

**A STUDY OF TECHNOLOGICAL PEDAGOGICAL
CONTENT KNOWLEDGE (TPACK) COMPONENTS
AND TECHNOLOGY INTEGRATION SELF
EFFICACY (TISE) AMONG PRIMARY
MATHEMATICS TEACHERS AND THE
RELATIONSHIP BETWEEN THEM**

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ABSTRACT

The main purpose of this study is to identify the relationships among different components of technological pedagogical content knowledge (TPACK) and technology integration self efficacy (TISE) among mathematics teachers in primary schools. A descriptive quantitative research design was implemented in this study to achieve this purpose. The instruments used in this study are TPACK survey instrument (Pamuk et al., 2013) to measure teacher's technological pedagogical content knowledge and Computer Technology Integration Survey (CTIS (Wang et al., 2004) to measure participants' technology integration self efficacy in teaching. The participants for this study comprised of 173 mathematics teachers from 24 primary schools of five areas in Banjarmasin. The results of this study were analyzed using descriptive analysis and inferential statistics. The descriptive analysis involved the mean, percentage, frequency, and standard deviation. The finding from the descriptive analysis was that the majority of the respondents had moderate level of technology knowledge ($M = 3.4241$, $SD = .65369$); content knowledge ($M = 3.9016$, $SD = .47232$); pedagogical knowledge, ($M = 3.9937$, $SD = .41847$); pedagogical content knowledge ($M = 3.7835$, $SD = .43183$); technological pedagogical knowledge ($M = 3.9351$, $SD = .53921$); technological content knowledge ($M = 3.9385$, $SD = .47165$); technological pedagogical content knowledge ($M = 3.9167$, $SD = .43293$); and technology integration self efficacy ($M = 3.8085$, $SD = .44973$). The inferential statistics of this study involved the normality data, structural model and hypothesis. The normality data test result shows that C.R multivariate is $1.852 < c.r < 2.58$. The structural model test results show that the value of chi square is 4.843; P-value is 0.184; CMIN/DF is 1.614; RMSEA is 0.063; GFI is 0.993; AGFI is 0.911; TLI is 0.989; and CFI is 0.999. Structural equation modeling (SEM) was used to test all hypotheses. The finding of hypothesis test shows that there are significant relationships between TPACK and TISE; significant relationships between technological knowledge and TISE; significant relationships between technological content knowledge and TISE; and no significant relationships between technological pedagogical knowledge and TISE among mathematics teachers. The findings also show that technological knowledge, pedagogical knowledge, content knowledge, pedagogical content knowledge, technological content knowledge and technological pedagogical knowledge have positive correlations toward technological pedagogical content knowledge. The implication of this study is to increase primary schools mathematics teachers' ability of technological pedagogical content knowledge and their self-efficacy technology integration.

KAJIAN TENTANG KOMPONEN PENGETAHUAN KANDUNGAN PEDAGOGI TEKNOLOGI (TPACK) DAN INTEGRASI TEKNOLOGI KEBERKESANAN DIRI (TISE) DALAM KALANGAN GURU MATEMATIK DI SEKOLAH RENDAH DAN HUBUNGAN ANTARA MEREKA

ABSTRAK

Tujuan utama kajian ini adalah untuk mengenal pasti hubungan antara komponen pengetahuan kandungan pedagogi teknologi (TPACK) dan integrasi teknologi keberkesanan diri (TISE) dalam kalangan guru matematik di sekolah rendah. Satu reka bentuk penyelidikan kuantitatif deskriptif telah digunakan dalam kajian ini untuk mencapai tujuan ini. Instrumen yang digunakan dalam kajian ini ialah TPACK survey (Pamuk et al., 2013) untuk mengukur pengetahuan kandungan pedagogi teknologi dan instrument Computer Technology Integration Survey (CTIS) (Wang et al., 2004) untuk mengukur integrasi teknologi keberkesanan diri (TISE) peserta dalam pengajaran pembelajaran. Peserta kajian terdiri daripada 173 orang guru dari 24 buah sekolah rendah dari lima kawasan di Banjarmasin. Analisis deskriptif melibatkan min, peratusan, kekerapan, dan sisihan piawai. Keputusan kajian ini menggunakan analisis deskriptif dan statistik inferensi. Dapatan analisis deskriptif bahawa majoriti daripada responden melaporkan tahap sederhana pada pengetahuan teknologi ($M = 3.4241$, $SD = 0.65369$); pengetahuan kandungan ($M = 3.9016$, $SD = 0.47232$); pengetahuan pedagogi, ($M = 3.9937$, $SD = 0.41847$); pengetahuan kandungan pedagogi ($M = 3.7835$, $SD = 0.43183$); teknologi pengetahuan pedagogi ($M = 3.9351$, $SD = 0.53921$); pengetahuan kandungan teknologi ($M = 3.9385$, $SD = 0.47165$); teknologi pengetahuan kandungan pedagogi ($M = 3.9167$, $SD = 0.43293$); dan integrasi teknologi keberkesanan diri integrasi ($M = 3.8085$, $SD = .44973$). Statistik inferensi kajian ini melibatkan data normal, model struktur dan hipotesis. Keputusan ujian data normal menunjukkan bahawa CR multivariate adalah $1.852 < cr < 2.58$. Keputusan ujian model struktur menunjukkan bahawa nilai khi kuasa dua adalah 4,843; P-nilai adalah 0.184; CMIN / DF adalah 1.614; RMSEA ialah 0.063; GFI adalah 0.993; AGFI adalah 0.911; TLI adalah 0.989; dan CFI adalah 0.999. Struktur pemodelan persamaan (SEM) digunakan untuk menguji semua hipotesis. Dapatan ujian hipotesis menunjukkan terdapat hubungan yang signifikan antara TPACK dan TISE; pengetahuan teknologi dan TISE; pengetahuan kandungan dan teknologi TISE; dan tidak ada hubungan yang signifikan antara pengetahuan teknologi pedagogi dan TISE kalangan guru matematik. Dapatan kajian juga menunjukkan bahawa pengetahuan teknologi, pengetahuan pedagogi, pengetahuan kandungan, pengetahuan kandungan pedagogi, pengetahuan kandungan teknologi dan pengetahuan pedagogi teknogikal mempunyai korelasi positif terhadap teknologi pengetahuan kandungan pedagogi. Implikasi kajian ini adalah untuk meningkatkan keupayaan matematik guru sekolah rendah tentang pengetahuan kandungan pedagogi dan integrasi teknologi keberkesanan diri mereka.

TABLE OF CONTENTS

	Page
DECLARATION	ii
ACKNOWLEDGMENT	iii
DEDICATION	iv
ABSTRACT	v
TABLE OF CONTENT	vii
LIST OF TABLE	xiv
LIST OF FIGURE	xviii
LIST OF ABBREVIATIONS	xx
LIST OF SYMBOL	xxi
 CHAPTER 1 INTRODUCTION	 1
1.1 Introduction	1
1.2 Background of Study	2
1.3 Statement of Problem	10
1.4 Objectives of Study	18
1.5 Research Questions	20
1.6 Hypotheses	22
1.7 Significance of Study	26

1.8	Limitations of Study	28
1.9	Definitions of Terms	29
1.10	Theoretical Approach	31
1.10.1	Theory of Technological Pedagogical Content Knowledge(TPACK)	31
1.10.2	Theory of Technology Integration Self Efficacy (TISE)	38
1.11	Conceptual Framework	40
1.12	Conclusion	42
CHAPTER 2 LITERATURE REVIEW		43
2.1	Introduction	43
2.2	Mathematics in Primary Schools	44
2.3	Integrating Technology in Primary Schools Mathematics	45
2.4	Development Model and Standard of TPACK Mathematics Teachers	49
2.5	Technological Pedagogical Content Knowledge (TPACK) in Mathematics Education	53
2.6	Studies of Technological Pedagogical Content Knowledge (TPACK)	58
2.7	Studies of Self Efficacy Belief about Technology Integration	60
2.8	Studies of Technological Pedagogical Content Knowledge and Self Efficacy	62
2.9	Conclusion	64

CHAPTER 3 METHODOLOGY **65**

3.1	Introduction	65
3.2	Research Design	65
3.3	Population and Sample	66
3.4	Instrument	72
3.4.1	Technological Pedagogical Content Knowledge (TPACK) Survey	72
3.4.2	Computer Technology Integration Survey (CTIS) Survey	80
3.4.3	Demographic Information	82
3.5	Pilot Study	82
3.5.1	Validity	83
3.5.2	Reliability	88
3.6	Research Procedures	90
3.6.1	Data Collecting Procedures	90
3.6.2	Input Data	91
3.7	Data Analysis Procedures	91
3.7.1	Descriptive Data	92
3.7.2	Hypothesis Testing and Analysis of Structural Equation Models	93
3.8	Conclusion	103

CHAPTER 4 FINDING OF THE STUDY

104

4.1	Introduction	104
4.2	Profile of Participants	105
4.3	Descriptive Analysis	108
4.3.1	Research Question 1: The Level of Technological Pedagogical Content Knowledge components among Mathematics Teachers in Primary Schools	109
4.3.2	Research Question 2 : The Level of Technology Integration Self Efficacy among Mathematics Teachers in Primary Schools	117
4.1	Inferential Statistic	119
4.4.1	Normality of Data Test	119
4.4.2	Structural Model	120
4.4.3	Hypotheses Test	125
4.4.3.1	Research Question 3 : The Relationships Exist between technological pedagogical content knowledge (TPACK) components among mathematics teachers in primary schools	125
4.4.3.2	Research Question 4 : The Relationships Exist between Technological Pedagogical Content Knowledge Components toward Technology Integration Self Efficacy	138
4.4.3.3	Research Question 5: Pedagogical Content Knowledge Mediating of The Relationship Between Content Knowledge to Technological Pedagogical Content Knowledge and The Relationship Between Pedagogical Knowledge to Technological Pedagogical Content Knowledge	142

4.4.3.4	Research Question 6 : Technological Content Knowledge Mediating of The Relationship Between Content Knowledge to Technological Pedagogical Content Knowledge, The Relationship between Technological Knowledge to Technological Pedagogical Content Knowledge, and The Relationship Between Technological Knowledge to Technology Integration Self Efficacy	146
4.4.3.5	Research Question 7: Technological Pedagogical Knowledge Mediating of The Relationship Between Technological Knowledge to Technological Pedagogical Content Knowledge, The Relationship between Pedagogical Knowledge to Technological Pedagogical Content Knowledge, and The Relationship Between Technological Knowledge to Technology Integration Self Efficacy	152
4.4.3.6	Research Question 8 : Technological Pedagogical Content Knowledge Mediating of the Relationship between Technological Content Knowledge to Technology Integration Self Efficacy and The Relationship between Technological Pedagogical Knowledge to Technological Technology Integration Self Efficacy	158
4.5	Conclusion	162
CHAPTER 5 SUMMARY, DISCUSSION, IMPLICATIONS AND RECOMMENDATION		167
5.1	Introduction	167
5.1	Summary of Research	168
5.2	Discussion	173
5.2.1	The Technological Pedagogical Content Knowledge components among Mathematics Teachers in Primary Schools	174

5.2.2 Technology Integration Self Efficacy among Mathematics Teachers in Primary Schools	175
5.2.3 The Relationships Exist between technological pedagogical content knowledge (TPACK) components among mathematics teachers in primary schools	177
5.2.4 The Relationships Exist between Technological Pedagogical Content Knowledge Components toward Technology Integration Self Efficacy	179
5.2.5 Pedagogical Content Knowledge is Mediating of The Relationship Between Content Knowledge to Technological Pedagogical Content Knowledge and The Relationship Between Pedagogical Knowledge to Technological Pedagogical Content Knowledge	182
5.2.6 Technological Content Knowledge is Mediating of The Relationship Between Content Knowledge to Technological Pedagogical Content Knowledge, The Relationship between Technological Knowledge to Technological Pedagogical Content Knowledge, and The Relationship Between Technological Knowledge to Technology Integration Self Efficacy	184
5.2.7 Technological Pedagogical Knowledge is Mediating The Relationship Between Technological Knowledge to Technological Pedagogical Content Knowledge, The Relationship between Pedagogical Knowledge to Technological Pedagogical Content Knowledge, and The Relationship Between Technological Knowledge to Technology Integration Self Efficacy	186
5.2.8 Technological Pedagogical Content Knowledge is Mediating of Relationship between Technological Content Knowledge to Technology Integration Self Efficacy and The Relationship between Technological Pedagogical Knowledge to Technological Technology Integration Self Efficacy	188

5.3	Implication of Research	190
5.4	Suggestion for Future Research	192
5.5	Conclusion	193
REFERENCES		194
APPENDIX A		203
APPENDIX B		214

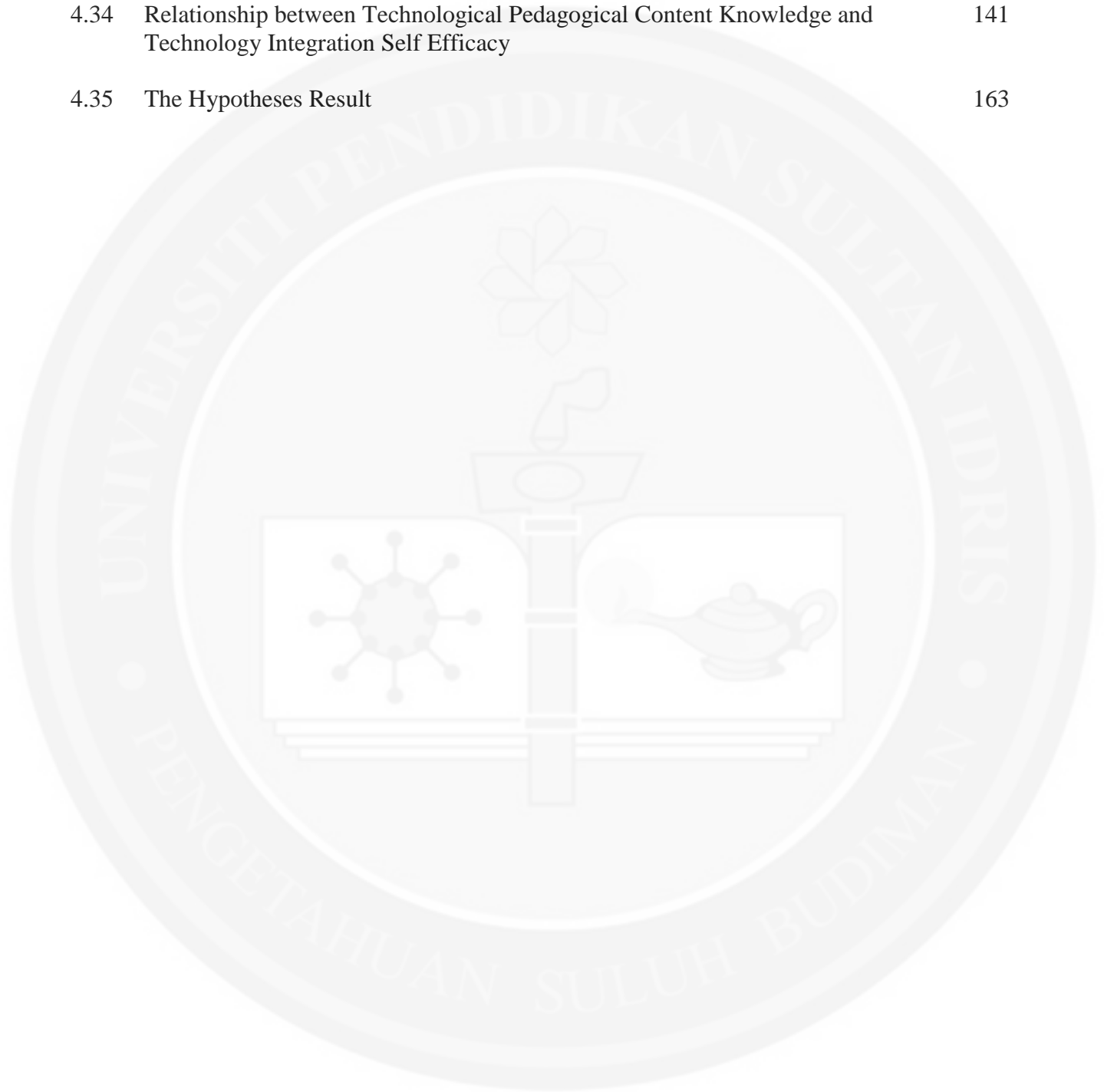
LIST OF TABLES

Table	Page
2.1 Summarizes of Technology Integration Strategies for Mathematics	48
2.2 The Five Stage Developmental Processes in Mathematics Teachers	51
2.3 Descriptor for Major Themes in the Mathematics Teacher TPACK Development Model	52
2.4 A Framework for Learning to Teach with Technology	55
2.5 Low and High-Level Enactments of TPACK	56
3.1 The Sample Distribution	69
3.2 Categorization Level Criteria of Technology Knowledge	74
3.3 Categorization Level Criteria of Content Knowledge	75
3.4 Categorization Level Criteria of Pedagogical Knowledge	76
3.5 Categorization Level Criteria of Pedagogical Content Knowledge	77
3.6 Categorization Level Criteria of Technological Pedagogical Knowledge	78
3.7 Categorization Level Criteria of Technological Content Knowledge	79
3.8 Categorization Level Criteria of Technological Pedagogical Content Knowledge	80
3.9 Categorization Level Criteria of Technology Integration Self Efficacy	81
3.10 Validity of Technological Knowledge	84
3.11 Validity of Content Knowledge	85
3.12 Validity of Pedagogical Knowledge	85
3.13 Validity of Pedagogical Content Knowledge	86

3.14	Validity of Technological Pedagogical Knowledge	86
3.15	Validity of Technological Content Knowledge	86
3.16	Validity of Technological Pedagogical Content Knowledge	87
3.17	Validity of Technology Integration Self Efficacy	87
3.18	Reliability coefficient of TISE and TPACK instrument	89
3.19	Research Questions and Statistical Analysis Used	92
3.20	Research Questions, Hypotheses and Statistical Analysis Used	93
3.21	Goodness of Fit Criteria	101
4.1	Frequency and Percentage of Teachers' Gender	105
4.2	Frequency and Percentage of Teachers' Age	106
4.3	Frequency and Percentage of Teachers' Education Level	107
4.4	Frequency and Percentage of Teachers' Experience years in Teaching	107
4.5	Frequency and Percentage of Teachers' Access Computer at home status	108
4.6	Mean and Standard Deviation of Technological Pedagogical Content Knowledge	110
4.7	Frequency and Percentage of Technology Knowledge Level	111
4.8	Frequency and Percentage of Content Knowledge Level	112
4.9	Frequency and Percentage of Pedagogical Knowledge Level	113
4.10	Frequency and Percentage of Pedagogical Content Knowledge Level	114
4.11	Frequency and Percentage of Technological Pedagogical Knowledge Level	115
4.12	Frequency and Percentage of Technological Content Knowledge Level	116
4.13	Frequency and Percentage of Technological Pedagogical Content Knowledge Level	117
4.14	Mean and Standard Deviation of Technology Integration Self Efficacy	118
4.15	Frequency and Percentage of Technology Integration Self Efficacy Level	118

4.16	The Result of Goodness of Fit Measurement Model Before Modified	121
4.17	The Result of Goodness of Fit of Measurement Model After Modified	123
4.18	SEM analysis of Model Structure Studies	124
4.19	Relationship between Technological Knowledge to Technological Content Knowledge	126
4.20	Relationship between Technological Knowledge to Technology Pedagogical Knowledge	127
4.21	Relationship between Technological Knowledge to Technology Pedagogical Content Knowledge	128
4.22	Relationship between Content Knowledge to Technological Content Knowledge	129
4.23	Relationship between Content Knowledge to Pedagogical Content Knowledge	130
4.24	Relationship between Content Knowledge to Technology Pedagogical Content Knowledge	131
4.25	Relationship between Technological Pedagogical Knowledge to Pedagogical Knowledge	132
4.26	Relationship between Pedagogical Knowledge to Pedagogical Content Knowledge	133
4.27	Relationship between Pedagogical Knowledge to Technology Pedagogical Content Knowledge	134
4.28	Relationship between Pedagogical Content Knowledge to Technology Pedagogical Content Knowledge	135
4.29	Relationship between Technological Content Knowledge to Technology Pedagogical Content Knowledge	136
4.30	Relationship between Technological Pedagogical Knowledge to Technology Pedagogical Content Knowledge	137
4.31	Relationship between Technological Knowledge to Technology Integration Self Efficacy	138
4.32	Relationship between Technological Content Knowledge to Technology Integration Self Efficacy	139

4.33	Relationship between Technological Pedagogical Knowledge to Technology Integration Self Efficacy	140
4.34	Relationship between Technological Pedagogical Content Knowledge and Technology Integration Self Efficacy	141
4.35	The Hypotheses Result	163

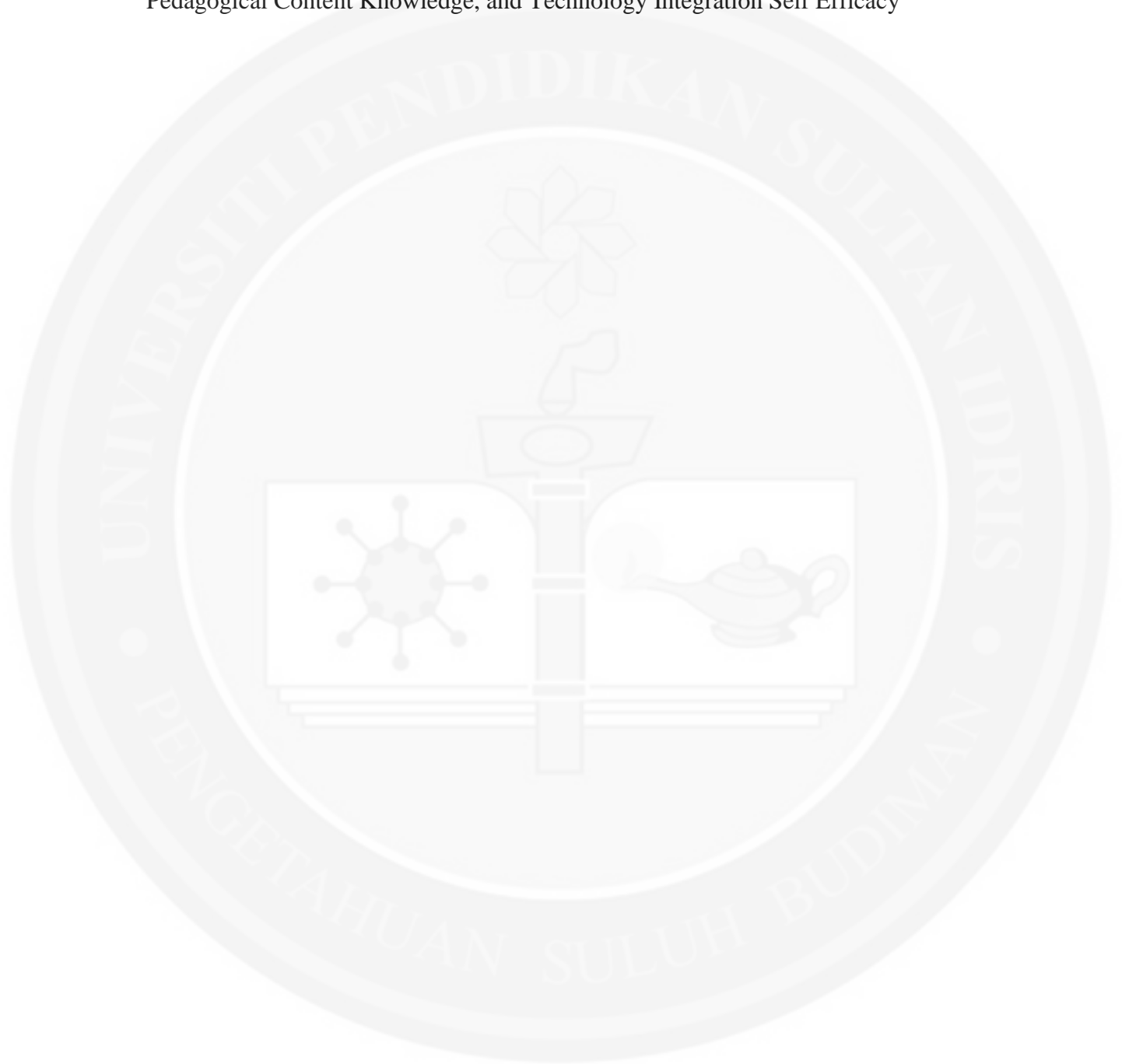


LIST OF FIGURE

Figure

	Page
1.1 PCK Model by Shulman	32
1.2 Technological Pedagogical Content Knowledge (TPACK) Diagram Venn	32
1.3 Conceptual Framework TISE and TPACK.	40
2.1. Visual description of teacher levels as their thinking and understanding merge toward the interconnected and integrated manner identified by TPACK	50
4.1 Original Structure Model	120
4.2 Fit Structure Model	122
4.3 The Relationship among Content Knowledge, Pedagogical Content Knowledge, and Technological Pedagogical Content Knowledge	143
4.4 The Relationship among Pedagogical Knowledge, Pedagogical Content Knowledge, and Technological Pedagogical Content Knowledge	145
4.5 The Relationship among Content Knowledge, Technological Content Knowledge, and Technological Pedagogical Content Knowledge	147
4.6 The Relationship among Technological Knowledge, Technological Content Knowledge, and Technological Pedagogical Content Knowledge	149
4.7 The Relationship among Technological Knowledge, Technological Content Knowledge, and Technology Integration Self Efficacy	151
4.8 The Relationship among Technological Knowledge, Technological Pedagogical Knowledge, and Technological Pedagogical Content Knowledge	153
4.9 The Relationship among Pedagogical Knowledge, Technological Pedagogical Knowledge, and Technological Pedagogical Content Knowledge	155
4.10 The Relationship among Technological Knowledge, Technological Pedagogical Knowledge, and Technology Integration Self Efficacy	157

4.11	The Relationship among Technological Content Knowledge, Technological Pedagogical Content Knowledge and Technology Integration Self Efficacy	159
4.12	The Relationship among Technological Pedagogical Knowledge, Technological Pedagogical Content Knowledge, and Technology Integration Self Efficacy	161



LIST OF ABBREVIATION

AMOS	Analisis of Moment Structures
c.r	critical ratio
CK	Content Knowledge
N	Population size
N	Sample size
<i>p</i>	Probability
PCK	Pedagogical Content Knowledge
PK	Pedagogical Knowledge
SD	Standard deviation
SEM	Structural Equation Modeling
Sig.	Significant
SPSS	Statistical Package for Social Science
TCK	Technological Content Knowledge
TISE	Technology Integration Self Efficacy
TK	Technological Knowledge
TPACK	Technological Pedagogical Content Knowledge
TPK	Technological Pedagogical Knowledge

LIST OF SYMBOLS

%	Percentage
<	Less than
>	More than
\leq	Equal less than
α	Cronbach's index of internal consistency
μ	Mean
σ	Standard Deviation

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter deals with the background of study, statement of problems, research objectives, research questions, significance of study, limitations of study, terms of definition, conceptual framework, and hypotheses. The summary of this chapter is presented at the end of each chapter.

1.2 Background of Study

The primary school years are the time when pupils learn to like or dislike mathematics, where feeling of despondency and failure first surface and where misconceptions of mathematics are often formed. The learning of mathematics is a complicated and dynamic process linking to the interaction between previously acquired levels of understanding to the conceptualization and incorporating of new materials. Most modern views of mathematics education acknowledge that children do not simply take in mathematical knowledge that is transmitted to them, no matter how well it is organized and structured (Bobis, 2004).

Children frequently construct and develop their own ways of doing mathematics – often in a manner quite different from the way it was introduced or intended to be processed (Bobis, 2004). In the mathematics learning process, it should have mathematical power in students, such as attitudes or mindsets which expected to get after the learning of mathematics. The attitudes are content, problem solving, reasoning and proof, communication, connection and representation (NCTM, 2000).

In the past, mathematics had been thought of in terms of content only – a body of facts and procedures that needed to be memorized. It is now more aptly described as a way of thinking, and the learning of it is characterized not only by its products but also by a growth in understanding of mathematical concepts and processes. The development of such concepts and processes is based on finding mathematical patterns and relationships. The effective use of the patterns and relationships provides opportunities for students to choose

and apply mathematical understandings to a range of problem solving situations. Because mathematical thinking is concerned primarily with the processes, such as investigating and conjecturing, it is inherently linked to problem solving – a process in itself (Bobis, 2004).

Although mathematics is an important subject but many of the students cannot solve the problems of mathematics well. Several reasons why this happened are matters related to teachers, students, the availability of facilities, teaching methods and the other factors that influence student in mathematics learning (Budiman, 2011; Shadiq&Ini 2004; Nur, 2001). Some of teachers teach mathematics in the way they were used to be and they are stuck in old way. As a result, effective teaching cannot be entirely content-driven, student-centered and or teacher-centered.

The mathematics teachers that have great knowledge of the subject matter is not enough to teach mathematics well (Idris, 2006). New concepts and understandings of mathematics need to be linked to a student's existing knowledge base and personal experiences. Students need to be involved in the learning process, actively engaged in thinking and encouraged them to verbalize their thought processes and reflect upon their problem solving endeavors. Therefore, the role of the mathematics primary school teachers is thus particularly important. Mathematics teacher have to know how to explain the subject matter and other factors that may be involved in teaching such as; the teachers' understanding of curriculum, course design and syllabus, understanding of student backgrounds and the PCK (Pedagogical Contents Knowledge) that enable him/her to relate and use proper pedagogical approach to the contents and the learners. On other hand, mathematics teachers should be sensitive to making the study of mathematics to be creative,

less stressful and the learning is meaningful. Moreover, the nature of the primary classroom allows the teachers to make important links between mathematics and the other subjects' areas. To accomplish this, teachers should use better information and communication technologies to follow developments in their content areas, to use and adjust contemporary approaches, methods, techniques and procedures that suit the contents and the learners.

Information Communication Technology (ICT) has been developed rapidly and has been used in all areas of knowledge, including in the field of education. Realizing the importance of information technology in education, mathematic teachers should utilize the technology to assist the learners achieve their goals and to ease them in understanding and using the concepts of mathematics. ICT has been proven to be a means that develop individual intellectual skill in mathematics which is a prerequisite to not only the prosperity of each individual in this information explosion but also in shaping education policy in a country as a whole. Oldknow & Taylor (2000) noted there are at least three reasons for promoting the integration of ICT in education: i) public policy; ii) desirability and; iii) inevitability.

ICT is an educational teaching and learning tool that can be used to develop better strategies for teachers and learners in acquiring the knowledge of mathematics. ICT, once it is well-planned, can be effective instructional means to be used by students for deeper understanding of the subject matter and for teachers in facilitating learning among the students. Educational technology such as television, video and computer multimedia

provide information that can be authentic and challenging as well in addition to stimulating student's sensorial apparatus through color, movement, images and sound (Pandey, 2005).

The effective use of educational technology requires that teachers have both the necessary technology skills and a certain comfort level to make full use of what technology has to offer. Fitzallen (2005) puts great emphasis on the recognition of a need for teachers to gain an understanding of how Information and Communication Technology (ICT) can be used to extend students' thinking and problem-solving skills, rather than being just a publication and research tool. Roblyer, M. D & Doering, A. H. (2006) examined that using technology in education not only motivates students by tapping into their comfort zone, but also enhancing instructional methods, increasing productivity and allowing students to gain required information. There are four objectives that can be enhanced by ICT in education: i) expanding access to all levels of education; ii) improving the quality of education; iii) enhancing lifelong learning; and iv) facilitating nonformal education (Pandey, 2005). Therefore, one of the major challenges that many schools are facing is preparing students with essential skills necessary for success in a rapidly changing, technology-driven society (Schoen & Fusarelli, 2008).

In mathematics education, ICT have played important role in enhancing the learning of mathematics. National Council of Teacher of Mathematics (NCTM) (2000) described six principles that address crucial issues that are fundamental to mathematics program at schools: i) equity; ii) curriculum; iii) teaching; iv) learning; v) assessment; and vi) technology. Within technological principle, NCTM stresses that technology is essential in teaching and learning mathematics and it influences that mathematics that is taught and

enhances students' learning (NCTM, 2000). In the mathematics classroom envisioned in the Principle and Standards, every student should have access to technology to facilitate his or her mathematics learning under the guidance of a skillful teacher (NCTM, 2000).

Many of research results from mathematics education illustrate that the integrating of ICT may change the environment of teaching and learning mathematics (Chandra & Briskey, 2012; Tay, Lim, Lim, & Koh, 2012). ICT seems to provide a focal point that encourages interaction between learners and the technology itself. This implies that ICT used in instruction will support constructivist pedagogy, where learners use technology to explore and reach an understanding of mathematical concepts (Sang, Valcke, Braak, Tondeur, & Zhu, 2011; Crisan, 2004). British Educational Communications and Technology Agency (BECTA)(2003) describe that the benefits of ICT that are used in mathematics learning will increase motivation amongst pupils, fast and accurate feedback to pupils using ICT and greater collaboration between pupils. Thus, ICT can make students more active and not solely dependent to their teacher so they can study independently. Furthermore, for ICT to be used effectively in everyday teaching, radical changes are advocated in approaches to the teaching of mathematics. For this reason, it is important to promote research and practice that are able to provide teachers the opportunities to adequately utilize and integrate the technology into mathematics classrooms.

ICT challenges current descriptions and practices of pedagogy in terms of the perceptions of time, place, authority and the purpose of teaching. Information and communications technology can expand the opportunities to extend the connections between learners, teachers and information beyond the formal school day and the agreed