideration of values in mathematics education ¾ from both research and practice perspectives.

Work was undertaken in mid-2001 to ask teachers to identify and to implement certain values (chosen by them) that they are not currently incorporating in their classrooms. This would appear to move them to the third level of the taxonomy of accepting a value, with the possibility of progression to the fourth, organisational level should they so desire. Within this research project, at least, it may be assumed that teachers will be moving through different levels of the cognitive domain as they consider the possibilities beforehand, make decisions *in situ*, and then reflect upon the consequences and/or alternative actions afterwards.

As with all research involving people, we need to consider that our presence alone is bound to have some impact upon the otherwise closed teaching situation ¾teachers are unavoidably aware of being observed by us (and on videotape), making certain assumptions about our intentions and even our judgements ¾ although we have tried to convince the teachers that we are not judging them either personally or professionally. However, our attention is necessarily selective and partial. No matter how unobtrusive, the space we occupy (physically and mentally) cannot be ignored.

One important point, in closing, is that the episodes recounted in this paper do not categorise teachers per se; rather, they are but part of the rich tapestry that comprises teachers' work.

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