EVALUATING THE EFFETIVENESS OF GSU-BASED LEARNING MODULES IN IMPROVING THE PRIMARY SIX STUDENTS' UNDERSTANDING LEVEL IN GEOMETRY

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To my beloved family members

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ABSTRACT

The aim for the research is to evaluate the effectiveness of the GSU-Based Learning Modules designed and developed by Tan (2011) improving the students' understanding level in learning geometry. The research covered the topic of Shapes and Spaces KBSR for primary six students. The GSU-Based Learning Modules were implemented using the computer aided software, called *Google Sketch-Up* (GSU). A quasi experimental design, Wu's Geometry Test (WGT) was used to gather the samples and data. Ten students were selected and put in a group accordingly to their levels of van-Hiele's thinking level, which were Below Level 0 (BL0), Level 0 (L0), and Level 1 (L1). Observations and interviews were adopted to gather information related to the students understanding level before and after the use of GSU-Based Learning Modules. Data were analysed based on three main categories of *constructing, analysing* and *informal deduction* of geometry shapes. The findings of this research showed a positive improvement and proved that GSU-Based Learning Modules were effective in improving the students' understanding level in geometry.

ABSTRAK

Penyelidikan ini dilakukan bertujuan untuk menilai keberkesanan Modul Pembelajaran Berasaskan (GSU) yang telah direka dan dibangunkan oleh Tan (2011) bagi membantu untuk meningkatkan tahap pemahaman pelajar dalam geometri. Kajian ini telah dihadkan pada bab "Bentuk dan Ruang" KBSR bagi pelajar tahun enam sahaja. GSU telah diimplementasikan menggunakan perisian komputer, yang dipanggil *Google Sketch-Up* (GSU). Dengan menggunakan reka bentuk eksperimen kuasi, Ujian Geometri Wu (WGT) telah digunakan untuk mengumpul sampel dan data. Kemudian, data dianalisis menggunakan kaedah kualitatif, seperti pemerhatian langsung dan temu bual berstruktur. Kedua-dua kaedah analisis yang digunakan adalah berasaskan kepada kategori pengiktirafan, visualisasi, sifat, konsep, dan perhubungan. Kategori-kategori ini telah digunakan untuk penilaian berasaskan tahap pemikiran geometry model van-Hiele. Hasil kajian ini telah membuktikan bahawa GSU amat berkesan dalam mempertingkatkan tahap pemahaman pelajar dalam geometri.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Geometry is connected to mathematics that concerns with shape, size, properties of space, and relative position of figures. As early as Thales (6th Century BC), geometry has been independent by itself relating on lengths, areas, and volumes, with a formal mathematical science. This subject has been introduced in Malaysian school at primary level as early as primary one. Geometry subject is so important that it is continued till to the higher level at the secondary level (Form 5). Almost forty percent out of sixty topics comprises of Geometry content base in KBSR Mathematics curriculum (Ministry of Education, 2005). In order for the students to progress in geometry subject, they need to have a conceptual understanding, and to visualize the properties of geometry.

Based on Malaysian Mathematics curriculum, students at primary one are exposed to geometry subject, which it is called Shapes and Space. At the age of seven, students are required to understand the use of vocabularies related to three-dimensional (3-D) and two-dimensional (2-D) shapes. Next, when they are in primary two, they will learn to use the vocabulary related 3-D, and 2-D shapes. At this level, students are also required to be able to describe and classify common 3-D, and 2-D shapes. Moving on to primary three, students will get to build 3-D shapes, recognize and sketch lines of symmetry.

Carpenter (1980) had suggested that on how the development of formal reasoning skills actually affects the learning of mathematics. Spatial ability and

cognitive development is known as visualization, and this is an important factor in learning mathematics. Previously spatial visualization might be highly important to mathematics learning in primary grades (Fennema&Behr, 1980). Spatial visualization is important for the mathematics learning, but it also greatly dependent on concrete and pictorial representations.

During primary four, students learn on the sides of geometry shapes, measure the perimeter of geometry shapes, comparison of shapes, area of geometry shapes, and volume of geometry shapes. In primary five, the students are thought to calculate the perimeter, area, and volume in two different composite 2-D, and 3-D shapes. Finally, when they are in the year six, they are exposed to understand and implement their calculation of what they have learned for the past five years in perimeter, area, and volume in respective 2-D, and 3-D shapes. According to Van de Walle (2004:4), the shape and space mathematics category which focus on patterns and relations has its own language that requires the precise use of mathematical terms and symbols. He thinks that it uses cognitive and constructivist learning theories also emphasise on the role of meta-cognition or self-monitoring of thinking and learning. Knowledge is constructed through a process of creating personal meaning from new information OBTAINED prior to the existing knowledge, but within the realistic settings (McMillan, 2004:12).

In Malaysian syllabus (KBSR), drawing and visualization are taught through activities using paper and pencil work in constructing real 2-D and 3-D shapes or models. This activity is a very important task in Geometry classes. Geometry learning in our primary school education system is not attractive enough to the students as the finish product is static. Furthermore, the contextual learning by using the real 2-D and 3-D model shapes is much more effective way. However, there are limitations in having suitable teaching aids to use real model shapes in our learning process for visualisation of drawing.

With the advances in teaching facilities, both teachers and students have the opportunity to have an effective way in learning geometry. By using the computer aided software, teachers can effectively address the challenges faced and at the same

time to develop the abilities of their students. By this method, students can visualize the mathematical concept which was difficult to do previously. The use of technology would provide promising illustrations of geometry related problems.

Recently, Tan (2011), developed a learning module to help the primary students to overcome the difficulty of learning geometry. The author studied on the students' thinking level and developed a learning module. Tan designed the learning module using the guide of van-Hiele's model of thinking level in geometry. He also implemented the learning module into practice by using the *Google SketchUp* (GSU) software. Tan called his learning module as GSU-Based Learning Modules.

1.2 Background of Problem

Primary school students nowadays are facing problem in learning mathematics especially in learning geometry.. They do not seem to love learning geometry in their mathematics syllabus because of they do not understand the shapes and spaces of geometry. According to Noraini (1999), most of the students are unable to develop their understanding and learning geometry chapter easily because they are having lack of understanding in concept, reasoning, and problem solving skills.

Many of the primary school students are unable to adapt this topic as we educators teach them just to finish the syllabus and there isn’t any visualization-oriented activities going on in our traditional classroom (Noraini, 2007). This shows that the ways of a teacher's teaching method had also been an influence in students' understanding in geometry. According to Tan (2011), learning difficulties in geometry in schools are often neglected from the beginning stage of elementary school to middle school level.

It is believed that by using Tan’s learning modules the students' understanding level can be improved. For example, in geometry topic, students will be needed to understand the concepts, properties, and relationships between the shapes and spaces.

The characteristics of learning along with understanding will generate the knowledge. Where mathematicians call it as “intuitions” or “ability to transfer ideas to one another” which will be in a logical way to solve a problem. (Shimshon Amitsur, in Sfard 1998, p. 446) learning module which utilises van Hiele's geometry model of thinking level. By using Tan’s learning modules, this research will evaluate the level of understanding of the primary students in geometry before and using the use of learning module with computer aided design.

Many mathematics teachers relate their students thinking development in geometry with the famous model called van Hiele’s levels of geometry thinking. This model was proposed by a couple of Dutch educators, Dina van-Hiele-Geldof and Pierre van-Hiele when they realised their students were having difficulties in learning geometry. In this model there are five levels which are Level 0 (Recognition or Visualization), Level 1 (Analysis), Level 2 (Informal Deduction), Level 3 (Deduction), and Level 4 (Rigor). According to van Hiele’s theory, “a child must have enough experiences (classroom) with this geometry learning before moving to a higher and sophisticated level”. Basically students at the primary level will be able to achieve the first three level of van-Hiele's model of geometry thinking, which are Level 0 (recognition or visualisation) till Level 2 (informal deduction).

Tan (2011), had designed and developed learning modules called GSU-Based Learning Modules to help primary school students to progress in their van-Hiele's geometry thinking. He had also implemented his learning module to be into practice by using the *Google SketchUp* (GSU) software. In his study, he had proved that GSU-Based Learning Modules had helped primary students to progress in learning geometry based on the first three levels of van-Hiele's geometry thinking. However, the researcher has not explored the GSU-Based Learning Modules in other perspective such as students' understanding level in learning geometry. Thus, the aim of this present study is to analyse the students' understanding level using the GSU-Based Learning Modules. There could be an assumption made that student's progression in van-Hiele's geometry thinking is due to the students' understanding level increased after the use of GSU-Based Learning Modules.

According to Anna (2000), that there is an importance for understanding mathematics. Every student should have a good understanding in geometry so that the learning process would be easier. At times, students learn geometry by memorizing the geometry's properties, rather than discovering the underlying properties (Strutchens et . al., 2001). By memorizing, students would not be able to have a solid understanding in learning geometry, and this would affect them when they move on to learn geometry at a higher level. This is because geometry is a subject that been taught in schools from primary till secondary. Students need to have a good understanding level in geometry, so that they are able to catch up with geometry topic when the level of difficulties goes higher. Anna (2000) defines that "teach mathematics for understanding" has three instructions, such as tasks, tools, and normative practice. Based on Anna's argument on understanding, this study will be focusing on engaging the student's understanding level improvement based on the material (GSU-Based Learning Modules) that would be used throughout this study.

1.3 Objective of the Study

The objective of this study is to evaluate the effectiveness of GSU-Based Learning Modules built by Tan (2011) in improving the students' understanding level in geometry.

1.4 Research Question

This study will determine and address the research question as below:-

Can the students' understanding level of geometry learning improve through the use of GSU-Based Learning Modules?

1.5 Importance of the Study

Through this study, there would be evidence provided to show that the use of GSU-Based Learning Modules will improve on students' understanding level in learning geometry.

1.6 Operational Definitions

1.6.1 Level of Understanding in Learning Geometry

In this study, the students' understanding level improvement would be evaluated after the implementation of GSU-Based Learning Modules. The focus of this study would be on primary six students' understanding level in learning geometry. Students' understanding level were analysed using the qualitative analysis method by conducting observations and interviews.

1.6.2 GSU-Based Learning Modules

The GSU-Based Learning Modules was designed and developed by Tan (2011) based on the van Hiele's geometry model of thinking using the first three level only, which are *recognition or visualization*, *analysis*, and *informal deduction*. Tan (2011) used the van-Hiele's model of thinking level in geometry in proving the progression of students' thinking level. The modules cover three geometry shapes and spaces, such as:-

a) Isosceles triangle and equilateral triangle

b) Square and cube

c) Rectangle and cuboid

1.6.3 Google Sketch-Up (GSU)

Google marketed Sketch-Up which is a 3D modelling program for architectural, civil, and mechanical engineers. It was also designed for the field of film makers, game developers and other related professions. It is used in this study because it is compatible with Tan's learning modules apart from having easily available and user friendly.

1.6.4 Wu's Geometry Test (WGT)

The Wu's Geometry Test (WGT) is used to select the samples for this study. This test has 75 questions on geometry. Every 25 questions are categorized according to the van-Hiele's geometry of thinking level, such as *recognition or visualization, analysis,* and *informal deduction*.

1.7 Scope and Research Limitations

This study was conducted based on the following scope and limitations:-

a) The analysis on the students' understanding level was only evaluated using qualitative method: observations and interviews.
b) The module used only covers Triangles, Squares, Cubes, and Cuboid.
c) The study will be limited to primary six students and on the chapter of "Shapes and Spaces".

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