# EARLY MATHEMATICS TEACHING: THE RELATIONSHIP BETWEEN TEACHERS' BELIEFS AND CLASSROOM PRACTICES

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*This paper describes a pilot study which is part of a larger research project into theories underpinning the teaching and learning of early mathematics in Hong Kong. In this pilot study we focus on the relationship between teachers' beliefs and their instructional practice in pre-school and lower primary school. Findings reveal that there were more consistencies between beliefs and practices in kindergarten teachers compared with primary grade teachers.*

## INTRODUCTION

There is much research evidence showing that teachers' beliefs concerning both the nature of mathematics and the learning of mathematics are significant factors influencing their instructional practices. For example, Thompson (1984, 1992) showed that the patterns of teachers' behaviours are likely be manifestations of consciously or unconsciously held notions, beliefs and preferences concerning the discipline of mathematics. Yelland, Butler and Diezmann (1999) have also pointed out that beliefs about how children learn influences the ways in which teachers interact with learners. In Hong Kong there is a dearth of research concerning beliefs and practice related to the pre-school stage and this is one of the rationales for this study.

A significant piece of research conducted on early childhood teachers is that of Vartuli (1999). Her study covered teaching in Head Start, kindergarten, and first to third grade classes. In her research, Vartuli reported that as grade level increased the level of self-reported developmentally appropriate beliefs and practices decreased and the same held true for observed practice. That is, there were more consistencies between beliefs and practices in Head Start and kindergarten teachers compared with primary grade teachers. Vartuli also makes the following ironic comment: "It appears that as children get older they are allowed less responsibility for their own learning".

## METHODOLOGY

The pilot study involved three teachers belonging to a K2 class (4-year-olds) a K3 class (5-year-olds) and a primary one class (6-year-olds). One pre-school and one primary school were selected as being reasonably typical of mainstream schools in Hong Kong. Data were collected in one school year and all teachers were addressing addition.

Videotaped classroom observation, questionnaire and interviews were used to collect data. Three consecutive lessons on mathematics teaching were videotaped. To ensure that the videos captured normal classroom teaching a standardized briefing note was used to make sure that teachers involved were clear about the aims of the research. In addition, the teachers were later asked to judge how typical the videotaped lessons were, compared with their normal classroom teaching.

Whereas videotaped classroom observation served to study teachers' behaviours and classroom practices, the questionnaires and interviews served to investigate teachers' conceptions and beliefs. The questionnaire data was essentially used to serve as prompts during follow-up interviews to make explicit teachers' conceptions on the nature of mathematics and its teaching and learning. Two stages of interview were scheduled. The first stage aimed at mainly exploring the beliefs of teachers whereas the second stage, with the help of video extracts, aimed at investigating the relationship between teachers' beliefs and their classroom practices. Video and interview data were transcribed and read by the first author and an independent specialist in early mathematics education. High consistency was obtained between the two raters.

## RESULTS

Thompson (1992) noted that the studies of teachers' beliefs and conceptions have focused on beliefs about mathematics or beliefs about teaching and learning, or both. According to Ernest (1989) and Schoenfeld (2001), teachers' beliefs can be investigated from several aspects: teachers' views of the nature of mathematics, their views of its teaching and learning, their past experiences in learning and teaching mathematics as well as the cultural beliefs and values that shape their teaching. In the following sections we attempt to illustrate some of these aspects with respect to the teachers studied.

### *Teachers' views of the nature of mathematics*

Although teachers might not be aware of their own beliefs about the nature of mathematics, they actually hold beliefs and values that may play a significant role in shaping their approaches to teaching and patterns of instructional behaviour (Nickson, 1992; Thompson, 1992). The interview and questionnaire data showed that all three sampled teachers held very similar views about the nature of mathematics. This can broadly be described as the "static" view of mathematics knowledge, which believes that mathematics is a product that is discovered, not created (Ernest, 1989; Thompson, 1992). It has been suggested that mathematics teaching adopting this view is characterized by skill drilling in arithmetic operations and emphasising standardized calculating procedures and accurate results (Thompson, 1992). This is reflected in the following comments:

> There are a lot of formulas in mathematics that you have to memorize… When you are sure of how to use the formulas, you can get the answer… More practices with the formulas will enable mastery of specific kinds of mathematics calculations. (K3 teacher)

> [Mathematics] is fixed. To me, that means the result, the answer is fixed … There is more chance to succeed. If they [the children] got one hundred marks [in maths], they are very excited… It is comparatively more difficult to get full marks in other subjects. (P1 teacher)

### *Teachers' attitudes towards mathematics*

In addition to their views on the nature of mathematics, there was also a consistent attitude displayed by all three teachers. As noted by Comiti and Ball (1996), elementary mathematics teachers usually have little post secondary subject study and thus are not subject experts. Therefore, it might not be a coincidence that all the sampled teachers claimed that they did not do well in their own mathematical studies. The sentence "I am weak in mathematics" can be found in every interview of both primary and pre-primary

teachers. They did not have very positive attitudes towards studying mathematics themselves.

> I don't like mathematics. Whenever I think of it, I hate it! (K2 teacher)

Teachers' negative attitudes are likely caused by their own experiences in learning mathematics. Both primary and pre-primary teachers reiterated that they learnt mathematics in a very traditional way, usually involving the drilling of mathematical symbols and reciting mathematical formulae.

> To me, [mathematics] is boring. I don't like mathematics. When I was young, I learnt mathematics in a very traditional way… The teacher was not using any activities… All I know is to recite formulas or to calculate with calculators. (K3 teacher)
>
> My feelings are that mathematics is something very difficult… [What my teacher looked for] were correct answers. We had to do a lot of exercises mechanically and to get the correct answers without knowing why… The way of drilling mathematics is not applicable today. It was painful. (P1 teacher)

*Teachers' views of mathematics teaching and learning*

However, negative experiences in learning mathematics *may* have a positive impact on teachers' beliefs about the appropriate way to teach the subject. The three teachers were very keen on building children's positive attitudes towards mathematics and cultivating their interest in the subject. They were enthusiastic towards mathematics teaching, hoping that children will not learn to hate the subject as they did.

> I want children to get involved in the subject. I know some of them don't like mathematics. I will encourage them. (P1 teacher)

They were eager to motivate children and arouse their interests and were also well aware of current trends in mathematics teaching and learning (advocated by the Education Department in Hong Kong and in their own training programs) such as learning through play, using concrete manipulatives, stressing problem-solving, discussion and logical thinking.

> [I have learnt to] use games and activities to teach. (K3 teacher)
>
> Activities, discussion, play, open-ended problems [are the current teaching methods]. It is not passing knowledge to children any more. (K2 teacher)
>
> It is a training to change my attitudes of teaching mathematics; using games and play to teach mathematics. (P1 teacher)

From the questionnaire and interview data it appeared that the teachers were equipped with pedagogical knowledge to enable them to transform and represent mathematical knowledge for teaching. However, the videotaped classroom images showed that the teachers were implementing them in very different extent and depth.

*The lessons and the relationships with teachers' beliefs*

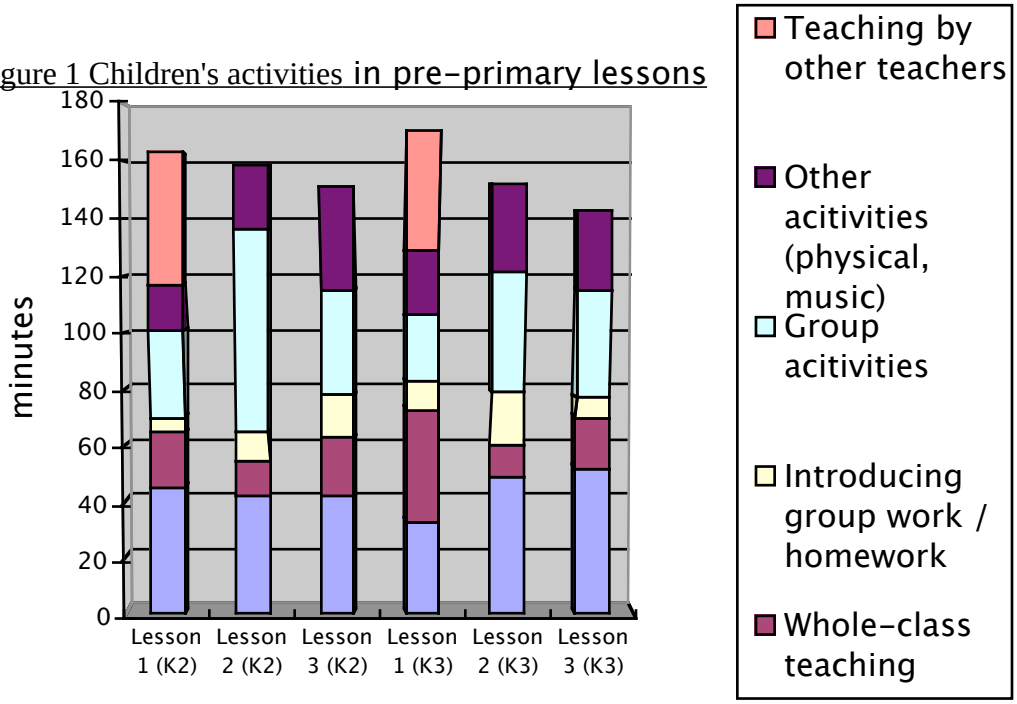
1. The pre-primary lessons

Integrated learning was the main organisational approach in the kindergarten school. There would not be any specific time slot allocated to teachers teaching mathematics or children learning mathematics individually or in groups. Mathematics learning took place not only in large group teaching and group times but also integrated with other activities

such as physical exercises, music activities and during daily routines such as queuing up to washroom, waiting time and morning exercises.

Figure 1 shows the time children spent in each kind of work in the lessons in K2 and K3, for approximately three hours each day. Teachers started and ended the day at different times, accounting for the differences in total time the video captured. Normally, teachers introduced new concepts during large group teaching, followed by instructing the children about tasks they have to finish during group time or at home. Children then finished their work according to their speed during group times. They were free to choose other activities or play with other materials available in class after finishing their assigned work. Activities were used in both large group teaching and during group times to motivate children. The design of many activities were targeted at helping children to find the "correct answers". In this respect, beliefs about mathematics were consistent with teaching. Nevertheless, although mechanical drilling was also evident, the pre-primary lessons appeared to be generally activities-based, stressing the relation between arithmetic statements and real life situations. The pre-primary teachers seemed to be trying to implement their pedagogical beliefs despite some other constraints, such as school schedules, parents' aspirations and so on. A typical example concerned playing a game which resulted in all the possible pair-bonds for a sum of 8 being discovered. Overall, a consistency between beliefs about teaching and classroom practices was clearly identified.

Figure 1 Children's activities in pre-primary lessons

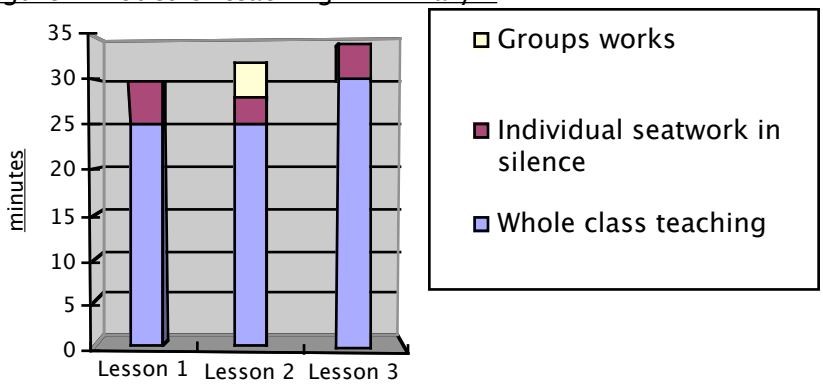



2. The primary lessons

The Primary lessons usually last for 35 minutes each. Figure 2 shows the modes of teaching adopted in the three mathematics lessons. Large group teaching appeared to be the dominant mode of teaching, accounting for almost 80% of the time in the lesson. As the video data revealed, the teacher mainly taught according to the textbook. The script of

a lesson usually began with a review of previous work, followed by the acquisition phase. After introducing the basic concepts, children were usually asked to do consolidation work, often in the form of written exercises in the textbook. Teachers would check answers with children to make sure that the answers were "correct". In this respect, the teacher's beliefs and practice was consistent.

Figure 2 Modes of teaching in Primary 1




On the other hand, video images revealed a technique-oriented approach; a repeated drilling of verbal counting skills and manipulation of abstract numerals on the blackboard. This was quite contrary to the teacher's professed beliefs about the best way to teach mathematics. Some games and activities were introduced but a very limited time was spent on them. Instead, pencil and paper work dominated. It appeared that there was a gap between what the teacher professed and what was being practised.

*Teachers' awareness of the relationship between beliefs and practices with the help of video extracts*

By using video extracts during the second interview, teachers were able to identify the degree of consistency between their beliefs and their instructional practices. Both pre-primary teachers found that their beliefs and practices were quite consistent although they admitted that there were pressures from parents, and sometimes the school, pushing them to adopt a more skill-oriented teaching approach. However, they still found flexibility in implementing what they believe. These perceptions were in accord with the authors' observations.

On the other hand, the primary school teacher was not initially aware of the discrepancy between her beliefs and instructional practices. With the aid of video clips, the teacher became aware that she was not practising what she believes.

> The video shows no relation with the current trend of mathematics education at all. I am just teaching arithmetic operations… My classroom practices are not the same as what I am thinking… I have to reorganize the whole curriculum. (P1 teacher)

The video clips served as a powerful stimulus to help the primary teacher become aware that although she professed belief in some current teaching ideas she was not implementing them. She also realized that she was not fully utilizing the teaching resources available in the classroom to avoid abstract teaching of symbols and numbers.

The teacher reflected on her own practices and provided reasons for the inconsistency. The first reason was discipline; she noted that it was necessary to train the children to get accustomed to daily classroom discipline.

> In the beginning of the term, their discipline is not satisfactory. Thus, it is necessary for the children to sit and listen… Later, when I realize that children are interested in learning mathematics, I can use other teaching approaches. (P1 teacher)

The irony of her comment is that it is quite likely the children will *never* become interested while they are forced to just 'sit and listen'. Other reasons given were time limit, the textbook and preparing children for examinations.

> I remembered that I am teaching in a hurry. Hurrying to finish [all topics] on the textbook… It was very tight. I have to hurry preparing children to sit for examination also. (P1 teacher)

The final reason the teacher gave was a lack of preparation.

> Not enough preparation. I haven't thought thoroughly what to teach. I have to be frank, it is a failure. Actually, I can work harder on this. (P1 teacher)

Although the time spent in each kind of activity was not directly comparable because of the different teaching approaches, it was quite clear that the pre-primary teachers were practising what they believe whereas the primary teacher was not. These preliminary findings appear to validate Vartuli's results (described earlier) but in the Hong Kong context.

## DISCUSSION AND ANALYSIS

One of the problems associated with research on beliefs and practices is to distinguish between genuinely held beliefs and professed 'beliefs' that may simply be rhetoric. The latter may be an expression of what the teacher thinks he/she *should* believe, especially related to current curriculum trends. All three teachers in this study were well aware of the pedagogical approaches advocated in their teacher training programmes and in the guides issued by the government Education Department. However, this study shows that the primary teacher's professed beliefs in such approaches was not reflected in her instructional practice. One interesting comparison can be made between two of the teachers' comments:

> Children will have a deeper understanding by manipulating concrete materials themselves. It is necessary for children to experience before they understand (K2 teacher)

> Especially for lower primary children, they need to compute more in order to master the mathematical concepts (P1 teacher)

These two comments vividly illustrate a fundamentally different belief about how children learn mathematics. For the K2 teacher, concrete experiences come *before* understanding whereas the implication in the P1 teacher's comment is that computational skill comes first. (It is also interesting that she does not use the word *understanding* related to concepts, but rather mastery). Nevertheless, we should not infer from this that the primary teacher does not also believe that activities and games can be important in learning, as she professes. All three teachers commented in their interviews on the constraints on them being able to implement their teaching beliefs. We have already seen

some of these for the P1 teacher. A frequent comment from all three concerned parental pressure.

> Parents are looking for children's marks only. They don't bother whether their children understand or not. …… Parental expectations are critical in influencing my approach to teaching. (P1 teacher)

> [Parents] are concerned about children's assessment results very much. …. I have to follow the schedule of the school as well as the expectations of the parents. (K3 teacher)

However, perhaps the most significant factor concerning the comparison between the pre-school teachers and the primary teacher lies in the constraints imposed by entry into the 'formal' education system. For example, a timetable of thirty-five minute lessons (common in Hong Kong) might not be long enough and flexible enough for teachers to allow children to have hands-on work after large-group teaching. Moreover, different subjects being taught by different teachers (again common) does not easily allow flexible handling of time. In addition, the fixed syllabus and the adoption of specific textbooks in primary schools imposes additional constraints. By contrast, pre-primary school teachers generally use the whole three-hour teaching time, except for some special subject teaching such as English (Figure 1). This longer and continuous time slot allows teachers to have flexibility in arranging different activities for children. In addition, since pre-primary schools are considered as a "preparatory stage" for formal schooling in primary school, there is no prescribed syllabus. Although the expectation of parents on an academic-oriented teaching content is substantial, the teachers in this study did manage to adopt teaching strategies in line with their beliefs. However, further study of other teachers in kindergarten and primary schools will inform us whether or not the pattern discussed in this article is indeed a common one.

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