UNIVERSITI PUTRA MALAYSIA

EFFECTS OF MOTIVATIONAL ADAPTIVE INSTRUCTION ON MOTIVATION TOWARDS MATHEMATICS LEARNING AMONG LOWER SECONDARY SCHOOL STUDENTS

WONG SHU LING

FPP 2018 48

EFFECTS OF MOTIVATIONAL ADAPTIVE INSTRUCTION ON MOTIVATION TOWARDS MATHEMATICS LEARNING AMONG LOWER SECONDARY SCHOOL STUDENTS

By

WONG SHU LING

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

September 2018

COPYRIGHT

To my beloved parents, thank you for your unconditional love and having faith in me which allows me to dream.

To my brothers and sisters, thank you for loving me so dearly.

To my husband, thank you for your purest love and support, and having this adventure with me.

Abstract of the thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

EFFECTS OF MOTIVATIONAL ADAPTIVE INSTRUCTION ON MOTIVATION TOWARDS MATHEMATICS LEARNING AMONG LOWER SECONDARY SCHOOL STUDENTS

By

WONG SHU LING

September 2018

Chairman: Wong Su Luan, PhD
Faculty: Educational Studies

This quasi-experimental study sought to investigate effects of the motivational adaptive instruction (MAI) on students' motivation towards mathematics among lower secondary students in a technology-enhanced learning context. A mathematics motivational adaptive instructional approach was designed in accordance with the Attention, Relevance, Confidence, and Satisfaction (ARCS) motivational model to improve students' motivation towards mathematics learning. Geometer's Sketchpad (GSP) was utilised in the study to foster a technology-enhanced learning environment. In this study, the motivation construct was constituted of four components, which were attention, relevance, confidence, and satisfaction. This study also determined the effectiveness of the MAI on retaining students' motivation in learning mathematics.

Non-equivalent control group design with pre-test, posttest, and delayed-posttest was adapted for the study. Two intact groups of Malaysian Form Two students were randomly assigned to either an experimental group or a comparison group. There were 20 students in each group and therefore 40 students were involved in the study. The treatment period was two weeks, and a delayed-posttest was conducted two weeks after the treatments were completed. Further, the Course Interest Survey (CIS) was used to measure students' motivation which includes students' attention, relevance, confidence, and satisfaction towards mathematics. The study yielded highly reliable and reliable internal consistency for the instrument at pre-test, posttest, and delayed-posttest.

Analysis of Covariance (ANCOVA) was conducted to investigate the effects of the motivational adaptive instruction on students' motivation towards mathematics while students' pre-test scores were taken as covariate. There were no significant differences in overall motivation *(F (1, 37) =1.58, p > .05),*

attention *(F (1, 37) = .38, p > .05)*, relevance *(F (1, 37) = .02, p > .05)*, and confidence *(F (1, 37) = .07, p > .05)* mean scores between the experimental and comparison groups after pre-test scores were controlled. However, ANCOVA showed there was a significant difference in students' satisfaction towards mathematics learning, *F (1, 37) = 5.23, p < .05,* between the experimental and comparison groups after the covariate was controlled. Paired *t* tests were conducted to compare the means of posttest and delayed-posttest to assess if there was retention of motivation two weeks after the treatments were completed. The absence of significant difference in motivation indicated that motivation towards mathematics were retained. However, the results should be interpreted with caution due to insignificant effects of the intervention on the constructs.

The findings imply that the motivational strategies were not likely to improve students' overall motivation significantly, but the strategies did enhance students' satisfaction in mathematics learning. This study supports the efficiency on the motivational strategies in the ARCS model to improve students' satisfaction toward mathematics in a technology-enhanced learning context. The findings imply that integration of technology in the learning process does not necessarily enhance motivation. The features of technology should be well understood and utilised with appropriate motivational strategies to enhance motivation in the classroom. This study strengthens the idea that teacher is a stimulus that is able to stimulate positive reactions towards a particular classroom or lesson. It is concluded that more time and constructive effort are required to advance students' motivation while positive stimuli can be conditioned to help students anticipate mathematics lessons.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KESAN PENGAJARAN PENYESUAIN MOTIVASI PADA MOTIVASI PELAJAR TERHADAP PEMBELAJARAN MATEMATIK DI KALANGAN PELAJAR SEKOLAH MENENGAH RENDAH

Oleh

WONG SHU LING

September 2018

Pengerusi: Wong Su Luan, PhD
Fakulti: Pengajian Pendidikan

Kajian eksperimen kuasi ini bertujuan untuk mengkaji kesan pengajaran penyesuaian motivasi (MAI) atas motivasi pelajar terhadap matematik di kalangan pelajar menengah rendah dalam konteks pembelajaran yang dipertingkatkan dengan penggunaan teknologi. Pengajaran penyesuaian motivasi ini adalah dirancang mengikut model motivasi Perhatian, Relevansi, Keyakinan dan Kepuasan (ARCS) untuk meningkatkan motivasi pelajar dalam pembelajaran matematik. Geometer's Sketchpad (GSP) telah digunakan dalam kajian ini untuk membina konteks pembelajaran yang dipertingkatkan dengan penggunaan teknologi. Dalam kajian ini, motivasi terdiri daripada empat komponen iaitu perhatian, relevansi, keyakinan dan kepuasan. Kajian ini juga mengkaji kesan MAI untuk mengekalkan motivasi pelajar dalam pembelajaran matematik.

Reka bentuk eksperimen ialah kumpulan kawalan yang tidak bersamaan dengan ujian pretest, posttest dan posttest tertunda telah digunakan dalam kajian ini. Dua kumpulan pelajar Tingkatan 2 telah ditentukan sebagai kumpulan eksperimen atau kumpulan perbandingan secara rawak. Setiap kumpulan mempunyai 20 orang pelajar, jadi 40 orang pelajar telah terlibat dalam kajian ini. Tempoh masa perawatan bagi dua kumpulan adalah dua minggu dan posttest tertunda telah dijalankan dua minggu selepas perawatan telah tamat. Seterusnya, Soal Selidik Minat Kursus (CIS) telah digunakan untuk mengukur motivasi pelajar, termasuk perhatian, relevansi, keyakinan, dan kepuasan terhadap matematk. Instrumen CIS ini telah mengesahkan kebolehpercayaannya termasuk kegunnaan pada pretest, posttest dan posttest tertunda.

Analisis Kovarians (ANCOVA) telah dijalankan untuk menyiasat kesan pengajaran penyesuaian motivasi pada motivasi pelajar terhadap matematik apabila skor pada pretest diambil kira sebagai kovariat. Keputusan kajian ini menunjukkan perbezaan yang tidak signifikan antara kumpulan eksperimen dan kumpulan perbandingan bagi motivasi keseluruhan ($F\ (1, 37) = 1.58, p > .05$) terhadap matematik sementara skor pretest telah dikawal. Namun begitu, keputusan ANCOVA telah menunjukkan perbezaan yang signifikan bagi kepuasan pelajar terhadap pembelajaran matematik, $F\ (1, 37) = 5.23, p < .05,$ antara kumpulan eksperimen dan kumpulan perbandingan selepas kovariat telah dikawalkan. Ujian-*t* pasangan telah dijalankan untuk menilai pengekalan motivasi selepas dua minggu rawatan telah tamat dengan membuat perbandingan min pada posttest dan posttest tertunda. Keputusan ujian tersebut telah menunjunkkan perbezaan yang tidak signifikan menyatakan bahawa motivasi terhadap matematik telah dikekalkan. Walau bagaimanapun, keputusan ini harus ditafsirkan dengan berwaspada disebabkan oleh kesan pengajaran penyesuaian motivasi yang tidak signifikan pada keseluruhan motivasi pelajar terhadap matematik.

Penemuan kajian ini menunjukkan bahawa strategi motivasi tidak meningkatkan motivasi pelajar terhadap matematik dengan signifikan. Namun demikian, strategi motivasi telah meningkatkan kepuasan pelajar terhadap pembelajaran matematik dengan signifikan. Kesimpulannya, kajian ini menunjukkan bahawa lebih banyak masa dan usaha adalah diperlukan untuk mempertingkatkan motivasi pelajar terhadap matematik manakala rangsangan positif boleh membantu pelajar lebih berharapan pada pembelajaran matematik yang seterusnya.

ACKNOWLEDGEMENT

First and foremost, I would like to express my heartfelt gratitude and sincere appreciation to my advisor and supervisor, Professor Dr. Wong Su Luan. She has been a great support to me by guiding me with her words of wisdom throughout my study. She always makes time to provide constructive comments and insights which help me grow as a researcher and a person. She is a person who I look upon as my mentor and source of inspiration.

I am truly grateful to my co-supervisor, Associate Professor Dr. Ahmad Fauzi Mohd Ayub. There has been guidance, constructive feedback and comments which greatly improve my work. Various insights and ideas have contributed to the quality of this work. Besides, I am grateful to Professor Emeritus Dr. Larry Miller, who had taught me research methods at the early stage of this study.

I would like to express my sincere appreciation to the MyBrain15 and Graduate Research Fellowship for providing me the financial aid to further my studies. Also, I am thankful to Putra Graduate Initiative Grant for the financial aid to support this study until completion.

Last but not least, I am heartily grateful to express my utmost gratitude and appreciation to each and every one who has contributed to the thesis in one way or another. Thank you very much.

I certify that a Thesis Examination Committee has met on 13 September 2018 to conduct the final examination of Wong Shu Ling on her thesis entitled "Effects of Motivational Adaptive Instruction on Motivation towards Mathematics Learning Among Lower Secondary School Students" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

Members of the Thesis Examination Committee were as follows:

Umi Kalthom binti Abdul Manaf, PhD
Senior Lecturer
Faculty of Educational Studies
Universiti Putra Malaysia
(Chairman)

Nurzatulshima bt Kamarudin, PhD
Senior Lecturer
Faculty of Educational Studies
Universiti Putra Malaysia
(Internal Examiner)

Fariza Khalid, PhD
Senior Lecturer
Universiti Kebangsaan Malaysia
Malaysia
(External Examiner)

_____

RUSLI HAJI ABDULLAH, PhD
Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: Disember 2018

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. Members of the Supervisor Committee were as follows:

Wong Su Luan, PhD
Professor
Faculty of Educational Studies
Universiti Putra Malaysia
(Chairman)

Ahmad Fauzi Mohd Ayub, PhD
Associate Professor
Faculty of Educational Studies
Universiti Putra Malaysia
(Member)

_____

ROBIAH BINTI YUNUS, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

Declaration by graduate student

I hereby confirm that:

- this thesis is my original work;
- quotations, illustrations and citations have been duly referenced;
- this thesis has not been submitted previously or concurrently for any other degree at any other institutions;
- intellectual property from the thesis and copyright of thesis are fully-owned by Universiti Putra Malaysia, as according to the Universiti Putra Malaysia (Research) Rules 2012;
- written permission must be obtained from supervisor and the office of Deputy Vice-Chancellor (Research and Innovation) before thesis is published (in the form of written, printed or in electronic form) including books, journals, modules, proceedings, popular writings, seminar papers, manuscripts, posters, reports, lecture notes, learning modules or any other materials as stated in the Universiti Putra Malaysia (Research) Rules 2012;
- there is no plagiarism or data falsification/fabrication in the thesis, and scholarly integrity is upheld as according to the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) and the Universiti Putra Malaysia (Research) Rules 2012. The thesis has undergone plagiarism detection software.

Signature: _____ Date:_____

Name and Matric No.: Wong Shu Ling GS44802

Declaration by Members of Supervisor Committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) are adhered to.

Signature: _____

Wong Su Luan, PhD
Professor
Faculty of Educational Studies
Universiti Putra Malaysia
(Chairman)

Signature: _____

Ahmad Fauzi Mohd Ayub, PhD
Associate Professor
Faculty of Educational Studies
Universiti Putra Malaysia
(Member)

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ANCOVA	Analysis of Covariance
ARCS	Attention, Relevance, Confidence, Satisfaction
CAI	Computer Assisted Instruction
CIS	Course Interest Survey
EDA	Exploratory Data Analysis
EFA	English as Foreign Language
EPRD	Educational Planning and Research Division
ETeMS	English for Teaching Mathematics and Science
GPMP	Gred Purata Mata Pelajaran or Subject Average Grade
GPN	Gred Purata Nasional or National Average Grade
GSP	Geometer's Sketchpad
HOTS	Higher Order Thinking Skills
ICT	Information and Communication Technology
IEA	International Association for the Evaluation of Educational Achievement
MOE	Ministry of Education Malaysia
OECD	Organization of Economic Co-operation and Development
PISA	Program for International Student Assessment
PMR	Penilaian Menengah Rendah
PT3	Pentaksiran Tingkatan 3
SPSS	Statistical Package for Social Science
SPM	Sijil Pelajaran Malaysia
STEM	Science Technology Engineering and Mathematics
TEL	Technology-enhanced Learning
TIMSS	Trends in International Mathematics and Science Study
UNESCO	United Nations Educational, Scientific, and Cultural Organisation

CHAPTER 1

INTRODUCTION

1.1 Background

In Malaysia, mathematics is a compulsory subject for all primary and secondary school students, which is assessed in national examinations. Also, in Malaysia Education Blueprint 2013-2025, mathematics is greatly emphasized due to the focus on Science, Technology, Engineering, and Mathematics (STEM) education as the Ministry envisions to develop innovative thinkers and equip students with the ability to apply STEM skills when they encounter the challenges in the competitive global economy (Ministry of Education Malaysia, 2017). One of the initiatives from the Ministry is to raise student interest towards STEM education through new teaching and learning approaches and a strengthened curriculum (Ministry of Education Malaysia, 2017). In particular, mathematics education as a part of STEM education is discussed in this study.

Over the years, the findings from Malaysian students' participation in international assessments were used as input to improve the existing curriculum, teaching and learning approaches, and assessment methods (Ministry of Education Malaysia, 2013). In this way, the quality of educational outcomes can be evaluated and compared with that of other countries. In particular, Malaysia has participated in Trends in International Mathematics and Science Study (TIMSS), an international assessment of mathematics and science for fourth- and eighth-grade students, which takes place every four years. TIMSS is conducted by the International Association for the Evaluation of Educational Achievement (IEA). The aim of TIMMS is to assess curricular elements that are common to its participating countries (Mullis, Martin, Foy, & Arora, 2012). In 1999 when Malaysia first participated in TIMSS, its eighth-grade students' mathematics performance was above average with a mean score of 519, and Malaysia ranked 16th out of 38 countries (Ministry of Education Malaysia, 2013). However, over the following years, Malaysian eighth graders' mathematics achievement in TIMSS showed a declining trend whereby in TIMSS 2011 they attained a low mean score of 440 and Malaysia ranked 26th out of 45 countries (Ministry of Education Malaysia, 2013). Nevertheless, in TIMSS 2015 the mathematics score improved by 25 points to an overall score of 465 (Mullis, Martin, Foy, & Hooper, 2016). Malaysia was one of the 18 countries which had shown improved mathematics performance in TIMSS 2015 as compared to TIMSS 2011 (Ministry of Education Malaysia, 2017).

In addition, Malaysia has participated in the Program for International Student Assessment (PISA), which is a grand-scale international assessment that is conducted by the Organization of Economic Co-operation and Development (OECD) to measure students' proficiency in mathematics, science, and reading every three years (OECD, 2014). The focus of PISA is students' ability to apply

their knowledge in meeting real-world problems. The results in PISA 2009 showed that nearly 60% of the 15-year-old Malaysian students who participated in the assessment were below the minimum benchmarks of mathematical literacy set by PISA, which is required to participate effectively and productively in life (Ministry of Education Malaysia, 2012). Later in PISA 2012, the mathematics performance was subpar again, and Malaysia was placed 52nd out of 65 participating countries, with a mean score of 421 that was below the OECD average (OECD, 2014). Besides, Malaysia ranked 39th out of 44 countries in the first assessment of PISA on creative problem-solving skills (OECD, 2014). In PISA 2015, the mathematics mean score was 446 while the OECD average was 490 (Ministry of Education Malaysia, 2016). However, the performance data for Malaysia from PISA 2015 may not be comparable to the results from previous years due to a 51.4% weighted response rate from the initially sampled schools, which was below the response rate threshold of 65% set by PISA (OECD, 2017). In brief, the findings from these international assessments suggest that there have been fluctuations in Malaysian students' mathematics performance.

In both TIMSS and PISA reports, students' attitudes, engagement, drive, and self-beliefs in mathematics learning have been discussed (Mullis et al., 2012; OECD 2014). Specifically, the PISA 2012 report explored the role of student engagement, students' intrinsic motivation, instrumental motivation, and mathematics self-efficacy, of which motivation and engagement were taken as the driving force behind learning. The study reported that students who have low interest and do not anticipate a mathematics lesson generally do not excel at mathematics (OECD, 2014). Moreover, students' enjoyment of and interest in mathematics can be influenced by classroom instruction and dynamics, and teachers' decisions (OECD, 2014). Besides, in TIMSS, several affective domains such as students' confidence in mathematics, students' value of mathematics, students' views on engaging teaching in mathematics lessons, and whether students like mathematics learning, constitute to students' attitudes toward mathematics (Mullis et al., 2016). In short, the affective domain, such as motivation, has a pivotal role in mathematics learning as mathematics performance is correlated with students' motivation.

As a measure to enhance the teaching and learning of STEM across the education system, teachers are urged to use information and communications technology (ICT) tools more effectively to include additional resources and information (Ministry of Education Malaysia, 2013). For instance, the Ministry has spent almost RM 6 billion on ICT in education over the past decade (Ministry of Education Malaysia, 2012). Most of the fund was used to increase the number of computer labs to support English for Teaching Mathematics and Science (ETeMS) and to equip every school with a computer lab (Ministry of Education Malaysia, 2013). In a review done by the United Nations Educational, Scientific, and Cultural Organisation (UNESCO) in 2012, ICT has not been fully utilised in schools as it was mostly used as a word processing tool. Besides, nearly eighty-percent of Malaysian teachers spent less than an hour a week on ICT in teaching and learning while only one-third of students perceived their teachers as regular ICT users in teaching (Ministry of Education Malaysia, 2012). Subsequently, the Ministry continues to work towards having all schools achieve the minimum

benchmark for ICT utilization to foster students' higher order thinking and communication skills (Ministry of Education Malaysia, 2013). As such, in the Malaysia Education Blueprint 2013-2025, one of the measures is to ensure the fundamentals are in place. This entails providing ICT devices, network, and application; training teachers for ICT competencies; and strengthens curriculum and assessment for going toward intensive and innovative ICT usage in teaching and learning (Ministry of Education Malaysia, 2013). Therefore, the mathematics classroom in Malaysian public schools is undergoing a shift to technology-enhanced learning.

The mathematics performance of 15-years old or grade eight Malaysian students has shown fluctuations over the years. As reported by TIMSS and PISA, students' attitudes and motivation toward mathematics are correlated with mathematics performance. Moreover, teachers play a role in promoting a learning environment in the classroom that is conducive to fostering students' positive attitude or motivation toward mathematics. Meanwhile, the Ministry of Education Malaysia has taken measure to improve ICT infrastructure and teachers' competency in ICT and pedagogical knowledge in STEM education. As motivation is one of the affective domains in learning, therefore, it is pertinent to explore the teaching approaches and instructional strategies that would improve students' motivation toward mathematics in a technology-enhanced learning environment in Malaysian public schools.

1.2 Problem Statement

Thien and Ong (2015) adopted PISA 2012 results and revealed that Malaysian students' underperformed mathematics results were closely related to their high level of anxiety and low self-efficacy in mathematics learning. In particular, intrinsic motivation is associated with a difference of 20 score points in mathematics performance (Thien & Ong, 2015). As supported by Hidi and Renninger (2006) on the vital role of affective characteristics in governing the attention and engagement in achieving goals, mathematics professionals are concerning about the fading of students' motivation mathematics learning.

Moreover, 50% of the lessons in Malaysian classrooms were observed and described as unsatisfactory by the researchers from the Higher Education Leadership Academy at the Ministry of Higher Education (Ministry of Education Malaysia, 2013). The teaching approaches were claimed to have over-emphasised preparation for examinations (Ministry of Education Malaysia, 2013). As a result, the instruction was not stressed on the relevance of learning to daily life, and it led to a decreased interest in STEM subjects (Ministry of Education Malaysia, 2013).

Put together, students' motivation in mathematics learning is lacking and fading as students have low self-efficacy, low intrinsic motivation, and lessons that are not stressing on relevance to daily life. Motivation is one of the affective domains

in learning that is positively related to students' mathematics performance. This suggests that positive affect components should be considered in intervention programmes to enhance students' positive affect, in this case, students' motivation toward mathematics and eventually improve mathematics performance (Ng et al., 2012). Furthermore, Thien and Ong (2015) and Ismail and Awang (2012) urge teachers to refine and polish their instructional strategies to enhance students' self-efficacy and motivation to decrease their anxiety in mathematics learning. On the other hand, the Ministry has provided a technology-enhanced learning (TEL) environment by building computers labs in schools (Ministry of Education Malaysia, 2013). The motivation towards mathematics within a Malaysian TEL context was studied and concluded as influential in improving students' mathematical understanding (Abu Bakar, Ayub, Wong, & Tarmizi, 2010; Poh & Leong, 2014). In view of this, the incorporation of positive affect components in mathematics instructional interventions within a technology-enhanced learning context in Malaysia is necessary.

It is, therefore, pertinent that a study be conducted to investigate the effects of motivational adaptive instruction in improving students' motivation towards mathematics in a technology-enhanced learning environment.

1.3 Research Objectives

The main aim of the study was to investigate the effects of motivational adaptive instruction on students' motivation towards mathematics in a technology-enhanced learning context. Specifically, this aim was supported by the following research objectives:

1. To explore the motivational profile of mathematics learning for lower secondary school students;
2. To investigate the effects of motivational adaptive instruction on students' motivation towards mathematics learning;
3. To investigate the effects of motivational adaptive instruction on retaining students' motivation towards mathematics learning.

Particularly, this study aimed to answer the following research questions:

1. What is the motivational profile of mathematics learning for public lower secondary school students in Malaysia?
2. Does the motivational adaptive instruction have an effect on students' motivation towards mathematics learning?
3. Does the motivational adaptive instruction have an effect on students' attention towards mathematics learning?
4. Does the motivational adaptive instruction have an effect on students' sense of relevance towards mathematics learning?
5. Does the motivational adaptive instruction have an effect on students' confidence towards mathematics learning?
6. Does the motivational adaptive instruction have an effect on students' satisfaction towards mathematics learning?

7. Is there a significant difference in motivation between posttest and delayed-posttest?

1.4 Significance Of The Study

The findings of this study are beneficial for mathematics teachers by informing their understanding of better classroom teaching practice to motivate students to learn mathematics. The instructional material that was developed from this study could be used as a reference for teachers to plan their instruction to achieve desirable learning outcomes and motivational objectives. The investigation of motivational effects of the adaptive instruction can notify mathematics teachers that it is possible to make a change in students' motivation towards mathematics learning. Besides, the motivational strategies that were adopted in the study could serve as suggestions for teachers on how to incorporate motivational elements into their instruction as shown in this study.

Moreover, the findings of the study can raise students' awareness of their attitudes or motivation in learning mathematics. Students who understand the vital role of motivation in learning and who are aware of their motivational level in learning are more likely to tackle their motivational problems to achieve better results in mathematics. In other words, it is crucial to make students see that their motivation or attitudes towards the subject are closely related to the amount of effort they put into learning. Also, it is advantageous for students if their parents are more aware of the impact of motivation upon academic achievements. Parents play a major role in giving the support needed to motivate their children to learn and excel in learning.

For policy makers, this study might provide them with another perspective about students' role in learning. Apart from focusing on pushing students to perform better in mathematics, it is equally important to place great emphasis on students' motivation as they can influence student achievement in the learning process. As such, authorities should consider the importance of students' affective characteristics by upgrading the necessary facilities in schools to support teachers in their instructional planning. For example, providing graphic calculators, installing power sockets in the classrooms to afford the incorporation of ICT in instruction, as well as educating mathematics teachers about the development in the use of ICT for teaching and the importance of affective characteristics in learning. Further effort can be made on developing a mathematics module that takes motivation into account together with mathematics learning objectives. Certainly, mathematics modules should be designed systematically by analysing the mathematics proficiency and motivational profile of students. Nevertheless, there is no single solution to all motivational problems because different mathematics classrooms require different approaches. Nevertheless, this study intends to illustrate a motivational adaptive instructional design that could make a difference in students' learning experience.

1.5 Assumptions And Limitations

The study was based on the following assumptions. First, it assumed all the subjects had the capacity to understand the measure of motivation instrument. The instrument was prepared in dual languages, which were English and Malay. Therefore, it assumed that the subjects were able to understand the instructions to complete the instruments and the listed items. Second, it assumed that all the subjects had the necessary technical abilities to complete the measure of motivation instrument such as choosing and ticking the response that would reflect themselves the best.

The limitations of the study were summarised as follows. First, only two classes of Form Two students from two different public secondary schools in the state of Selangor, Malaysia were included. As such, the results from this study cannot be generalized beyond this group of students. Second, subjects who had not completed the measuring instruments were not included in the final data. The observations and measurements were conducted before and after the treatment. Therefore, for third limitation, the pretest, posttest, and delayed posttest settings might emerge testing effect as an internal validity threat. The further details of the threats are discussed in Chapter 3.

1.6 Definition Of Terms

It was necessary to clarify the constitutive and operational definitions of the key terms in this study to provide a clear understanding and direction in the research process. These definitions are presented in this section as a reference to other researchers in generalizing the research findings in this study. Besides, these definitions can serve as a reference for other researchers to generalize the research findings in this study.

1.6.1 Motivation

According to Wigfield and Eccles (2000), motivation refers to one's behaviour as the product of the degree that one values a task and the beliefs that one has about how well he or she can perform the task. In the ARCS model, motivation was defined as what people desire, what goals people opt to pursue, and how much effort they put in to execute the action, and hence motivation explains the magnitude and directions of people's behaviour (Keller, 1987). This definition of motivation construct is constituted by the four components from the ARCS model, namely, attention, relevance, confidence, and satisfaction (Keller, 2010). In this study, motivation is operationally defined as students' magnitude in attention, relevance, confidence, and satisfaction in learning mathematics. As such, motivation construct in this study is constituted from four components which are attention, relevance, confidence, and satisfaction.

Attention. Attention is conceptualised as the arousal of curiosity by novel stimuli by Berlyne (1954). In the ARCS motivational model, attention refers to the combination of a variety of concepts which includes arousal theory, curiosity,

boredom, and sensation seeking to stimulate and engage students for learning (Keller, 2010). In this study, attention refers to students' engagement level in learning mathematics.

Relevance. In the expectancy-value theory, relevance is referred in the value aspect which is defined as how one perceives the attainment value, utility value, and intrinsic value of a learning task to oneself (Wigfield & Eccles, 2000). Relevance is defined as how one uses own goals, motives, and values to perceive attraction of a desired outcome whereby it often is from pragmatic perspective (Keller, 2010). In this study, relevance refers to students' perceptions on the value or usefulness of mathematics content that they learnt in school.

Confidence. In the ARCS model, confidence refers to one's expectancies for success and one's attribution of success and failure (Keller, 2010). Moreover, confidence relates to belief in self as defined in self-efficacy, which refers to one's perceptions of his or her own ability to perform a task successfully (Bandura, 1994). Confidence also relates to one's perceptions of control on the outcome of one's behaviour whereby attribution of success might make to one's ability or lucks (Weiner, 1985). In this study, confidence is defined as students' perceptions of their ability to perform mathematical tasks successfully and control the outcomes of their mathematics activities.

Satisfaction. In broad terms, satisfaction is defined as the feeling of mastery or pleasure after having succeeded at a task (Keller, 2010). In particular, satisfaction is related to sustaining motivation whereby it builds on the basis of conditioning theory and the interactions between extrinsic reinforcement and cognitive evaluation (i.e., comparing one's situation to that of other's) (Keller, 2010). In this study, satisfaction refers to the extent to which students' expectations are met by mathematics teachers' feedback or conditioning reinforcement.

1.6.2 Instructional Design

Instructional design is defined as a systematic process for designing instruction based on what is known about "learning theories, information technology, systematic analysis, educational research, and management methods" (Morrison, Ross, Kalman, & Kemp, 2011, p. 6). According to Gagné, Briggs, and Wager (1992), instructional design refers to an arrangement of instructional events by considering the consistency and compatibility of technical knowledge at each point of decision making, such as different types of information and data, learning theories, and conditions of learning to support learners to achieve learning outcomes. In this research, instructional design refers to the systematic process of preparing subject content materials that aims to achieve mathematics learning objectives.

1.6.3 Motivational Design

Motivational design is defined as the instructional design that considered an aspect of learning, which is students' motivation and its influence on the learning experience (Hess, 2015). Keller (2010) defines motivational design as a process of arranging resources and a series of steps which aimed to improve motivation. This study adopted the definition of motivational design as the systematic process to develop a motivational lesson plan that aims to improve students' motivation towards mathematics learning.

1.6.4 Motivational Adaptive Instruction

Park and Lee (2004) state that motivational adaptive instruction is a teaching approach that combines instructional plan and motivational plan to improve motivation. According to Keller (2010), motivational adaptive instruction refers to the teaching plans that have adopted motivational elements. This research defines motivational adaptive instruction as the mathematics instruction that implements the motivational strategies from the ARCS motivational model.

1.6.5 Technology-Enhanced Learning

Kirkwood and Prince (2014) define technology-enhanced learning as the situation where information and communication technologies are integrated into teaching and learning. As defined by Lee and Choi (2017), technology-enhanced learning refers to the approaches of integrating digital technology to improve the quality of learning. In this study, technology-enhanced learning refers to the learning context where Geometer's Sketchpad is used in the teaching and learning of mathematics.

1.7 Summary

This chapter discussed the background and context of this study, problem statement, research objectives and questions, significance of the study, assumptions and limitations, and definition of key terms in this study. Background of the study begins with Malaysian fluctuating mathematics performance at international assessment, and positive relationship between affective characteristics like motivation towards mathematics learning and mathematics performance. Problem statement was highlighted in terms of students' lacking in motivation towards mathematics learning among Malaysian lower secondary students, and teaching approaches in Malaysian classroom that were not emphasising enough on the relevance of subject content to real life. Therefore, this study proposed a motivational adaptive instruction was designed in accordance with the ARCS motivational model to improve students' motivation in mathematics learning. This study aims to investigate the effects of the

motivational adaptive instruction on students' motivation towards mathematics learning.

REFERENCES

Abas, A. (3 March, 2016). Decline in SPM 2015 results [VIDEO]. Retrieved from http://www.nst.com.my/news/2016/03/130756/decline-spm-2015-results-video

Abdul Kader, B. A. (13 February, 2008). *Malaysian Smart Schools Project.* Retrieved from UNESCO Bangkok: http://www.unescobkk.org/fr/education/ict/online-resources/databases/ict-in-education-database/item/article/malaysian-smart-schools-project/

Abdullah, A. H., & Zakaria, E. (2013). The effects of van Hiele's phases of learning geometry on students' degree of acquisition of van Hiele's levels. In M. Z. Omar, R. M. Yasin, R. Hamid, N. M. Tawil, K. Yusoff, & M. S. Rasul, *Procedia-Social and Behavioural Sciences* (pp. 251-266). Elsevier.

Adams, J. S. (1965). Inequity in social exchange. In L. Berkowitz, *Advances in experimental social psychology* (Vol. 2, pp. 267-299). New York: Academic Press.

Ainley, M. (2006). Connecting with learning: Motivation, affect and cognition in interest processes. *Educational Psychology Review, 18*, 391-405. doi:10.1007/s10648-006-9033-0

Ames, C., & Archer, J. (1988). Achievement goals in the classroom: Students' learning strategies and motivation processes. *Journal of Educational Psychology, 80*(3), 260-267.

Ary, D., Jacobs, L. C., Sorensen, C., & Razavieh, A. (2010). *Introduction to research in education* (8th ed.). Canada: Wadsworth Cengage Learning.

Bai, H., Pan, W. H., & Kebritchi, M. (2012). Assessing the effectiveness of a 3-D instructional game on improving mathematics achivement and motivation of middle school students. *British Journal of Educational Technology, 43*(6), 993-1003.

Bakar, K. A., Ayub, A. F., Wong, S. L., & Tarmizi, R. A. (2010). Exploring secondary school students' motivation using technologies in teaching and learning mathematics. *Procedia Social and Behavioral Sciences, 2*, 4650-4654. doi:10.1016/j.sbspro.2010.03.744

Bandura, A. (1994). Self-efficacy. In V. S. Ramachaudran, *Encyclopedia of human behavior* (Vol. 4, pp. 71-81). New York: Academic Press.

Belland, B. R., Kim, C., & Hannafin, M. J. (2013). A framework for designing scaffolds that improve motivation and cognition. *Educational Psychologist, 48*(4), 243-270.

Berlyne, D. E. (1954). A theory of human curiosity. *British Journal of Psychology, 45*(3), 180-191. doi:10.1111/j.2044-8295.1954.tb01243.x

Brophy, J. (2004). *Motivating students to learn* (2nd ed.). London, NJ: Erlbaum.

Brophy, J. (2008). Developing students' appreciation for what is taught in school. *Educational Psychologist, 43*(3), 132-141. doi:10.1080/00461520701756511

Campbell, D. T., & Stanley, J. C. (1963). *Experimental and quasi-experimental designs for research.* Chicago: McNally.

Chang, C., Chang, C. K., & Shih, J. L. (2016). Motivational strategies in a mobile inquiry-based language learning setting. *System, 59*, 100-115. doi:10.1016/j.system.2016.04.013

Chang, C., Liu, E. Z., Sung, H., Lin, C., Chen, N., & Cheng, S. (2014). Effects of online college student's internet self-efficacy on learning motivation and performance. *Innovations in Education and Teaching International, 51*(4), 366-377. doi:10.1080/14703297.2013.771429

ChanLin, C. (2009). Applying motivational analysis in a web-based course. *Innovations in Education and Teaching International, 46*(1), 91-103.

Cheng, Y., & Yeh, H. (2009). From concepts of motivation to its application in instructional design: Reconsidering motivation from an instructional designer perspective. *British Journal of Educational Technology, 40*(4), 597-605. doi:10.1111/j.1467-8535.2008.00857.x

Chew, C. M., & Lim, C. S. (2011). Encouraging the innovative use of Geometer's Sketchpad through lesson study. *Creative Education, 2*(3), 236-243. doi:10.4236/ce.2011.23032

Chew, C. M., & Lim, C. S. (2013). Enhancing primary pupil's geometric thinking through phase-based instruction using the Geometer's Sketchpad. *Asia Pacific Journal of Educators and Education, 28*, 33-51.

Clayton, K., Blumberg, F., & Auld, D. P. (2010). The relationship between motivation,learning strategies and choice of environment whether traditional or including an online component. *British Journal of Educational Technology, 41*(3), 349-364.

Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education* (6th ed.). London: Routledge.

Cook, T. D., & Campbell, D. T. (1979). *Quasi-experimentation: Design & analysis issues for field settings.* Boston: Houghton Mifflin Company.

Damian, L. E., Stoeber, J., Negru, O., & Baban, A. (2014). Perfectionism and achievement goal orientations in adolescent school students. *Psychology in the Schools, 51*(9), 960-971. doi:10.1002/pits.21794

Deci, E. L. (1972). Intrinsic motivation, extrinsic reinforcement, and inequity. *Journal of Personality and Social Psychology, 22*(1), 113-120.

Deci, E. L. (1992). The relation of interest to the motivation of behavior: A self-determination theory perspective. In K. A. Hidi, & S. A. Krapp, *The role of interest in learning and develoment* (pp. 43-71). Hillslade, NJ: Lawrence Erlbaum Associates.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior.* New York: Plenum Press.

Dimakos, G., & Zaranis, N. (2010). The influence of the Geometer;s Sketchpad on the geometry achievement of Greek school students. *The Teaching of Mathematics, 13*(2), 113-124.

Erbas, A. K., & Yenmez, A. A. (2011). The effects of inquiry-based explorations in a dynamic geometry environment on sixth grade students' achievements in polygons. *Computers & Education, 57*, 2462-2475. doi:10.1016/j.compedu.2011.07.002

Feng, S., & Tuan, H. (2005). Using ARCS model to promote 11th graders' motivation and achievement in learning about acids and bases. *International Journal of Science and Mathematics Education, 3*(3), 463-484. doi:10.1007/s10763-004-6828-7

Field, A. (2005). *Discovering Statistics Using SPSS: and sex, drugs and rock'n' roll.* London: Sage.

Foshee, C. M., Elliott, S. N., & Atkinson, R. K. (2015). Technology-enhanced learning in college mathematics remediation. *British Journal of Eductional Technology*, 1-13. doi:10.1111/bjet.12285

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). *How to design and evaluate research in education* (8th ed.). New York: McGraw-Hill.

Gabrielle, D. M. (2003). *The effects of technology-mediated instructional strategies on motivation, performance, and self-directed learning.* Florida State University.

Gagné, R. M., Briggs, L. J., & Wager, W. W. (1992). *Principles of instructional design* (4th ed.). Orlando, USA: Harcourt Brace & Company.

Gay, L. R., Mills, G. E., & Airasian, P. (2006). *Educational Research: Competencies for Analysis and Applications* (8th ed.). Upper Saddle River, New Jersey: Pearson Prentice Hall.

George, D., & Mallery, P. (2003). *SPSS for Windows Step by Step: A simple guide and reference, 11.0* (3rd ed.). USA: Allyn & Bacon.

Gilbert, M. C. (2016). Relating aspects of motivation to facets of mathematical competence varying in cognitive demand. *The Journal of Educational Research, 109*(6), 647-657. doi:10.1080/00220671.2015.1020912

Gravetter, F. J., & Wallnau, L. B. (2014). *Essentials is statistics for the behavioral sciences.* Wadsworth: Jon-David Hague.

Grossnickle, E. M. (2016). Disentangling curiosity: Dimensionality, definitions, and distinctions from interest in educational context. *Educational Psychology Review, 28*, 23-60. doi:10.1007/s10648-014-9294-y

Hannafin, R. D., Burrus, J. D., & Little, C. (2001). Learning with dynamic geometry programs: Perspectives of teachers and learners. *The Journal of Educational Research, 94*(3), 132-144. doi:10.1080/00220670109599911

Hannula, M. S. (2006). Motivation in mathematics: Goals reflected in emotions. *Educational Studies in Mathematics, 63*(2), 165-178. doi:10.1007/s10649-005-9019-8

Heinze, A., Reiss, K., & Franziska, R. (2005). Mathematics achievement and interst in mathematics from a differential perspective. *Zentralblatt fuur Didaktik der Mathematik, 37*(3), 212-220. doi:10.1007/s11858-005-0011-7

Hess, A. N. (2015). Motivational design in information literacy instruction. *Communications in Information Literacy, 9*(1), 44-59.

Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. *Educational Psychologist, 41*(2), 111-127. doi:10.1207/s15326985ep4102_4

Hodges, C. B. (2004). Designing to motivate: Motivational techniques to incorporate in e-learning experiences. *The Journal of Interactive Online Learning, 2*(3), 1-7.

Hodges, C. B., & Kim, C. (2013). Improving college students' attitudes towards mathematics. *TechTrends, 57*(4), 59-66. doi:10.1007/s11528-013-0679-4

Holmes, V. L., & Hwang, Y. (2016). Exploring the effects of project-based learning in secondary mathematics education. *The Journal of Educational Research, 109*(5), 449-463.

Huett, J. B., Kalinowski, K. E., Moller, L., & Huett, K. C. (2008). Improving the motivation and retention of online students through the use of ARCS-based emails. *American Journal of Distance Education, 22*(3), 159-176. doi:10.1080/08923640802224451

Huett, J., Moller, L., Bray, M., Young, J., & Huett, K. (2008). Supporting the distant student: The effect of ARCS-based strategies on confidence and performance. *Quarterly Review of Distance Education, 9*(2), 113-126.

Idris, N. (2009). The impact of using Geometer's Sketchpad on Malaysian students' achievement and van Hiele geoemtric thinking. *Journal of Mathematics Education, 2*(2), 94-107.

Ismail, N. A. (2009). Understanding the gap in mathematics achievement of Malaysian students. *The Journal of Educational Research, 102*(5), 389-394. doi:10.3200/JOER.102.5.389-394

Ismail, N. A., & Awang, H. (2012). Students' factors and mathematics achievement: Evidence from TIMSS 2007. *Eurasia Journal of Mathematics, Science and Technology Education, 8*(3), 249-255.

Jabatan Pendidikan Negeri Pulau Pinang. (24 January, 2017). *Jerayawara Inisiatif Perkukuhan STEM*. Retrieved from Jabatan Pendidikan Negeri Pulau Pinang: http://www.jpnpp.edu.my/index.php/88-sample-data-articles/megazine/sport/137-jerayawara-inisiatif-perkukuhan-stem

Jones, K., Mackrell, K., & Stevenson, I. (2009). Designing digital technologies and learning activities for different geometries. In C. Hoyles, & J.-B. Lagrange, *Mathematics education and technology-rethinking the terrain: The 17th ICMI study* (pp. 47-60). New York: Springer .

Keller, J. M. (1983). Motivational design of instruction. In C. M. Reigeluth, *Instructional design theories and models: An overview of their current status.* Hillsdale, NJ: Erlbaum.

Keller, J. M. (1987). Development and use of the ARCS model of instructional design. *Journal of Instructional Development, 10*(3), 2-10.

Keller, J. M. (2010). *Motivational design for learning and performance.* New York: Springer.

Keller, J. M., & Subhiyah, R. (1993). *Manual for the Course Interest Survey (CIS)*. Florida State University.

Kim, C., & Keller, J. M. (2010). Motivation, volition, and belief change strategies to improve mathematics learning. *Journal of Computer Assisted Learning, 26*, 407-420. doi:10.1111/j.1365-2729.2010.00356

Kim, C., Park, S. W., & Cozart, J. (2014). Affective and motivational factors of learning in online mathematics course. *British Journal of Educational Technology, 45*(1), 171-185. doi:10.1111/j.1467-8535.2012.01382.X

Kirkwood, A., & Prince, L. (2014). Technology-enhanced learning and teaching in higher education: what is 'enhanced' and how do we know? A critical literature review. *Learning, Media and Technology, 39*(1), 6-36.

Knowles, C. R. (2001). *Prevention that works! A guide for developing school-based drug and violence prevention programs.* California: Corwin Press Inc.

Lee, J., & Choi, H. (2017). What affects learner's higher-order thinking in technology-enhanced learning environments? The effects of learner factors. *Computers & Education, 115*, 143-152.

Leech, N. L., Barrett, K. C., & Morgan, G. A. (2005). *SPSS for intermediate statistics: Use and interpretation* (2nd ed.). Mahwah, New Jersey: Lawrence Erlbaum.

Lembaga Peperiksaan. (2014). *Format Pentaksiran Tingkatan 3.* Putrajaya: Lembaga Peperiksaan Kementerian Pendidikan Malaysia.

Leong, C. K. (2014). Educating the educators: Technology-enhanced mathematics teaching and learning. *Proceedings of the 19th Asian Technology Conference in Mathematics.* Yogyakarta: Mathematics and Technology, LLC.

Leong, K. W. (2015). The effects of instruction using the ARCS model and GeoGebra on upper secondary students' motivation and achievement in learning combined transformation. *Asia Pacific Journal of Educators and Education, 30*, 141-158.

Lokman, T. (25 December, 2014). PT3 uses different methods. *New Straits Times*. Retrieved from http://www.nst.com.my/news/2015/09/%E2%80%98pt3-uses-different-methods%E2%80%99

Maeng, U., & Lee, S. (2015). EFL teachers' behavior of using motivational strategies: The case of teaching in the Korean context. *Teaching and Teacher Education, 46*, 25-36. doi:10.1016/j.tate.2014.10.010

Mason, M. M. (1998). The van Hiele levels of geometric understanding. In *The professional handbook for teachers geometry* (pp. 4-8). Boston: McDougal Littell Inc.

Ministry of Education. (31 May, 2017). *Number of schools by type group and states*. Retrieved from Ministry of Educatin Malaysia: https://www.moe.gov.my/index.php/en/korporat/statistik/bilangan-sekolah-mengikut-kumpulan-jenis-dan-negeri

Ministry of Education Malaysia. (2002). *Integrated curriculum for secondary schools: Form 2 Mathematics.* Putrajaya: Curriculum Development Centre.

Ministry of Education Malaysia. (2004). *Integrated curriculum for secondary schools: Syllabus mathematics.* Curriculum Developmenet Centre, Ministry of Education Malaysia.

Ministry of Education Malaysia. (2012). *Preliminary report: Malaysia Education Blueprint 2013-2025.* Putrajaya: Ministry of Education Malaysia.

Ministry of Education Malaysia. (2013). *Malaysia Education Blueprint 2013-2025: Preschool to post-secondary education.* Putrajaya: Ministry of Education Malaysia.

Ministry of Education Malaysia. (31 Mac, 2016). *Number of Schools by Type Group and States.* Retrieved from Ministry of Education Malaysia: http://www.moe.gov.my/images/statistik/sekolah/Senarai%20Sekolah%20Menengah%2031Mac2016.xlsx

Ministry of Education Malaysia. (2016). *PISA 2015: Programme for International Assessment.* Putrajaya: Ministry of Education Malaysia.

Ministry of Education Malaysia. (2017). *Malaysia education blueprint 2013-2025: Annual report 2016.* Putrajaya: Ministry of Education Malaysia.

Morrison, G. R., Ross, S. M., Kalman, H. K., & Kemp, J. E. (2011). *Designing effective instruction* (6th ed.). New York: John Wiley & Sons.

Mullis, I. V., Martin, M. O., Foy, P., & Arora, A. (2012). *TIMSS 2011 International Results in Mathematics.* Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

Mullis, I. V., Martin, M. O., Foy, P., & Hooper, M. (2016). *TIMSS 2015 International Results in Mathematics.* Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

Mustapha, R. B., & Greenan, J. P. (2002). The role of vocational education in economic development in Malaysia: Educators' and employers' perspectives. *Journal of Industrial Teacher Education, 39*(2).

Ng, K. T., Lay, Y. F., Areepattamannil, S., Treagust, D. F., & Chandrasegaran, A. L. (2012). Relationship between affect and achievement in science

and mathematics in Malaysia and Singapore. *Research in Science & Technological Education, 30*(3), 225-237.

OECD. (2013). *PISA 2012 Results: Ready to learn: Students' Engagement, Drive and Self-Beliefs Volume III.* OECD.

OECD. (2014). *In PISA 2012 results: What students know and can do- Student performance in mathematics,reading and science* (Revised ed., Vol. 1). OECD Publishing. doi:10.1787/9789264208780

OECD. (2016). Mathematics performance (PISA) (indicator). doi:10.1787/04711c74-en

OECD. (2017). *PISA 2015 Technical Report.* OECD Publishing. Retrieved from http://www.oecd.org/pisa/data/2015-technical-report/

Pallant, J. (2011). *A step by step guide to data analysis using the SPSS program: SPSS Survival Manual.* Crows Nest, Australia: Allen Unwin.

Pantziara, M., & Philippou, G. N. (2013). Students' motivation in the mathematics classrooms: Revealing causes and consequences. *International Journal of Science and Mathematics Education, 13*, 385-411. doi:10.1007/s10763-013-9502-0

Park, O. C., & Lee, J. (2004). Adaptive Instuctional Systems. In D. H. Jonassen, *Handbook of research for education communications and technology* (pp. 651-684). Mahwah, NJ: Erlbaum.

Pavlov, I. P. (1906). The scientific investigation of the psychical faculties or processes in the higher animals. *Science, 24*(620), 613-619.

Poh, G. T., & Leong, K. E. (2014). Improving students' van Hiele level of geometric thinking using Geometer's Sketchpad. *Malaysian Online Journal of Educational Technology, 2*(3), 20-31.

Priya, K. (19 December, 2013). Better PMR results. *The Star*. Retrieved from http://www.thestar.com.my/news/nation/2013/12/19/better-pmr-results/

Priya, K. (3 March, 2015). SPM results 2014: Overall performance take a dip. Retrieved from http://www.thestar.com.my/news/nation/2015/03/03/spm-results-down/

PT3 exam results kept under wraps for few reasons, says Education official. (15 December, 2015). *Borneo Post Online*. Retrieved from read:http://www.theborneopost.com/2015/12/15/pt3-exam-results-kept-under-wraps-for-few-reasons-says-education-official/

Reeve, J. (1989). The interest-enjoyment distinction in intrinsic motivation. *Motivation and Emotion, 13*(2), 83-103.

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivation: Classic definitions and new directions. *Contemporary Educational Psychology, 25*, 54-67. doi:10.1006/ceps.1999.1020

Schiefele, U. (1991). Interest, learning and motivation. *Educational Psychologist, 26*(3), 299-323.

Sistem Guru Online. (14 December, 2014). *RPT Rancangan Pengajaran Tahunan Tingkatan 2 Subjek Matematik.* Retrieved from Sistem Guru Online: https://www.sistemguruonline.my/2014/12/rpt-rancangan-pengajaran-tahunan-tingkatan-2-subjek-matematik.html

Skaalvik, E. M., Federici, R. A., & Klassen, R. M. (2015). Mathematics achievement and self-efficacy: Relations with motivation for mathematics. *International Journal of Educational Research, 72*, 129-136. doi:10.1016/j.ijer.2015.06.008

Sketchpad Geometry Activities. (2009). Retrieved from Key Curriculum: http://learningcenter.dynamicgeometry.com/documents/VisualDemoPythagTheorem.zip

Skinner, B. F. (1953). *Science and human behavior.* New York: Free Press.

Smart Selangor Delivery Unit. (2016). *2016 Smart Selangor Executive Summary.* Selangor: Smart Selangor Delivery Unit.

Song, S., & Keller, J. M. (2001). Effectiveness of motivationally adaptive computer-assisted instruction on dynamic aspects of motivation. *Educational Technology Research and Development, 49*(2), 5-22.

SPM 2013 Results Summary. (21 March, 2014). Retrieved from http://eduhelp.my/v1/index.php?option=com_content&view=article&id=581:spm-2013-results-summary&catid=65:news&Itemid=87

Star, J. R., Chen, J. A., Taylor, M. W., Durkin, K., Dede, C., & Chao, T. (2014). Studying technology-based strategies for enhancing motivation in mathematics. *International Journal of STEM Education, 1*(7), 1-19.

Stevens, T., & Olivárez, A. J. (2005). Development and Evaluation of the Mathematics Interest Inventory. *Measurement and Evaluation in Counseling and Development, 38*(3), 141-152.

Tabachnick, B. G., & Fidell, L. S. (2001). *Using multivariate statistics.* Thousand Oaks, CA: Sage.

Tech Dome Penang. (1 December, 2014). Tech Dome Penang Project Kickoff. Retrieved from http://techdomepenang.org/press-release/13-tech-dome-penang-project-kickoff

Tella, A. (2007). The impact of motivation on student's academic achievement and learning outcomes in Mathematics among secondary school students in Nigeria. *Eurasia Journal of Mathematics, Science & Technology Education, 3*(2), 149-156.

Thien, L. M., & Ong, M. Y. (2015). Malaysian and Singaporean students' affective characteristics and mathematics performance: evidence from 2012. *SpringerPlus, 4*, 563-577. doi:10.1186/s40064-015-1358-z

Walter, J. G., & Hart, J. (2009). Understanding the complexities of student motivations in mathematics learning. *The Journal of Mathematical Behaviour*, 162-170. doi:10.1016/j.jmathb.2009.07.001

Weiner, B. (1985). An attributional theory of achievement motivation and emotion. *Psychological Review, 92*, 548-573.

Wigfield, A., & Eccles, J. S. (2000). Expectancy-value theory of achievement motivation. *Contemporary Educational Psychology, 25*, 68-81. doi:10.1006/ceps.1999.1015

Wiggles, A., & Eccles, J. S. (1992). The developmental of achievement task values: A theoretical analysis. *Developmental review, 12*, 265-310.

Yu, R., & Singh, K. (2016). Teacher support, instructional practices, student motivation, and mathematics achievement in high school. *The Journal of Educational Research*, 1-14. doi:10.1080/00220671.2016.1204260

BIODATA OF STUDENT

Wong Shu Ling was born on the 20th September 1990 in Sarawak, Malaysia. She received her primary and secondary education in Miri, Sarawak. During her secondary school years, she has been actively participated in voluntary organization, Malaysian Red Crescent, and worked as president at the school and the district level for the organization. In 2006, she was awarded as Best Leader in a youth leadership training camp in Miri Chapter. Later in 2007, she was awarded as Best Female Participant in Tutti-Fratelli national youth camp that was organised by Klang Chapter, Selangor Branch of Malaysian Red Crescent. She also worked as Assistant Head Girl in her high school prefectorial board. In 2009, she continued her post-secondary education at Labuan, Malaysia.

In 2010, she furthered her undergraduate studies at Universiti Sains Malaysia for the degree of Bachelor of Science with Education (Mathematics) and graduated with first class honours. During her degree, she was in the dean's list for four semesters. She continued her active participation in voluntary activities and first aid training and awarded the Best Member by Malaysian Red Crescent Universiti Sains Malaysia. In 2012, she was chosen to represent Malaysia to participate Youth Summer Camp organised by German Red Cross in Xanten, Germany.

Wong Shu Ling embarked on her postgraduate journey in 2015 in Universiti Putra Malaysia. She started her Master of Science, Educational Technology program under the supervision of Professor Dr. Wong Su Luan and Associate Professor Dr. Ahmad Fauzi Mohd Ayub.

LIST OF PUBLICATION

Wong, S. L., Wong, S. L., & Mohd Ayub, A. F. (2018, 11-13 December). Application of Geometer's Sketchpad in Malaysian Schools: A literature review. Proceedings of International Conference on Creativity, Innovation, and Invention in Digital Technology 2018. Penang: Centre for Instructional Technology and Multimedia (CITM).

Wong, S. L., & Wong, S. L. (2017, 4-8 December). Motivation towards mathematics learning in the technology-enhanced environment. In W. Chen et al. (Eds). Proceedings of the 25th International Conference of Computers in Education. New Zealand: Asia-Pacific Society for Computers in Education.

Wong, S. L., & Wong, S. L. (2017). Integrating motivation in instructional design: A critical literature review. Pertanika Journal of Scholarly Research Review, 3(1), 17-23.

Wong, S. L., & Wong, S. L. (2016). Use of Geometer's Sketchpad in the Malaysian Mathematics Classroom. Proceedings of Graduate Research in Education Seminar (GREDUC) 2016, Universiti Putra Malaysia: Faculty of Educational Studies.