

THE EFFECTIVENESS OF USING MATHEMATICS DICTIONARY IN  
ENHANCING PUPILS' PERFORMANCE AND EFFICACY  
IN LEARNING POLYGONS

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A project report submitted in partial fulfilment of the  
requirements for the award of the degree of  
Master of Education (Mathematics)

School of Education  
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Universiti Teknologi Malaysia

FEBRUARY 2021

## **DEDICATION**

This thesis is dedicated to my parents for given me the support to take up the challenge to sign up for this course and inspired to work hard towards completing my goal. I would also grateful to my son for giving me the support and cooperation of not interrupting me while I was in the midst of completing my course.

## **ACKNOWLEDGEMENT**

In this research study, there have been many students, lecturers and teachers involved in the preparation. I am grateful for the inspiration of many participants who have contributed to my understandings.

In particular, I am grateful for my supervisor, Dr. Najua Syuhada Binti Ahmad Alhassora, at Universiti Teknologi Malaysia for guiding me through my research studies and had given feedback, advices and much effort of encouragement. Without her support, I would not have gone this far to complete this work. Like once said, “complete what you have started”.

## ABSTRAK

Kamus Matematik adalah alat pembelajaran yang berpotensi untuk pelajar belajar dengan berkesan. Subtopik dipilih dari geometri yang merupakan topik Poligon, digunakan untuk mengenalpasti keberkesanan penggunaan kamus Matematik dalam meningkatkan prestasi dan efikasi sendiri murid. Kajian ini bertujuan untuk mengenal pasti prestasi dan efikasi sendiri murid sekolah rendah setelah pelaksanaan kamus Matematik. Seramai 20 pelajar sekolah rendah di Sekolah A telah mengambil bahagian dalam kajian ini. Reka bentuk kajian untuk kajian ini adalah quasi-experimental. Ujian pra dan ujian pasca digunakan untuk mengukur prestasi pelajar. Selepas itu, responden diberi soal selidik efikasi sendiri untuk mengukur tahap efikasi sendiri mereka dalam mempelajari topik Poligon. Hasil kajian menunjukkan bahawa terdapat peningkatan yang signifikan dalam ujian pasca mereka ( $\text{min} = 9,70$ ), dibandingkan dengan ujian pra ( $\text{min} = 7,75$ ). Hasil kajian dalam ujian normaliti menunjukkan bahawa ujian pra ( $\text{nilai-p} = .193$ ) tidak mempunyai bukti yang cukup untuk menyatakan bahawa populasi tidak diedarkan secara normal, sedangkan untuk ujian pasca ( $\text{nilai-p} = .000$ ) adalah sebaliknya. Sebagai perbandingan dengan ujian pra dan ujian pasca, ia menunjukkan nilai yang signifikan ( $0.00$ ), yang menunjukkan peningkatan dalam prestasi. Dengan kata lain, kamus matematik dapat meningkatkan prestasi pelajar. Tahap efikasi sendiri pelajar tinggi ( $\text{median} = 3.00$ ), yang menunjukkan bahawa pelajar mempunyai efikasi sendiri yang tinggi setelah implementasi kamus Matematik. Dapatan kajian ini menunjukkan bahawa adalah penting bagi pelajar untuk menggunakan kamus Matematik dalam usaha membantu mereka meningkatkan pencapaian dan efikasi sendiri dalam topik Poligon.

## ABSTRACT

The Mathematics dictionary is a potential learning tool for students to learn effectively. A subtopic was chosen from geometry which is Polygon topic, is use to identify the effectiveness of using the Mathematics dictionary in enhancing pupil's performance and self-efficacy. This study aimed to identify the performance and self-efficacy of the upper primary school pupils after implementing Mathematics dictionary. A total of 20 upper primary school students in primary 6 in School A were participated in this study. The research design for this study was a quasi-experimental study. Pre-test and post-test were used to measure the performance of the students. Subsequently, the respondents were given a self-efficacy questionnaire to measure their level of self-efficacy in learning Polygon topic. The findings showed that there is a significant improvement in their post-test (mean = 9.70), as compared to the pre-test (mean = 7.75). The findings in the normality test showed that pre-test (p-value = .193) do not have enough evidence to state that the population is not normally distributed, whereas for the post-test (p-value = .000) is the contrary. As comparison with both pre-test and post-test, it showed a significant value (0.00), which showed the improvement in performance. In other words, the mathematics dictionary could enhance the students' performance. The students' self-efficacy level is high (median = 3.00), which showed that the students have high self-efficacy after the implementation of Mathematics dictionary. The findings of this study indicate that it is important for students to use the Mathematics dictionary in an effort to help them improve their achievement and self-efficacy in the topic of Polygons.

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## LIST OF ABBREVIATIONS

BC	-	Before Christ
PISA	-	Programme for International Student Assessment
NCTM	-	National Council of Teacher of Mathematics
GSE	-	General Self-Efficacy
UTM	-	Universiti Teknologi Malaysia
SK	-	Sekolah Kebangsaan
PDPA	-	Personal Data Protection Act
SPSS	-	Statistical Package for the Social Sciences
HOTS	-	Higher-Order Thinking Skills
Df	-	Degree of Freedom
F	-	Frequency

## LIST OF SYMBOLS

%	-	Percentage
$\alpha$	-	Coefficient Alpha
sig.	-	Significance
cm <sup>2</sup>	-	Centimetre Square

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# CHAPTER 1

## INTRODUCTION

### 1.1 Introduction

One of the important subjects in Mathematics that helps to improve logical, critical thinking and problem solving is Geometry (Bayuningsih, 2018). It covers various aspects of topics from lines and angles, polygons, perimeter and area, solid geometry, algebraic expressions, Pythagoras' theorem, coordinates and circles. This subject must be taught properly to the pupils starting from early age in the primary level (Douglas, 2018). Early stage of learning process, vocabulary is important to convey the information to the pupils that emphasize in various archives. However, it is also more equally important to use visual to further enhance the understanding of the geometry concept among the pupils (Heinemann, 2000).

Geometry is defined as a group of Mathematics with the relation of measurement of shape, size, angles, relative position of figures, and the properties of space. Geometry is traced back to the ancient Mesopotamia and Egypt in the 2<sup>nd</sup> millennium BC. Early Geometry was only a collection of experimental discovery concerning of lengths, angles, areas, and volumes, which were developed to meet practical needs in surveying, construction, astronomy, and other forms of purposes (Meyer, 2006).

There are three types of cognitive learning styles which are visual, auditory and kinesthetic. Visual learning style is commonly known as spatial learning style which is a way of learning in which information relates to images (Kirby, 2017). Based on observations and identification which indicates that through visual learning style, pupils are required to see what they are expected in order to analyze and

understand. Thus, in learning Geometry concept, visual learning style is one of the most important methods that can help pupils to get better understanding (French, 2004). There are several types of teaching aids used by the Mathematics teachers in teaching geometry subject, such as the two- and three-dimension geometry building blocks, GeoGebra programme and magnetic construction set. However, studies showed that there are increasing number of students who are struggling in Mathematics and there are not many studies highlighted about the importance and benefits of using Mathematics dictionary as one of the teaching aids in teaching especially in geometry lesson (Paul, 2010).

Dictionary is often referred as reference book (Allen, 2019). Many people focus on proving that the myths of dictionaries are only for language (Chiphambo, 2019). In fact, there are several dictionaries for Mathematics subjects as well (Chiphambo, 2019). However, the existence of Mathematics dictionaries is not well known and less used by the Mathematics teachers in Malaysian classroom (Almalaoushi, 2011). There is an existing research on the benefits of integrating Mathematics dictionary into Mathematics instruction (Almalaoushi, 2011). However, based on the previous research, the main problem lied in the Mathematics dictionary was the vocabulary and terminology are exceedingly technical, and it presents various problems (Shukur, 2011). The words may be new to the students which they find difficulty to understand and to pronounce it. Often technical words have no simple concrete referent (Shukur, 2011). Therefore, most of the Mathematics teachers do not integrate the Mathematics dictionary into their lessons (Chiphambo, 2019).

In the Malaysia context, Mathematics teachers tend to use the traditional methods, strategies and teaching aids in teaching geometry (Almalaoushi, 2011) that hinders the mastery of understanding about the geometry concept that eventually failed to promote critical thinking among the pupils effectively. Furthermore, there was concern over pupils who were weak in geometry due to vocabulary and terminology that were not well established (Azimah, 2019); students were only able



to understand and solve straight forward questions (Ramli, Shafie &Tarmizi, 2013). Therefore, this is the Mathematics teachers' responsibility to see to this matter.

There is empirical evidence regarding the performance of Malaysian pupils in geometry subject. Based on the self-evaluated mastery level of students in solid geometry test, the statistics showed that the achievement of Malaysian pupils in geometry subject was still at the low level (Kuek & Hafizah, 2011). Majority of the pupils failed to visualize and answer the questions correctly. In fact, previous studies (Bandura, 1997; Bandura, 2005) showed that pupils were lacking of interest when it came to answering questions regarding geometry. This scenario proved that pupils' performance is interrelated to their self-efficacy. Pupils' self-efficacy play a significant role to motivate them in learning Mathematics especially in subjects that require them to visualize and understand the concept (Bandura, 1997; 2005).

Using Mathematics dictionary in teaching had shown some benefits toward pupils in other countries (Thompson, 2010). Therefore, this study aims to identify the effectiveness of using Mathematics dictionary in enhancing pupils' performance and self-efficacy in geometry significantly in polygon topic in Malaysia.

## **1.2 Background of Problems**

Conceptual understanding is an important thing especially in learning Mathematics (Gürbüz, Çatlioğlu, Birgin, & Erdem, 2010). Emphasizing on conceptual understanding became more serious when it comes to learning geometry, topic such as polygon at the early age of primary school levels (Gürbüz, Çatlioğlu, Birgin, & Erdem, 2010). This is due to the nature that geometry subject involves with the visualization skills. By having a good conceptual understanding, pupils are able to accept the idea of geometry and it can help the pupils to be more creative and critical in solving the questions (Pollard, Hains-Wesson, & Young, 2018). However, Mathematics teachers need to give a great attention in their delivering methods in

order to ensure the pupils master the concept before entering the deep learning phase. The National Council of Teacher of Mathematics (NCTM, 2006) mentioned that the pupils should be able to identify and describe a variety of two- and three-dimensional shapes presented in a diversity of ways and use geometrical concepts when recognizing and working on simple sequential patterns and when analysing sets of data. Yet, geometry in spatial thinking are often ignored or minimized in early education (Sarama & Clements, 2009). Traditional approach which based on the memorization only is less effective to be used in teaching Mathematics especially in the Polygon topic as the method is not suitable to prepare and challenge the pupils with ample skills in order to complete and solve problems outside of the classroom (Weinstein, 2019).

However, Mathematics teachers have limitation in using new teaching approach or teaching aids to teach the students. This is supported by the previous findings by Addelman (2012) which stated that Mathematics teachers still use traditional methods in teaching. Furthermore, the reason why Mathematics teachers still use traditional method to teach Polygon topic is because they are not having enough time to cover a large content of syllabus (Addelman, 2012). As a result of the less effective of teaching method and techniques, pupils' achievement of the Polygon topic showed less satisfactory performance. In addition, the performance is also likely due to the poor level of pupils' self-efficacy.

### **1.2.1 Pupils' Performance in Learning Polygon**

Based on the PISA 2012 report that showed the exposure students' exposure to the Mathematics concept under the topic of Polygon, Geometry, and followed by the percentage of students who answered how familiar they are with the following Mathematical concepts. It indicated that the respondents were under performed based on the results shown.

In general, most students at primary levels find Mathematics as a difficult subject and tend to develop inferiority, hesitation and complexity toward it. In such situation hinders their learning progress and they do not learn the things meant of Mathematics while motivational studying environment and level of interest play vital role in achieving high performances especially in Mathematics. Students' learning environment and the way of stimulating them in accordance with their interests and tendencies will automatically lead towards their performance-based destination that will surely reduce the level of frustration amongst all (Aunola, 2006). Percentage of students who answered how familiar they are with the following Mathematical concepts.

Table 1.1 Students' Exposure to the Mathematics Concept Polygon

<b>Polygon</b>										
	<b>Never heard of it</b>		<b>Heard of it once or twice</b>		<b>Heard of it a few times</b>		<b>Heard of it often</b>		<b>Know it well, understand the concept</b>	
	<b>%</b>	<b>S.E.</b>	<b>%</b>	<b>S.E.</b>	<b>%</b>	<b>S.E.</b>	<b>%</b>	<b>S.E.</b>	<b>%</b>	<b>S.E.</b>
<b>OECD Average</b>	14.5	(0.1)	10.9	(0.1)	14.6	(0.1)	22.9	(0.1)	37.2	(0.2)
<b>Malaysia</b>	12.6	(0.8)	15.4	(0.8)	22.0	(0.8)	31.2	(1.0)	18.7	(0.8)

There are several reasons that lead to poor performance in the topic. These issues relate to 1) Method of teaching; 2) A lack of connection between the subject and students; 3) Lack of self-efficacy; 4) Lack of understanding about signs and symbols; 5) Many Mathematics teachers are not well versed in the subject; 6) Accessible textbooks; 7) Attitude towards learning the subject (Shield & Kelly, 1999; NIED, 2010). Therefore, these evidences clearly showed the students' poor performances in Mathematics, especially in geometry subject because of it cover wider topics among other subjects (Bayuningsih, 2018).

According to Kwan Eu Leong from University of Malaya, who had published a journal on the "Students' Performance in Geometrical Reflection Using GeoGebra" in 2017. Figure 1.1 to show the comparison of pre-test and post-test results of Geometrical reflection for Year 1 students.

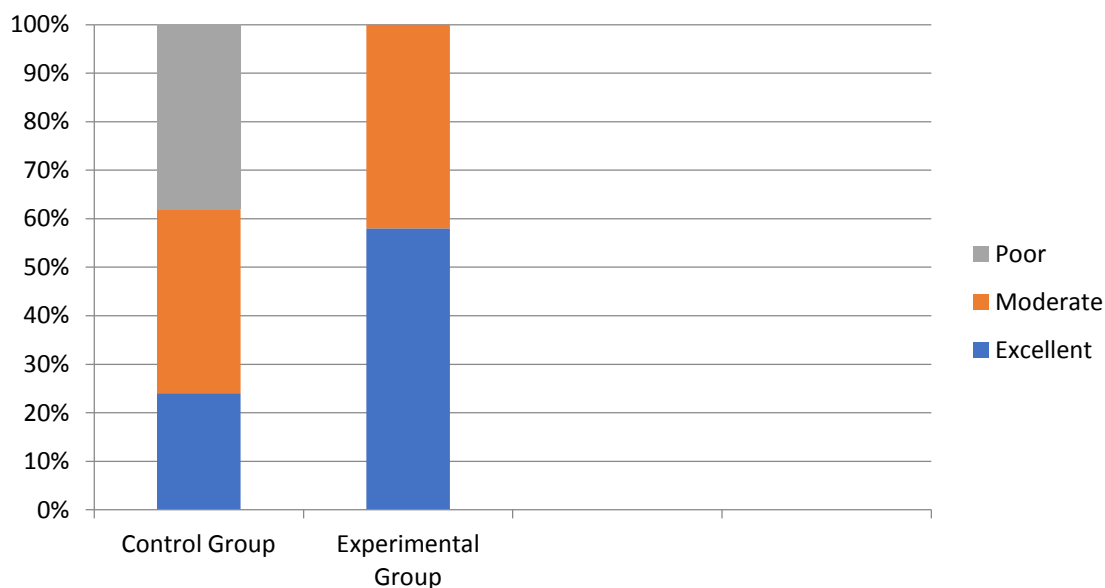


Figure 1.1 Comparison of Pre-test and Post-test results of Geometrical Reflection for Year 1 Students

Figure 1.1 indicated that the students under the control group who are in the moderate and poor make up the highest percentage (38%). Meanwhile, the students in the experimental group who are in the moderate and excellent level make up the highest percentage (42% and 58%). According to Idris (2006), students who are lack of understanding in learning geometry will usually lead to the loss of interest and consequent to poor performance in the subject. He stated that certain factors have been identified as causing difficulties in geometry learning; which are geometry language, visualization abilities and ineffective instruction. In addition, he highlighted that spatial visualization has a direct connection with geometric accomplishment due to the fact that geometry is visual by nature.

Geometry is the study of shape, angle and space, which requires visualizing abilities but most of the students have difficulties in visualizing three-dimensional objects in a two-dimensional perspective (Guyen & Kosa, 2008). Therefore, students are having difficulty in learning geometry concepts, geometry reasoning and geometry problem-solving skills due to the fact that they are unable to develop sufficient understanding of the subject (Battisa, 1999; Idris, 2006).

### **1.2.2 Pupils' Self-Efficacy in Learning Polygon**

Poor foundation of primary school pupils in learning polygon could be related to several factors include low geometry interest and psychological fear (Ormrod, 2000). Lack of instructional aides which lead to the less interactive of teaching and learning process in polygon is also contribute to this problem (Shield & Kelly, 1999; NIED, 2010). The poor performance in geometry among primary school students will eventually lead to the low self-efficacy and behaviour of avoidance of the subject (Armin, 2019).

Mathematics teachers play an important role to assist the pupils to achieve their goals in learning Polygon. However, the Mathematics teachers do not teach Geometry Polygon well because of their poor practises. There are large number pupils who dislike polygon topic because they are having difficulties in understanding the concept. They think numbers, shapes and space are difficult and hard to compute (Gokkusagi, 2006).

### **1.2.3 The Need of Mathematics Dictionary in Learning Polygon Geometry**

The world of polygon geometry has a language of its own. Although most of our pupils learn the label names for several two-dimensional shapes from some educational programmes, they still need to understand geometric concepts, recognize opportunities for applying these concepts and images, and be able to communicate using the concepts and images in authentic situations (Sarama & Clements, 2009). Therefore, it is necessary to use Mathematics dictionary to help the students to interpret the geometric language. Also, Mathematics dictionary facilitate with graphics and diagrams would be a beneficial advantage for easier comprehension for the students.

Pupils need the time and opportunity to develop spatial sense and investigate two- and three-dimensional figures in a setting that encourages inquiry and immerses pupils in the experience, language, and conceptual understanding of geometry. Language is necessary to organize and articulate thought. Learning the appropriate language for Geometry, therefore, is required for understanding and discussing geometric principles (Fitzgerald, 2006). The vocabulary necessary for flexible geometric thinking is developed as pupils manipulate objects in space and examine them from various perspectives (Jones & Tzekaki, 2016). For example, flipping and rotating triangles or locating them as the faces on different three-dimensional figures enables pupils to recognize that triangles can exist in a wide variety of forms as long as certain characteristics are present. With the aid of Mathematics dictionary, discussing a variety of activities, pupils internalize the vocabulary that enables them to develop spatial sense, practice problem solving, and make discoveries in geometry (Sarama & Clements, 2009).

Mathematics dictionary, it illustrated the basic understanding of Polygon, Geometry followed by the basic identification of shapes, which pupils could relate the shapes around them. With the provision of activities in every topic related to polygons, this allowed the pupils to have a basic concept of what these polygons are all about in the simplest way (Sriraman, 2009). Subsequently, the topics would move to a higher level allowing them to see the purpose of the polygons of how and where they could apply these concepts to their everyday lives (Sternberg, 2004). Such as the area of their own bedroom. They must first measure the length and the width and multiply both numbers and they get the area. Next step that they need to do was to move their single size bed into the room. Then they would need to measure the area of their bed in order to imagine how they can decorate or fit the bed in. When pupils are able to understand the concept of Mathematics easily, they would take interest to knowing more instead of avoiding the problem. This on the other hand would improve their self-efficacy when they know the topic better, according to the research exercised (Schunk & Zimmerman, 2006).

Students can benefit from the aid of visual representations to guide them through the understanding of the polygons, and students who are struggling to understand in words required additional, focused supports and practices. Visual representations are powerful method for students to access abstract mathematical concepts and ideas (van Garderen & Montague, 2003).

#### **1.2.4 The Importance of Learning Geometry (Polygon)**

Geometry plays an important role in the primary and secondary schools Mathematics curriculum. It facilitates students with rich sources such as the understanding of arithmetical, algebraic, and statistical concepts (Battista, 1999). Also, Volderman (1998) stated that geometry provides a complete understanding of the world in our daily lives. Geometry appears in nature in the structure of the solar system, a geological formation, rocks and crystals, plants and flowers such as sunflower. It also plays a vital role in the human society where structural is concerned such as art, architecture, cars, machines, and almost everything that are built and created by man. On the same route, studies showed that geometry is applicable and relevant to employment in everyday lives, and other subjects such as science, arts, and technology. Also, geometry is used to develop students' spatial awareness, intuition, visualizations and to solve practical problems (Sunsuma, Masocha & Zezekwa, 2012).

Despite of the importance of learning geometry, research have shown the evidence that were accountable for the difficulty in learning geometry, which are lack of proof by students, lack of background knowledge, poor geometrical reasoning skill, lack of geometric language understanding, lack of visualisation abilities, teachers' method of teaching, non-availability of instructional materials, gender differences among others (Mason, 2009; Noraini, 2006; Uduosoro, 2011; Telima, 2011 and Aysen, 2012).

Empirical studies on distinguished Mathematics difficult concepts were brought up by researchers. Study conducted by Salman (2005), focusing on the difficulty levels of topics in the primary school Mathematics curriculum while study Azuka, Jekayinfa, Durojaye and Okwoza (2013) has studied on the difficulty levels of topics in the new senior secondary school Mathematics curriculum. Besides, there is also study to identify the teachers and students' difficulties in Mathematics syllabus (Adegun & Adegun, 2013; Abdul-Raheem, 2012; Uduosoro, 2011). These were partial researches and studies that were carried out to determine the difficulties in geometric concepts in Mathematics and many more that focused on the difficulties in understanding the geometric concepts by genders which is not relevant to this research.

The purpose of this study was to find out the effectiveness of using the Mathematics dictionary in polygons topic which is derived from geometry, whether it can improve the performance and self-efficacy of the students. Geometry itself has a variety of sub-topics that can be inter-related to other topics such as solving sine equations algebraically under the topic of periodic phenomena (Pejlare & Rodhe, 2016), drawing polygons on the graph and calculate the rate of change of speed, distance and time under the topic of calculus (Diab, 2019), which is also relatable to other subjects such as physics. In the architectural standpoint, there are many building structures that involved in polygon design due to the fact that the polygon shape structures can withstand the compression and tension, buildings such as the Eiffel Tower in France. The bridge structures also used polygonal shapes to support the bridge designs (Tabish, & Jha, 2018). We can see that polygon shapes plays a huge role in our everyday lives from the biggest structure to the bolt and nuts. Therefore, geometry plays a very important role in the society on the daily living basis where everything applies to polygons. Thus, the fundamental basic of polygons need to be acquired and strengthen among the pupils.



### 1.3 Problem Statement

Polygon is one of the topics under the Geometry domain. Geometry might be perceived as difficult as it covers many of other sub-topics and subjects related. There are many pupils who failed to pick up the idea of geometry (Elchuck, 1992). Students who are deficient in the understanding of this subject frequently lead to disappointment and loss of attention, which usually result in evasion and poor performance. There are a range of factors which contribute to difficulties in learning geometry such as too many words and phraseology, lack the ability to visualize, and instruction that are ambiguous (Cangelosi, 1996; Morin & Franks, 2009; Bhagat, & Chang, 2015). As a result, in general, they have low aspirations and weak commitment with the same attitude toward other subjects when faced with difficult tasks. They dwell on their personal deficiencies and on the obstacles that they encountered, rather than focusing on how to perform successfully. They give up easily in the face of difficulties, and are slow to recuperate and improve their sense of efficacy following failure. They lose confidence in their capabilities very quickly and experience stress and depression (Maier, & Curtin, 2005).

Other reason which can be related to the poor performance in Polygon was because the pupils are unable to extract necessary information from given data and do not know how to interpret the answers and make conclusions. Traditional approaches in learning Polygon emphasize more on how much the pupils can remember and less on how well the pupils can think and reason. Thus, learning becomes forced and seldom brings satisfaction to the pupils (Padhila, 2019). Ideally, pupils are able to learn the concepts of polygons with the guide of the Mathematics dictionary that provides diagrams and simple explanations. There are many pupils who failed to develop the concept of Polygon which lead to discouragement and loss of interest, which commonly will result in avoidance and poor performance in Polygon (Hardianti, 2017).

Since there is limited study about using Mathematics dictionary as the teaching aids in increasing primary school pupils' performance and efficacy in

Malaysia context, thus there is a need to carry out the study to examine the effect of using Mathematics dictionary towards pupils' performance and efficacy. Besides, most research regarding pupils' performance and efficacy have been made, however less research emphasize on using Mathematics dictionary in enhancing pupils' performance and self-efficacy (Ugwuanyi, Okeke & Asomugha, 2020; Saligumba & Tan, 2018). Therefore, the purpose of this research is to encourage the pupils to search on the information on their own, and to develop the interest in understanding more about the principles of polygons. Once they can understand the concept easily with the aid of the Mathematics dictionary, they will naturally build up their self-efficacy and the thirst for more knowledge (Warren, Reilly, Herdan & Lin, 2020; Catapano, 2013). Therefore, teachers act as a catalyst to show the importance for the use of Mathematics dictionary.

#### **1.4 Research Objectives**

The purpose of this study is to identify the effectiveness of using Mathematics dictionary in enhancing pupils' performance and efficacy in learning Polygon. There are two research objectives for this study:

- i) To identify the effectiveness of using Mathematics dictionary toward pupils' performance in learning polygon.
- ii) To identify the pupils' level of efficacy in learning polygon after using Mathematics dictionary.

## **1.5 Research Questions**

The research questions for this study are as follows:

- i) Is there any significant effect of using Mathematics dictionary in enhancing pupils' performance in learning polygon?
- ii) Is there any significance effect of using Mathematics dictionary in enhancing pupils' efficacy in learning polygon?

## **1.6 Research Hypothesis**

The test rejects of the hypothesis for normality:

- i) Null Hypothesis ( $H_0$ ): There is no significant effect of using Mathematics dictionary in enhancing pupils' performance in learning polygon?
- ii) Null Hypothesis ( $H_0$ ): There is no significance effect of using Mathematics dictionary in enhancing pupils' efficacy in learning polygon?

## **1.7 Theoretical Framework**

The Mathematics dictionary is a tool that will be used to guide the students into doing the questions provided. This is to determine the performance of the students and the development of self-efficacy once they have completed the test. The students will be tested in the polygon questions, which they have learned in their early school years.

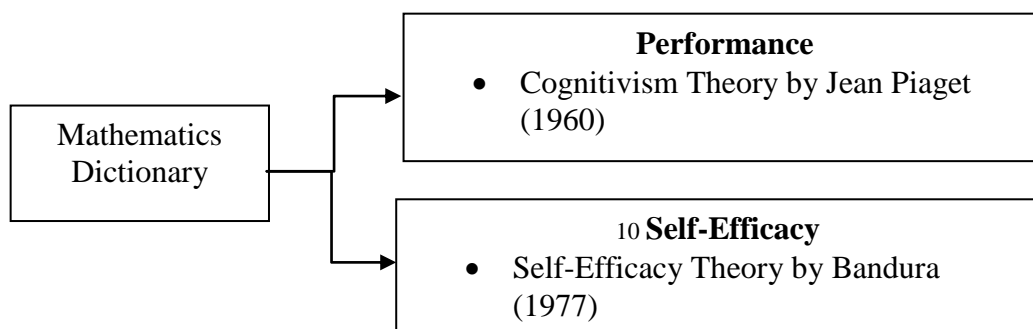


Figure 1.2 Theoretical Framework

Cognitivism is a learning theory that show how students or learners identify, distinguish and register the information, follow by resolve problems or obstacles and eventually learn what is being taught or presented. It is a process where the sensory input is converted, filtered, developed, saved, improved and exercised. The main focal point of cognitivism is to observe how learners communicate or transfer knowledge to one another in the most effective and competent method by studying the mental development and how the brain structures change during the learning process (Ai-min, 2010; Wahyudi, 2018).

In the contexts of this study, cognitive theory is used to explain the pupils' performance in Polygon topic after using the Mathematics dictionary. Mathematics dictionary is a tool that require students to utilize their cognitive ability to read the Mathematics dictionary in order to perform better in the Polygon topic. Besides, the Mathematics dictionary is considered as a mathematical instruction that is translated into a language in order for the learner to read and register into the brain. While learner use their cognitive, they will be converting the information into the concept, in other words, enables the learner to visualize and apply the concept into practical use (Riccomini, Smith, Hughes & Fries, 2015).

Meanwhile, self-efficacy theory by Bandura will explain pupils' efficacy level in learning Polygon topic after using Mathematics dictionary. Self-efficacy refers to self-believing of one's own capability to achieve one's goal or task (Bandura, 1997). They are important in their own right, and sometimes influence

motivation, but only indirectly (Bong & Skaalvik, 2004). However, theoretically, this process will help to heighten the students' self confidence level when they are able to perform well in order to achieve good results with the help of the Mathematics dictionary.

In the context of this study, the Mathematics dictionary interprets the relation between the polygon geometric performances. Further investigation shows whether the use of Mathematics dictionary would differentially explain the relations between the performance and the efficacy based on concurrent data.

## 1.8 Conceptual Framework

This framework consists of two variables which are the independent and dependent variables. The independent variable is the Mathematics dictionary while the dependent variables are the performance in Polygon test and self-efficacy. The conceptual framework is shown in Figure 1.3 below.

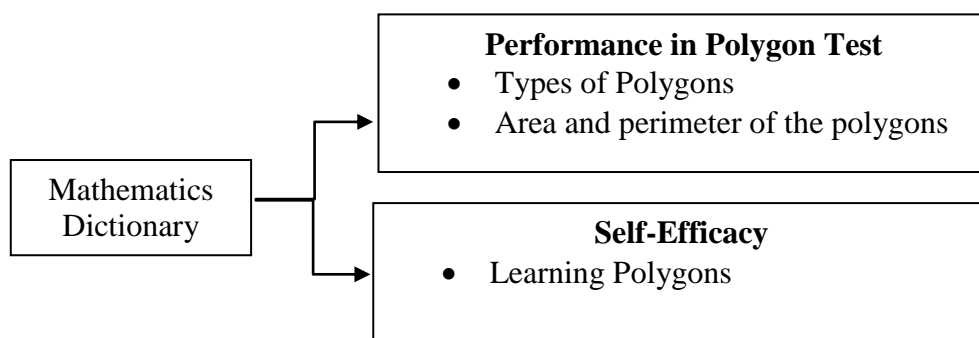


Figure 1.3 Conceptual Framework

Performance in polygon test which is the first dependent variable to determine the significance of the students' understanding of the concepts provided to them. The upper primary level subtopic of the polygon includes the identification of the types of polygon shapes ranging from triangle to decagon (Chiphambo & Feza,

2020). The types of polygons consist of different number of sides and vertices, and they consist of the same numbers as the number of sides and vertices increase. However, with the length of the sides increase or decrease, the area and perimeter vary too (Nagaraj, Ponnappan, Ganesan & Prabakaran, 2018). In this study, pupils will be given the pre-test and post-test on the Polygon topic. The differences will be analysed whether there is significant different on pupils' performance after the implementation of Mathematics dictionary.

Self-efficacy which is the second dependent variable determines the significance of learning polygons. Mathematics dictionary aids the students in understanding the geometric concept of polygons and the application to the polygon test. Achieving the knowledge of polygons concept and application may help students to develop the higher level of self-efficacy (Ünlü, Avcu, & Avcu, 2010; Korkmaz, 2013). In this study, pupils will be given a set of questionnaires on the self-efficacy in learning the Polygon topic to identify their efficacy level after the implementation of Mathematics dictionary.

The Mathematics dictionary is the catalytic source that brings the relation between the performance and self-efficacy together. Students with higher level of self-efficacy are believed to have higher chance of performing better than those who have low level of self-efficacy. Therefore, the Mathematics dictionary is set to the test whether it can help both parties achieve higher self-efficacy level once they are able to achieve the knowledge at the same time (Ayotola & Adedeji, 2009; Komalavalli & Tjprc, 2019).

## **1.9 Significance of Study**

This study will benefit the society considering that Polygon plays a vital role in science and technology today. The greater demand for students from primary school level up to university graduates with Polygon knowledge justifies the need for

effective approach derived from the results of this study will be able to train students better.

### **1.9.1 Pupils**

The pupils are able to comprehend the concept of Polygon with vocabulary and images to illustrate the terminology of the Polygons with the Mathematics dictionary. The pupils will find it easy to understand what a polygon is and enjoy learning the names of various polygon shapes from the initial stages. Polygons are fundamental to the study of geometry and learning about them forms a great foundation for middle school Mathematics. In the context of this study, the implementation of Mathematics dictionary is expected to enhance pupils' performance and self-efficacy toward Polygons topic.

### **1.9.2 Mathematics Teacher**

For the Mathematics teachers, the study will help them uncover critical areas in the educational process that many teachers did not explore. In other words, this will guide them to recall certain unexplored and forgotten areas. Teachers need to look at developing vocabulary in Mathematics. Learning new content vocabulary is critical to deepening mathematical understanding. Without an appreciation of the content vocabulary involved, students are often denied access to Mathematics. Teachers play an important role to entice the interest of the students, allowing them to think out of the box. The Mathematics dictionary is able to help the teachers to look at bigger perspectives going through the example to help pupils to relate the theories and concepts to the outside world, so that they are able to develop clear understanding of the polygons related to the surroundings. Teachers are also able to organise games and activities with the Mathematics dictionary, and students are required to fully utilise the dictionary to guide them through the tasks.

### **1.9.3 Ministry of Education**

Administrators will be guided on what should be emphasized by teachers in the school curriculum to improve pupils' performance in Polygon, Geometry. This can also provide an overview of the Geometry review, the goals and aims of the different syllabuses of the entire Mathematics curriculum from primary level up to upper secondary level, as well as the syllabus design considerations across the levels. The administrator can elaborate on the Geometry framework that centres on Mathematics problem solving. It serves as a guide for Mathematics teaching, learning and assessment across the level. The role of the assessment is to highlight the importance of Geometry which can be integrated into the classroom learning.

### **1.10 Definition of Key Terms**

This section will discuss about the definition of the effectiveness, performance, efficacy and dictionary in learning Mathematics, specifically in Polygon topic. Therefore, the conceptual and operational definition is explained in subtopic 1.10.1 until 1.10.4.

#### **1.10.1 Effectiveness**

Effectiveness is defined as the objectives are achieved to the extent of targeted problems are solved (Harcourt, 2010). In the context of this study, effectiveness is referred to the effectiveness or the degree of accomplishment in using the Mathematics dictionary to enhance pupils' performance and self-efficacy in learning Polygons in Geometry. For instance, when pupils are asked to identify the shape of a hexagon and find the area of the given shape, he or she is able to use the dictionary to first find the name the shape, and they are also able to refer the formula to calculate the area with the guide with simple explanation easily. This shows the



efficiency of using the guided tool. Specifically, the effectiveness is measured by comparing the pre and post-test given to the pupils throughout the experimental study.

### **1.10.2 Performance**

Performance is defined as the accomplishment of a given task measured against pre-set known standards of accuracy, completeness, cost, and speed (Cambridge University Press, 2019). In the context of this study, it is referred to the performance of pupils' after the implementation of Mathematics dictionary in learning Polygon, one of the domains in Geometry. This will help the students to improve in their understanding with simple explanation and with the guided images. Besides, this helps the students to further relate and visual the concept and allowing them to perform better with the understanding.

### **1.10.3 Self-Efficacy**

Efficacy is defined as a person believing in one self's ability to acquire new information and complete task or activities to the expected level of performance (Cambridge University Press, 2019). In the context of this study, it is referred to the development of self-efficacy among the pupils after the implementation of Mathematics dictionary in learning Polygon in Geometry. In this study, efficacy was measure by using General Self-Efficacy Scale (GSE) which containing 10 items.

### **1.10.4 Dictionary**

The Mathematics dictionary covers comprehensive syllabus for students in the secondary school level and above. It consists of over one thousand mathematical

concepts alphabetically with related words listed under the head word. The main topics in the dictionary cover fractions, geometry, logic, probability, units of measurement, and trigonometry, with the support of two-coloured diagrams and images (Tapson, 2013).

In the context of this study, the Mathematics dictionary used in this research is in the form of hardcopy and it is mainly focused on the sub-topic of Polygon under the topic of Geometry. It is referred to the printed resource that lists definition of the Mathematics contents in words and diagrams in alphabetical order. In learning Mathematics, pupils need to understand and have a guideline of vocabularies or diagrams in order to show the function and importance of the Polygons.

### **1.11 Chapter Summary**

Geometry is a flexible and complex topic where it has interrelation in various Mathematics topics, including sciences and technology especially involving in the engineering field. Therefore, pupils need to understand the concept and terminology of this topic in order to proceed with certain topics; otherwise they may have difficulties in comprehending proceeding topics. As based on the Mathematics dictionary explored online and through e-books, the Mathematics dictionary shows and explain the basic definition of geometry with only vocabulary and lack of illustrations to explain further, which probably only the adults are able to comprehend. Pupils from primary level are unable to grasp the meaning and concept in the Mathematics dictionary, as for pupils from secondary level is a fifty-fifty chance of understanding the full concept of the polygon in Geometry. In other words, it is not user-friendly. Therefore, it is essential to have Mathematics dictionary that is able to allow all pupils to understand the concepts and terminology well.

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