Visualization Skills among Universiti Teknologi Malaysia Student

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***Abstract*—A visualization skill is very important in engineering field and it is positively correlated with achievement in engineering disciplines. Therefore, this study was carried out to study visualization skills level among students in Universiti Teknologi Malaysia (UTM) Skudai. 730 respondents engaged in this study which covered thirteen faculties in this campus. The respondent in this study consists of first year student to fourth year student. This quantitative study was analyzed using descriptive method. The instruments that had been used in this study were biographical data sheet and short version of visualization standard tests. The finding of this study revealed that student at UTM to be at moderately high skills in visualizations. Thus, the appropriate approach should be taking into account in order to apply the right technique in teaching to enhance student's visualization skills.**

***Index Terms*—Visualization Skills, engineering drawing, engineering field.**

I. Introduction

Engineering drawing is a way to communicate graphically. It covers technical regulations or requirements of drawing and visual skills (Olkun, 2003). Visualization is a skills or capabilities naturally born. Sorby and Baartmans (2003) observe that the visualization skills can be enhanced by explaining students with lower visualization ability and then trained using specific training modules to enhance their visualization capabilities in engineering drawing. According to Sorby and Baartmans (2003), the uses of multimedia with workbook have shown positive impact in developing and enhancing three-dimensional spatial skills of the student.

On the other hand, spatial ability is a psychometric structure with two main factors: spatial orientation and spatial visualization (Michael, Guilford, & Fruchter, 1957). McGee (1979) defines spatial abilities as a measure of the ability to restructure mentally or manipulate the components of the visual stimulus which involves identifying, maintaining and recalling configurations when the figure or part of the figure moved. Spatial abilities are the ability to describe and manipulate the information received in the learning and problem solving (Clements, Douglas, Michael, and Battista, 1992). Spatial Abilities also are prominent in many intellectual fields, such as solving problems in engineering, design, physics and mathematics (Smith, 1964; Pellegrino, Alderto and Shute, 1984). According to Olkun (2003), spatial ability is crucial and can be enhanced through appropriate activities. According to Terlecki and Newcombe (2005), facilitation of computer experience through training may have differential effects on males and females spatial abilities, and males not only perform at higher levels than females on tests of spatial and mental rotation abilities but also tend to have more spatial experiences.

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II. Background of Study

Given that first-year engineering students enter the academic field of engineering with a variety of backgrounds and experiences, and thus, varying degrees of visualization skill development. Thus, it required for additional attention and effort in some students to get a better result in their study. Sometimes standard instruction and coursework at the introductory level of engineering graphics is not enough. Students on this lower end of visualization skill development need to close the gap between the level of their skills in this area and the level skills of their peers. Since visualization skills are essential for success in engineering and other technical fields of study, it is important to develop visualization ability during the developmental years of students. This study will examine approach that can be used in enhancing the visualization skills of beginning engineering students.

In this research, this study was conducted on 730 undergraduate students in which they were randomly selected by each faculty at UTM, Skudai, Malaysia. Items on the questionnaire used in this study were tested in terms of reliability and validity. The Alpha value from the study is 0.804.

III. Visualization Skills According to Gender

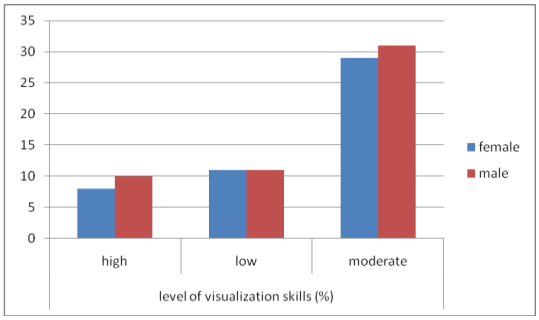

Fig. 1. Level of Visualization skills by Gender

Fig. 1 shows the level of visualization skills across gender. The figure show that the visualization skills of female lag significantly behind those of their male counterparts. Theories of these differences are related to a male sex hormone (Hier & Crowley, 1982), or the environmental factor is the main reasons for male-female differences in spatial skill levels (Fennema & Sherman, 1977). Levine et al

(1999) states on average male exceed woman in spatial ability in the fourth stage. This is because; males tend to look for a technique or method by using space and direction or orientation strategy while females prefer to use sign and route directions (Lawton, 1994 and Geary, 1998). This study is consistent with the findings Koenig et al (1990) found that women's advantage is in relation to absolute space (location of the object) while the male advantage is in the space coordinate relations (distance and direction). Based on visualization tests, gender differences in strategy use has not been adopted widely, but at least one (J Gluck and S Fitting, 2003) form that male more commonly used holistic strategies than female, and female more often used analytic and mixed strategies than male in two different spatial tests. The holistic strategy relies on visualizing the whole object, and the analytic strategy uses a structured, stepwise approach. The holistic strategy has found to be most effective (i.e. less time consuming) in timed tests. Linn & Peterson (1985) have, therefore, concluded that "spatial strategy selection" is a factor in gender differences in mental rotation tasks. However, Hsi et al (1997) determined that visualization strategies can be acquired through training.

IV. Visualization Skills According to Course

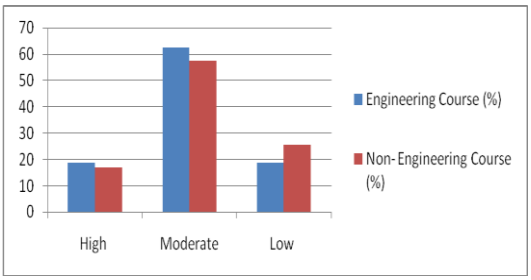

Fig. 2. Level of Visualization skills by Course

Fig. 2 shows the scores on visualization test based on course. This data is taken to see the level of visualization skills among engineering students and non-engineering students. Overall results showed that the level of visualization skills of engineering students is non-engineering students at a moderate level.

Based on the result, Visualization is one element of a difficult skill to learn in the engineering curriculum, such as engineering drawing graphics (Kopp, 1999). Most students have a problem when studying the topics in engineering drawings that require high visualization skills (NSF, 2006). The previous research show that visualization is important in engineering drawing because, in the technical work, communication through graphic is compulsory and engineering drawing is the basic of capability of communication technique in graphic method. In developing the knowledge, student uses their scheme of mental to visualize or to develop the view or certain image. Visualization is the one way of thinking where the image produced or memorize back in memory. Contero et al., (2005) suggest that engineering students need to improve their visualization skills ability because it is necessary in explanation, information devices beside use to explain the concept, ideas and process also to attract the interest and information delivery.

Therefore, engineering students should be provided with the knowledge and basic skills of drawings in various disciplines or fields of engineering. Most studies in visualization skills investigate and test new methods of improving the skills such as conventional, computer-based and the integration methods. Some of the alternatives to traditional methods have been successfully adopted, while others are still being tested for their effectiveness on students, especially in engineering. Thus, there is a need for comprehensive research on improving learning and teaching of visualization skills to students in engineering programs/courses.

V. Discussion

The research in method of increasing student's visual abilities in teaching and learning should be carried out. There are lots or research has been done in the most areas in science and technologies especially in engineering (Basham, 2007; Contero et. al., 2005; Sorby et. al., 2005; Sorby, 2007). As examples in chemical engineering, intuitive understanding may be developed when student observe visual interactions among numerous atoms, and subject those simulated atoms to fundamental laws of nature such as conservation of energy, gravitational and electrostatic forces. Besides that, when learning construction technology, students need to visualize material and sequences of the construction process also component of the facility are assembled. In computer science, interactive visualization has become a recognized branch of knowledge that studies how human-computer interactions create graphic illustrations of information efficiently. In short, each discipline in engineering and computer-related field lends itself to incorporating interactive simulations in teaching and learning. In investigating effective and engaging ways to teach engineering course such as engineering drawing, the best practice offer way to optimize their use through co-constructed meaning and application (Nguyen & Khoo, 2009).

The approach of the conventional method in the learning process cause the student faced difficulties to memorize and understand back what they failed to do so in the classroom. When the students do self-study, their cognitive level will increase. Thus, the heavy load of information in working memory will cause the failure of information to being register in the long term memory during conduct that activity (Klein, 1996). Even though, there are practical practices for several subject, but not all the content of the syllabus can be practice practically when it involved huge, dangerous and costly equipment (Bullough, 1974). With that, it is very important to have a dynamically cognitive device to overcome the problem such as the multimedia animation appearance and the uses of courseware and also teaching aids which more practical and suitable with the topic.

VI. Conclusion

Evidence that spatial abilities can be improved is less valuable than the answer to the question of whether improvements are also significant for women than for men,

so that women can hold up to men and beat their deficit and cognitive ability. In the reality, individual that have high spatial ability will be taking the whole concept before solve the problem in their approach. Those who have high spatial skill level are suitable with career in the engineering field, architect, designer, mechanical and mathematics (Baum, 1994). Finding effective ways to use technology to enhance learning is a challenge that educators, academics, policymakers and the technology industry must work together to solve (Gates, 2002).The advantage of introducing new technologies into the creation of didactic material suitable for university and technical education should be made known and applied. There are many other possibilities for the creation of computational models mainly where the subject matter is suitable for description along its sequential stages of development.

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