Chapter 3-3

CULTURAL DIVERSITY AND THE LEARNER'S PERSPECTIVE: ATTENDING TO VOICE AND CONTEXT

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1. PROBLEMATISING CULTURAL EXPLANATIONS

In the Discussion Paper for this ICMI study, it is stated, "For this study, culture refers essentially to values and beliefs." The ICMI Study is distinguished from other studies "in that it is specifically concerned with comparing practices in different settings and with trying to interpret these different practices in terms of cultural tradition." The Discussion Paper makes it clear that the ICMI study is "limited to only a selection of cultural traditions" and then argues that "Those based in East Asia and the West seem particularly promising for comparison." In invoking a comparison between East-Asian and Western cultural traditions of mathematics education, the ICMI Study does not "merely refer to geographic areas." Instead, a comparison is made between the "Chinese/Confucian tradition on one side, and the Greek/Latin/Christian tradition on the other." By framing the comparison in this way, the ICMI Study is at risk of oversimplifying the situation by appearing to assume that school systems can be aligned with one 'cultural tradition' or the other.

Of the researchers who contributed to this chapter, the school systems of three draw on more than one cultural tradition and an understanding of mathematics classrooms in these school systems is not advanced by the postulated East Asian-Western (or Confucian/Christian) dichotomy. Australia, in particular, is culturally plural. In the south-eastern suburbs of Melbourne, a class of twenty-five children can include over twenty distinct ethnic backgrounds. This raises the question of the interaction between home culture and school system, and suggests that the identification of a nation with a single culture may be appropriate only rarely in a world that is increasingly internationally mobile. This immediately problematises cultural explanations of international differences in student achievement, since such explanations assume that either the school system or the student body (or both) can be identified with a single culture. The challenge for school systems in countries such as Australia or South Africa is to accommodate and cater to a multiplicity of cultural backgrounds. Perhaps culture itself is not the essential characteristic in distinguishing one school system from another, but rather the differences in how school systems (and classroom practices) have developed in response to either homogeneity or heterogeneity of culture. In this chapter, Japan provides an example of a less culturally-diverse setting. The argument begins with the need to explicitly challenge the identification of nation with culture.

In his re-analysis of data from the Second International Mathematics Study (SIMS), Bracey (1997) suggested that the differences in mathematics performance found at an international level were replicated in a partitioning of the U.S. sample along cultural or ethnic lines. As a simple illustration of this point: Asian-American students, participating in a school system that has been substantially maligned in the U.S. popular press, perform at a level comparable with their high-performing counterparts in schools in Asian countries. This single illustration suggests that differences on particular measures of mathematical performance are at least as attributable to the cultural affiliation of the students as to the particular school system attended. The significance of such internal cultural variation is lost in the aggregation of performance data for countries as culturally plural as the USA, Australia, or Canada. Such analyses also have implications for societies with a small number of substantial ethnically-distinct communities, such as Malaysia and South Africa.

Berliner reiterated this point in an article in the Washington Post (Sunday, January 28, 2001, p.B3). That is, rather than serving an agenda of international competitive comparison, the results of international achievement testing can be analysed to identify members of a nation who are less well served by the school system than others.

> Which America are we talking about? . . . Average scores mislead completely in a country as heterogeneous as ours . . . The TIMSS-R tells us just what is happening. In science, for the items common to both the TIMSS and the TIMSS-R, the scores of white students in the United States were exceeded by only three other nations. But black American school children were beaten by every single nation, and Hispanic kids were beaten by all but two nations. A similar pattern was true of mathematics scores . . . The true message of the TIMSS-R and other international assessments is that the United States will not improve in international standings until our terrible inequalities are fixed.
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> (Berliner, 2001, B3).

A corollary to this line of reasoning is voiced by Wang (2001) who, in discussing technical concerns with TIMSS, cites Hu (2000, p. 8) as saying, "This study does not break down Americans by race, if they did, Asian Americans would likely score as high as Asians in their home countries, and Whites would rank near top of the European nations." There are several ways to interpret this observation. Berliner's approach seems the most rational and productive. From several perspectives the comparison of national means of student achievement is problematic. Comparisons between sectors of the community within a given country may be more fruitful, within a given state or school system even more so. Such comparisons may at least highlight community groups who are less equal in the benefits they accrue from a school system intended to benefit all students equally. Educational policy can then be framed to address any inequalities. It should be stressed that it is the capacity of the system to benefit learners that is at issue here, and that different learners will experience the school system differently. Some of these differences will be cultural.

In attempting to tease out the patterns of institutional structure and policy evident in international comparative research (particularly in the work of LeTendre, Baker, Akiba, Goesling, and Wiseman, 2001), Anderson-Levitt (2002) noted the "significant national differences in teacher gender, degree of specialization in math, amount of planning time, and duties outside class" (p.19). But these differences co-exist with similarities in school organization, classroom organization, and curriculum content. Anderson-Levitt (2002, p. 20) juxtaposed the statement by LeTendre et al. that "Japanese, German and U.S. teachers all appear to be working from a very similar 'cultural script'" (2001, p.9) with the conclusions of Stigler and Hiebert (1999) that U.S. and Japanese teachers use different cultural scripts for running lessons. The apparent conflict is usefully (if partially) resolved by noting with Anderson, Ryan and Shapiro (1989) that both U.S. and Japanese teachers draw on the

same small repertoire of "whole-class, lecture-recitation and seatwork lessons conducted by one teacher with a group of children isolated in a classroom" (Anderson-Levitt, 2002, p.21), but they utilise their options within this repertoire differently.

But what are the implications from the perspective of cultural traditions. The analyses summarized above suggest that the cultural affiliation of the learner (whatever their geographical location) is at least as important as the cultural alignment of the school or school system and certainly should not be simplistically identified with nationality.

This is not intended to challenge the premise that school systems enact cultural values. However, it does challenge the simplistic identification of culture with nationality, and it highlights the possible significance of the cultural affiliation of the learner. Once the confusion of nation with culture has been problematised, then the utility of international comparative research can be considered with greater cultural sensitivity. For example, the identify-cation of international differences and similarities in student mathematical performance has limited utility, except as a form of national report card, unless it is accompanied by data that suggest cultural, societal, or instruct-tional differences that might be used to explain such differences and similarities and then to promote improved mathematical learning and associated performance.

Naively, one might argue that if Asian countries are consistently successful on international measures of mathematics performance, then less-successful non-Asian countries would do well to adapt for their use the instructional practices of Asian classrooms. Such a line of reasoning is grounded in four key assumptions: (i) that the term "Asian" identifies a coherent body of practice; (ii) that the performances valued in international tests constitute an adequate model of mathematics, appropriate to the needs of the less-successful country; (iii) that differences in mathematical performance are attributable to differences in instructional practice (and not to other differences in culture, societal affluence or aspiration, or curricu-lum); and (iv) that the distinctive instructional practices of more-successful countries (should these exist) can be meaningfully adapted for use by less-successful countries. All such arguments give inadequate attention to issues of cultural heterogeneity, particularly in relation to differences in the students' experience.

Hess and Azuma (1991) assert that formal schooling confronts students with organisational conditions that "are not conducive to learning." They claim that "Teachers deal with these circumstances by encouraging facilitative dispositions in students or by making learning events more appealing" (Hess & Azuma, 1991, p. 2). Most importantly, Hess and Azuma assert that:

> Cultures differ in the emphasis they place on these two strategies. Japanese tend to stress developing adaptive dispositions; Americans try to make the learning context more attractive. National differences in educational achievement may be more completely understood by analysis of cultural differences in student dispositions. The interaction of student characteristics and teacher strategies creates very different classroom climates in the two countries.
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> (Hess & Azuma, 1991, p. 2).

The curriculum is the embodiment of the aspirations of the school system. It may be that the priority given in many culturally-multiple countries to making the learning context (setting, content, and delivery) more attractive to students is, in fact, the most appropriate curricular response to a student community that does not draw on a single set of values and beliefs for motivation and aspiration. To a significant extent, the teacher is the agent of the system by whose actions the curriculum is put into effect. Teachers, however, interpret the curriculum in idiosyncratic fashion, within the constraints and affordances of both system and culture. Both the curriculum and the teacher have been the focus of recent international comparative study. Among the studies of curriculum and teaching practice, we can lose sight of the student.

> What is absent from nearly all the rhetoric and variables of TIMSS pointing to the future needs of the global economy is indeed this human side: the notion that students themselves are agents. TIMSS makes students from 41 countries into passive objects of 41 bureaucratic gazes, all linked to the seduction of one global economic curriculum.
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> (Thorsten, 2000, p. 71).

As educational research has increasingly drawn our attention to the importance of the social processes whereby competence is constructed and in which competence is constituted (for both teaching and learning). The agency of the student, the nature of learner practice, and the cultural specificity of that agency and that practice must be accommodated within our research designs. The authors of this chapter are collaborators in research into mathematics classrooms in many countries, with particular emphasis being given in the data collection and analysis to the perspective of the learner.

2. THE LEARNER'S PERSPECTIVE STUDY

The particular results from the Learner's Perspective Study reported here are based on analyses of sequences of ten lessons, documented using three video cameras, and supplemented by the reconstructive accounts of classroom participants obtained in post-lesson video-stimulated interviews. These data are further supplemented by copies of student written materials, by student test performance, and by teacher questionnaires. Details of the study design, the participant countries, and other findings not reported here can be found at www.edfac.unimelb.edu.au/DSME/research/lps. Each participating country in the LPS used the same research design to collect videotaped classroom data for ten consecutive lessons and post-lesson video-stimulated interviews with at least twenty students in each of three participating 8th grade classrooms.

This methodological approach offers an informative complement to the survey-style approach of the TIMSS and TIMSS-R video studies. A research design predicated on a nationally representative sampling of individual lessons, as in TIMSS and TIMSS-R, inevitably reports a statistically-based characterization of the representative lesson. A more fine-grained study of sequences of ten lessons, informed by the reconstructive accounts of the participants, has the potential to address:

- Consistency of lesson structure over a ten lesson sequence
- Degree of variation in lesson structure in the practices of competent teachers
- The extent to which any such variation is linked to the location of the lesson in the instructional sequence and to the teacher's instructional intentions
- Student awareness of the structure of the lesson and how this is related to their perception of significant educational moments in the lesson and to their subsequent learning.

Further details of methodology and research setting are provided in each of the following sections.

The remainder of this chapter addresses three issues:

a) The importance and distinctiveness of the learner's perspective;
b) The need to consider available resources in evaluating practice; and,
c) The relationship between curriculum and societal and political contexts, and how these things are perceived by students.

3. CONTRASTING THE COMPLEMENTARY PERSPECTIVES OF TEACHER AND STUDENT (JAPAN)

The video component of the Third International Mathematics and Science Study (TIMSS) was the first attempt ever made to collect and analyze videotapes from the classrooms of national probability samples of teachers at work (Stigler & Hiebert, 1999; Stigler et al., 1999). Focusing on the actions of teachers, it has provided a rich source of information regarding what goes on inside eighth-grade mathematics classes in Germany, Japan and the United States with certain contrasts among the three countries. The findings of the study include aspects of mathematics lessons as identified with a strong resemblance between Germany and the United States but with Japan seemingly unique. One of the sharp differences between the lessons in Japan and those in the other two countries relates to how lessons were structured and delivered by the teacher. The structure of Japanese lessons was characterized as "structured problem solving."

The Learner's Perspective Study (LPS), on the other hand, is a nine-country study of the practices and associated meanings in "well-taught" eighth-grade mathematics classrooms with a focus on learner practice (Clarke, 2001a, 2001b). In part, the study is motivated by the need to research the postulated cultural specificity of teacher practice and by a strongly felt belief that the characterization of the practices of the mathematics classroom must attend to learner practice with at least the same priority as that accorded to teacher practice.

Among the most interesting analyses afforded by the data collected in the LPS are those related to lesson structure. Analyses of LPS classroom data from Germany, Japan, the USA and Australia have been carried out for the purpose of comparison with the national "lesson patterns" reported as a consequence of the first TIMSS video study (Stigler & Hiebert, 1999). These analyses (papers available at www.edfac.unimelb.edu.au/DSME/research/lps) found little evidence of the reported lesson patterns, and alternative bases for the international comparison of classroom practice have been suggested. An important consideration in any analysis of curriculum implementation or, in this case, lesson structure, is how the intended structure is perceived and experienced by the learners it is intended to benefit. For example, while Japanese teachers may devote considerable effort into the planning and structuring of their lessons, these structures may not be perceived by the students. Discrepancies in perceptions of lesson structures between the teacher and the students will be explored through the analysis of post-lesson interviews with both groups.

The LPS data collection in Japan was conducted at the three public junior high schools in Tokyo. The teachers, one female and two males, roughly represented the population balance of mathematics teachers of the school level. The topic taught in each school corresponded to the three different content areas prescribed in the National Curriculum Guidelines. The first school was located in the old downtown Tokyo. The teacher, Ms. K, who has been teaching mathematics for more than twenty-five years, taught the 8th grade class of thirty-two students. The content taught was "linear function". The teacher intended to achieve the goals of the entire unit. Namely, she tried to have the students learn about the relationship between different representational forms: diagram, graph, and formula, and to think about the domain of change, determine an independent variable against a dependent variable, learn the concept of the rate of change, and so on.

3.1 Different perceptions of lesson structure between the teacher and the students

While Japanese teachers may devote considerable effort into the planning and structuring of their lessons around a "yamaba", a climax of lesson, these structures may be perceived differently, or not at all, by the students. The methodology employed in the LPS offered students the opportunity in post-lesson video-stimulated interviews to "parse" the lesson they had just experienced. That is, the teacher and the students interviewed after lessons, were given control of the video replay and asked to identify and comment upon classroom events of personal importance. It is clearly possible that students identify as significant classroom events quite different from those intended by the teachers.

In the post-lesson interview of the lesson J1-5, the teacher identified nine elements in the lesson to be significant, while each of two students interviewed identified eight and seven elements respectively (Table 1). Although the numbers of elements identified as felt to be significant are similar between the teacher and the two students, their places in the entire lesson were different. Only four elements were identical among three of them. As for the lesson J1-7, the teacher identified twelve elements in the lesson to be significant, while one of the two students identified only eight elements and the other student only three.

Table 3-3-1. Elements in the Lessons Felt to Be Significant

Lesson	Teacher	Student 1	Student 2
J1-5	9	8	7
J1-7	12	8	3

When we look into our data more closely, we can see both conformities and discrepancies in perceptions of classroom events of personal importance between the teacher and the students. The following excerpts from lesson J1-5 relate to the elements in the lesson felt be significant to all three of them.

Ms. K (14:00)

K Can I just pause for a moment?

INT Okay. Here. Um, fourteen minutes, the scene of group discussion.

K Well, this class is comparatively quiet, so I haven't let their desk in groups until today. But I thought it might be useful for students to complete the graph along with the discussion. They can help one another by thinking together, and it allows everyone to see other students' work. Maybe some of them can understand where they couldn't do by themselves.

The two students identified the same event as one of personal significance and commented on the event as follows:

Student 1 (NI) (14:25)

NI Here.

INT Here, right. Fourteen minutes twenty-five seconds. Where you started group work. Ok. Why here?

NI Discussing the graph and the chart in groups and finishing it up.

INT This scene, right? Ok, about this scene.

NI Here, I can share what I thought and what others thought, the answers I thought I had made a mistake on, could actually be right, not a mistake, my mistakes could actually be the answer. Huh?

INT What you thought was a mistake, might actually be correct.

NI Right. What I thought couldn't be incorrect, could actually be a mistake. I can compare my answers with other people and talk it over, so it's nice.

Student 2 (TA) (14:22)

TA Here, in groups.

INT Yes, uh, fourteen minutes and twenty-two seconds, the scene where group learning has started. Ok. What did you think here?

.....

INT Where you thought was important.

TA Yes.

INT Important in today's class.

TA In today's class, yes.
INT Um, what were you doing uh, then, together?
TA Oh, together, we first compared the part of the homework I did, and the part my friend did, and we discussed the parts that were different and shouldn't it be this, and such. Then, after that, there was a part we didn't understand and it was the same part, so we were asking each other how we were suppose to solve it, and so we asked the teacher.

Though Student 2 was not so explicit as both the Teacher and Student 1 were in commenting on it, the three of them seemed to share the belief that the learners can help one another by thinking together. The discrepancies in perceptions of classroom events of personal importance between the teacher and the students were most evident in relation to the occasion, later in the lesson, when the teacher did not understand their solution to the problem. The two students, who had worked together in solving the problem, made similar comments as follows.

Student 1 (NI) (37:45)
NI Here, right here.
INT Uh, thirty-seven minutes forty-five seconds. Uh, where she went on to the explanation about the graph, Ni-san, right?
NI The teacher, what the teacher was thinking, and what me and Ta-san were thinking were different, so, we were both trying to explain but the teacher didn't really understand us, and finally, after a while, she understood.
INT The teacher, she wrote down a graph but it was different, right? From what you and Ta-san got, and there was a gap between what you were thinking and what she was thinking, right?

Student 2 (TA) (37:26)
TA Yes.
INT The scene where Ni-san comments on the graph. Thirty-seven minutes twenty-six seconds.
TA Uh, this, the teacher mistook what I said or something and Ni-san pointed out her mistake, but the teacher made mistakes once in a while so it would be nice if someone could say the correct answers in situations like this.
INT Ohh. So, you felt to the teacher, the teacher that your ideas were being interpreted differently, so you were trying somehow to say this to her. Uh, actually she said this for you.
TA Said this for me. Yes.

.....

INT That's important. So, then, Ta-san, anything you felt, or rather, thought?

TA Feel ?

INT If you got across what you wanted to say.

TA Oh, what I wanted to get across? I was explaining but Ms. K misunderstood again so what I wanted to say didn't really get across to her but there's a scene after this where I explain something else again.

INT Yes.

TA And, there, uh, I think Ms. K understood the correct answer.

INT Yes, where you went up to the chalkboard. The scene where you're explaining, the teacher understood you correctly.

TA Yes.

Ms. K did not realized until the final part of the entire lesson that she understood differently the explanation made by two students during teaching at their desk as well as in the whole class discussion. All three of them identified the same element around sixteen to seventeen minutes from the start as significant. At this moment, the teacher intended to assess what these two students were doing and she gave a hint to think about. The students commented in the post-lesson interviews on the importance of the teacher's coming and appreciated the teacher's help.

The excerpts from the interview data suggest that the students perceived lesson structure differently from their teacher. As was mentioned earlier, one of the characteristics of Japanese teachers' planning of lessons is the deliberate structuring of the lesson around a climax within a structure. The students in Japanese classrooms can be unaware of the occurrence of these climactic points or their intended significance. The teacher, in turn, can be unaware of what students think of their importance. Essential to any judgment (or understanding) of the effectiveness of an instructional strategy is the meaning that learners attributed to that strategy or instructional act. International comparative research must attend more closely to students' construals of classroom events.

4. AFFORDANCES AND CONSTRAINTS: LARGE CLASS SIZE AND LIMITED RESOURCES (THE PHILIPPINES)

Large class size and lack of resources interplay with other factors to bear upon students' emergent understanding of mathematics, and, most importantly, upon the student's evolving learning style, and the teacher's teaching style, as well as upon the attitudes, values and beliefs of both. Classes in the Philippines are very large ranging from 40 to even 72 pupils per class (Mariñas, 1999). Both class size and the limited availability of instructional resources place significant constraints on teachers and learners. In characterizing classrooms on a national or cultural basis (for the purpose of comparison), constraints such as class size and instructional resources must be taken into account.

4.1 The classroom

Already teaching for 8 years, the LPS teacher discussed here ranked third among those identified as competent by the mathematics supervisor of the public secondary school system in a city that is a business center in the Greater Manila Area. Belonging to the top five sections based on students' average grade in all subjects, out of 44 sections in the second year, her mathematics class consisted of 57 students with 28 boys and 29 girls coming mostly from the average to low socio-economic status. The class met for 40 minutes from 12:10 to 12:50 P.M. from Monday to Friday in a classroom that is 8m x 6m in floor area. A center aisle divided the room into two sets of chairs with 5 rows per set and 5 chairs per row. All the girls sit together on the right side and the boys on the left side of the room, respectively. Touching the back wall is a row of 10 chairs. Daily for ten days, all except for 3 or 4 chairs were filled with students. The only space for convenient movement is in front where the teacher's table is, along the aisle, and in front of the back row of chairs. Except for the teacher's table and the blackboard, there are no other teaching and learning fixtures found in the room.

4.2 The lessons

The lessons were on Geometry covering the basic concepts (point, line, collinear, plane, coplanar, ray, line segment), coordinate of a point, distance, congruent segments, between-ness, midpoint, angles, kinds of angles, points in the interior or exterior of an angle, measuring angles, congruent angles, and Angle Addition Property. The lessons were mainly in English. By man-

date of the Department of Education, Mathematics is taught in English although the national language is Filipino.

The lessons were primarily from the unified lesson plan based on a common syllabus being implemented for the first time in the school year 2001-2002 for the entire Greater Manila Area. Pairs of teachers prepared daily lesson plans for their assigned chapters for a given year level. Individual teachers modified the plans as they saw fit as evidenced by handwritten texts and pasted cutouts on the teacher's copy of the daily lesson plans. Changes can be made on the practice exercises and quizzes but not on the long tests and periodical tests because these should be uniform for the entire Greater Manila Area.

4.3 Teacher practice

When the teacher entered the room, she would greet the class "Good afternoon" and in response, the class would stand up and in chorus say "Good afternoon, Ms. Santos. Mabuhay!" At the end of the class, she would say "Good bye." And students would stand up and say together "Goodbye Ms.Santos, Mabuhay!" The introductory activity consisted either of discussion of answers to the assignment, a review of the previous lesson through a quiz or GANAS. In GANAS, the teacher would announce the extra points that may be earned and gives 1 or 2 items that she would read. The introductory activities were also in the form of a visualization problem or guessing game that students enjoyed. During the lesson presentation, the teacher asked questions that were mostly short with specific answers such as factual questions and those answerable by yes or no to which students answered individually or in chorus. These questions did not require much thought for an answer such as those on stating definitions (e.g. reflex angle) and postulates (angle addition property). According to Herrington et al. (1997), since factual questions require short responses, then a large number of students may be called and in a subtle way, the teacher can discipline students without disrupting the flow of the lesson. As such, they are helpful in dealing with large classes.

The teacher also typically used a strategy that involved posing a series of incomplete questions whose answers would eventually lead to a complete idea. She claimed that the students tended to guess the answers to her questions and so, in order to gradually lead them to the correct answer she has to pose several incomplete questions.

4:25 Teacher: Okay. So to get the distance, so say for example we have here [draws on the board] X, Y, Z. Okay. To get the distance of XY, that is get the?

4:42	Class:	Absolute value.
5:01	Teacher:	Okay. Absolute value? Negative 3 minus 0?
5:05	Class:	Negative 3.
5:06	Teacher:	Okay, negative 3. Absolute value of negative 3?
5:08	Class:	3.
5:09	Teacher:	That is how you get the distance. What do we mean by between-ness? So when do we say that a point is in between 2 other points? When do we say that a point is in between 2 other points? Michaela.
5:31	Michaela:	Midpoint.
5:32	Teacher:	If the point is?
5:33	Michaela:	The midpoint.

The teacher sometimes referred to the seat plan to call on particular students as in recitation, if the answer is correct, the student earns points. In a large class, a seat plan is a big help for the teacher to ensure that every student gets the chance of reciting.

The teacher also attempted to explain the lesson well. Based on students' facial expressions, reactions or verbal comments, the teacher would slow down the explanation, repeat the explanation or request a student who understands to make the explanation to the class. During the practice where simpler items were given, the teacher moved around and at times attended to those who needed help. The teacher claimed that it was important to move around because she could get the ideas of students while they are discussing and monitor their work so that she could give hints when needed. However, they would stop talking when she got near them.

After the exercises, a GANAS, which is a little more complicated, may follow. A GANAS is a short test that is sometimes given under time limit. The teacher's reason for such texts is to train students to work under pressure. The test items were taken from the teacher's lesson plan or sometimes from the student's workbook and were similar to those in the practice exercises that required computations or short answers. Quizzes were either orally read by the teacher or written on manila paper and posted on the board. She moved around while the students answered and reminded them of the remaining time. When the time was up, she told them to stop writing, exchange papers (which they did with their seatmates), and to write "corrected by" on the paper that they would mark. She then called students to answer the items or at times she would give the answers. Each correct answer usually earned one point. After the papers were marked, she asked them to return them to the owners. She then surveyed how many students got at least 75% correct answers by asking them to raise their hands. This approach was used by the teacher as a way to make decisions as to whether

she should give a remedial lesson or additional seatwork. The teacher collected the papers by having students pass them to the aisle and then forward to the teacher.

This system of checking and collecting the papers from quizzes, assignments and practice exercises may well have been developed specifically for a large class like this. The teacher is handling 7 classes, besides having an advisory class. At an average of 57 students per class, she would have a tremendous number of papers to mark notwithstanding that the long test has 50 items. Thus a system of checking and collecting papers was established. But this system of checking is not without risks. It limits the teacher's knowledge of what her students really do not know or cannot do. And the accuracy of the students' marking can only be assumed. The danger is that it is possible that the student gets the correct answer but the process that he used is wrong. Consider Roger's work. He got only 3 out of 5 points for he did not show his method of solution. If there were fewer pupils, she could have asked Roger about his solution. The problem was "The measures of 3 angles are in the ratio 1:2:3. What is the measure of each angle?" Using the numbers 2 and 3 in the ratio as divisors of 120, Roger got the following: 120/2 = 60 – measure of the 3rd angle, 120/3 = 40 – measure of the 2nd angle, 60 – 40 = 20 – measure of the 1st angle. 20 + 40 + 60 = 120. In a quiz with GANAS, Mary Jane correctly answered "none" to the question "How many lines can pass through 3 non-collinear points?" In interview, it emerged that her answer was prompted by the term "non-collinear." This raises the question as to the form of student understanding likely to develop in such a classroom setting.

On the last day of data collection, students took a long test covering the whole period of documented instruction. The printed test which covered 10-day lessons, had 10 of them multiple choice items, 10 true or false items, 10 completion/naming items, 5 illustration, and 2 word problems with all item types testing only knowledge, comprehension or computation. These are the typical components of such tests. Two days before the test, students had practice exercises and one day before they had graded recitation, both of which were announced. All items in the graded recitation were similar to those given in the long test, except for the changes on the given numbers or labels. Student scores ranged from 9 to 48 with a mean of 26.58 out of a perfect score of 50. Of the 20 students interviewed, 11 got scores above the mean and 1 did not take the test. Surprisingly, of the 19 interviewees who took the test, 17 claimed that they were at least average in mathematics.

Post-lesson interviews provided many examples to show that students' understanding of mathematics was superficial: devoid of visualization and care in considering the given task conditions. The students had their own methods of solving problems and though these might be related to the

teacher's method, the students did not necessarily see the connections, leading to frequent student misunderstandings, which the teacher was unable to monitor, detect or correct.

4.4 Resources available to the learner

Twelve out of 20 students interviewed claimed that the best way to learn mathematics is by listening attentively to the teacher's lesson presentation. Rebeca said:" Because we need to listen to the teacher. We need to because for a child the reason that you come here (school) is to listen to the teachers. In order to understand her lesson especially in mathematics" This is consistent with the finding of Arellano (1997) that 5 out of 6 Filipino students are auditory learners. Thus, the predominant learning style is listening which matches a teaching strategy that is mainly exposition, which does not require much teaching/learning resource, and for which the large class size is not a problem.

There were those who said that besides focusing on what the teacher was saying it is necessary to copy the teacher's solution so that if you could not get it you can study it at home. Nolito said that he copied the notes on the board so that when they have a test he can review and somehow get a high mark in the test. Upon reaching home, he would read his notes, make an example on a paper and solve it. It was observed that students copied notes while listening to the teacher. So that they may have something to fall back on if they needed more time to think and reflect about the lesson and review for the examination. Students such as these are reflective learners (Dunn, Dunn, & Perrin, 1994) and it has been reported 3 out of 4 Filipino students are reflective learners (Arellano, 1997).

Some students also learn from their classmates. Donato took the initiative to teach his seatmate Karlo who did not get the correct answer. But he would also ask Karlo, whom he considers as good in mathematics, to teach him when he could not understand the lesson. Six out of the 20 interviewed students reported that they would ask two or three of their brighter classmates even when they are not their seatmates. When a student is absent from class, he would rely on his classmates to help him understand the lesson that he missed. Due to large class size and small classroom area, the closeness resulted in easier communications and the tendency for students to ask questions of each other and to help each other learn the lessons. The large class size might explain why students tended to ask the more substantive questions or seek the help of the brighter students since this required more time and attention which they could not get from the teacher.

There were 7 out of the 20 interviewed pupils who sought the help of family members such as their parents or older siblings. None of the students pay for tutors since this is probably not economically possible for them.

Another form of constraint arising from a large class size was the inhibition of asking questions because of the embarrassment it might cause if a student gave a wrong answer.

Interviewer:	Suppose you couldn't understand it right away, what do you have in mind?
Laurencio:	I would not tell my teacher about it, I'm embarrassed Interviewer: You're embarrassed to Ms. Santos? Has there ever been an instance when you had asked Ms. Santos questions? None yet? Why are you embarrassed?
Laurencio:	I have many classmates.
Interviewer:	Ahh, because there are many... hasn't there been even just one of your classmates who asked Ms. Santos?
Laurencio:	There is , sometimes. They are also embarrassed.
Interviewer:	Because there are many... so what if there are many students, why? Why is it embarrassing to ask questions?
Laurencio:	Because, Ma'am, if the answer is wrong they might laugh.

Students attach substantial importance to social acceptance. This could be the reason why in class despite getting the same answer which the teacher got by using her own method, Michaela, the most consulted and best student in mathematics, prefers to use the teacher's method in subsequent similar problems because she does not want to be different from what her classmates do.

4.5 Competence under constraint

Large classes and lack of materials have been consistently cited as reasons for teachers' inability to introduce innovative teaching strategies aimed at improving learner outcomes (HS Math Survey, 1995). Given the economic infeasibility of reducing class size and providing more resources in the Philippines, it appears that improvement may not be attainable. To the teacher described here, there seemed to be no alternative but expository teaching to the whole class. The crowded classroom conditions afforded students the opportunity to assist each other, and it appeared that many students made use of this opportunity.

It is possible that the real constraints to competence are not so much the physical or material aspects but the inadequacy of the teacher's repertoire of

alternative teaching skills. However, it is clear that both teachers and students have developed forms of classroom practice as a consequence of the large class size and limited resources. International comparisons of classroom practice need to take such constraints (and affordances) into account.

5. THE LEARNER'S PERSPECTIVE ON CONTEXTUALISED MATHEMATICS (SOUTH AFRICA)

In South Africa, the LPS investigation took place in a context of curriculum fluidity, and offered some opportunity to observe the various ways in which teachers and learners respond to curriculum changes, and to describe the forms and substance of classroom mathematical cultures co-created. One of the three schools in which this investigation took place was Umhlanga High school, in the Kwazulu-Natal Province.

The new political dispensation in South Africa, marked by an election of a new ANC-led government, brought with it an opportunity to introduce a new education system. This system is based on a pedagogy of learner-centredness, integration, issues of relevance, Outcomes-Based Education, equality, equity and human rights. It is thus considered to be in contrast with the old apartheid education system which promoted separateness (DoE, 1997). Such attempts to reconstruct curricula to meet ideals of equity, and the consequent curricular fluidity, should be acknowledged in international research comparisons and not concealed in comparisons of national means or characterizations of typical practice.

During the LPS data collection period at Umhlanga High school (October 2001), the government-appointed Curriculum Review Committee had already released a Revised National Curriculum Statement for public comments. What still remains one of the common threads, though, between the initial National Curriculum for the new education system and the Revised National Curriculum is a commitment to an education system which is relevant to the lives of the learners (DoE, 1997:01 &. DoE, 2001:12). It is for this reason that this new curriculum, Curriculum 2005 (C2005), is termed by some as a 'boundary-bashing' curriculum (Muller and Taylor, 1995). In other words, it is seen as a curriculum that encourages the collapse of boundaries between different disciplines.

This discussion focuses on one teacher, Bulelwa, who used AIDS as a context for teaching number patterns. For C2005 Mathematics, an awareness of number patterns is considered one of the most important learning outcomes because the learners at this level are expected to be able to identify

and analyse regularities in a given pattern (DoE, 2001:88). The relevance of a context such as AIDS can be argued for, both at provincial and national level. At a provincial level, Kwazulu-Natal, the province in which Bulelwa's school is located, is reported to have the highest infection rate in South Africa. In addition, a woman, Gugu Dlamini, was stoned to death following her public declaration that she was HIV-positive. This incident took place in a township that is situated about 60km from Bulelwa's school.

At a national level, the year 2001 saw a legal battle between the Government and the AIDS activists over the provision of a drug (Nevarapine) which, it is argued, reduces the mother-to-child transmission. Opposition parties (like the Democratic Alliance) have also voiced their disapproval of President Mbeki's stance on AIDS. The details and debates pertaining to this 'battle' are well beyond the scope of this paper. The point, though, is that AIDS, even as a context to advance mathematics, is not a play-reality or a 'benign' context. It is a sensitive and a realistic social concern, and one chosen because of its relevance to the particular community in which Bulelwa's mathematics class was situated.

Umhlanga High school is situated in one of the (apartheid-created African) townships in the Kwazulu Natal province. Its students are mainly Zulu-speaking Africans. The school is situated about 7 kilometres West of the main airport in the province, and 20 kilometres North East of the city centre (Durban). The school is a modern, double storey building with a total of about a thousand learners ranging from grade 8 to grade 12. For a township school, Umhlanga High school is relatively better resourced: there is an administration 'block' with a receptionist who 'mans' it. The school is electrified and there are computers and photocopiers in the administration section.

Bulelwa, a grade 8 mathematics teacher, is also the head of the school's Mathematics department. She is very positive about Curriculum 2005 (C2005) and what it means for mathematics. She has a Bachelor of Science degree with Mathematics and Statistics majors. The learners in Bulelwa's class are seated in groups of not more than six. She encourages the learners in her class to interact and discuss ideas. There is a chalkboard, which Bulelwa did not use extensively, at least during our data collection period, because she prepared worksheets for the learners.

The section that she was teaching, during our data collection period, was number patterns. Broadly speaking, this section entails an investigation of numeric patterns. The learners are expected to identify and analyse regularities and changes in these patterns in order to complete the patterns (as reflected in the table) as well as make predictions (i.e. form generalisations) about other numbers in the pattern. All the patterns we saw were presented in a table format. These tables were context-free, for example

Input	1	2	3	4	5
Output	3	5	8		

The current lesson was also based on number patterns. However, as previously hinted, the table that the teacher used for the worksheet was based on the context of AIDS sufferers and the world population. It took place during the second week of our visit and thus the learners were already familiar with the presence of 'strangers' in the classroom

ACTIVITY 7 (NUMBER PATTERNS IN NATURE)

Mathematicians have studied number patterns for many years. It was discovered that there are links between mathematics and our natural environment and sometimes events occurring in our societies. For this reason an understanding of algebra is central to using mathematics is setting up models of real life situations.

Study the tables given and answer the questions that follow.

Year	1960	2000	2040	2080	2120
World population growth	3 000 million	6 000 million	12 000 million		

Year	1997	1998	1999	2000	2001
World increase in the number of AIDS sufferers	16, 7 million	33,4 million	66,8 million		

From the tables, you can see that the AIDS and population figures follow trends, which can be seen, from the number patterns. These patterns allow researchers to predict what these figures will be for the future.

(a) Describe the pattern of population increase every 40 years as shown in the first table.
(b) Describe the pattern of the increasing number of AIDS sufferers as shown in the second table
(c) Fill in the missing numbers in each table
(d) Researchers believe the earth cannot support a population approaching 192,000 million people. If the population continues to double every 40 years, then in which year will it be 192,000 million? Explain how you worked out your answer.
(e) The world population in the year 2000 is said to be 6000 million . In which year will the number of AIDS sufferers be greater than 6000

million if the trend in the second table continues? Discuss what this means.

(f) How is HIV virus/AIDs transmitted?

(g) What can we do as a society to break the pattern of the increasing number of AIDS sufferers? (i.e. decrease the number of AIDS sufferers)

The introductory statement makes it explicit that the mathematical purpose of the task is to observe the number patterns in the two tables and describe what these would imply for real life settings. All the items, except for (f) and (g), are obtained from an OBE mathematics workbook i.e. text materials Bulelwa has as resource for planning her teaching for the new curriculum. Items (f) and (g) were added on by the teacher, and her intentions in this are discussed below.

At face value, the absence of letter symbols, the usage of the familiar context and the mode of expression in this worksheet first blur and then collapse the boundary between mathematics and the real world, familiar knowledge. More specifically, close examination of each of the question items reveals that mathematical demands (and this is Grade 8) do not extend beyond recognising and extending numerical patterns, doing the straightforward doubling and addition calculations required, and describing these mathematical actions in words. How this situation might be further mathematised is not part of this lesson (for example, worked on to produce mathematical models, be they equations or simple graphs, that are then used to manipulate possible scenarios and projections and in turn reflect these back on the real world).

In Bernstein's terms the worksheet has an element of a weakly classified text (Bernstein, 1996: 20), and in Skovsmose's terms (Skovsmose, 1994), we can see how the teacher draws in learners' backgrounds and foregrounds (for AIDS impacts significantly on their lived realities).

5.1 Contrasting perceptions of the lesson: the teacher

In this section, we focus briefly on the lesson and the teacher's reflection on this lesson on the basis of the interview conducted at the end of the data collection period.

The Lesson: The teacher started off by linking the current lesson with the previous ones on number patterns. She indicated that unlike the previous ones, the current lesson draws on the HIV-AIDS context. She then pointed out that the lesson will highlight the applicability of mathematics in addressing the escalation of HIV-AIDS.

Having set the scene for the lesson, the teacher goes through the items (a to g) in the worksheet to clarify briefly and broadly, what each item requires of the learners. She then follows this with a general discussion on AIDS. This discussion is opened up by a question to the learners: "When did you first hear about AIDS?" As some of the learners reflect and murmur the answer amongst themselves, she relates how she came to know about AIDS as a university student and how she and her friends used to corrupt the acronym AIDS as American Ideas for Discouraging Sex. She concludes this introductory part of the lesson by advising the learners on how careful they should be because AIDS is real.

After these introductory remarks, the teacher advises the learners to engage the worksheet. She, in the meantime, walks around from one group to another; monitoring progress and offering tips. Having made some observations from a few groups, the teacher advises the learners to inform their discussions on the basis of the number patterns. She expresses her concern that the learners seem to avoid items d and e in the worksheet, which require them to carry out calculations and reason about the basis of these calculations.

Reflections: There are two ways in which the role of AIDS is presented in this classroom. Firstly, as an epidemic that the learners should be careful of, secondly, as a context to study mathematics. In presenting AIDS as a real context, Bulelwa assumes the role of a concerned citizen whose responsibility it is to advise the learners about AIDS. She is all too aware that AIDS is not a benign but sensitive issue. Thus her classroom becomes some form of platform for the learners to reflect on and talk about AIDS, a point she articulates during the interview.

> I was concerned (with regard to the stigma that AIDS has) but the subject itself is a concern for debate. So even if there is somebody who has AIDS, I felt it would enlighten them more, it would make them feel that you don't have to ....it's a subject that we need to open up for debate. We need to discuss how it gets transmitted, for those who don't know about it yet. Because...In our community we still find people who are illiterate. Who feel there is no AIDS.

The second role that 'AIDS' played was that of a context to study mathematics. In this instance, we note another identity, that of Bulelwa as a mathematics teacher. In this respect, Bulelwa felt that the lesson was about mathematics (number patterns) and that mathematics was prioritised during the lesson. This is implicit in her utterances during the interview with Renuka (R). Below, a snapshot of that interview is provided.

R: What made you choose HIV-AIDS for your teaching?

B: Well, actually it was still number patterns. I wanted to choose something connected to real life. It's not that we learn mathematics in isolation. Just like when we started, we had an outbreak of cholera. I brought some statistics from the department; you know...the actual statistics from the department. So I taught them at the time how to get a table, a statistical table and analyse information. So it was learning mathematics, but with something that was happening at the time.

R: How did you feel about the whole issue of mathematics and context? Did you feel that there was one which you were prioritising?

B: I felt I was prioritising mathematics because most of the questions I asked were of a mathematics nature except the last two questions... "How it was transmitted" and "What can we do?" Because obviously if doing a lesson in class and the OBE context it need not just end up in a classroom situation. If you are dealing with the situation like this you need also to go out into the communities. So what I found out is that they (the learners) had more knowledge on AIDS...that they could handle most of the questions. That's why it was difficult for them to handle a question that was long.

Bulelwa is clearly conscious of the mathematical purpose of the lesson. In fact, she feels that she was prioritising the mathematics over the AIDS context since most of the questions in the worksheet were 'mathematical'. In this instance, Bulelwa presents herself more as a mathematics teacher advancing the mathematical purposes of the lesson.

In managing the blurring of the boundary between mathematics and real life knowledge (or in bringing in learners' backgrounds and foregrounds), we see Bulelwa enacting two different, perhaps competing identities (Setati, 2002) as a mathematics teacher of the new curriculum in South Africa. On the one hand, she is a mathematics teacher and is aware of her responsibilities in this regard. On the other hand, she is a responsible citizen who wishes to alert the learners to AIDS and its effects. Thus, at different stages, within the same lesson, the one role becomes foregrounded and the other backgrounded. In this way, she breaks or weakens the insulation between the mathematics and the everyday.

The question to ask and to be addressed in the next section is: How do learners respond to and experience this lesson? It is in this regard that the next section becomes relevant: The learners' experiences of the lesson.

5.2 Contrasting perceptions of the lesson: the student

We address the learners' experiences and response to the lesson by focusing on one group of learners. We are aware that a focus on one group is not a fair reflection of the classroom events as experienced by other learners in the classroom. However, from focusing on one group, we hope to be able to tease out that which may be masked as a result of a whole class observation. First, we give a brief discussion of the way in which a group of learners respond to this lesson and then their reflections of this lesson as espoused in their post-lesson interview.

The learners' response to the lesson: After Bulelwa had set the scene and discussed the worksheet with the learners, a six-member group, all of them boys, spent a considerable amount of time on items (f) and (g) in the worksheet. Their discussion on the transmission of HIV-virus in response to item (f) is mainly confined to sexual transmission. Afterwards they discuss some practical suggestions on how they can raise their communities' awareness of AIDS, this in response to item (g). There does not seem to be any intention from the learners to go through all the items in the worksheet. In particular, at no stage during the lesson, did we observe the learners carrying out the calculations, as would be expected, particularly with respect to items (a) to (e).

Towards the end of the lesson she highlights her awareness that most learners are trying to avoid item (e) and reminds them of the importance of completing the table. The focus group had not attended to item (e) of the worksheet as well. For example, when the answer 2040 was offered in response to item (e) by another group, they (the focus group) could not decide whether the answer was correct or not. Only one member of the group disputed this answer on the basis that 'it was a guess'. In sum, it is fair to suggest that a considerable amount of time was spent on items (f) and (g) and other 'off-the-worksheet' discussions.

The reflections: The discussion here is based on the interview by Godfrey (G) with three learners: Mandla (M), Nxunu (N) and Sthembiso (S). These learners were interviewed in a mixture of isiZulu (the learners' first language but the researcher's fourth language) and English (a second language to both the learners and the researcher). The first question required the learners' opinion on what they thought the lesson was about. Mandla was the first one to provide the answer.

M: (Softly) HIV…
G: Come again…?

M: HIV...the way one can contact it...
N: (takes over impulsively) Yes...the way people can get AIDS.

For these learners, what was visible in this mathematics lesson was the context – AIDS. Even though the teacher thought her lesson prioritised the mathematics, the learners' responses suggest it is the AIDS that was visible. The learners' did see the mathematics though, but they saw the mathematics as being supportive of the AIDS context. This is notable in the following part of the interview.

G: Now tell me, did you learn any mathematics today?
[S consults with M and N before responding]
S: Yes...we learnt about the year in which the AIDS became known.
M: (takes over). Yes, as well as how many people had it during particular years and how the numbers increased from year to year as well as the number of people who died.

Asked whether they saw any relationship between mathematics and AIDS, the Mandla and Nxunu suggested they did, and the interview continued.

G: Is it?
S: Because you have numbers which show how many people died of AIDS and how many are still alive as well as the percentages...So which means you needed to divide in order to get the percentages.
G: (looking at M)
M: Yes...I agree that Maths relates to AIDS because ...everyday people die of AIDS and ...
N: (takes over) We need a count of how many people die of Aids everyday.

The learners' comments on what the lesson was about and the relationship between mathematics and the context are centred around the context of AIDS. No reference, in the entire interview, was made in relation to the first table (which showed the world population growth).

Bernstein uses the term recognition rules to describe the students' orientation or awareness of the speciality of the context. The learners' failure to prioritize the mathematical intentions of the lesson may be regarded as a lack of recognition rules. In this respect, the way the learners engaged the worksheet, by attending to items (e) and (f), and not to other items, which demand them to calculate, may be seen as inappropriate for a mathematics classroom.

On the other hand, Skovsmose uses a different gaze to explain the learners' actions in class. He identifies two aspects that can support students'

mathematical learning and interest, these are the students' foreground and background. Background refers to meanings that belong to the history of the person whilst the foreground refers to the learners' interpretation of his/her future (Skovsmose, 1994: 177; Skovsmose and Nielsen, 1996:1269). Given the cultural practice alluded to by the teacher, given the sensitivity and prevalence of AIDS in the province where the school is located; the context of AIDS may be regarded as being within the learners' social reality. For them, it may be argued, AIDS is not just a context to advance some mathematical intentions, it is an epidemic which they must be cautious of, and advise other members of the community of its dangers as well. If, however, such an instructional approach is to be evaluated on the basis solely of the mathematical understandings that students develop, then the aspirations of the curriculum are misrepresented. Further, if explanations of practice and effectiveness are sought on cultural grounds alone, the realities of politics, societal need, and cultural plurality are in danger of being omitted from consideration.

6. CONCLUSIONS

Experience in the Learner's Perspective Study suggests that one way to interpret the ICMI Study would be in relation to multiple claims of cultural affiliation, as these are experienced by teachers and students in countries such as Australia, Germany, the Philippines, South Africa and the USA. In these countries, students from a wide variety of cultural backgrounds participate in the same school systems (including some that might be considered 'East-Asian' or 'Western'). The problematics of a school system serving the needs of students from these different 'cultural traditions' is an important aspect of the ICMI Study that should not be overlooked. Teachers in Australia, Japan, The Philippines and South Africa face very different challenges with regard to cultural diversity of the communities they serve, class size and instructional resources, and societal and political priorities.

Our research must do more than document occurrence, whether it is of student achievement, curriculum content, teacher action, lesson structure, or teacher and student belief. Our research must also attend to the cultural homogeneity or heterogeneity of the student community, to the constraints that class size and resources put on the realization of curricular aspirations, and to the simultaneous need to address academic discipline-specific goals as well as political and social priorities. Our research must address the interrelationship of these things. From the studies that have been done, we have every reason to believe that it is in these interrelationships that the character and function of culture will emerge: in the teacher practice that

mediates between curriculum content and the student, through the actions and the lesson structure that constitute the enactment of that curriculum in the classroom, together with the beliefs and expectations on which the student's participation is predicated, culminating in the learning of which student achievement is simply the most evident socially-constructed and culturally-mediated correlate. Culture is not outside these things. It is in the combination of these and other elements that culture itself is constituted. Nor, as has already been stated, is culture a synonym for nationality. As several studies have shown, the culture of the classroom can be constructed differently within a particular country or school system. There are, however, cultural values and beliefs that frame the educational endeavours of teachers, students and policy-makers within each country. These same endeavours are also afforded and constrained by economic, societal and political considerations. International comparative research must do more than document cultural differences, it must accommodate them by attending more closely to context and to voice – particularly the voice of the learner.

REFERENCES

Anderson, L.W., Ryan, D., and Shapiro, B., 1989, *The IEA Classroom Environment Study*. Pergamon, New York..

Anderson-Levitt, K.M., 2002, Teaching Culture as National and Transnational: A Response to Teachers' Work, *Educational Researcher*, **31**(3):19-21.

Arellano, E., 1997, Mathematics Learning Styles of Filipino High School Students: Towards a Theory of Learning. Doctoral dissertation, University of the Philippines Diliman.

Bernstein, B., 1996, *Pedagogy, Symbolic Control and Identity: Theory, Research and Critique*, Taylor and Francis, London.

Bracey, G.W., 1997, On Comparing the Incomparable: A Response to Baker and Stedman, *Educational Researcher*, **26**(4):19-26.

Clarke, D.J., 2001a, *Study Design: Learner's Perspective Study*. University of Melbourne (see website: www.edfac.unimelb.edu.au/DSME/research/lps).

Clarke, D.J., 2001b, *Perspectives on Practice and Meaning in Mathematics and Science Classrooms*. Kluwer Academic Publishers, Dordrecht, the Netherlands.

Department of Education (South Africa), 1997, Senior Phase (Grades 7 to 9) Policy Document.

Department of Education (South Africa), 2001, Revised National Curriculum Statement for Mathematics.

Dunn, R., Dunn, D., and Perrin, J., 1994, *Teaching Young Children through their Individual Learning Styles*, Allyn and Bacon, Boston.

Herrington, T., Sparrow, L., Herrington, J., and Oliver, R., 1997, *Investigating Assessment Strategies in Mathematics Classroom*. Edith Cown University, Perth: Mathematics, Science and Technology Education Centre.

Hess, R.D. and Azuma, H, 1991, Cultural Support for Schooling: Contrasts between Japan and the United States, *Educational Researcher*, **20**(9):2-8, 12.

High School Mathematics Education Group, 1995, *Needs Assessment Survey*, ISMED, Quezon City.

Hu, A., 2000, TIMSS: Arthur Hu's index. [On line] Available: http://www.leconsulting.com/arthurhu/index/timss.htm. (December 30, 2000). Cited in Wang (2001).

LeTendre, G., Baker, D., Akiba, M., Goesling, B., & Wiseman, A., 2001, Teachers' Work: Institutional Isomorphism and Cultural Variation in the US, Germany, and Japan. *Educational Researcher* **30**(6): 3-15.

Mariñas, B., 1999, *Philippines. An International Comparative Study of School Curriculum.* NIER, Tokyo.

Muller, J. and Taylor, N., 1995, Schooling and the Everyday Life: Knowledges Sacred and Profane, *Social Epistemology*, **9**(3):257-275.

Setati, M., 2002, Unpublished PHD dissertation, University of the Witwatersrand

Skovsmose, O., 1994, *Towards a Philosophy of Critical Mathematics Education*, Kluwer, Dordrecth.

Skovsmose, O. and Nielsen, L., 1996, Critical Mathematics Education, in: *International Handbook of Mathematics Education*, A.J. Bishop et al. eds., Kluwer Academic Publishers, Netherlands, pp.1257–1288.

Stigler, J.W., Patrick Gonzales, Takako Kawanaka, Steffen Knoll, and Ana Serrano, 1999, *The TIMSS Videotape Classroom Study: Methods and Findings from an Exploratory Research Project on Eighth-Grade Mathematics Instruction in Germany, Japan, and the United States.* U.S. Government Printing Office, Washington, DC.

Stigler, J.W. and Hiebert, J., 1999, *The Teaching Gap*, NY, Free Press, New York.

Thorsten, M., 2000, Once upon a TIMSS: American and Japanese Narrations of the Third International Mathematics and Science Study, *Education and Society*, **18**(3):45-76.

Wang, J., 2001, TIMSS Primary and Middle School Data: Some Technical Concerns, *Educational Researcher*, **30**(6):17-21.