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AUTHOR Bishop, Alan; FitzSimons, Gail; Seah, Wee Tiong; Clarkson, Philip

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ABSTRACT

Values in mathematics education are those deep, affective qualities which education aims to foster through the school subject of mathematics and are a crucial component of the classroom affective environment. As a result of demands that students become more economically oriented and globally conscious, mathematics educators are being challenged as to which values should be developed through mathematics education. The concern is that, although values teaching and learning inevitably happen in all mathematics classrooms, they appear to be mostly implicit. Thus, it is likely that teachers have only limited understanding of what values are being taught and encouraged. The new questions asked include: (a) What are teachers' understandings of their own intended and implemented values? (b) To what extent can mathematics teachers gain control over their own values teaching? and (c) Is it possible to increase the possibilities for more effective mathematics teaching through values education of teachers and teachers in training? In order to begin to answer these questions, the authors theorize values teaching in mathematics. In this paper the authors analyze three interrelated sources of values which permeate mathematics classrooms: general educational, mathematical, and specifically mathematics educational. The authors also analyze the various influences on teachers' values with regard to explicit and implicit values teaching through an adaptation of Billett's (1998) framework for the genesis of social knowledge. (Contains 64 references.) (Author/ASK)

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by
Alan Bishop
Gail FitzSimons
Wee Tiong Seah
Philip Clarkson

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Values in Mathematics Education: Making Values Teaching Explicit in the Mathematics Classroom. ®

Alan Bishop, Gail FitzSimons, Wee Tiong Seah, Faculty of Education, Monash University, Melbourne, Australia

Philip Clarkson, Faculty of Education, Australian Catholic University, Melbourne, Australia.

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Abstract

Values in mathematics education are the deep affective qualities which education aims to foster through the school subject of mathematics and are a crucial component of the classroom affective environment. As a result of demands that students become more economically oriented and globally conscious, mathematics educators are being challenged about which values should be developed through mathematics education. Our concern is that, although values teaching and learning inevitably happen in all mathematics classrooms, they appear to be mostly implicit. Thus it is likely that teachers have only limited understanding of what values are being taught and encouraged. The new questions we are asking are: (a) What are teachers' understandings of their own intended and implemented values? (b) To what extent can mathematics teachers gain control over their own values teaching? (c) Is it possible to increase the possibilities for more effective mathematics teaching through values education of teachers, and of teachers in training? In order to begin to answer these questions we need to theorise values teaching in mathematics. In this paper we will analyse three interrelated sources of values which permeate mathematics classrooms: general educational, mathematical, and specifically mathematics educational. We will also analyse the various influences on teachers' values with respect to explicit and implicit values teaching through an adaptation of Billett's (1998) framework for the genesis of social knowledge.

1. Introduction

At present 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, and a casual question to teachers about the values they are teaching in mathematics lessons often produces an answer to the effect that they don't believe they are teaching any values. It is a widespread belief that mathematics is the most value-free of all school subjects, not just among teachers but also among parents, university mathematicians and employers.

However we were and are convinced that values teaching and learning does go on in mathematics classes, as it does in all classrooms. Mathematics is just as much human and cultural knowledge as is any other field of knowledge, and adults certainly express feelings, beliefs and values about mathematics which clearly relate to the mathematics teaching they experienced at school. Furthermore we believe that the quality of mathematics teaching would be improved if we understood more about this phenomenon.

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

1. To investigate and document mathematics teachers' understanding of their own intended and implemented values.

2. To investigate the extent to which mathematics teachers can gain control over their own values teaching.

3.To increase the possibilities for more effective mathematics teaching through values education of teachers, and of teachers in training.

In this paper we will describe the plans for the project, and in particular we shall analyse three interrelated sources of values which permeate mathematics classrooms: general educational, mathematical, and specifically mathematics educational. We will also analyse the various influence on teachers' decision-making with respect to explicit and implicit values teaching from a range of perspectives.

2. Values, and Some Theoretical Perspectives

Culture is "an organised system of values which are transmitted to its members both formally and informally" (**McConatha & Schnell, 1995**, p. 81). It is reasonable, then, to postulate that despite the rather similar, canonical form of school mathematics being taught in different educational systems around the world today, its nature and content in any one culture

actually reflect that particular culture's outlook towards, and interpretation of, life events (Nunes, 1992). In other words, like many other school subjects, school mathematics is value-laden.

There is generally acknowledged to be a close relationship between values and attitudes, reaching back to Rokeach (1973), with values occupying a more central and deeply held position than attitudes, which are often considered to be reflected in our patterns of response to particular situations (Seligman et al., 1996). However, it appears that research efforts in the affective dimension in general, and in values in particular, have been both relatively recent and scarce. This is due in part to rather fuzzy understandings of, agreement with, and distinction among the various affective variables such as attitudes, beliefs and values (McLeod, 1992). To make matters worse, related terminology has also been used interchangeably, as in religious faith/beliefs/values. The word 'value' itself also has several different meanings (see Seah, 1999; **Swadener & Soedjadi, 1988** for example). Another contributing factor is that the reliability of affective studies has generally been questionable in the academic field (**Southwell, 1995**).

Specifically among subjects offered in schools, mathematics has not enjoyed as much academic/research attention in affective issues as some other subjects, such as the languages, literature studies, physical education (eg **Aplin & Saunders, 1996; Lee & Cockman, 1995; Murray, 1977**), and the sciences (eg Allchin, 1999; **Proctor, 1991; Tan, 1997**). It may be that these other subjects deal with aspects of life experiences more directly and more explicitly, so that values can be easily associated and/or discussed within them. Mathematics, on the other hand, often deals with abstract entities and ideas, and with how these are applied to real-life situations (and indeed to many of the other school subjects mentioned above!). Values in mathematics, then, is a relatively more implicit conception.

The affective dimension, however, is but one of the components of educational outcomes, the other components being the cognitive and psychomotor dimensions (**Krathwohl, Bloom & Masia, 1964**). There have been many mathematics educational studies on what Raths, Harmin and Simon call value indicators, such as interests, attitudes and beliefs . However, as **Bishop** notes, a number of such studies have exposed inconsistencies between value indicators and subsequent teacher decisions and actions (see, for example, Sosniak, Ethington, & Varelas, 1991; Thompson, 1992). This then brings into focus a greater need to examine values, which represent a more influential affective force.

In this paper we have attempted to distinguish between values, beliefs and attitudes, but acknowledge that there is a need to avoid polarisations. It is our intention to focus on the first, while accepting that all three constructs are dialectically related. We are primarily concerned with values of mathematics and of mathematics education, rather than those more global such as social, economic, ecological, moral, and so forth - although they are not necessarily discrete.

The affective dimension of the 'Taxonomy of Educational Objectives' views values and value complexes as representing the internalisation of value indicators through the valuing process. Values in mathematics education, then, are the deep affective qualities which education fosters through the school subject of mathematics. They represent an individual's internalisation and 'cognitisation' of affective variables (such as beliefs and attitudes) in the context of the culture of the community in which the individual finds himself/herself. They are inculcated through the nature of mathematics and through the individual's experience in the mathematics classroom. These values equip the individual with cognitive and affective lenses that shape and modify his/her way of perceiving and interpreting the world, and guide his/her choice of course of action. Previous research by Buxton (1981) and Fasheh (1982), indicate this in relation to mathematics teaching practices, while Martin (1988/1997) shows how values can enter into the mathematical modelling process.

The recent developments in culture and mathematics, such as Bishop's (1988) research on enculturation, Harris's (1991) research with Aboriginal students, and Powell and Frankenstein's (1997) overview on ethnomathematics and the politics of mathematical knowledge, have brought the issue of values into greater focus, raising awareness of non-Western mathematical ideas together with non-Western beliefs and values. It seems it is only since the realisation that there exist mathematical ideas other than those in the canonical mathematics curriculum of the West (Howson & Wilson, 1986) that there has been any concern about values teaching in mathematics. Until twenty years ago mathematics was considered a value-free and culture-free subject. That is no longer the case.

However, the realisation that mathematics teaching is as value-laden a school subject as any other has not meant that there are any clear ideas about how such values are taught. In fact we can state categorically that there is no empirical research to date on values teaching in mathematics. McLeod (1992) in one of the most comprehensive reviews of the affective research literature failed to find any research focussed on values. The tone of his discussion however makes it clear that ideas about both beliefs and attitudes towards mathematics do relate to the deeply held values of both teachers and students.

Wilson's (1986) chapter is one of the rare writings about values in mathematics teaching and the book in which it appears contains many useful points. Science educators have been almost as remiss as mathematics educators in their failure to address values, but Poole's (1995) book has made a huge contribution to knowledge. In our own work the enculturation book already noted (Bishop, 1988) has a chapter on the values underlying Western mathematics, and in Bishop (1991) values in the mathematics teaching process are analysed and discussed. Clarkson (1991) discussed issues of values embedded in different cultures and their implications for mathematics learning. This project is a natural development from those analyses, and seeks to begin the difficult process of gaining some empirical basis for claims about values teaching in mathematics classrooms and about how to improve teachers' knowledge in this area.

At present there are three principal literatures which have been used to frame the project, and which in turn will be informed by the project. These are the literatures on the affective domain and values education generally (eg., Raths, Harmin & Simon, 1987;

Tomlinson & Quinton, 1986), on affective aspects of mathematics education (McLeod, 1992; Thompson, 1992; Sosniak et al., 1991), and on social and cultural aspects of mathematics education (Wilson, 1986; Bishop, 1988, 1991).

3. The Research Questions

In this section we shall explore the research questions in more detail, and outline our plans and approaches for researching the questions before reflecting in more depth at some underlying issues.

Initial analyses reveal that there are three kinds of values which teachers intend to teach: the general educational, the mathematical, and the specifically mathematics educational. For example, when a teacher admonishes a child for cheating in an examination, the values of ÔhonestyÕ and Ôgood behaviourÕ derive from the general educational and socialising demands of society. Then when a teacher proposes and discusses a task such as the following: ÒDescribe and compare three different proofs of the Pythagorean theoremÓ the mathematical values of ÔrationalismÕ and ÔopennessÕ are being conveyed (see Bishop, 1988). However there are other values being transmitted which are specifically associated with the norms of the institutions within which mathematics education is formally conducted. For example, the values implied by the following instructions from the teacher: ÒMake sure you show all your working in your answers,Ó ÒDonÕt just rely on your calculator when doing calculations, try estimating, and then checking your answers,Ó are about 'examination-wiseness' and 'efficient mathematical behaviour.'

If these different values are considered important in good practice teaching then improving teachers' knowledge of their values teaching will improve their mathematics teaching. Of particular interest in this project are those values whose sources are either the culture of the mathematics itself, or the norms of the institutions of mathematics education. The general educational values, whose source is society, will not be a separate aspect of focus, but will be viewed within the context of mathematics education where they will be interesting from the international perspective.

As can be seen from the recent Third International Mathematics and Science Study (TIMSS) study (Lokan, Ford, & Greenwood, 1996), Korea was a country which fared very well in all the assessments, and Taiwan has similarly performed well in other cross-cultural studies (see, for example, Stigler & Stevenson, 1991). Following the publication of such findings, there are reasons given concerning the quality of teaching, the quality of the textbooks used, the support given by parents, and so forth. But the explicit transmission of values is rarely discussed. It will therefore be interesting to compare the values being fostered in the classrooms of Taiwan and Korea compared with those in Australian classrooms. An important outcome of the project therefore is the light it could shed on the differing nature of values education in mathematics in the three countries.

We now turn to the first of three questions which are directing this project, and how we intend to investigate them.

3.1 What are teachers' understandings of their own intended and implemented values?

At present there is little knowledge about how aware teachers are of their own value positions, about how these affect their teaching, and about how their teaching thereby develops certain values in their students. Initial teacher education and in-service professional development need this kind of research basis in order to help change the situation.

We believe that the key to making development of values teaching possible is to investigate teachers' understanding of their own values. We intend to study both teachers' intentions, and their actual teaching behaviours (see question 3.2). Values teaching happens both implicitly and explicitly and there is not necessarily a one-to-one correspondence between what is intended and what occurs. There is good evidence that teachers appear not to have consistent sets of attitudes to mathematics teaching events (Sosniak et al., 1991).

To gain some insight into this question, we intend to use two sequenced complementary approaches; a series of case studies followed by a broadly circulated questionnaire. About 40 mathematics teachers in Victoria (and a similar number in Taiwan and Korea) will be interviewed in depth about the values that underlie their teaching of mathematics and the values that they teach, try to teach, would like to teach, and would be unwilling to teach, as they teach mathematics. The purpose of the interviews is to identify and understand the positions taken by these teachers on value issues, and to identify teachers among them who would be willing to participate further in the research.

In this phase, random sampling is inappropriate. Instead the sample will be chosen to include the major categories of school, and teachers who, in age, gender, experience and role within their schools, represent the range of mathematics teachers in their state or country. The sample will be inclusive rather than representative. In the sampling frame we aim to achieve representation from schools from government, Catholic and Independent sectors, rural and urban schools, and schools with and without high numbers of students from non-English Speaking backgrounds. Similarly we will strive to select a sample of teachers that is balanced with respect to gender and experience. In Korea and Taiwan, different frames will be required, and will be developed by consultation between the principal researchers and the collaborating investigators in those countries.

Transcripts of the interviews will be translated and shared across the three countries. During the interviews, teachers will be advised of the subsequent phases of the research, and invited to express their willingness to participate further.

Following the analysis of the interviews, questionnaires will be developed and administered to large and representative samples of mathematics teachers in the three countries. A procedure will be used to provide a representative sample of schools in Australia, and parallel procedures developed in Korea and Taiwan, with the aim of obtaining a representative sample of 500 in each of the three countries. The questionnaires will explore in detail the values held and taught by mathematics teachers, and will

be developed using knowledge gained from the interview phase of the study. One outcome of this phase of the project will be a detailed report that focuses on the common values held and taught, and identifying systematic differences between the three countries.

We move now to the second question for this research project:

3.2 To what extent can mathematics teachers gain control over their own values teaching?

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

Research and development projects suffer from the same lack of knowledge as do teacher education institutions. There are important ideas which have been developed in the last few years which could have widespread benefits for mathematics learners around the world. In the areas of technology (see Noss & Hoyles, 1996), ethnomathematics (see Gerdes, 1995), and critical mathematics education (see Skovsmose, 1994), the role of mathematics teachers in teaching values is being critically examined. But what is of particular interest about these developments, and their proponents, is that they imply a strong concern to change the values which they assume are currently being taught. This ignores the fact that not only do we not know what values are currently being taught, but that we have little idea of how potentially controllable such values teaching is by teachers. Therefore an additional aim for the project concerns whether teachers have, or can gain, control over their values teaching. This would then theoretically enable them to teach other values besides those which they currently teach.

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

A series of critical incidents developed from the earlier case study and survey data will be used as the central focus for the initial semi-structured interviews. At the conclusion of two interviews with each teacher, there will be a documented shared agreement on some of the 'intended values' of each individual.

Concerning the 'implemented values', for each of the teachers, classroom observations will take place over a three-week period during which two mathematics lessons each week will be observed. These lessons will be videotaped with the research assistant involved in the initial interview present recording critical incidents and decision points. Following the observations, an interview will be held with each teacher in which the observer will present a description of the classroom which highlights those perceived values that were being implemented and the behaviours associated with them. The focus of the interview will be on the comparisons between the 'intended values' claimed by the teacher and the 'implemented values' noted by the observer. Each summary will then be passed to the researcher who participated in the pre-observational interview for a final review and comment, presumably leading in some instances to further discussions with the teacher.

It has been emphasised above that beliefs and values are different. In the second intervention approach we will build on the insights so far gained to focus on whether teachers can change a 'held belief' into an 'implemented value' observable in their classroom. This is a crucial phase from a theoretical perspective.

Following a number of group discussions with the 20 teachers, a joint plan will be devised to attempt to implement certain specified values different from those normally emphasised by the teachers. The principle aim of the group discussion sessions is for the teachers to be able to support each other during what could be a challenging experimental period. Use will be made of the group video-analysis method (Ladson-Billings, 1995), and the teachers will be asked to keep journals with weekly entries.

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

Teachers will individually receive documentation of the success of their efforts to bring about change, and our report will focus on the strategies that succeeded and the values teaching that was implemented.

The third research question is:

3.3 Is it possible to increase the possibilities for more effective mathematics teaching through values education of teachers, and of teachers in training?

It is our contention that improving and making values teaching more explicit in mathematics classrooms will make mathematics learning more effective. Hence this third aim.

There is a definite need to develop professional development programs based on the research outcomes of this project. Our review of the literatures, and our broad experience of practices in initial-training and in-service courses in mathematics

education suggest that there is a particular need for activities which focus on the behavioural aspects of values in mathematics education, such as the choosing, the preferring, the consistency of behaviour etc. However another strand of previous research which we will use in this project and will be of considerable help in achieving this important outcome, is that of Ôteacher decision-makingÕ. BishopÕs (1976) original work using critical incidents laid the foundations for research developments which demonstrate that a simple recording of teacher behaviour will not be adequate. One also needs to know why teachers choose to do what they do, what they think they then do, what they appear to do, and what alternatives they can generate. The research in this project will thus give rise to various values-clarification activities of relevance to teacher development at all levels. With these it will be possible to develop some curriculum ideas for use in pre service courses and professional development sessions.

4. Three Kinds of Values to be Investigated

Bishop (1996) has identified three kinds of values to be considered in the mathematics classroom: the general educational, the mathematical, and the specifically mathematics educational. General educational values are qualities which teachers, schools and/or the society/culture aim to inculcate in their pupils, but which are not mathematical in nature. These often have a moral overtone and are essential for the maintenance and enhancement of the social fabric. For example, a general educational value is portrayed when a mathematics teacher makes use of the context of a practice question to discuss issues pertaining to gambling or environmental conservation. Taplin's (1997) discussion of promoting human values through different approaches of teaching mathematics refers to this class of values in particular.

Mathematical values are associated with the nature of mathematical knowledge itself, and are derived from the way mathematicians of different cultures have developed the discipline of mathematics. Based on White's (1959) ideological, sentimental and sociological components of culture, Bishop (1988, chap. 3) classified values of mathematical culture. He identified three corresponding, complementary pairs of mathematical values, namely, rationalism/objectism, control/progress, and openness/mystery.

One important idea regarding these pairs of mathematical values is that of complementarity: neither value in any pair is more significant than the other. But are these pairs portrayed equally in practice? Commonly encountered negative attitudes of pupils towards the subject, which are often carried into adulthood, has led Bishop (1988) to suspect that schools may not have achieved a balanced portrayal and transmission of these complementary pairs of mathematical values. Seah's (1999) preliminary analysis of four secondary mathematics textbook series from Singapore and Victoria, Australia, has also provided evidence to support Bishop's (1988) proposal that there exist in these textbooks a predominant emphasis of the values of:

objectism	over	rationalism
control	over	progress
mystery	over	openness.

The relative emphasis of objectism is characterised by the frequent use of symbols which are treated as objects to be manipulated - often without understanding. So teachers hear pupils complain that a novel concept is "too difficult to understand, sir."

Turning our attention to the third category of values in the mathematics classroom, the norms and practices of doing school mathematics as advocated by mathematics teachers, textbooks and to a lesser degree, perhaps, the school ethos, reflect values which are both mathematical and educational. Examples of such values would include encouraging/expecting pupils to display in detail their problem-solving workings, to double-check answers for accuracy, and to work through mathematics practice questions efficiently.

Of course, these three categories of values in the mathematics classroom do not exist exclusively of one another. Depending on the socio-cultural context of a classroom, the mathematical value of rationalism, for example, can also possibly be portrayed as a general educational value and/or a mathematics educational value.

The interaction between values in the mathematics classroom and institutional, societal values is, we believe, two-way in nature. Using Allchin's (1999) terminology, other values are imported into values in the mathematics classroom just as some of the latter values are exported to the larger context of institution, society or culture. For example, institutional values shape values in the mathematics classroom as much as values in the mathematics classroom influence the development of institutional values.

All these values in the mathematics classroom are amply represented in Victoria's mathematics *Curriculum and Standards Framework* [CSF] (Board of Studies, 1999). For example, the CSF goals that pupils "be aware of the fundamental importance of mathematics to the functioning of society ...[and] .... understand the dynamic role of mathematics in social and technological change" (p. 212) emphasise the need to portray both the values of control and progress.

5. Influences on Teachers' Values

Any classroom interaction is subject to a variety of influences in relation to beliefs and values, emanating from a range of sources. These include: (a) the society within which the educational system is situated, (b) the particular educational institution,

and (c) the teachers and students who act within the community of practice of the classroom. We have adapted Billett's (1998) five-level framework for the genesis of social knowledge to analyse these sources in more detail. The categorisation is made for analytical purposes only, as it is recognised that there are complex dialectical relationships between them. This will be discussed further below.

1. S*ocio-historic knowledge* factors affect the values underpinning decisions made by management and teachers. Billett describes these as a product of the evolving history of the species; guiding concepts and procedures. For example: (a) the historic, ideological purposes of schooling (Apple, 1979; Popkewitz, 1997), particularly as manifested in Australia (e.g., Marginson, 1997; Mayer, 1992; Seddon, 1994); (b) public attitudes towards mathematics and mathematics education (e.g., Cockcroft, 1982; Ernest, 1992; Galbraith & Chant, 1993); and (c) the history of mathematics curriculum frameworks in Australia (e.g., AEC, 1991 ? and in our State, Ministry of Education, Victoria, 1988).
2. *Socio-cultural practice* , is described by Billett as historically derived knowledge transformed by cultural needs; goals, techniques, and norms to guide practice and expectations of transformed socio-historic knowledge. At the institutional level these are influenced by: (a) current school management philosophy with respect to educational and social values (*in loco parentis*); (b) current frameworks such as CSF for mathematics (CSF, 1999) as interpreted by those delegated with responsibility for curriculum within the school; and (c) the ethos of the mathematics faculty or teacher's peer group.
3. *The community of practice in the classroom* is identified by Billett as particular sociocultural practices shaped by a complex of circumstantial social factors (activity systems), and the norms and values which embody them. This community is influenced by: (a) the teachers' goals with respect to and portrayal of mathematical, mathematics educational, and general educational; (b) students' goals and portrayal of learning values (e.g., the didactical contract ? Brousseau, 1997), instrumental values (e.g., mathematics as a positional good ? Marginson, 1997), and personal values (e.g., acquiescence with or disruption of the teacher's and fellow students' intentions).
4. *Microgenetic development* is elaborated by Billett as individuals' (teachers' and students') moment-by-moment construction of socially derived knowledge, derived through routine and non-routine problem solving. The nature of teaching as a profession is reflected in the *relative* autonomy assumed within the walls of the classroom, where teachers' decisions are constantly being made or revised on the basis of a continuous flow of new information. The instantaneous nature of many decisions is likely to be influenced to a greater or lesser extent by the teacher's internalised sets of values.
5. Billett's last category was *ontogenetic development* , in which he included individuals' personal life histories, socially determined, and which furnish the knowledge with which to interpret stimuli; this development includes participation in multiple overlapping communities. The manifestation of values teaching in the mathematics classroom would be likely to be influenced by: (a) the teacher's prior experiences of learning mathematics, researching mathematics education, classroom teaching, and using mathematics in other life/workplace experiences; and (b) the students' prior experiences of using and learning mathematics in formal, informal, and non-formal settings ? and the relationships, if any, made between in-school and out-of-school mathematics.

6. Issues Facing Educational Research

Theoretical issues. As indicated above, the classroom is a complex site of political, historical, social, and cultural influences. The socio-cultural interactions, effected personally or through decree or public opinion outside of the classroom, together with the multiple positionings involving class, gender, ethnicity, teacher-student relations and so on, which arise within the community of practice of the classroom, all combine to influence the moment-by-moment classroom interactions. Influences at each level are imbued with values held by the various stakeholders, often in tension or even contradiction with one another. Although it is frequently assumed ? especially from a positivist standpoint of the unproblematic conception of individualism ? that teachers are in positions of autonomy within the classroom, and able to make rational decisions. Lerman (1999), following the work of Derrida, brings into question the basis of presuppositions concerning autonomy and rationality. The influences acting on the discursive practices in which knowledge and power are situated present a challenge to this research project to isolate particular values from observations of classroom interactions and interview data.

Lerman also highlights the dilemma facing researchers who attempt to examine teachers' beliefs and theories in one context (e.g., the interview situation) about their practices in another (e.g., the classroom). Such activities tend to be "based on a notion that the core of a subject's identity is somehow unified and decontextualised" (p. 113). Evans (in press) has illustrated the fallacy of this approach in a study of the transfer of learning in adults whose responses varied according to the practices called up by the situation(s) in which they perceived themselves.

Our focus is on mathematics teachers and their classroom activities but, as noted above, these are contingent. We need to decide which values are of interest, in the sense of ameliorating mathematics teaching, from the possible range of practices in: (a) the discipline of mathematics, (b) the field of mathematics education, and (c) personal or socially accepted (contextualised, relativistic) values. We need to find some way of learning about which values teachers think they are teaching: some of which are actively pursued, even openly addressed; others of which are covert ? possibly recognised and consciously underplayed or possibly not recognised at all. Whether values are critically evaluated at any of Billet's levels is another question. Interviews may reveal whether reasoned choices have been made or whether decisions have been made unconsciously.

Our task as researchers, then, is to be conscious of the multiple subjectivities of the people we are working with as teachers within institutional settings and as collaborators in this project. We need to bear in mind the real and imagined power differentials implicit in interactions between the academy and practitioners and, in such a sensitive realm, to make the utmost endeavour not to be seen as judgemental or to undermine teacher confidence in any way.

Practice issues. Clearly this is not only a difficult area to research, but it is also a sensitive one. Already a group of collaborating colleagues in Taiwan are meeting the situation of teachers who are reluctant to discuss their values, perhaps feeling it is too sensitive and personal area to be researched and publicised. We too are finding a reluctance by teachers to become involved in the project, perhaps due to this reason, but also due no doubt to other issues of overwork, and so on.

Part of the problem, as we have indicated in various places above, is that at present the values teaching and learning that goes on in mathematics classrooms is done implicitly. One of our challenges in the long term is how to get values related activities, values clarification exercises, *and so forth* , on the formal agenda and in the formal curriculum. It happens in other subjects so why not in mathematics?

For example, it happens in science education where one can consider ideas such as "the social responsibility of scientists" and discuss their roles, the conflicts they need to deal with, the need for personal value judgements *and so forth* . That is all part of a good science education nowadays.

But could it be accepted that one would discuss "the social responsibility of mathematicians"? Why does that seem such a strange idea? After all mathematics permeates all our lives and will increasingly do so. So why should a good, modern, mathematical education not face students and teachers with the moral, ethical, and social issues of applying mathematics everywhere? When one is teaching mathematics to students from an obviously non-Western culture could one not discuss the issues of the imposition of Western cultural values in society? Number theory research underpins all the modern code making and breaking activities of espionage these days. Is that an issue to discuss? Casinos are based on probabilistic theories that the everyday punter knows little of. Should this not be discussed? Mathematical models are the bases of the economic rationalists' bottom-line arguments. Are they not worth debating?

In our view mathematics is too important a subject nowadays **not** to have its values explicitly addressed. Teachers, learners, and everyone who desires an education fitting students for their roles in a more democratic society needs to understand about the role that values play in a mathematical education. We hope that this project will go some way to improve that understanding. We shall be reporting our progress in subsequent conferences.

References

Allchin, D. (1999). Values in science: An educational perspective. *Science and Education, 8* , 1-12.

Aplin, N., & Saunders, J. (1996, 1997, March 14). *Values and value priorities of Singaporean and Australian swimmers.* , [Online]. Australian Association for Research in Education. Available: http://www.swin.edu.au/aare/conf96/APLIN96.422 [1999, May 20].

Apple, M. W. (1979). *Ideology and curriculum* . Oxon: Routledge & Kegan Paul.

Australian Education Council. (1991). *A national statement on mathematics for Australian schools.* Melbourne: Curriculum Corporation.

Billett, S. (1998). Transfer and social practice. *Australian & New Zealand Journal of Vocational Education Research, 6* (1), 1-25.

Bishop, A. J. (1976). Decision-making, the intervening variable. *Educational Studies in Mathematics* , *7* , 41-47.

Bishop, A. J. (1988). *Mathematical enculturation: A cultural perspective on mathematics education.* Dordrecht: Kluwer Academic Publishers.

Bishop, A. J. (1991). Mathematical values in the teaching process. In A. J. Bishop et al.. (eds.) *Mathematical knowledge: Its growth through teaching* (pp. 195-214). Dordrecht: Kluwer Academic Publishers.

Bishop, A. J. (1996). How should mathematics teaching in modern societies relate to cultural values ? Some preliminary questions. In D. T. Nguyen, T. L. Pham, C. Comiti, D. R. Green, E. Southwell, & J. Izard (Eds.), *Proceedings of the seventh South East Asian Conference on Mathematics Education (SEACME 7*), (pp. 19-24). Hanoi: Vietnamese Mathematical Society.

Bishop, A. J. (1999). Mathematics teaching and values education: An intersection in need of research. *Zentralblatt fuer Didaktik der Mathematik, 31* (1), 1-4.

Board of Studies. (1999). *Curriculum & Standards Framework II (Draft for consultation).* Melbourne: Author.

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.

Buxton L. (1981). *Do you panic about maths?* London: Heinemann.

Clarkson, P.C. (1991) *Bilingualism and mathematics learning* . Geelong: Deakin University Press.

Cockcroft, W. H. (Chairman). (1982). *Mathematics counts: Report of the Committee of Inquiry into the Teaching of Mathematics in Schools.* London: Her Majesty's Stationery Office.

Cooney, T. J., Shealy, B. E., & Arvold, B. (1998). Conceptualizing belief structures of preservice secondary mathematics teachers. *Journal of Research in Mathematics Education, 29* (3), 306-333.

Ernest, P. (1992, August). *Images of mathematics: A philosophical perspective.* Paper presented at ICME 7, Working Group 21, The public image of mathematics and mathematicians. Québec, Canada.

Evans, J. (in press). Building bridges: Reflections on the problem of transfer of learning in mathematics. *Educational Studies in Mathematics* .

Fasheh, M. (1982). Mathematics, culture, and authority. *For the Learning of Mathematics, 3* (2), 2-8.

Fisher, D., & Rickards, T. (1998). Associations between teacher-student interpersonal behaviour and student attitude to mathematics. *Mathematics Education Research Journal, 10* (1), 3-15.

Galbraith, P. L., & Chant, D. (1993). The profession, the public, and school mathematics. In B. Atweh, C. Kanes, M. Carss, & G. Booker (Eds.), *Contexts in mathematics education* (pp. 267-273). Brisbane: Mathematics Education Research Group of Australasia.

Gerdes, P. (1995). *Ethnomathematics and education in Africa* . Sweden: Stockholm University.

Harris, P. (1991). *Mathematics in a cultural context* . Geelong: Deakin University Press.

Howson, A. G. & Wilson, B. J. (1986) *School mathematics in the 1990s* . Cambridge: Cambridge University Press.

Krathwohl, D. R., Bloom, B. S., & Masia, B. B. (1964). *Taxonomy of educational objectives: The classification of educational goals (Handbook II: Affective domain)* . New York: David McKay.

Ladson-Billings, G. (1995). Towards a theory of culturally relevant pedagogy. *American Educational Research Journal, 32* (3), 465-491.

Lee, M. J., & Cockman, M. (1995). Values in children's sport: Spontaneously expressed values among young athletes. *International Review for the Sociology of Sport, 30* , 337-349.

Lerman, S. (1999). A review of research perspectives on mathematics teacher education. In F-L Lin (Ed.), *Proceedings of the 1999 International Conferenece on Mathematics Teacher Education* (pp. 110-133). Taipei: National Taiwan Normal University.

Lokan, J., Ford, P., & Greenwood, L. (1996). *Maths and science on the line: Australian junior secondary students' performance in the Third International Mathematics and Science Study* . Melbourne: ACER.

Marginson, S. (1997). *Markets in education* . St Leonards, NSW: Allen & Unwin.

Martin, B. (1988/1997). Mathematics and social interests. In A. B. Powell, & M. Frankenstein (Eds.), *Ethnomathematics: Challenging eurocentrism in mathematics education* (pp. 155-171). Albany, NY: State University of New York. (Reprinted from *Search, 19* (4), 1988, 209-214.)

Mayer, E. (Chair). (1992). *Report of the Committee to advise the Australian Education Council and Ministers of Vocational Education, Employment and Training on employment-related Key Competencies for post-compulsory education and training* . Melbourne: Australian Education Council and Ministers of Vocational Education, Employment and Training.

McConatha, J. T., & Schnell, F. (1995). The confluence of values: Implications for educational research and policy. *Educational Practice and Theory, 17* (2), 79-83.

McLeod, D. B. (1992). Research on affect in mathematics education: A reconceptualization. In D. A. Grouws (Ed.), *Handbook of research on Mathematics teaching and learning* (pp. 575-596). New York: Macmillan.

Ministry of Education, Victoria. (1988). *The mathematics framework P-10* . Melbourne: Ministry of Education (Schools Division), Victoria.

Murray, L. (1977). Value categories for Australian sport. *International Review for Sociology of Sport, 12* (3), 97-105.

National Council of Teachers of Mathematics. (1995). *Assessment standards for school mathematics.* Reston, USA: Author.

Nebres, B. F. (1988) School mathematics in the 1990s: Recent trends and the challenge to developing countries. In A. & K. Hirst (Eds) *Proceedings of the sixth international congress on mathematics education* . Budapest, Hungary: Janos Bolyai Mathematical Society.

Noss, R., & Hoyles, C. (1996). *Windows on mathematical meanings: learning cultures and computers* . Dordrecht: Kluwer Academic Publishers.

Nunes, T. (1992). Ethnomathematics and everyday cognition. In D. A. Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp. 557-574). New York, NY: Macmillan.

Perry, B., Howard, P., & Tracey, D. (1999). Head teachers' beliefs about the learning and teaching of mathematics. *Mathematics Education Research Journal, 11* (1), 39-53.

Pompeu Jr, G. (1992). *Bringing ethnomathematics into the school curriculum: An investigation of teachers' attitudes and pupils' learning* . Unpublished doctoral dissertation, Cambridge University, Cambridge, UK.

Poole, M. (1995) *Beliefs and values in science education* . Buckingham, UK: Open University Press.

Popkewitz, T. S. (1997). The production of reason and power: Curriculum history and intellectual traditions. *Journal of Curriculum Studies, 29* (2), 131-164.

Powell, A. B. and Frankenstein, M. (1997) *Ethnomathematics: Challenging eurocentrism in mathematics education* , New York, NY: State University of New York Press.

Proctor, R. (1991). *Value-free science?: Purity and power in modern knowledge* . Cambridge, MA: Harvard University Press.

Raths, L. E., Harmin, M., & Simon, S. B. (1987). Selections from values and teaching. In P. F. Carbone, (Ed.), *Value theory and education* (pp 198-214). Malabar, USA; Krieger.

Rokeach, M. (1973) *The nature of human values* . New York: Free Press.

Rowley, G. L., Brew, C., & Leder, G. (1997, November). *The impact of self-selection on patterns of gender difference in mathematics achievement* . Paper presented to the Annual Conference of the Australian Association for Research in Education, Brisbane.

Rowley, G. L., Brew, C., & Ryan, J. (1996, April). *Statewide assessment in mathematics: The problems presented by curricular choice* . Paper presented to the Annual Conference of the American Educational Research Association, New York.

Rowley, G. L., Brew, C., Leder, G., Ryan, J., & South, A. (1996, November). *Innovation in senior secondary mathematics curriculum: The voice of the teacher* . Paper presented to the joint Annual Conferences of the Educational Research Association (Singapore) and the Australian Association for Research in Education, Singapore.

Seah, W. T. (1999). *The portrayal and relative emphasis of mathematical and mathematics educational values in Victoria and Singapore lower secondary mathematics textbooks: A preliminary study.* Unpublished Masters of Education project, Monash University, Melbourne.

Seddon, T. (1994). *Context and beyond: Reframing the theory and practice of education* . London: Falmer Press.

Seligman, C., Olson, J. M. & Zanna, M. P. (Eds) (1996). *The psychology of values: The Ontario symposium, Vol 8* , New Jersey: Lawrence Erlbaum Associates.

Skovsmose, O. (1994). *Towards a philosophy of critical Mathematical Education.* 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.

Southwell, B. (1995, July). *Towards a theoretical framework for research in beliefs and values in mathematics education.* Paper presented at the 18th annual conference of the Mathematics Education Research Group of Australasia, MERGA 18, Northern Territory University, Darwin.

Stigler, J. W., & Stevenson, H. W. (1991). How Asian teachers polish each lesson to perfection. *American Educator , 15* (1), 12-47.

Swadener, M., & Soedjadi, R. (1988). Values, mathematics education, and the task of developing pupils' personalities: An Indonesian perspective. In A. J. Bishop (Ed.), *Mathematics education and culture* (pp. 193-208). Dordrecht: Kluwer Academic Publishers.

Taplin, M. (1997). Mathematics and education in human values. In N. Scott & H. Hollingsworth (Eds.), *Mathematics: Creating the future; Proceedings of the 16th Biennial Conference of the Australian Association of Mathematics Teachers* (pp. 289-295). Melbourne: Australian Association of Mathematics Teachers.

Thompson, A. G. (1992). Teachers' beliefs and conceptions: A synthesis of the research. In D.Grouws (Ed.), *Handbook of research on mathematics teaching and learning* (pp.127-146). New York, NY: Macmillan.

Tomlinson, P., & Quinton, M. (Eds.). *Values across the curriculum* . Lewes, UK: The Falmer Press.

White, L. A. (1959). *The evolution of culture.* New York, NY: McGraw-Hill.

Wilson, B. J. (1986). Values in mathematics education. In P. Tomlinson & M. Quinton (Eds.), *Values across the curriculum* (pp 94-108). Lewes, UK: The Falmer Press.

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Organization/Address: FACULTY OF EDUCATION, MONASH UNIVERSITY, 3800, AUSTRALIA

Telephone: 61-3-9905-2772 FAX: 61-3-9905-3668

E-Mail Address:

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