

Primary Mathematics Practice: The Victorian Position

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In order to establish what constitutes current primary practice in Victoria, video and other data were collected from a stratified random sample of ten year 3 and 4 classrooms in Victoria. Three video vignettes, representing the contrasting pedagogical flows captured on the videotapes, were produced to stimulate discussion in three separate Focus Groups of randomly selected teachers, principals, and mathematics teacher educators and consultants. This paper reports on their views of what constitutes current Victorian practice in primary mathematics.

The work reported here is part of an ongoing program of research and development into models of primary mathematics practice consistent with classrooms functioning as communities of inquiry (see, for example, Groves, Doig & Splitter, 2000).

Smith (1996) and Simon (1997) argue that attempts to reform school mathematics have undermined teachers' sense of efficacy by condemning the traditional expository model of teaching without replacing it with a clear new alternative. Hence the articulation of a new model of mathematics teaching is an imperative for research in mathematics education.

In the current climate of accountability in education, with its emphasis on test results, there is a danger that, rather than seriously explore what a new model of classroom practice might look like, there will be an attempt to return to the traditional expository model. Results from the recent Third International Mathematics and Science Study (TIMSS), in which Singapore, Korea, Japan and Hong Kong all performed significantly better in mathematics than Australia and the United States, have already led to calls for Australian and American schools to return to traditional models of classroom practice "more like their counterparts in Japan and Singapore" (Colvin, 1997) where "Asian teachers spend more time on rote and memorisation" (Donnelly, 1998).

However, there is extensive research evidence to show that, at least in Japanese and Korean schools, teaching is not characterised by rote learning but instead involves a considerable amount of whole class, teacher orchestrated discussion building on students' ideas (Stevenson & Stigler, 1992; Schmidt et al, 1996). Moreover, Stigler's TIMSS study of video data from 100 German, 81 United States and 50 Japanese year 8 classrooms led him to conclude that "Japanese teachers come closer to implementing the spirit of current ideas advanced by American reformers than do American teachers" (Stigler, 1996).

A recent TIMSS report (Mullis et al, 1997) has provided valuable information on mathematics classroom practice around the world, based on data from teacher questionnaires. However, Australia was not one of the three countries taking part in Stigler's video study, nor does it have data from regular school inspections, as does England. While Australia is taking part in the *TIMSS-R Video Study* in which lessons in

mathematics and science at the eighth grade level are being video taped in five countries, there has been no similar study at the primary level.

Stigler and Hiebert (1999) argue that because teaching is a cultural activity, change needs to be continual, gradual and incremental. According to Yackel (1994), a first priority for effective teacher development is to make problematic for teachers aspects of current practice. This, in turn, requires a knowledge of current practice and belief structures (Cooney & Shealy, 1997). Therefore a critical step in articulating a new model of primary mathematics teaching is to identify the dominant models of current classroom practice and, for our research, the extent to which these support or hinder mathematics classrooms functioning as communities of inquiry.

Stigler (American Federation of Teachers & National Centre for Educational Statistics, 1998) claims that it is because discussions of teaching take place outside of the context of actual examples that “caricatures of different styles of teaching that don’t really exist ... [lead to] emotional debates over how you should teach”. He goes on to say: “Let’s look at examples and let’s say exactly what it is about this that you’d like to see changed. That’s how we come to understand what good teaching is. We haven’t had this conversation in this country [the USA]”.

The *Mathematics classrooms functioning as communities of inquiry: Models of primary practice* project attempted to have such a conversation in Australia by examining current models of mathematics practice. This paper reports on one aspect of this study, namely the views of teachers, principals, and mathematics teacher educators and consultants on what constitutes current Victorian practice in primary mathematics.

Methodology

In order to establish what constitutes current primary mathematics practice, video and other data were collected from a stratified random sample of ten year 3 and 4 classrooms in Victoria. One mathematics lesson of approximately one hour’s duration was videotaped in each of the ten classrooms and an outline of the aims for each lesson, as well as copies of any work-sheets used by the children, were collected.

An analysis of the videotapes was carried out, using a framework based on that developed by Schmidt et al (1996), who use the term “characteristic pedagogical flow” to describe recurrent patterns of observable characteristics in a set of lessons. Based on our observations, field-notes, and this analysis, three edited tapes of up to 10 minutes each were produced, representing the contrasting characteristic pedagogical flows observed.

These “vignettes” were used as a stimulus for part of three separate four-hour Focus Group meetings for randomly selected teachers (n=12), principals (n=6) and mathematics teacher educators and consultants (n=10). Discussions in this part were based on the findings from the analysis of the ten lessons and a viewing of the three vignettes.

The first two hours of each meeting addressed the extent to which participants believed that the videotapes reflected dominant models of current Victorian practice. Participants were provided with the framework used in the analysis and were asked to focus on the major structural features identified.

The researchers took extensive notes of the discussions, which were also tape recorded for later transcription. In addition, the last fifteen minutes of each “half” of the meeting

were devoted to participants completing written responses to a list of “prompts” in order to provide data on individual views.

Results from the analysis of data from the second half of the meetings have been presented elsewhere (Groves, Doig & Splitter, 2000). This paper focuses on participants’ views of what constitutes dominant models of current practice in primary mathematics. The major data source for this paper is the participants’ comments, written at the conclusion of the first half of the meeting.

Participants were asked to describe a typical lesson in terms of structure, organisation, interactions, cognitive demand, and teacher actions. Written comments confirmed points made in discussions, however they did not necessarily address all aspects of the discussion.

Results

The written comments are analysed below under the five aspects listed above.

Structure

The structure of a “typical” lesson was seen by all participants as falling into three distinct phases: introductory, teaching/learning, and concluding. However, as can be seen in Table 1, the three groups’ views varied in terms of the actual “content” within each phase.

Table 1

Summary of Participant Views of Lesson Structure

Participant group	Phase		
	Introductory	Teaching/Learning	Concluding
Mathematics educators	Given by teacher Sets up lesson of the day Reviews previous work Usually a game or an activity	Small groups Teacher roams from group to group May include a teaching group Children do set task(s) unaided	Sharing the lesson’s experiences Correction of children’s work
Principals	Usually number work, counting or mental arithmetic Sets up lesson of the day	Small groups Groups rotate through tasks May include a teaching group	Sharing the lesson’s experiences Correction of children’s work
Teachers	Usually number work, mental arithmetic Sets up lesson of the day	Small groups Groups rotate through tasks Tasks may include games or worksheets May include a teaching group	Sharing the lesson’s experiences Correction of children’s work

The introductory phase of a typical lesson was often seen as teacher-directed and focused on establishing the context and focus of the day's lesson. Principals and teachers, frequently commented on the content of this phase as being number work, particularly counting and mental arithmetic. A few participants suggested that this phase lasts for about ten to fifteen minutes.

The teaching/learning phase of lessons was characterised by children working in small groups or, less frequently, individually. Mathematics educators saw the teacher as roaming from group to group, assisting when and where necessary. All three groups included the use of "teaching groups" as a possible way of structuring this phase. Some principals and teachers also suggested that groups might rotate from task to task (as happened in at least one of the classrooms shown in the video vignettes viewed by the participants).

The comments from all groups on the concluding phase were in strong agreement. This phase was seen to be characterised by either correction of work, or by a time devoted to individuals or groups sharing their answers, experiences or findings with the whole class. It should perhaps be noted that these are two quite disparate types of activity.

Organisation

The single major theme emerging from comments on the organisation of typical lessons was the use of "groups". As can be seen in Table 2, all groups suggested that lessons may function with either mixed or similar ability groups, or even with a mixture of these within a single lesson. While mathematics educators and principals saw the use of a teaching group as usual practice, teachers saw both the use of a teaching group and no teaching group as common.

Another theme to emerge was lesson flow, with all groups of participants agreeing that the dominant pattern of lesson flow is one of whole-part-whole—that is to say, children are organised as a whole class at the beginning and end of lessons, and work in groups during the middle phase.

Table 2

Summary of Participant Views of Lesson Organisation

Participant group	Aspect		
	Groupings	Lesson flow	Other
Mathematics educators	Mixed ability Some same ability Teaching group	Teacher explains (to whole class) beginning and end of lesson only Whole-part-whole pattern	Teacher explanations at end of lesson classified as discussion
Principals	Mixed ability Same ability Teaching group Special assistance group	Whole-part-whole pattern	Worksheets and concrete materials used All students work on the same topic
Teachers	Mixed ability Same ability	Whole-part-whole pattern	Measurement tasks are hands-on

Teaching group	All students work on
No teaching group	the same topic

Amongst other comments, at least one mathematics educator saw the end-of-lesson explanations as discussion, while only teachers mentioned the use of practical tasks, concrete materials and worksheets. There appears to be a tension between the comments of principals and teachers *vis-a-vis* grouping and task content—for both mixed and similar ability groups, principals and teachers saw children as working on the same topic, although it is not clear whether the content is the same for all groups.

Interactions

The classroom is a social environment, with many interactions taking place. Participants comments can be classified into three categories based on the source of interactions: the teacher, children, and resources in the classroom.

This last category of responses essentially focused on the learning tasks or activities, or on the concrete materials available for use by the children. As can be seen in Table 3, this is the only category where there are differences between the groups.

Table 3

Summary of Participant Views of Interactions Within Lessons

Participant group	Source		
	Teacher	Children	Resources
Mathematics educators	With whole class at beginning and end of lesson Asks/answers questions throughout lesson For management of children	With other children in the group With all other children in sharing time	Children interact with resources (reason unspecified)
Principals	With whole class at beginning of lesson Focus is management of children With children in teaching group	With other children in the group With teacher (reason unspecified)	Between children and teaching/learning tasks because the materials are there Minimal interaction between children and teaching/learning materials
Teachers	With children at beginning of lesson Asks/answers questions throughout	With other children in the group With other children in general	Between children and teaching/learning tasks (reason unspecified) Between children and

lesson With children on a needs basis	(unspecified time)	teaching/learning materials when children feel the need
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A dominant thread running through the comments on teacher-based interactions is that these are either for management purposes or answering children's questions. Teacher interactions can take place at any time during a lesson, although participants' comments separate into those claiming that interactions occurred at the beginning of the lesson and those remarking that interactions occurred on a needs basis throughout the lesson. Children's interactions were said to be essentially with other group members, although there were comments suggesting that interactions with the teacher or with other (non-group) children occur in most lessons.

Cognitive Demand

Cognitive demand is the overt or covert demand of questions or tasks on children's understandings. Participant comments were classified into three categories: the level of cognitive demand, the source of the cognitive demand, and questioning as an aspect of cognitive demand.

As can be seen in Table 4, there was some difference in the focus of comments but also a great deal of similarity. Teachers did not rate the level of cognitive demand, while those who did saw it at best as low. The greatest differences were in comments on the source of cognitive demand. Mathematics educators addressed content and different ability levels, while principals and teachers saw curriculum content as the source of cognitive demand.

Table 4

Summary of Participant Views of Cognitive Demand Within Lessons

Participant group	Categories		
	Level	Source	Questioning
Mathematics educators	Low to very low Not challenging children	Curriculum content Aimed at middle ability children only	Closed questions
Principals	Low Not challenging children	The tasks set for children to do (curriculum content)	Seeking correct answers Not challenging Teacher managed
Teachers	Tasks for children to do extend them	The tasks set for children to do (curriculum content)	Teacher managed By children A few open-ended

Comments about questioning were similar from every group, although the specificity and number of comments varied. The number of comments on the occurrence of open-ended and children-posed questions made by teacher participants was very small, but comments about questions being teacher managed were made by almost all teacher

participants. Only teachers suggested that cognitive demand also existed in classroom discussions that occurred in sharing time or during group work. Principals made comments about teachers' mathematical knowledge, lack of confidence, and poor discussion management skills being contributing factors to low cognitive demand in lessons.

Teacher Actions

Three categories of teacher actions were identified from the comments: managing, teaching, and explaining.

Table 5 shows the diversity of opinion on teacher actions, although some patterns of agreement do appear. For example, all groups saw teachers as managing the operation of the classroom and its activities. Similarly, all groups saw teachers giving assistance as required. However there were differences in the comments on "explaining", with mathematics educators seeing explaining content as a major feature of lessons, while principals made no similar comments. The teacher participants saw both content and the "how to do" aspects of learning tasks as common aspects of explaining in the classroom context.

Table 5

Summary of Participant Views of Teacher Actions

Participant group	Categories		
	Managing	Teaching	Explaining
Mathematics educators	Judging correctness of answers Managing routines (whole class or group formations)	No teaching group Assistance as needed Flitting	Exposition of content
Principals	Judging correctness Managing routines (whole class or group formations)	Whole class Assistance as needed Flitting	No comments
Teachers	Managing routines (whole class or group formations)	Answer questions Assistance as needed Flitting	Exposition of content Explaining how to do activities

Conclusion

The overall aim of the *Mathematics classrooms functioning as communities of inquiry: Models of primary practice* project was to identify the dominant model, or models, of Victorian primary mathematics practice and the extent to which these support or hinder mathematics classrooms functioning as communities of inquiry.

The use of video vignettes to act as stimuli for discussion and reflection on experience assisted the three groups of participants to focus and comment on Victorian practice in a productive way, thus avoiding Stigler's "caricatures ... [and] emotional debates". The task was further assisted by explicit reference to the framework we had developed to analyse the videotapes — space restrictions prevent this framework from being included here.

The methodology adopted sought evidence from a group of educators who had experience of classroom practice at varying degrees of familiarity, from those with a broad state-wide perspective (mathematics educators and consultants) to those whose experiences are close and daily (teachers). Despite these differing backgrounds there was remarkable agreement on almost every aspect of teaching practice upon which comments were sought.

The overwhelming view from the Focus Groups was that the dominant model of practice in Victorian primary mathematics can be characterised as being: “whole-part-whole” with the “part” being group work of either mixed or similar ability. The beginnings and ends of lessons are devoted to whole class activities, with number and mental arithmetic characterising the beginnings, and sharing experiences characterising the ends. The group work is based on tasks for all students that address the same topic, with students assisting one another while the teacher is engaged either with a special assistance group, or in roaming from group to group assisting where and when needed.

Apart from this structural description, there are features within lessons that appear to be dominant. An example of such a feature is the low level of cognitive demand perceived by principals and mathematics educators to exist in these typical lessons.

These comments stand in sharp contrast to Focus Group responses to questions about the value of mathematics classrooms functioning as communities of inquiry. The results of the analysis of the Focus Group discussions, and the subsequent written comments relating to this, showed overwhelming support from all groups for mathematics classrooms functioning in this way. This was, however, coupled with a realisation that current Australian practice falls far short of this goal. The fragmented, outcomes-based curriculum was seen as the major constraint on the development of a conceptually focused model of mathematics teaching, that incorporates a high level of cognitive demand (see Groves, Doig & Splitter, 2000).

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