

**CHARACTERISTICS OF MATHEMATICS  
LESSON VALUED AS EFFECTIVE BY  
EXCELLENT TEACHERS AND THEIR PUPILS**

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**UNIVERSITI SAINS MALAYSIA  
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**By**

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# **CIRI-CIRI PENGAJARAN MATEMATIK YANG DIHARGAI SEBAGAI BERKESAN OLEH GURU CEMERLANG DAN MURID-MURID MEREKA**

## **ABSTRAK**

Kajian ini bertujuan untuk menjawab empat soalan kajian: (1) Apakah ciri-ciri pengajaran matematik yang dinilai sebagai berkesan oleh Guru Cemerlang sekolah rendah? (2) Apakah ciri-ciri pengajaran matematik yang dinilai sebagai berkesan oleh murid? (3) Apakah persamaan atau perbezaan antara ciri-ciri pengajaran matematik yang dinilai berkesan oleh guru dan murid? (4) Apakah persamaan atau perbezaan ciri-ciri pengajaran matematik yang dinilai sebagai berkesan oleh murid yang mempunyai pencapaian akademik yang berlainan? Kajian ini telah dijalankan menggunakan kaedah kajian kes. Seramai dua orang Guru Cemerlang dan dua belas orang murid Tahun Empat (umur sepuluh tahun) terlibat dalam kajian ini. Guru Cemerlang dipilih untuk menyertai kajian ini kerana mereka dianugerah berdasarkan kepakaran mereka dalam pengajaran dan mata pelajaran. Mereka dianggap sebagai berkesan dan berupaya menjalankan pengajaran matematik yang berkesan. Data dikumpul melalui pemerhatian pengajaran, *photo voice* dan temubual secara mendalam. Sebanyak tiga kali pemerhatian pengajaran dijalankan ke atas setiap guru. Murid yang terlibat dalam kajian ini diberi sebuah kamera digital untuk menangkap gambar peristiwa atau bahan yang dianggap berkesan semasa setiap pemerhatian pengajaran dijalankan. Selepas setiap pemerhatian terhadap pengajaran dijalankan, murid ditemubual berdasarkan gambar yang telah diambil oleh mereka, seterusnya temubual dengan guru dijalankan secara mendalam. Analisis data kualitatif menunjukkan bahawa guru menilai aktiviti praktikal, aktiviti berkumpulan, ICT, *talking board*, *board work*, latihan dan katakunci sebagai ciri-ciri yang berkesan.

Mereka menekankan penglibatan murid yang aktif, meningkatkan pemahaman murid dan membantu murid untuk menjawab semasa peperiksaan. Sebaliknya, murid berpendapat aktiviti yang melibatkan mereka seperti *board work*, lakonan, dan aktiviti praktikal; input guru serta penggunaan alat bantu mengajar sebagai berkesan. Perbandingan antara persepsi guru dengan murid menunjukkan bahawa guru banyak berkongsi pandangan yang sama dengan murid berkenaan ciri-ciri pengajaran matematik yang berkesan. Katakunci dan bahan maujud yang dinilai sebagai berkesan oleh murid yang mempunyai pencapaian akademik yang sederhana dan rendah sahaja namun, tidak dinilai sebagai bekesan oleh pelajar yang berpencapaian tinggi. Dapatan kajian menunjukkan bahawa amalan menjelas konsep, menilai dan memberi maklum balas serta memberi murid membuat latihan adalah urutan pengajaran matematik yang berkesan. Dengan melibatkan murid dalam aktiviti praktikal dan *board work* akan dapat meningkatkan kefahaman murid dalam konsep matematik berkenaan.

**CHARACTERISTICS OF MATHEMATICS LESSON VALUED AS EFFECTIVE  
BY EXCELLENT TEACHERS AND THEIR PUPILS**

**ABSTRACT**

This study aimed to answer four research questions: (1) What are the characteristics of mathematics lesson valued as effective by the primary school Excellent Teachers? (ii) What are the characteristics of mathematics lesson that are valued as effective by the pupils? (3) What are the similarities or differences between the Excellent Teachers' and pupils' perceptions of effective mathematics lesson? and (iv) What are the similarities or differences between characteristics of mathematics lesson valued as effective by the pupils with different academic performance? The research was conducted using a case study design. A total of two Excellent Teachers and twelve pupils participated in the study. Excellent Teachers were selected to participate in this study because they were awarded based on their competency and expertise in teaching and subject matter. They were expected to be effective and able to conduct effective mathematics lesson. The participating pupils were Primary Four or ten years old. Data were collected through lesson observation, photo voice and in-depth interview. Each teacher was observed for three lessons. Participating pupils took photographs of the episodes or materials they perceived as effective during every observed lesson. Immediately after each observed lesson, pupils were interviewed based on photographs taken by them, followed by in-depth interview with the teacher. Analysis of qualitative data indicated that hands-on activity, group activity, ICT, talking board, board work, exercise and keywords were the major characteristics of mathematics lesson valued as effective by teachers. They emphasized on active engagement of pupils, enhancing

pupils' understanding and helping pupils to score in examination. On the other hand, pupils valued the effectiveness of their involvement in the teaching and learning process through board work, role play and hands-on activity; teacher's input as well as the use of teaching aids. Comparison between the teachers' and pupils' perceptions showed teachers shared many similar views with their respective pupils concerning the characteristics of effective mathematics lesson. Keywords and concrete objects, which were valued as effective by moderate and low academic performers, were not valued as effective by high performing pupils. The findings of the study showed that teacher explaining, assessing, giving feedback and pupils practicing could be a sequence in an effective mathematics lesson. In addition, involving the pupils through hands-on activity and board work may enhance their understanding of mathematical concepts.

# **CHAPTER 1**

## **INTRODUCTION**

Mathematics is a compulsory school subject in most educational system including Malaysia. As Smith (2004) pointed out, mathematics is important for “its own sake; as an intellectual discipline; for the knowledge economy; for science, technology and engineering; for the workplace; and for the individual citizen” (p. 3). Hence mathematics is important for the development of both individual and country.

In Malaysia, mathematics is a compulsory school subject at both primary and secondary level. The mathematical content knowledge learned in primary school is particularly important because the basic mathematical knowledge learned such as basic concepts of numbers, arithmetic operation skills, measurement, shape and space are widely used in the daily life. In addition, mathematics is hierarchical in nature. Basic mathematical concepts and skills are required before mastering the higher level of mathematical concept. If students do not have a strong foundation of mathematics in the primary level, they will face difficulties in learning mathematics in the secondary and tertiary levels. Besides, if the students acquire incorrect mathematical concept in the primary school, these misconceptions might become the proactive inhibitors (Dole, 2003) to the learning of correct concept in future. Proactive inhibition is a brain mechanism; it prevents the association of conflicting ideas. If a student has developed misconceptions, when he faces a new and correct knowledge, the new knowledge will be rejected or distorted so that it is similar to the knowledge he learned before. Therefore, building a good foundation of mathematical concept by pupils when they are in the primary school is crucial.

Furthermore, as pointed out by Skemp (1986), “In learning mathematics, although we have to create all the concepts anew in our minds, we are only able to do this by using the concepts arrived at by past mathematicians. There is too much for even a genius to do in a lifetime” (p. 34). Therefore, the learning of mathematics in early age or by average students is very dependent on effective teacher and teaching (Skemp, 1986). In addition, primary pupils have limited language competency (Punch, 2002), they might not have the ability to learn mathematics by themselves or through textbook or internet. Thus, primary mathematics teachers play a crucial role in pupils learning of mathematics. Teachers need to provide the pupils effective mathematics lessons that facilitate their learning well.

Yet, there is still no universal definition of effective teaching and teacher that is agreed and accepted by all people. Miyakawa (2006) proposed that there were three viewpoints in defining the effectiveness of effective lesson, which included teaching process, learning process and the students’ achievement or outcomes. From the first viewpoint, the lesson that adopted the teaching approach that was considered as “good” was considered as good lesson. For example, lesson that utilized open-ended approach was recognized as good lesson in Japan (Becker & Shimada, 1997). From the second viewpoint, the effectiveness was defined based on the learning process of the students. For example, constructivists believed that students construct their own knowledge and meaning. Thus, the lesson was considered as effective if the students were able to construct the knowledge and meaning by themselves (Balacheff, 1990). From the third viewpoint, the effectiveness is defined by assessing the students’ achievement. This was the most popular ways of defining the effectiveness of lesson. The lesson was considered effective when the students were able to score well after the lesson or during the national assessment. The third

viewpoint was coherent with the findings of studies conducted by Lim (2009) and Vistro-Yu and Villena-Diaz (2009). They found the teachers, students, parents and society coined effective mathematics teaching and learning as those that were able to aid the students in getting high score in the examination.

## **1.1 Problem Statements**

Providing primary pupils effective mathematics teaching is essential. Several studies have been done (e.g. Mohd Majid Konting, 1997; Lim, 2009) in order to explore the characteristics of effective mathematics lesson. Yet, there are three issues that urge the need of conducting this study. These issues are discussed as below:

First, there were many studies (e.g. Li & Li, 2009; Huang & Li, 2009a) carried out to identify the characteristics of effective mathematic teaching in order to improve the teaching and learning in the classroom. Some studies (e.g. Perry, 2007; Wong, 2007; Wong, Wong, Lam, & Zhang, 2009) were carried out to determine the teachers' belief system of effective mathematics teacher and teaching. These researchers focused on the teacher's beliefs of effective mathematics teacher and teaching because they believed that teachers' beliefs influence their instructional practices (Cai, Perry, Wong, & Wang, 2009). However, teachers' beliefs were found not necessarily reflected in their classroom practices (Cai, 2005; Cai & Wang, 2006; Rahat & Tsamir, 2009; Cai & Wang, 2010). This mismatch occurred might be due to constraints in the social context of the teaching, such as the expectations of the students and parents, the adopted text or curricular scheme, the assessment system and the overall national system of schooling (Ernest, 1989). For example, Wang and Cai (2007a) found that although the Chinese teachers recognized the importance of "students-centered" teaching, they seldom practice it in their classes due to the large

classroom size and broad coverage of content required by the national curriculum. Therefore, teachers' beliefs might be idealistic, and might not really reflect their practices.

In the opinion of the researcher, teachers teach the pupils by conducting mathematics lessons. Teaching is a social cultural activity, in the process of teaching, teacher might plan according to his/ her own beliefs of an effective mathematics lesson. However, the lesson is co-constructed by the teacher and students. During the lesson, teacher might be forced to change his plan according to the students' needs and abilities. Therefore, focus on studying the lesson might be more pragmatic to describe the effective mathematics lesson.

Second, in order to identify the characteristics of mathematics lessons which were culturally valued as effective, some studies were carried out by studying the mathematics lessons that were evaluated as effective (Li & Li, 2009; Lin & Li, 2009) or that were developed to be effective (Huang & Li, 2009b). Nevertheless, these studies were only conducted in some countries, such as China, Taiwan and Korea because in these countries, teachers' teachings are open to the public for evaluation and sharing purpose. In Malaysia teaching is not open to the public. Teachers' teachings are only observed by principal or inspectorate from Ministry of Education for the purpose of evaluation. Thus, there is no lesson that is evaluated as or developed to be effective in Malaysia. However, there is a promotion scheme in Malaysia which identify and honor teachers who "are equipped with knowledge, skill and expertise in teaching and learning" (Ministry of Education Malaysia's Official Portal, 20.9.2009). This award is called Excellent Teacher or "*Guru Cemerlang*", the term used in Malay. Since these teachers were awarded based on their competency and expertise in teaching and subject matter, they were expected to be effective and

able to conduct effective mathematics lesson. Yet, there were few studies done about the teaching of the Excellent Teacher. There was a gap of showing how the teaching or the lesson conducted by the Excellent Teacher that make he/she recognized as expert in teaching and their subject matter. Therefore, the researcher intended to include Excellent Teacher in this study.

Third, teaching and learning are interrelated and interdependent processes. These can be shown by the language used by other culture, such as in Dutch, the term “leren” is used to means both teaching and learning. Likewise, in Japanese, the term “tagushushido” is used to combine teaching and learning. Therefore, Clarke (2006) argued that it was more fruitful to study the teaching process by assuming teaching and learning as complementary component. Since, teaching and learning are interrelated, the students’ perception are as essential as the teacher’s perception.

Besides, Hopkins (2008) stated that the concept of listening to learner’s voices as a way of improving teaching and learning is gaining momentum. Listening to the students is essential because we are not able to facilitate their learning well without knowing the teaching processes and conditions they prefer and perceive as effective in helping them to learn. The arguments of Clarke and Hopkins showed that listening to the students’ perceptions is crucial and essential in determining the effective mathematics lessons.

In line with this thought, there were some studies (e.g. Mok, 2006; Kaur, 2009; Shimizu, 2009) done to explore the teacher’s and students’ views of effective mathematics lesson. The findings of these studies (Li, Kulm, Huang, & Ding, 2009) showed comprehensive descriptions of the mathematics lesson. Besides, by comparing the teacher’s and students’ perceptions of effective mathematics lessons, the researchers found that some students valued different aspects from their teacher.

For example, Li et al. (2009) found that the students care about the teacher's attitudes and respect to them, but the teacher perceived that students were learners and they should be well disciplined. This showed that comparison between teachers' and students' perspectives helped us to obtain the aspects which might be overlooked or taken for granted by the teachers.

Listening to students is indispensable. Yet, to the knowledge of the researcher, there was yet any studies done in Malaysia which explore the students' perceptions of effective mathematics lesson. Most of the studies (e.g. Mohd Majid Konting, 1997; Lim, 2009) done in Malaysia which aimed to explore the effective teaching and teacher were focusing on the teacher. Hence, this study aimed to include both the teachers' and pupils' perceptions of effective mathematics lesson. Furthermore, Perger (2007) discovered that pupils with different academic performance had different perceptions on the best practice in learning mathematics. Thus, this study also aimed to compare the perceptions of pupils with different academic performance concerning the effective mathematics lesson.

## **1.2 Research Objectives**

The objectives of this study included:

1. To explore the characteristics of mathematics lesson valued as effective by primary Excellent Teachers.
2. To explore the characteristics of mathematics lesson valued as effective by pupils.
3. To compare the characteristics of effective mathematics lesson from the perceptions of primary Excellent Teachers and pupils.

4. To compare the characteristics of effective mathematics lesson from the perceptions of pupils with different academic performance.

### **1.3 Research Questions**

Given the purpose of the study, this research would seek to address the following research questions:

1. What are the characteristics of mathematics lesson valued as effective by the primary school Excellent Teachers?
2. What are the characteristics of mathematics lesson valued as effective by the pupils?
3. What are the similarities or differences between the primary school Excellent Teachers' and pupils' perceptions of effective mathematics lesson?
4. What are the similarities or differences between the characteristics of mathematics lesson valued as effective by the pupils with different academic performance?

### **1.4 Significance of the Study**

The findings of this study would contribute to the in-service teachers, pre-service teachers, parents, school administrators, educators and researchers in the following ways:

First, this study involved Excellent Teachers. Therefore, the findings of the study could be used as a sharing with other in-service and pre-service teachers on how the Excellent Teachers carried out their mathematics lesson effectively. Even though Excellent Teachers play a role model to other teachers and have a duty to help other teachers in their teaching, nevertheless, not every school has Excellent

Teacher. Thus, the findings of this study would provide guidance for teachers in their teaching.

Second, the findings would add to academic pool of knowledge by showing the characteristics of mathematics lessons valued by Excellent Teachers and pupils. Besides looking at the teachers' and pupils' individual perception, this study also looked at what was co-valued by the teacher and students that optimise the learning process of pupils in primary school. In addition, the findings also revealed the reasons of each characteristic of mathematics lessons valued by the Excellent Teachers and pupils.

Third, this study utilised an innovative and creative method, photo voice, to study the primary pupils' perceptions. In this method, each primary pupil was given a camera and required to take photographs during the observed lessons of the episodes they perceived as effective. Then, they were interviewed with the aid of the photographs taken by them. To the knowledge of the researcher, this was the first study carried out in Malaysia that employed photo voice in studying children. This study took the initiatives of showing to what extend the effectiveness of the photo voice in studying children.

## **1.5 Definition of Terms**

### **Excellent Teacher**

This is an award honored by the Ministry of Education Malaysia to teachers who are competent or regarded as experts in their field of teaching and subject matter. These teachers are expected to be able to conduct effective mathematics lesson that facilitate the students' learning well.

## **Primary Pupils**

Children with age 7 years old until 12 years old who are studying in primary public school.

## **National Primary School**

There are three types of primary public school in Malaysia differentiated by the medium of instruction. A National Primary School refers to school that uses Malay language as the medium of instruction.

## **Academic Performance**

The pupils' performance in their latest mathematics monthly test.

## **High, moderate and low performing pupils**

The participating pupils were selected by their teachers based on two criteria: (i) who were able to express themselves well, and (ii) their academic performance. The high, moderate and low performing pupils were then chosen based on their teachers' discretion upon their academic performance.

## **Photo voice**

This is a method of utilising photographic technique to elicit the pupils' concerns, problems and perceptions. The process of photo voice starts with giving the pupils briefings on the objectives of the study and handed cameras to each of them, students take photographs during the observed lesson, and interview the pupils based on the photographs taken by them.

**Value**

It is an action of an individual of regarding something as important enough to be emphasized.

**Mediation**

Mediation refers to the process of introducing concepts, knowledge, skills and strategies to the students. The mediator of the process can be tools or human.

**Zone of proximal development**

This is the gap or difference between the level of the pupils can achieve or perform when they are working independently and the level of the pupils can achieve when they are taught or guided by adult (such as parent and teacher) or peers which are more skilful.

**Scaffolding**

Scaffolding is the process of helping the pupils when they are learning by giving supportive help. The supportive aid is temporary and will be withdrawn as the pupils internalized the skills.

**Teaching**

Teaching is an interactive process between teachers and learners over a subject in an environment.

**Mathematics lesson**

A mathematics lesson refers to a period of time during which students are taught about mathematics.

**Lesson plan**

A lesson plan is a teacher's detailed description of the course of instruction for one class.

## **CHAPTER 2**

### **LITERATURE REVIEW**

This chapter presents the literature review of this research. First, the literature concerning effective mathematics lesson, effective classroom condition, and effective mathematics teacher in other countries were reviewed, followed by the review of studies done in Malaysia concerning the effective mathematics teacher and teaching. Next, review of literature about expert teacher, selection of effective mathematics lesson, valuing and photo voice were reported. The theory that underpinned the study is discussed in theoretical framework. Finally, a conceptual framework is formulated to guide this study.

#### **2.1 Definition of the Word“Effective”**

Oxford Advanced Learners’ English-Chinese Dictionary (2005) defined the word “effective” as “producing the result that is wanted or intended; producing a successful result” (p. 545). The terms stated in the definition, such as “wanted” and “intended” imply that the meaning of “effective” could be subjective. Different kind of results might be emphasized by different individual, society or culture, therefore, different individual, society and culture might have different conceptions of effectiveness.

Review of literature showed that many researchers (Lim, 2009; Vistro-Yu & Villena-Diaz, 2009) referred effectiveness to students achievement in examinations, for instance, Vistro-Yu and Villena-Diaz (2009) referred “effective mathematics teaching” as “higher achievement scores in national and international assessments” (p. 198). As stated by Vistro-Yu and Villena-Diaz (2009), the educational leaders in Philippines

referred the effectiveness of teacher and teaching to the students' achievement in TIMSS and national tests. The school evaluation practices in Philippines stated that "a teacher is effective if he/she has succeeded in fulfilling the objectives for which his/her lessons are designed with the given resources and if he/she was able to address problems confronting the school community" (Vistro-Yu & Villena-Diaz, 2009, p. 191). Besides, the project Rescue Initiatives in Science Education (RISE) was implemented to improve the poor achievement of students in TIMSS by enhancing the teaching of teachers. Therefore, in Philippines, the effective mathematics teaching is associated with the higher achievement scores in national and international assessment (Vistro-Yu & Villena-Diaz, 2009).

Likewise, when Lim (2009) asked ten participating teachers to define the word "effective" in mathematics teaching, most of the teachers explained that an effective teacher was one who was able to help the students to score high marks in exam. Lim (2009) also mentioned that the teachers, students, parents and society in Malaysia viewed public examination results as the best indicators of effective teaching and learning. Lim (2009) argued that this perceived ultimate goal of school mathematics learning is influenced by the examination-oriented culture in Malaysia.

Review of literature showed that many different terms were used in place of effective mathematics lessons, such as "good mathematics teaching" (e.g. Kaur, 2009; Wilson, Cooney, & Stinson, 2005), "good mathematics instruction" (e.g. Lin & Li, 2009; Pang, 2009) "well taught mathematics lesson" (e.g. Kaur, Low & Seah, 2006), "exemplary mathematics lesson" (e.g. Mok, 2009). All studies that employed the terms

“good”, “well-taught”, “exemplary”, “excellent” and so forth are included as “effective”. These studies are reviewed and discussed in the following sections.

## **2.2 Effective Mathematics Lesson**

From the literature review, several studies (e.g. Li & Li, 2009; Wang & Cai, 2007a; Perry, 2007; Kaur, 2009) were carried out to identify the characteristics of effective mathematics lessons. Some of the studies were carried out by identifying the characteristics of mathematics lessons which were valued by the public as effective (e.g. Li & Li, 2009; Huang & Li, 2009b). Some researchers identified the characteristics of effective mathematics lessons by looking at the teachers’ perceptions (e.g. Wang & Cai, 2007b; Perry, 2007) and students’ perceptions (e.g. Kaur, 2009; Mok, 2006). There were also some studies carried out to determine the similarities and discrepancies between the perceptions of teachers and students on the characteristics of effective mathematics lessons (e.g. Kaur, 2009; Mok, 2009).

### **2.2.1 Characteristics of mathematics lessons valued as effective by the public**

This section discusses about the characteristics of mathematics lessons which were valued by the society as effective. How do the researchers find out the lessons that were valued by the public? In some countries, such as Japan, China and Taiwan, teaching is a publically sharable professional activity (Leung & Li, 2010). Various kinds of programs were conducted to improve the teaching of mathematics teacher and identify the effective mathematics lessons, such as teaching contest and lesson study. Lesson study is very common in Japan (Lewis, Perry & Hurd, 2009). In China, teaching

contest (Li & Li, 2009), collaborative development of exemplary lessons (Huang & Li, 2009b) are the professional events conducted. Teaching contest is also conducted in Taiwan (Lin & Li, 2009) and Korea (Pang, 2009). The lessons developed or dominated through the programs stated above showed the features of mathematics lessons that were valued by the society as effective. Therefore, by analyzing the lessons developed or dominated in these programs, the researchers were able to determine the characteristics of mathematics lessons that were valued by the particular society or culture as effective.

In China, teaching contest is a well-organized formal professional activity. Teaching contests were held at different administration levels and in different formats. Li and Li (2009) carried out a study to examine the characteristics of a lesson that won in the teaching contest. They found that the lesson was coherent; the teacher clearly identify and handle the difficult and essential points; teacher used textbook carefully and intensively; teacher used multiple methods to engage the students; students were given opportunities to explore, discuss, share and justify solutions under the guidance of teachers; and various kinds of interactions between teacher and students.

Another program that is held in China in order to improve the teachers' knowledge and teaching practices is exemplary lesson development. This is an in-service teacher professional program where the teachers and researchers collaborate to develop an exemplary mathematics lesson. The team that develops an exemplary lesson consisted of teachers and experts, such as educators or researchers. The process of developing an exemplary lesson is starting by a teacher teaches a lesson. Then, the team members discuss and reflect on the lesson. The teacher revises and re-delivers another lesson based on the discussion and reflection. The exemplary lesson is developed after

several cycles of teaching, reflection and revision. The lesson is taught by one teacher from the beginning until the end of the process in different classes of the same school (Huang & Bao, 2006).

Huang and Li (2009b) studied a lesson that was developed from exemplary lesson development. They found that the lesson had the following features: setting comprehensive and feasible teaching objectives; instructional coherence; focusing on the essence of core concepts; using systematic problem variation to practice knowledge; students were guide to develop the mathematical concepts; profound understanding and using the textbook by the teacher; and encouraging the students' participation and self exploration.

### **2.2.2 Teachers' beliefs of effective mathematics lesson**

This section discusses about the teachers' beliefs of effective mathematics lessons in several countries, such as the United States, China, Australia and so forth. As shown in Table 2.2, the characteristics of effective mathematics lesson listed by teachers were classified into five categories: (1) "teacher and teaching", which referred to the teacher's actions and teaching activities in the classroom; (2) "students and learning", which referred to the students' activities in the classroom or the activities that focus on the students; (3) "lesson structure", which referred to the sequence of the activities in the lesson; (4) "instructional content", which referred to the content being taught in the lesson; and (5) "classroom context", which referred to the interaction and relationship among teacher and students in the classroom or the atmosphere in the classroom.

In the United States, there were two studies (Wilson et al., 2005; Wang & Cai, 2007b) carried out to explore the teachers' beliefs of effective mathematics lesson. The study carried out by Wilson et al. (2005) found that the nine secondary mathematics teachers that were interviewed, believed that an effective teaching required knowledge of mathematics and knowledge about their students; promote mathematical understanding through relating mathematics to real life and visualizing mathematics; engage and motivate students using several approaches such as using technology, having students to write, doing group activity and hands-on activity; and require effective management.

Study done by Wang and Cai (2007b) reported similar findings. After interviewing eleven experienced mathematics teachers, they found that these teachers perceived that effective mathematics lesson was focusing on the students' understanding; motivating students; having students' active participation; covering appropriate content; relating to real life; providing hands-on activity; productive peer-interaction; and teacher as a good facilitator.

The findings of these two studies (Wilson et al., 2005; Wang & Cai, 2007b) showed that the teachers in the United States deemed that student-centred lesson as effective. They commented that effective mathematics lesson was lesson that focused on students' understanding; engaging and motivating students; having hands-on activity; and students' working in group and interact with each other. In addition, they also mentioned about the effectiveness of relating mathematics to real life.

In Australia, Perry (2007) interviewed thirteen primary excellent teachers. These teachers viewed effective lessons as lessons that were planned based on the needs

of students yet flexible enough to change; children and teacher respect each others' views; students were actively engaged; students have a clear goal to be reached; plenty of meaningful questioning; and have a certain structure or routine.

In Hong Kong, there were three studies (Wong, 2007; Wong et al., 2009; Mok, 2009) carried out with the same themes of exploring the teachers' views of effective mathematics teaching. Different methods were used in these two studies, in the first study (Wong, 2007), teachers were invited for a face-to-face semi-structured interviews, whereas in the second study (Wong, et al. 2009), lesson observations and several interviews (which included interview for collecting demographic data, pre-observation interview, post-observation interview, interview based on hypothetical situations) were conducted with the participating teachers. In addition to these two studies, the third study (Mok, 2009) was part of Learner's Perspective Study (LPS). Mok (2009) observed and video recorded lessons, then asked the teacher to comment on what he/she perceived as important in that particular lessons. Table 2.1 shows the different participants in these studies (Wong, 2007; Wong et al., 2009; Mok, 2009).

Table 2.1

*Demographic Information of Participants in Three Studies Done in Hong Kong*

Study	Level of students being taught	Competency of the teacher
Wong (2007)	Primary	Experienced (Expert) teacher
Wong et al. (2009)	Primary	General teacher
Mok (2009)	Secondary	Recommended as good teacher by local mathematics educators, school principal, colleagues and students

In the first study (Wong, 2007), teachers believed that mathematics lessons were effective if students understand the content; students participate fully in the lesson; and the objectives of lesson which were closely coherent with the curriculum objectives were achieved. In the second study (Wong et al., 2009), the researchers found that the characteristics of effective mathematics lessons listed out by the seven participating teachers included learning by doing a lot of exercises; from rigid to flexible; enhancing students' understanding, thinking and skills of problem solving; teacher as mentor in helping students from solving problem by imitating the right ways of solving problem to solving these problem by themselves and solving standard problems to non-routine problems. In the last study (Mok, 2009), when the teacher reflected on one of his lesson, he commented that developed new knowledge from old knowledge; aware of the difficult point; making comparison; developing a habit in mathematics; and catering for the need of the students were important in his lesson.

By reviewing the findings of three studies (Wong, 2007; Wong et al., 2009; Mok, 2009), it was found that the findings showed both similarities and differences. Teachers from study carried out by Wong (2007) and Wong et al. (2009) reported the effectiveness of students' understanding of content. The deviations of findings might be due to the participants of these studies were different in level of students being taught and the competency of the teachers. However, by comparing the findings of these studies, it was found that Hong Kong teachers perceived that lesson that was teacher-led as effective. They used several kinds of approach in leading their students to understanding, such as developed new knowledge from old knowledge; aware of the difficult point; making comparison; teacher as mentor in helping students from solving

problem by imitating the right ways of solving problem to solving these problem by themselves and solving standard problems to non-routine problems and so forth.

In China, three studies (Wang & Cai, 2007a; Li et al., 2009; Mok, 2006) were done to explore the China teachers perceptions of effective mathematics lesson. The first study (Wang & Cai, 2007a) was done by interviewing nine experienced teachers; the second study (Li et al., 2009) was done by asking 11 elementary mathematics teachers to write free essay entitled “what is a good mathematics lesson?”; while the last study (Mok, 2006) was part of LPS, lessons were observed followed by teacher reflecting on their own lessons.

Wang and Cai (2007a) found that the characteristics of effective mathematics lessons listed by the nine teachers included having a coherent structure which including consecutive process of introducing, explaining, questioning, practicing and summarizing; covering sufficient content and practice; good questioning and answering processes; flexible teaching according to the spontaneous classroom situation; and appropriately using concrete mathematics examples.

Li et al. (2009) classified their findings from analyzing the free essay written by the participating teachers into four categories. Among the four categories, the category of “students and learning” (53%) was mentioned by the teachers the most, followed by the category of “teacher and teaching” (28%), “instructional content” (13%), and “classroom context” (6%). Under the category of “students and learning”, the teachers mentioned about student-centered instruction; students motivated to participate; students’ exploration and discovery; and students’ learning for understanding. While under the category of “teacher and teaching”, they said about the effectiveness of having

innovative instruction concept; effective teaching with low pressure; fulfilling instructional objectives; and using different teaching methods flexibly. In addition, these teachers also disclosed the importance of rich and/or solid content and connecting mathematics with real life.

After asking a teacher to comment on important episodes in his own lesson, Mok (2006) reported that this teacher pointed the effectiveness of foundation and linkage of knowledge; standardized language; and let the students think.

By comparing the findings of these studies (Wang & Cai, 2007; Li et al., 2009; Mok, 2006), it was found that China teacher believed that effective mathematics lesson was flexible teaching and covering sufficient content.

The studies discussed above studied the teachers' beliefs of effective mathematics lesson by interviewing them or asking them to write essays. There were researchers (Zhao & Ma, 2007; Huang, Chen & Zhao, 2005; Huang & Li, 2009a) studied the teachers' beliefs of effective mathematics lesson by using another method. They provided the participating teachers with video-taped lesson and asked them to evaluate the lessons in order to determine the aspects emphasized by teachers when they were talking about effective mathematics lesson.

Zhao and Ma (2007) carried out the research by interviewing five master teachers at elementary school level. They found that these teachers perceived that an effective mathematics lesson should have: the clarity of the lesson's instructional goals and objectives; students' participation; and attaining of instructional goals and objectives.

Similarly, Huang et al. (2005) used video-taped lessons to interview the teacher, but the participants of their study were five master teachers at secondary school level.

They found that these teachers evaluated the lessons from the following aspects: students' participation; teacher's questioning skills; teacher's construction of learning situation; use of innovative students' learning methods; room for exploration; organization of teaching content; the design and quality of in-class exercise; and summary and evaluation of the lesson in the classroom.

In 2009, Huang and Li (2009a) extended the study of Huang et al. (2005) by using the same video-taped lessons. They modified the interview questions and collected written response from the teachers. The participants of the study were five master teachers at secondary school level. Huang and Li (2009a) analyzed the responses of these five master teachers and the response of another five master teachers in the study carried out by Huang et al. (2005). Huang and Li (2009a) found that the ten master teachers evaluated the lessons from five aspects: instructional objectives, instructional design, instructional procedure, learning environment, and teacher quality. Out of these five aspects, learning environment was given the first priority. The characteristics of learning environment valued by the master teachers were students' participation, self-exploratory learning, independent thinking, collaboration and exchange. Teacher's quality such as teacher's subject knowledge, teaching skill, and personality was given the second priority. Connection within and between lessons and well-developed knowledge are stressed in designing and delivering a lesson. Comprehensive instructional objectives were also an important factor being considered in the lesson evaluation.

Table 2.2

*Categorization of Findings of Previous Studies (Teacher's Perceptions of Effective Mathematics Lesson)*

Country/ Study	Teacher and teaching	Students and learning	Lesson structure	Instructional content	Classroom context
United States/ Wang & Cai (2007b)	<ul style="list-style-type: none"> <li>- Concrete example (relate to real life)</li> <li>- Teacher as a good facilitator</li> </ul>	<ul style="list-style-type: none"> <li>- Focusing on the students' understanding</li> <li>- Hands-on activity</li> <li>- Peer interaction</li> </ul>		<ul style="list-style-type: none"> <li>- Appropriate content</li> </ul>	
United States/ Wilson et al. (2005)	<ul style="list-style-type: none"> <li>- Relate to real life</li> <li>- Teacher's knowledge of mathematics and students</li> </ul>	<ul style="list-style-type: none"> <li>- Focusing on students' understanding</li> <li>- Engaging students</li> <li>- Students working in group</li> <li>- Hands-on activity</li> </ul>			<ul style="list-style-type: none"> <li>- Effectively managing classroom environment</li> </ul>
Australia/ Perry (2007)	<ul style="list-style-type: none"> <li>- Plenty of meaningful questioning</li> <li>- Lesson was planned yet flexible to change</li> </ul>	<ul style="list-style-type: none"> <li>- Active engagement</li> <li>- Children clear about their goal</li> </ul>	<ul style="list-style-type: none"> <li>- Have a routine of class</li> </ul>		<ul style="list-style-type: none"> <li>- Teacher and students respect each other's views</li> </ul>
Hong Kong/ Wong (2007)	<ul style="list-style-type: none"> <li>- Achievement of teaching objectives that closely coherent to the curriculum</li> </ul>	<ul style="list-style-type: none"> <li>- Students understand the content</li> <li>- Students' participation and engagement</li> </ul>			
Hong Kong/ Wong et al. (2009)	<ul style="list-style-type: none"> <li>- From rigid to flexible</li> <li>- Teacher act as mentor (at the beginning, teacher demonstrate the right ways and students imitating the correct way)</li> </ul>	<ul style="list-style-type: none"> <li>- Doing a lot of exercise</li> <li>- Enhance students' understanding, thinking and skill of problem solving</li> </ul>			

Table 2.2 Continued

Hong Kong/ Mok (2009)	<ul style="list-style-type: none"> <li>- Developed new knowledge from old knowledge</li> <li>- Aware of the difficult point</li> <li>- Making comparison</li> <li>- Developing a habits in mathematics</li> </ul>	<ul style="list-style-type: none"> <li>- Catering for the need of the students</li> </ul>			
China/ Wang & Cai (2007)	<ul style="list-style-type: none"> <li>- Highlight the essential points</li> <li>- Good questioning and answering process</li> <li>- Flexible teaching</li> <li>- Concrete object</li> </ul>	<ul style="list-style-type: none"> <li>- Sufficient practice (its needed to give the students practice after teaching a new content)</li> </ul>	<ul style="list-style-type: none"> <li>- Coherent structure</li> </ul>	<ul style="list-style-type: none"> <li>- Cover sufficient content</li> </ul>	
China/ Li et al. (2009)	<ul style="list-style-type: none"> <li>- 28%</li> <li>- Having innovative instruction concept</li> <li>- Effective teaching with low pressure</li> <li>- Fulfilling instructional objectives</li> <li>- Using different teaching methods flexibly</li> </ul>	<ul style="list-style-type: none"> <li>- 53%</li> <li>- Students-centred instruction</li> <li>- Students motivated to participate</li> <li>- Students' exploration and discovery</li> <li>- Students' learning for understanding</li> </ul>		<ul style="list-style-type: none"> <li>- 13%</li> <li>- Rich and/or solid content in mathematic</li> <li>- Connecting mathematics with real life</li> </ul>	<ul style="list-style-type: none"> <li>- 6%</li> <li>- Classroom context and interaction</li> </ul>
China/ Mok (2006)	<ul style="list-style-type: none"> <li>- Foundation and linkage of knowledge</li> <li>- Standardized language</li> </ul>	<ul style="list-style-type: none"> <li>- Let the students think</li> </ul>			