EFFETS OF LESSON STUDY INCORPORATING PHASE-BASED INSTRUCTION ON FORM ONE STUDENTS' ACHIEVEMENT AND LEARNING MOTIVATION IN GEOMETRY

MAK WAI FONG

UNIVERSITI SAINS MALAYSIA

2016

EFFETS OF LESSON STUDY INCORPORATING PHASE-BASED INSTRUCTION ON FORM ONE STUDENTS' ACHIEVEMENT AND LEARNING MOTIVATION IN GEOMETRY

by

MAK WAI FONG

Thesis submitted in fulfillment of the requirements for the degree of Master of Arts (Education)

February 2016

ACKNOWLEDGEMENT

Firstly, I would like to express my greatest gratitude to my supervisor, Assoc. Professor Dr. Chew Cheng Meng, for his patience, support and guidance. My deepest appreciation to him for his motivation and inspiration to enable me to present and published paper related to this study.

I would like to thank EPRD, Kedah State Education Department and Kuala Muda Yan District Education Office for the approval in conducting this study. I would also wish to thank the students, teachers and principals for their support and enthusiastic participation. Special thanks to Dr. Tan Yew Hor and sister Tan Saw Fen whom I have been seeking for advice. Without their support, this thesis would not have been possible.

My affectionate thanks to my husband Lim Ehu Chai and my sister Mei Chee for their unconditional love. My greatest gratitude to my beloved children, Jia Min, Jia Yen and Jia Jian, for their thoughtfulness, constant support and encouragement all along.

TABLE OF CONTENTS

CHAPTER 5 DISCUSSION AND CONCLUSION

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

Short Form	Full phrase
ANOVA	The One-way Between-subjects Analysis of Variance
ARCS	Attention Relevance Concentration Satisfaction
C	Lesson Study Cycle
D1	Control Group 1
D2	Control Group 2
D3	Control Group 3
E1	Experimental Group 1
E2	Experimental Group 2
E3	Experimental Group 3
IMMS	Instructional Materials Motivational Survey
JPNK	Jabatan Pendidikan Negeri Kedah
LS	Lesson Study
LSPB	Lesson Study incorporating Phase-based Instruction
MCQ	Multiple Choice Question
MEB	Malaysian Educational Blueprint 2013-2025
MKO	More Knowledgeable One
MOE	Malaysian Ministry of Education
NCTM	The National Council of Teachers of Mathematics
OEQ	Open-ended Question

Short Form	Full phrase
PB	Phase-based
PISA	Programme for International Student Assessment
PIRLS	Progress in International Reading Literacy Study
PMR	Malaysian Lower Secondary Assessment
SISC+	School Improvement Specialist Coach Plus.
SME	Subject Matter Expert
SPM	Malaysian Certificate of Education
SPSS	Statistical Package for the Social Sciences
TIMSS	Trends in International Mathematics and Science Study
UPSR	Malaysian Primary School Evaluation Test
ZPD	Zone of Proximal Development

KESAN KAJIAN PELAJARAN MENGINTEGRASIKAN PENGAJARAN BERASASKAN FASA TERHADAP PENCAPAIAN GEOMETRI DAN MOTIVASI PEMBELAJARAN GEOMETRI MURID TINGKATAN SATU

ABSTRAK

Penekanan pendidikan STEM dalam Pelan Pembangunan Pendidikan 2013-2025 menjadikan pembelajaran geometri bertambah penting. Kajian ini adalah bertujuan untuk menentukan kesan Kajian Pelajaran menginterasikan Pengajaran Berasasakan Fasa (LSPB) terhadap pencapaian geometri dan motivasi pembelajaran geometri murid Tingkatan Satu berbandingan dengan pengajaran konvensional. Di samping itu, kajian ini juga untuk mengenalpasti kesan LSPB terhadap pencapaian geometri dan motivasi dalam pembelajaran geometri bagi kumpulan kajian LSPB asal (E1), kumpulan kajian semakan pertama (E2) dan kumpulan kajian semakan kedua (E3). Sampel yang terlibat dalam kajian ini adalah terdiri daripada 154 orang murid berpencapaian rendah dan enam orang guru matematik dari dua buah sekolah bandar. Kajian ini menggunakan reka bentuk kuasi eksperimental. Instrumen yang digunakan dalam kajian ini adalah Ujian Pra dan Ujian Pasca untuk menilai pencapaian geometri murid dan soal-selidik *Instructional Material Motivation Survey (IMMS)* untuk menilai motivasi pembelajaran geometri murid. Data kutipan dianalisis menggunakan SPSS versi 21. Hasil kajian mendapati bahawa terdapat perbezaan yang signifikan pada tahap $p < .01$ dalam pencapaian geometri dan motivasi pembelajaran geometri antara

kumpulan eksperimen dan kumpulan kawalan. Melalui pengajaran LSPB, analisis ANOVA satu hala antara subjek juga menunjukkan perbezaan signifikan dalam pencapaian geometri [F(2, 74)= 5.86, p= .004] antara tiga kumpulan murid eksperimen LSPB (E1- kumpulan kajian asal, E2- kumpulan kajian semakan pertama dan E3- kumpulan kajian semakan kedua), tetapi tiada perbezaan signifikan dalam motivasi pembelajaran geometri. Perbandingan Post hoc menunjukkan terdapat perbezaan signifikan dalam pencapaian geometri antara kumpulan E1 dan E3. Dapatan kajian menunjukkan bahawa LSPB meningkatkan pencapaian geometri dan motivasi pembelajaran geometri murid tingkatan satu berbanding dengan pengajaran konvensional. Selain daripada itu, pengajaran LSPB untuk kumpulan kajian semakan kedua telah memberi kesan yang lebih positif terhadap pencapaiaan geometri murid.

EFFECTS OF LESSON STUDY INCORPORATING PHASE-BASED INSTRUCTION ON FORM ONE STUDENTS' ACHIEVEMENT AND LEARNING MOTIVATION IN GEOMETRY

ABSTRACT

Learning geometry is emphasized as Malaysia has placed great importance in STEM education in The Malaysian Education Blueprint 2013-2025.This study was undertaken to ascertain the effects of Lesson Study incorporating Phase-based (LSPB) instruction on Form One students' geometry achievements and geometry learning motivation as compared to conventional instruction. This study also investigates the effects of LSPB on geometry achievement and motivation in learning geometry of the initial LSPB group (E1), the revised LSPB group (E2) and the re-revised LSPB group (E3). A sample of 154 low achievement students from two urban schools and six mathematics teachers were involved in this study. The researcher employed a quasi-experimental design. The instruments used in this study were the end-of-unit tests (pretests and posttests) to measure students' geometry achievement and the Instructional Material Motivation Survey (IMMS) to measure students' geometry learning motivation. Data obtained from the study were analyzed using SPSS version 21. The results revealed that there are significant differences at $p < .01$ level on geometry achievement and geometry learning motivation between the experimental group and the control group. With LSPB instruction, the one-way between-subjects analysis of variance (ANOVA) also

shows that there is a significant difference in geometry achievement [F (2, 74) = 5.86, p = .004] among the three experimental groups of students (E1-co-planned lesson, E2-revised lesson and E3-re-revised lesson) but no significant difference in geometry learning motivation. Post hoc comparisons indicated that there was a significant difference in geometry achievement between groups E1 and E3. These results implied that LSPB instruction improved Form One students' geometry achievement and geometry learning motivation compared to conventional instruction. Besides that, the re-revised lessons of LSPB instruction also yielded greater positive effect on students' geometry achievement.

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Mathematics is important in our nation's development as The Malaysian Educational Blueprint 2013-2025 has placed great importance on a STEM (Science, Technology, Engineering and Mathematics) driven economy. As geometry is the basic skill in mathematics (Hoffer & Hoffer, 1992; NTCM, 2000) the role of geometry in nation building cannot be downplayed. Geometry has been recognized as the heart of mathematics (Mlodinow, 2001). Learning geometry is important as geometrical thinking not only engage and connect learner between the real world with mathematics or other branches of sciences (Royal Society / Joint Mathematical Council, 2001; Mlodinow, 2001), but also in a wide array of scientific, technical field or even art courses since its principles are applicable. Learner can solve problems more easily when they represent the problems geometrically.

Recognition of geometry as a basic skill in mathematics has resulted in an increased emphasis on geometry in the revised Mathematics Curriculum 2006 by the Malaysian Ministry of Education (MOE). Topics on geometry contributed 32 chapters out of the 61 chapters in the Form 1 to Form 5 Malaysian Secondary School Mathematics Curriculum Specification. Thus, geometry has formed a significant component in Mathematics Curriculum for all students in Malaysia aged 11 to 19.

The Malaysian Board of Examination also places the importance of learning geometry in mathematics education. The number of questions to assess the geometric thinking of students at primary and secondary school public examinations has been increased. This is obviously shown in the percentage of geometry questions in Mathematics in public examinations, whereby questions on geometry contribute 15% in the *Ujian Pentaksiran Sekolah Rendah (UPSR)*, 45% in the *Penilaian Menengah Rendah (PMR)* and approximately 78% in the *Sijil Pelajaran Malaysia (SPM)* Mathematics Paper 2 (refer to Table 1.1).

Table 1.1
Percentage of Geometry Questions in SPM Mathematics 1449/2 (2010-2014)

Year	Number of Geometry Question /16	Total Marks from Geometry Questions /112	%
2010	11	87	77.68
2011	11	88	78.57
2012	11	88	78.57
2013	12	86	76.79
2014	12	88	78.57
		437	78.04

Geometric thinking enables students to analyse the properties of two- dimensional and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships, to specify locations and spatial relationship, to apply transformations and to use symmetry, visualization, spatial reasoning, and geometric modeling to solve problems (NCTM, 2000). Application of geometry is important in helping students to understand better basic mathematics concepts. Number lines are often used in learning basic skill of arithmetic, addition and subtraction, directed numbers and linear inequalities. Geometrical shapes are useful in learning statistics for data

representation in pictograms, bar graphs and pie charts, fractions, percentages, rates and ratio, and algebra. Therefore, "geometry is a unifying theme to the entire Mathematics Curriculum and as such is a rich source of visualization for arithmetical, algebraic and statistical concepts" (Sherard, 1981, p. 20).

Geometry teaches us the basic skill of logical thinking and reasoning. Geometry is used almost in all types of jobs and in our daily life for scheduling and planning our day efficiently. For example, geometry is applied in mapping the positions of the stars and planets on the celestial sphere, coordinates is used when reading a map and artists use their knowledge of geometry in creating their master pieces.

Obviously, geometry is fundamental and instrumental in learning mathematics. But Malaysian students face difficulties in learning geometry due to ineffective geometry classroom instruction (Noraini, 2006). Effect of traditional, rote-memorisation, drill and practice geometry classroom instructions have resulted students with poor reasoning skills and low visualization abilities. Students are unable to extract information from given data and are unable to interpret answers and make conclusions. Thus, the provision of quality geometry education to promote better geometric achievement and motivation in learning geometry is critical in our education process. As Stigler and Hiebert (1999) posited, changes in teaching is essential. And most important is what is happening in the classroom that could make the difference. We need teachers who are willing to work collaboratively, to infuse the best ideas into the geometry classroom and to improve teaching with research lesson (Stigler & Hiebert, 1999).

The Malaysian Educational Blueprint 2013 -2025 (MEB) was fully launched in 2013. One of the aspirations is to create a peer-led culture of professional excellence in Wave 3 (2021-2025), whereby teachers mentor and inspire one another, share best practices and peer coaching each other to meet professional standard. To enable teacher professional development through Lesson Study, Ministry of Education Malaysia (MOE) also has requested schools to prepare timetable that enables common lesson planning and study period for all science and mathematics teachers, so that teachers can have better lesson planning and sharing of best practices. The purpose for these policies is to improve student's achievement through classroom instruction.

In view of the benefits of teacher collaboration to share good classroom practices, Lesson Study was introduced as an on-site teacher development approach to further strengthen continual school-based teacher professional development in Malaysia. Lesson Study originated from Japanese Elementary Education. Lesson Study involves research lessons that improve teachings and knowledge whereby teachers work in small teams to plan, teach, observe, analyze and refine individual class lessons. Teachers also observe lessons at schools that host lesson study open house. The research lessons are published and widely disseminated throughout the country. Japanese lesson study is a commonly used teacher-led system for the improvement of teaching and learning.

The two key features of Lesson Study are;

(i) Collaborative culture of Lesson Study that involves continuing sharing of effective pedagogy among teachers, whereby teachers interact and observe one another's classroom practice. This collaborative nature helps strengthen relationships among

teachers, enhances professional collegial bonds and improves classroom practice (Stigler & Hiebert, 1999)

(ii) Reflective practice improves teachers' instructional strategies. Through reflection on teaching and group discussions, collaboratively teachers solve their teaching problems, improve their professional knowledge and pedagogical techniques (Fernandez & Yoshida, 2004).

1.2 Statement of the Problem

Malaysian Form Two students participated in TIMSS since 1999. The purpose of our participation is to know our students' achievement in an international context, to determine where the areas of greatest educational need and thus to gauge where reform might be needed in our country.

Malaysian students' geometry achievement in TIMSS is declining. The Average Scale Scores in geometry in TIMSS were 497 in 1999 (Mullis et al., 2000), 495 in 2003 (Mullis, Martin, Gonzalez, & Chrostowski, 2004), 474 in 2007 (Mullis, Martin, & Foy, 2008) and 432 in 2011 (Mullis, Martin, & Foy, 2012). Malaysia was ranked sixteenth in geometry achievement in TIMSS 1999 and TIMSS 2003 (Mullis el al., 2000; Mullis el al., 2004). In TIMSS 2007, Malaysia was ranked twenty-fourth and twentieth in TIMSS 2011 (Mullis el al., 2008; Mullis el al., 2012). The underlying challenge for the study of TIMSS achievement is to determine more about effective classroom teaching and learning of our country. The low rankings of geometry achievement in TIMSS indirectly

reflected that our Malaysian Form Two students' levels of geometric thinking are still far from satisfactory.

Despite the importance of geometry, schools or District Education Office hardly carry out studies or analysis of students' geometry achievement. Besides that, it is difficult to obtain students' geometry achievement from the Malaysian Examination Board.

In the Malaysian Public Examination, SPM (2013), students' mathematics achievement in scoring 'As' shows a decline compare to other subjects such as Bahasa Malaysia (+1.5%), English (-0.3%), Science (+6.1%) and History (+9.2%). The percentage of students scoring A+, A and A- have dropped by 1.1% and the Average Grade Score has 'decrease' by 0.08 from 4.91 to 4.99 (the Grade Score for SPM is ; 0 for A+ , 1 for A , 2 for A- , 3 for B+……. and 9 for failing the subject) (MOE, 2013). The declined in SPM mathematics results alerted the mathematics educators.

An analysis from the Kuala Muda Yan District Education Office (Kedah) on the students' mathematics achievements (*PMR and SPM*) of 39 secondary schools in 2013 in Table 1.1 revealed that many students passed mathematics but with low grades (Grade C). As geometry contributes a great portion in the mathematics questions in the examinations (45% in *PMR* and 75% in *SPM),* the results indirectly indicate that the students are weak in geometric concepts. The analysis also shows that there is an obvious decline in the percentage of passes and Average Grade Score in SPM mathematics compared to PMR.

This is due to the increase number of geometry examination questions in SPM mathematics (from 45% to 75%) and also students who have yet to master the basic concepts in geometry are unable to cope with geometry questions of higher levels of geometric thinking (van Hiele, 1986).

Table 1.2

Analysis of Mathematics Achievements in PMR and SPM 2013 in The District of Kuala Muda Yan ,Kedah.

Examination	% of Passes	Average Grade Score
PMR	94.91	*2.9 (Grade C)
SPM	78.39	5.38 (Grade C- a weak credit)

Source: Kedah State Education Department.
Note: * Grade Score for PMR is 1 for A, 2 for B, 3 for C, 4 for D and 5 for E

The difficulties encountered by students in geometry also are reflected in the examiner‘s report released by the *Laporan Pretasi PMR* 2003 (Malaysian Examination Syndicate, pp. 69-72). The report specifically stated that a great number of students were unable to answer the geometry questions in PMR Mathematics Paper 2 (numbered 15-20). In addition, students were also weak in using the geometry construction tools (compasses and protractors). Thus, the topic on Form One Lines and Angles is selected for this study.

In this topic, students are required to understand the concept of angles, the concept of parallel, intersecting and perpendicular lines, and use the properties of angles associated with intersecting lines to solve problems (MOE, 2003). As this topic is the first exposure students experience in learning about lines and angles in mathematics education, students need a very strong foundation in mastering the use of protractor to construct and

measure angles. Students have to master these skills before they are able to learn the properties of angles in polygons.

In learning geometry, Van Hiele (1986) proposes a five-level geometry thinking model. A study by Kuek and Hafizan (2011) to investigate mastery level of Form 4 students on Solid Geometry discovered that, students achieved the highest in Level 1, Visualization (53.21%), followed by Level 2, Analysis (16.79%), Level 3, Informal Deduction (15.09%), and Level 4, Formal Deduction (14.91%), Level 5, Rigor (was being not evaluated). Students have highest understanding or mastery at the first level but their mastery level get lower as it goes down along the level of van Hiele .Whereas, the minimum goal for all the Malaysian secondary school geometry contents is up to van Hiele Level 3. Secondary school students should be able to identify properties of figures (Level 2), and understand definitions of geometric concepts. In addition, the students should be able to classify figures hierarchically by ordering their properties and give informal arguments to justify their classifications (Level 3) (MOE, 2013).

Besides the low geometric thinking among the Malaysian secondary students, a study on the geometry thinking of the pre-service mathematics teachers by Nyet and Sopiah (2012) revealed that 88% of the pre-service mathematics teachers attained complete acquisition of van Hiele Level 1 (visualisation), 82.3% attained Level 2 (analysis), and 33.9% attained Level 3 and none were assigned to Level 4 and 5. These findings show that a great number of pre-service secondary mathematics teachers have not attained the required geometric thinking level to teach the required geometry

curriculum in secondary school. These results signal the urgency to enhance students' and teachers' levels of geometric thinking.

Students' geometry achievement and motivation in learning geometry are inter-related. Studies by Pintrich and Ryan (1997) indicated there was a positive correlation between a student's motivation and student's achievement in geometry. Research also showed that the main factor in declining achievement was due to significant decline in student motivation in learning as students move through the various mathematics curricula from elementary to middle school (Gottfried, Marcoulides, Gottfried, Oliver, & Guerin, 2007). If students fail to master the basic geometry concepts when they were in the middle school, with poor geometry background, they will face more difficulties as the geometry curriculum moves from the concrete to the abstract. Thus, students' with declining grades will result in reduced learning motivation. This will eventually lead to lack of learning motivation in geometry, many students do not know the basic geometry terminology and principles when they leave school.

According to Stipek (1998), the nature of instruction strongly impact students' motivation. Studies have shown that the boring and meaningless drill and practice was the most common teaching approach adopted by Malaysian mathematics teachers (Lim, 2010).Teaching and learning geometry is dominated by teacher-centered and textbook oriented approach (Lim & Hwa, 2007). There is minimal use of visualization tools such as the Dynamic Geometrical Tool and graphing tools in geometry classroom (Pumadevi, 2004). Consequently, fewer Malaysian students are motivated to study geometry.

van Hiele (1986) believed that students' geometry achievement could be improved through teachers' instruction that is appropriate to students' thinking levels. And the Keller ARCS of Motivational Model could stimulate and sustain students' motivation in the classroom (Keller, 1983). By using curriculum that incorporates elements of attention, relevance, confidence, and satisfaction (ARCS), student motivation will increase (Small, 1997). The problem is lacking research that combined the ARCS model with the van Hiele's model and there is insufficient evidence which technique of teaching would enhance students' geometry achievement and geometry learning motivation.

Instructional practices have proven to be powerful factors influencing students' motivation and performance (Stipek, 1998; Wentzel & Wigfield, 1998). Thus, one of the aspirations of Malaysian Educational Blueprint (Wave 3, 2021-2025) is to create a peer-led culture of professional excellence, wherein teachers inspire one another and hold their peers accountable for meeting professional standards. Studies have also shown that the collaborative culture and the reflective practice in LS have increased teachers' teaching effectiveness (Cheah & Lim, 2010; Chew, Lim, Wun & Lim, 2012; Fernandez & Yoshida, 2004) and effective Lesson Study has been shown to have long-term impact on students' learning and better academic performance (Takahashi & Yoshida, 2004). Everything we do at policy level eventually has to go down to the classroom (Stigler & Hiebert, 1999). Therefore, Lesson Study is used in this study to see its effect on students' geometry achievement and motivation in learning geometry.

1.3 Rationale of the Study

The quality of teachers is the most significant school-based determinant of student outcomes (Sander & River, 1996). A study by of Malaysia Higher Education Leadership Academy (MOE, 2013) found that, 50% of the lessons observed, out of 125 lessons in 41 schools were delivered unsatisfactorily. Besides that, feedback from the National Dialogue with more than 12,000 members of public and specific stakeholders reported that schools in Malaysia are in the dire need to enhance the quality of teachers (MOE, 2013).

To upgrade Malaysian teachers' quality, in 2007, Malaysian government raised the pre-service training qualification for teachers from a diploma to a bachelor's degree. MOE also mandated the requirement of seven days per year on professional development for teachers. Report from the Teaching and Learning International Survey (TALIS) found that the participation of teachers in professional development activities has been very good. Over 90% of teachers spend approximately 10 days each year on professional development. But teachers do not practise what they have learnt during the in-service training in the classroom. International research demonstrates that on-site training in the actual classroom is more effective than off-site training (Jacob & Lefgren, 2004; Stigler & Hiebert, 1999)**.** Therefore, recruiting highly qualified teachers, one-day workshops or in-service trainings practices will not result in improved classroom instruction. Tyack and Cuban (1995) suggested, if we are to achieve lasting improvements in classroom teaching and learning, we must focus on methods to help teachers improve instruction from the inside out. Lesson Study involves strong, continuous collaboration among teachers to get

together to plan and carry out real classroom teaching and then improve the taught lesson through reflection, review and revision. This process of continuous improvement will be a good model for teacher professional development which will eventually improve the quality of teaching in the classroom.

Lesson Study provides teachers with an opportunity to discuss and refine the content of the topic on Lines and Angles. Teachers would understand more deeply, have many thought-provoking, enriching conversations on pedagogical skills to engage students with hands-on usage of the protractors to construct and measure angles, to plan activities that involve students to understand and use the concept of lines and angles and thus solve problems associated with parallel lines and intersecting lines. Through Lesson Study also students can learn a great deal about how students understand and approach the content of Lines and Angles. In addition, Lesson Study can greatly influence teachers' attitude about teaching, which will in turn shape teaching in the classroom.

It is important that School Administrators give full support and monitor the implementation of Lesson Study in schools. Kedah State Education Department reviewed that 64 schools have implemented Lesson Study since 2011. But responses from the participating schools and teachers were not satisfactory. One of the contributing factors to the failure of the program is due to the lack of support and right guidance in the implementation of Lesson Study. This affects the confidence of the teachers in carrying out the activities. Therefore, this study is important to serve as guidelines to schools to conduct Lesson Study successfully.

In learning geometry, Van Hiele's Phases of Learning provides guidance in assisting students to move from one level of geometric thinking to a higher level (Crowley, 1987). With assistance from teachers, these five phases of learning provide a structured lesson that assist students to discuss and application of geometrical concepts, and to develop a more technical use of geometry language. Crowley (1987) posited, in the information phase, the interaction between teacher and students through discussion is emphasised. In the guided orientation phase, students make discoveries using guided activity. In the explicitation phase, students explain and express their views about the observed structure. In the free orientation phase, students solve more complex tasks. In the integration phase, students summaries the lesson learnt for the purpose of establishing a new overall view. According to Chew (2009), students must go through the information, guided orientation, explicitation, free orientation, and integration phases to advance from the first level to the second level, and then they have to go through the same phases to advance to the next stages. In this study, teachers in the experiment group will collaboratively plan structured lessons and activities that help students to explore and understand the planned geometry lessons better.

Studies also found that there is a positive correlation between students' achievement and motivation in learning mathematics (Ryan & Pintrich ,1997; Keller ,1998). Teachers face great challenge in stimulating and sustaining students' motivation towards learning. Stipek (1998) also claims that teachers have more influence on students' learning motivation in mathematics because they spend most of their times in the schools. The ARCS model of motivation (Keller, 1999) provides the guidance for

analyzing the motivational characteristics and designing motivational strategies that incorporated into lesson planning. Firstly, a lesson must gain students' attention with unexpected events or variation in teacher's instruction to arouse curiosity. The second requirement is to build relevance by connecting the content to important goals of the students, their past interests, and their learning styles. The third condition required for motivation is confidence by making the objectives clear and providing examples of acceptable achievements. To sustain continual motivation, the fourth condition-satisfaction is required to give recognition and evidence of success that support students' intrinsic feelings. These requirements are incorporated in planning lessons in this study, with clear and meaningful task activities that cater students of variation in interests, capabilities, and intelligences.

1.4 Objectives of the Study

The research objectives are as follows:

1. To determine the effect of Lesson Study incorporating Phase-based instruction on Form One students' geometry achievement as compared to conventional instruction.

2. To determine the effect of Lesson Study incorporating Phase-based instruction on Form One students' geometry learning motivation as compared to conventional instruction.

3. To determine whether there is a significant difference in geometry achievement among students who followed the initial lessons (Group E1), students who

followed the revised lessons (Group E2) and students who followed the re-revised lessons (Group E3) of Lesson Study incorporating Phase-based instruction.

4. To determine whether there is a significant difference in geometry learning motivation among students who followed the initial lessons (Group E1), students who followed the revised lessons (Group E2) and students who followed the re-revised lessons (Group E3) of Lesson Study incorporating Phase-based instruction.

1.5 Research Questions

Based on the objectives above, this study seeks to find answers to the following four research questions:

1. Is there a significant difference in geometry achievement between Form One students who learned Geometry through Lesson Study incorporating Phase-based instruction and Form One students who learned geometry through conventional instruction?

2. Is there a significant difference in geometry learning motivation between Form One students who learned geometry through Lesson Study incorporating Phase-based instruction and Form One students who learned geometry through conventional instruction?

3. Is there a significant difference in geometry achievement among students who followed the initial lessons (Group E1), students who followed the revised lessons (Group E2) and students who followed the re-revised lessons (Group E3) of Lesson Study incorporating Phase-based instruction?

4. Is there a significant difference in geometry learning motivation among students who followed the initial lessons (Group E1), students who followed the revised lessons (Group E2) and students who followed the re-revised lessons (Group E3) of Lesson Study incorporating Phase-based instruction?

1.6 Null Hypotheses

The null hypotheses of the study are as follows:

Ho1: There is no significant difference in geometry achievement between Form One students who learned geometry through Lesson Study incorporating Phase-based instruction and Form One students who learned geometry through conventional instruction.

Ho2: There is no significant difference in geometry learning motivation between Form One students who learned geometry through Lesson Study incorporating Phase-based instruction and Form One students who learned geometry through conventional instruction.

Ho3: There is no significant difference in geometry achievement among students who followed the initial lessons (Group E1), students who followed the revised lessons (Group E2) and students who followed the re-revised lessons (Group E3) of Lesson Study incorporating Phase-based instruction.

Ho4: There is no significant difference in geometry learning motivation among students who followed the initial lessons (Group E1), students who followed the revised lessons (Group E2) and students who followed the re-revised lessons (Group E3) of Lesson Study incorporating Phase- based instruction.

1.7 Significance of the Study

Geometric concepts are often neglected as teachings of computational skills are more emphasized in the elementary and middle level schools (Noraini, 2006). In this era of educational transformation, it is vital that Malaysian teachers are capable in guiding our students with logical reasoning skills on geometry, so that they are able to build on subsequently more rigorous experiences of formal geometry.

Geometry is the basic skill in learning mathematics. This study is to examine the effects of Lesson Study incorporating Phase-based (LSPB) instruction on geometry achievement and motivation in learning geometry among the secondary school students. Geometry contributes 61 % of the topics in the Malaysian Secondary School Mathematics Curriculum Specification. Effective LSPB instruction will help to promote effective classroom practice. This will eventually help to promote students' interest in learning geometry, raise the standard of mathematics among the students and helping them to achieve good grades at their National Examination (SPM). Our ultimate goal is to prepare our students to face the challenges in this increasing competitive global environment. This study specifically will:

- promote collaborative learning among teachers
- provide guidelines for teachers to carry out Lesson Study and Phase-based instruction to improve their classroom practice.
- provide guidelines for the State and District Education Department and school Proficiency Development Panel to carry out Lesson Study and

Phase-based instruction to aid the professional development of mathematics teachers

- provide guidelines for teacher-training colleges the application of Lesson Study and Phase-based instruction in their training of student–teacher.
- the methodology used in the present study can be duplicated in other studies to provide insights in other settings.

1.8 Limitations of the Study

The scope of this study is limited. Only two schools with approximately 154 participants from Kuala Muda District, Kedah were involved in this study and do not represent all secondary school students in this country. Therefore, the findings cannot be generalized nationwide.

The participating teachers are teaching mathematics in schools, but they were not mathematics option while in the universities. These teachers may not have mastered the mathematics contents and pedagogical knowledge as the mathematics option teachers. Although the teachers have gone through the same process of Lesson Study and Phase-based workshops as planned, but the researcher cannot control the commitments and natural talent of these teachers which may vary.

The students and teacher participants in the study are selected based on their placement in their respective classes. The subjects come from intact classes and cannot be chosen at random as this will disrupt the teaching and learning processes in school. The

selection of the sample school is also dependent on at least three teachers are allocated to teach Form One mathematics as required by one cycle of LSPB to be carried out.

The researcher as the MKO in this study is the participating schools' Mathematics School Improvement Specialist Coach. This may create unnecessary negative perceptions of the teacher and student participants.

The findings in this study are limited to the topic on Lines and Angles in Form One. It represents only one topic out of the 13 topics in the Malaysian Form One Mathematics Curriculum. Thus, the findings cannot be generalized as Malaysian students' mathematics achievement.

1.9 Operational Definitions of Key Terms

1.9.1 Lesson Study Incorporating Phase-based Instruction

Lesson Study is an ongoing, comprehensive professional development process which involved a small group of teachers under the coordination of an elected team leader. In Phase 1, the teachers will get together, work collaboratively to discuss and plan the lessons (Form One, Lines and Angles) based on van Hiele's Phases of Learning incorporating Keller' ARCS of Motivation. In Phase 2, one of the teachers will teach and observe by the other teachers. In Phase 3, the teachers will get together to study student misconceptions, to reflect and discuss to make modifications to the lesson. In Phase 4, re-teaching the improved lesson and reflection on the lesson will be carried out. The result

of the Lesson Study will be a better lesson plan that can be used by any teacher who wishes to teach the same content (Becker, Ghenciu, Horak & Schroeder, 2008)

1.9.2 Conventional Instruction

Conventional instruction is teacher-centred and rote learning. In the geometry class, teacher will show a few examples on writing boards, students are then drilled to practice the contents and skills that will be tested in the public examination. Students are made to memorise the mathematical formulae and the steps to find the answers,

1.9.3 Geometry Achievement

Students' achievement will be assessed using the end- of–unit test. A pretest and posttest will be carried out before and after the LSPB instruction. Comparison of the pretest and posttest results will reflect the effect of the treatment given.

1.9.4 Geometry Learning Motivation

Motivation is viewed as inner drive or desire to succeed. In this study, the Instructional Materials Motivational Survey based on Keller's Arcs of Motivation in Learning is adopted. A pre-survey and post-survey will be carried out before and after the LSPB instruction. Comparison of the scores obtain will reflect the effect of the treatment given.

1.9.5 Form One Students

Students aged 13 in the National Secondary School at Kuala Muda District, Kedah. The students in this study are of below average achievement in mathematics from

two Band 5 schools. These students are expected to have attained Level 1 (Visualisation) in the Van Hieles Model of Thinking in Geometry.

1.9.6 Teachers

Teachers with at least 4 years of teaching experience in mathematics at the National Secondary School in the Kuala Muda District, Kedah. The teachers are graduates from universities, but may or may not be trained in teaching mathematics. These teachers are under the coaching of School Improvement Specialist Coaches Plus (mathematics).

1.9.7 Lines and Angles (I)

Form One students study Lines and Angles (I) under element Shape and Space in mathematics. In this topic, students are expected to be able to recognize, label and name the different types of angles, draw and measure angles with protractors, identify intersecting lines, parallel lines and perpendicular lines, determine the value of angles on a line and solve problems involving angles formed by intersecting lines.

1.9.8 Summary

This chapter discusses the importance of mastering geometry among Form One students in the secondary schools in Malaysia. Subsequently, discussions of the problems related to geometry achievement and geometry learning motivation to give an insight into the existing situation of learning geometry in Malaysian schools. The need of teacher professional development through LSPB is also stressed as a means to overcome the

problem. In conclusion, this chapter presents arguments on the need for this study and the effect of LSPB instruction on Form One students' geometry achievement and students' geometry learning motivation. Four research questions and four null hypotheses were put forward. And finally, operational definitions of terms relevant to this study were discussed.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter deals with the theoretical perspectives and review of research literature on lesson study, students' geometry achievement and motivation in learning geometry. In section 2.2, Lesson Study, history of Lesson Study, Lesson Study cycle and components of Lesson Study are discussed. Section 2.3 discusses students' geometry achievement in TIMSS and factors affecting geometry achievement. Motivation in learning geometry and factors affecting motivation are discussed in sections 2.3 and 2.4. This chapter also focuses on Lev Vykotsky's Theory in carrying out the lesson study, the van Hiele Model of Learning Geometry and Keller's ARCS of Motivation Model. The theoretical framework of this study is discussed in section 2.6.

2.2 Lesson Study

Lesson Study (LS) originated from Japan during the time of Meiji in late nineteenth century. LS in Japanese is *jugyou kenkyuu* meaning research or study on lessons (Lewis, Perry, & Murata, 2006). LS caught the attention of mathematics educators world-wide when the Japanese students scored the highest percentage in TIMSS 1995 and was highlighted in the book The Teaching Gap (Stigler & Heiebert, 1999).

LS project in Malaysia was initiated by Lim and Chiew in 2004 in two semi-urban secondary schools in Kedah. They explored on the effects of LS process on mathematics teacher's content knowledge and teaching practices. Their study found that LS had influenced the teachers' content and pedagogical knowledge (Chiew & Lim, 2005). Thus LS was high-lighted as a school-based teacher professional development to strengthen teachers' quality. Their efforts in the research of LS also had promoted the practice of LS in Malaysia. LS were more widely spread globally through the formation of World Association of Lesson Study (Wals) and Asian Pacific Economic Cooperation (APEC) funded projects.

The main features of LS are as follows:

1. Shared long - term goal as "teaching is a cultural activity, it will not change drastically" (Stigler & Hiebert 1999, p. 121).
2. Peer observation on students' learning, focus on lesson content and subject matter. This will "enhance pedagogical knowledge and skills through peer's review, critique, and collaboration" (Shimahara, 1998, p.456)
3. Reflective practice – "Improves oneself by looking at others" (p.230) teachers observe, reflect and think deeply on their teachings to improve their instructional strategies as posited by Fernandez and Yoshida (2004).

There are four phases in the implementation of LS: Set goal, plan, implement and debrief (Lewis et al., 2006). Firstly, teachers get together in a small group to study the curriculum, to formulate goals for student learning and to decide