

Values in Mathematics Education: What is Planned and What is Espoused?

LIM Chap Sam and Paul ERNEST
University of Exeter, United Kingdom

This paper seeks to explore values that are explicitly and implicitly documented in the Malaysian school mathematics curriculum and to compare them with mathematics teachers' perceptions of what values are appropriate to be taught through mathematics. The study finds that what is planned only partially matches what is espoused by the teachers in the sample.

A number of authors have remarked on the significance of values in the mathematics curriculum (Bishop 1987, Ernest 1991). Such attention is despite the received view in many western countries that mathematics is neutral and value free, and that mathematics in school should likewise be taught in a value neutral way. This view contrasts with that in a number of non-western countries such as Malaysia in which it is official policy that an overarching set of values is to permeate every subject of the curriculum, including mathematics. This paper explores the values of the Malaysian mathematics curriculum.

Any study of values in the curriculum faces a number of problems. What are values? Where are they located? What methodology should be adopted to uncover (or construct) the values within a specific set of curriculum practices? As suggested by Robitaille and Garden (1989) in the work of the IEA comparative research on mathematics teaching, any research into the curriculum should acknowledge three possible levels of study: the intended (planned), implemented and attained curriculum. Thus, to explore values in mathematics education it is necessary to address these three levels too. In addition, just as it is necessary to distinguish espoused and enacted beliefs of the teacher, because what is said is not always what is done, and *vice versa* (Ernest 1989), so too it is necessary to differentiate between explicit statements or espousals of intended values, on the one hand, and the often unintended but implicit, hidden or enacted values in the curriculum, on the other. The extent to which the planned values are implemented will vary with different teachers and schools. Implemented values are harder to identify or research into but are the most important ones, because these will be most effectively communicated through the process of teaching and learning. Ultimately values matter because they influence one's behaviour (Raths *et al.* 1966).

Overall we distinguish six categories of values in the mathematics curriculum, derived by combining these two dimensions, as illustrated in Table 1. Although it would be valuable to

Table 1: Different categories of values in mathematics education

Curriculum Level	Intended (planned)	Implemented	Attained
Explicit values	Explicitly planned curriculum values	Teacher espoused classroom values	Values stated by learner as acquired
Implicit values	Implicit or hidden values in curriculum	Enacted teacher and classroom values	Values evidenced in learner's behaviour

study the values implemented in the classroom, as well as the values attained by the learner (explicit and implicit), this study is limited to the planned curriculum and to teacher-espoused values. Its aim is to explore the planned values as explicitly and implicitly documented in the Malaysian school mathematics curriculum and to compare them with mathematics teachers' perceptions of what values are appropriate to be taught through mathematics.

DEFINITION OF VALUES AND CATEGORISATION OF VALUES

The problem of values in education is complex, bringing in issues from philosophy, morality, educational evaluation, the nature of school subjects, etc. A review of relevant literature (e. g. Krathwohl *et al.* 1964, Raths *et al.* 1966, Fraenke 1977, Straughan and Wrigley 1980, Bishop 1988, Beck 1990, Halstead 1996) shows that there is little agreement on the definition of the term values as well as on its categorisation.

The approach we adopt here is both pragmatic and inclusive. For inclusiveness, we count all values which are expressed explicitly or developed implicitly during the processes of planning, teaching and learning mathematics. We include the whole range of values which are inherent in the institution of education, the curriculum, school, teachers, students, cultural influences and those from society in the large brought in by teachers and students. Pragmatically, we limit the values studied in this piece of research to the moral values explicitly adopted in the Malaysian curriculum, as well as the values we identify in teacher responses.

Values education is emphasised in the Malaysian curriculum where 'The 16 moral values' are explicitly spelled out in the Moral Education syllabus. These values were identified from the four main religious and ethnic groups of the country - Malay (Islam), Chinese (Buddhism and Taoism), Indian (Hinduism) and Christians. They are known as *Nilai-nilai murni* (the pure, ethical or noble values) and include: *compassion, self-reliance, humility, respect, love, justice, freedom, courage, physical and mental cleanliness, honesty, diligence, co-operation, moderation, gratitude, rationality and public-spiritedness*. The official policy is that these values are to be taught or inculcated indirectly through all school subjects, including mathematics and science.

After consulting the literature (Bishop 1988, Tan 1996) and analysing the data collected we find we can tentatively group the values from these sources into the following three categories:

- (i) Epistemological values - values involved with the acquisition, assessment and characteristics of mathematical knowledge and in epistemological aspects of the processes of teaching and learning mathematics, such as accuracy, systematicity and rationality.
- (ii) Social and cultural values-- values which favour or support the social group or society and which concern the individual's duty to society as related to mathematics education. Examples from this category are co-operation, justice and appreciation of the beauty of mathematics.
- (iii) Personal values - values affecting the individual as a learner and as a person, such as patience, confidence and creativity.

METHODS

This study draws upon two sources: official school curriculum documents and questionnaires completed by teachers. It employs the same method with each, namely text analysis. This is first applied in identifying the explicit and implicit values in the mathematics curriculum, and then to identify the values of mathematics teaching as stated by teachers in their questionnaire responses.

In Malaysia, the Curriculum Development Center develops and publishes two types of curriculum materials for each school subject: the general syllabus and the detailed syllabus. The former describes the overall aims, objectives and content and it is divided into primary and secondary levels. The latter is published for each year level and also contains a list of concepts, skills and suggested teaching methods. Mathematics is compulsory at primary and secondary level, but upper secondary students can choose an optional Additional Mathematics paper with a separate syllabus and demanding content. It is usually taken by students intending to continue their studies in science, engineering and technology.

The first author read through the general and detailed syllabuses and listed all values explicitly stated in the documents as explicit values. Implicit values were also inferred from a reading of the documents. Such a method is to some extent subjective, and risks being culturally biased, since the first author is Malaysian. As a means of triangulation, a colleague from South Africa not involved in the study read through one of the documents in English, and independently listed all occurring values according to his interpretation. Comparing the two lists, it was reassuring to find that they match well, except that the second colleague's list is somewhat shorter.

I. Primary school mathematics:

Mathematics education in primary school aims to build and develop pupils' understanding of number concepts and their basic skills in computation. All these will be used by them in order to solve daily life problems effectively and responsibly. Furthermore, pupils are enabled to appreciate the importance and beauty of mathematics. With mathematics pupils are able to manage their daily lives with discipline in keeping with the needs of building a developed nation and society as well as be able to further their education. [CnC, 1993, p.2]

From the aim of primary school mathematics stated in the syllabus (CnC, 1993, p2), we can deduce that the explicit values emphasised are effectiveness, responsibility, self-discipline, appreciation of the importance and beauty of mathematics. As further stated in the organisation of content, "the aspect of problem-solving has been integrated in each topic wherever possible" (p.3), the implicit values will be systematic and analytic because in order to solve daily life problem effectively, one has to analyse the situation/problems given, to choose and decide which strategies/methods appropriate to use, to apply these methods systematically.

Moreover, as estimation and approximation are considered as contributing to the power of mathematics, they necessarily become part of the objectives of the primary mathematics curriculum. To estimate or to make approximations, one needs to check the reasonableness of results. Thus, the value of reasonableness is implicitly expressed in the objective.

It is also stated in the introduction that "The primary school curriculum has been designed to give every child equal opportunities to acquire knowledge and skills and *to internalise the necessary moral values*." (p.1, emphasis added) Undoubtedly, the emphasis on moral values in Malaysian education has caused the 16 moral values to be integrated in mathematics teaching and learning wherever necessary and appropriate. Overall, the values addressed in the primary school mathematics curriculum are summarised in column 1 of Table 2.

II. Secondary school mathematics

The aim of the secondary mathematics programme is to develop logical, analytical, systematic and critical thinking, the skill of problem solving, and the ability to apply the knowledge of mathematics so that the individual is able to function effectively and responsibly in daily life and in so doing appreciate the beauty and importance of mathematics. [CnC, 1988, p.2]

We observe values such as effectiveness, responsibility and the appreciation of importance and beauty of mathematics being expressed in the aim of secondary school mathematics curriculum. Moreover mathematical values such as logical, analytical, systematic and criticality are being explicitly spelled out too. It is also emphasised in the introduction that the learning of mathematics should be both challenging and enjoyable experience for all students. To be challenging means the problems encountered must be reasonably difficult and thus requiring

efforts from the students in attempting to solve them. This in turn requires persistence and perseverance. Thus, in the process of taking up challenges, it is hoped that students will develop implicit values such as willingness to try, persistence and perseverance.

Likewise, to be an enjoyable experience means that the mathematical problems set must be accessible to the students so that they are able to solve them without too much difficulty and with confidence. They should thus feel self-satisfaction and motivation. Nevertheless, the questions set must not be too easy or they risk becoming boring, and the process of learning could become unenjoyable and meaningless.

In the detailed objectives of the Content Organisation [PAI], values such as problem solving, logicity, analyticity, effectiveness, rationality are further emphasised. In addition, inculcation of the 16 moral values is stressed, as can be seen from the following objective:

- inculcation of values acceptable to the Malaysian society (for example, the importance of making clear and accurate statements, being cautious when following procedures, being diligent, disciplined and not wasteful, exercising moderation and being co-operative) to produce a responsible citizen. [CDC, 1988. p.3]

This illustrates the interpretation carried out to identify values in the curriculum documents.

TEACHER QUESTIONNAIRES

In addition to the curriculum analysis three groups of teachers were given a questionnaire with open-ended questions including: How can learning mathematics help your students? How can learning mathematics help to develop your students' moral behaviours / personality? The three groups were opportunity samples, with teaching experiences ranging from 1 to 20 years. The kindergarten and primary school teachers were given the questionnaires during an in-service course on mathematics; the secondary teachers when the first author visited their schools.

Since the questionnaires are made up of open-ended questions, the data obtained was a free list of sentences or words related to values. The first author categorised them according to her personal interpretation, using as a guide the most commonly accepted meanings of the words given. Since the questionnaires and responses were in Malay it was not easy for another researcher to validate these interpretations. The results are presented in Table 2 below.

One interesting feature of the results concerns the relative weight given to the three categories. The kindergarten teachers stressed the epistemological values most, followed by personal values. The primary mathematics teachers put roughly equal emphasis on the three categories stressing cultural and social values a little more on (especially those of the 16 moral values that fall within this category), followed by personal values. The secondary mathematics teachers most emphasised personal values, followed by epistemological values.

Table 2: Analysis of curriculum values and espoused teachers' values

Epistemological V	Primary m.	Secondary	Additional	Kindergarten	Primary t.	Secondary t.
accuracy		E	E			3
alertness in thought				4		1
analyticality	I	E	E			3
care/cautiousness		E		1	3	3
criticality		E	E			12
decisiveness				2	1	1
discrimination				3	1	3
effectiveness	E	E	E			
efficiency/speed						1
reasonableness	I	I		4		
flexibility		I		1		1
logicality		E	E	3		1
practicality				1		
problem solving	E	E	E	5		2
rationality *		E				1
systematicity	I	E	E	7	3	3
valuing of time	E			4	5	1
Total Epist. values	6 (60%)	10 (50%)	7 (58%)	35 (49%)	13 (30%)	36 (35%)
Cultural/Social Values						
Importance/beauty	E	E	E		1	2
compassion *						2
co-operation *		E		5	2	6
gratitude *						1
honesty *				2	7	4
justice *				4	3	1
moderation *		E				
public-spirited *				1		
trustworthiness					3	3
Total cultural/s v.	1 (10%)	3 (15%)	1 (8%)	12 (17%)	16 (37%)	19 (19%)
Personal Values						
confidence		I	E	2		10
courage *					1	6
creative					1	
curiosity				1		
diligence *		E		1	2	2
self-discipline	E	E		2		10
far-sightedness						1
not easily deceived				2	3	
open-minded				2		
patience			I	4		12
perseverance		I				1
persistence		I		2		1
productivity			E			
punctuality				6	3	1
responsibility	E	E	E			1
self-reliance				2		
thrift	E	E		1	4	2
Total personal v.	3 (30%)	7 (35%)	4 (33%)	25 (35%)	14 (33%)	47 (46%)

Key: E = explicitly mentioned values, I = implicitly occurring values, * = the 16 moral values of Malaysia

The distribution of values in the mathematics syllabus matches best with the secondary teachers. Most of the explicitly stated values are epistemologica~ followed by personal values.

If these teachers espouse the values in mathematics as the syllabus weights them~ does this mean that their classroom practices matches the intended values, or do they endorse what they know they should? We cannot answer this without data on enacted values.

It is interesting to compare the explicit and implicit values of the mathematics curriculum with those espoused by the three groups of school mathematics teachers. Not all intended values are mentioned by the teachers and not all values mentioned by the mathematics teachers are explicitly or implicitly expressed in the curriculum. The value on which most agreement occurs seems to be 'organised and systematic'. It is expressed explicitly and implicitly in the curriculum as well as mentioned by all the three groups. Other values that are agreed upon by all three groups are care:ful/cautious, decisive, discrimination in the epistemological category; co-operation, honesty and justice in the cultural and social category; and diligence, punctuality and thrift in the personal category. Besides this, values such as confidence, criticality, logicity and appreciation of the importance and beauty of mathematics are widely agreed upon too.

More surprisingly, values such as effectiveness, responsibility, accuracy and analyticity which are much emphasised in the curriculum were rarely mentioned by the teachers. However, the teachers tend to express values such as careful, cautious, decisive and differentiate. These are values related directly to mathematics learning. Mathematics teachers will often caution their students to be careful when choosing the right algorithms, reading tables and graphs, etc.

It is noteworthy that all the teachers stress the importance of time and money. They emphasise both the importance of punctuality and the valuing of time as the most important values in mathematics education. Most of them~ especially the primary mathematics teachers, also seem to highlight the value of thrift in mathematics lessons. The only two values explicitly spelled out in the detailed primary mathematics syllabus are thrift and valuing of time. Thus what is included in the planned syllabus is reflected in teachers' espoused values.

Another interesting value in mathematics education selected by most of the teachers is not easily deceived by others. Teachers explained that one will know how to count correctly after learning mathematics, so any discrepancy in one's bill or account will be noticed. This value is especially prominent among the primary and kindergarten teachers.

Another group of values that are inter-related and selected by most samples comprises persistence, patience and discipline. These values are probably selected by mathematics teachers because they are related to the process of mathematical problem solving, as discussed above. Problem solving in mathematics might involve tedious calculation and a lot of thinking. Thus, a mathematics student might need to be very patient, persistent and self-disciplined so as

to succeed in solving a mathematical problem, This is especially so at the higher levels of mathematics learning. These values are expressed either explicitly or implicitly in the curriculum too.

Finally, the last thing to be remarked is that some of the 16 moral values (i.e. freedom, love, respect, humility and physical and mental cleanliness) neither occur explicitly or implicitly in the mathematics curriculum documents, nor were they espoused by any of the mathematics teachers. Officially they are supposed to be inculcated via all subjects including mathematics but apparently they are not. Is it too difficult for these values to be inculcated through mathematics lessons?

In conclusion it is interesting to note that most of the values expressed either explicitly or implicitly in the mathematics curriculum are espoused by the mathematics teachers. However, what is mentioned by the mathematics teachers may not reflect the values reflected and enacted in the mathematical classroom Any undesirable values that might be reflected in the classroom might not be reported in a study such as this. Further study is needed to investigate the extent to which the values mentioned are actually integrated into mathematics teaching as enacted values.

REFERENCES

- Beck, C. (1990) *Better Schools: A Values Perspective*, London: Falmer Press.
- Bishop, A.J. (1988). *Mathematical Enculturation-a cultural perspective on mathematics education*. Netherlands: Kluwer Academic Publisher.
- Curriculum Development Center [CDC] (1988) *Secondary School Integrated Curriculum- Mathematics*, Kuala Lumpur: Ministry of Education.
- Curriculum Development Center [CDC] (1990) *Secondary School Integrated Curriculum- Additional Mathematics*, Kuala Lumpur: Ministry of Education.
- Curriculum Development Center [CDC] (1993) *Primary School Integrated Curriculum- Mathematics*, Kuala Lumpur: Ministry of Education.
- Ernest, P. (1989) 'The Impact of Beliefs on the Teaching of Mathematics', in P. Ernest, Ed. *Mathematics Teaching: The State of the Art*, London: The Falmer Press.
- Ernest, P. (1991) *The Philosophy of Mathematics Education*, London: The Falmer Press.
- Fraenkel, J.R (1977) *How to Teach about Values: An Analytical Approach*, Englewood Cliffs, NJ: PrenticeHall.
- Halstead, J.M. (1996) Values and Values Education in Schools, In Halstead, J.M. & Taylor, M.J. (Eds) *Values in Education and Education in Values*, London: The Falmer Press.
- Krathwohl, D. R, Bloom, B. S. and Masia, B. B. (1964) *Taxonomy of Educational Objectives: The classification of educational goals - Handbook II: Affective domain*, New York: David McKay.
- Raths, L.E., Harmin, M. & Simon, S.B. (1966) *Values and Teaching: Working with Values in the Classroom*, Columbus: Charles E. Merrill Pub. Co.
- Robitaille, D.F. and Garden, RA.(eds.)(1989). *The IEA study of mathematics II: Contexts and outcomes of school mathematics*. Oxford: Pergamon.
- Straughan, R and Wrigley, 1. Eds (1980) *Values and Evaluation in Education*, London: Harper and Row.
- Tan Sok Khim (1996) *Moral values and teaching science: the compassionate scientist- a Malaysian school science curriculum enterprise?* [in press]