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Towards attaining 21st Century Skills through the use of Geometers' Sketchpad in the teaching of Mathematics

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ABSTRACT

Today's employment demands graduates who are equipped not only from the technical aspects but also from the interpersonal skills perspectives. The traditional chalk and talk approach in delivering syllabus at schools have been rapidly complimented with the use of Information Technology to suit the IT savvy generations among the students as well as the teachers. To satisfy the employers' needs for graduates with a well-balanced interpersonal skills, educators have been looking at integrating IT in their teaching with the objectives of attaining the 21st century skills. This paper discuss how the use of Geometers' Sketchpad in the teaching of Mathematics at a Malaysia's secondary school level could help to inculcate qualities of the 21st century skills.

***Keyword*:** Technology in Education, Geometer's Sketchpad, 21st Century Skills

1. Introduction

In response to the demands made by the work force for graduates who are not only good technically but also possess strong interpersonal skills, the educators worldwide have realized that there is a need to revisit the teaching and learning approaches. One of the ways is to integrate the element of Information Technology as part of the teaching and learning approach. Researchers suggested that Information Technology provides great support in enabling the production of graduates with the relevant skills as per demanded by the industry. (Trilling et.al, 2009, Cloud, 2010, Rotherham et. al, 2010).

Educators today are spoilt for choices when it comes to deciding the best Information Technology tools to help them in delivering effective teaching. In the teaching of Mathematics in Malaysia's Mathematics education at school levels, Geometers' Sketchpad (GSP) has been the tool of choice among the national schools. The Malaysia's Ministry of Education has selected this tool to be the official teaching and learning tool for technical subjects since 2003, and schools are given the liberty to design and use this tool to meet their own teaching objectives. (Meng et.al, 2011, Johari et.al, 2010). While the main idea is to get the students to have a good grip of the subjects taught, it is also imperative that the development of teaching and learning approach using this tool has include the inculcation of 21st Century Skills as part of the process.

This study will look at the activities involved in the teaching of mathematics at a Malaysia's secondary school using Geometers' Sketchpad (GSP) and map the skills developed to that of 21st Century skills, hence confirming that it is indeed possible to develop

those skills with the help of using Geometers' Sketchpad (GSP) in the process. This project also has leveraged on the fact that students today are IT savvy and due to the attractiveness of IT based application among Gen Y, the use of Geometers Sketchpad can be a platform for enjoyable social activities as well as a good technical learning platform for many 'IT savvy' students. (Ramli, 2013).

II. Background

The use of Geometers' Sketchpad (GSP) at school levels in Malaysia mainly focuses on the teaching of Mathematics. The reason for this focus maybe due to the fact that Mathematics has always been one of the core subjects that secondary level students need to show good aptitude on in order to progress to the tertiary level. (Levpušček et.al, Ramli et.al 2014). Though the importance of Mathematics subject at school has been well noted among teachers, education administrative, students and parents, many students still develop 'Mathematics anxiety'. This is a very common case with the school or even the university students (Humphrey et.al, 2010; De Wet, 2010, DeAbreu, 2012). For many years Mathematics educators continue to find ways to improve their delivery of the subject in order to overcome this issues. When Information Technology took the world by storm, many teaching tools have been tried and tested to be implemented as part of the teaching and learning process for this subject.

The Geometers' Sketchpad (GSP) is a dynamic geometry software that can be used for creating and analyzing mathematical concepts especially in the studies of algebras, geometry, trigonometry and calculus (Keypress, 2005). Geometers' Sketchpad (GSP) allows users to discover patterns based on the constructions of their own sketches (Stols, 2007). Furner et.al (2007) rated GSP to be an excellent tool which is capable in supporting discovery process where users could visualize and analyze a problem and then make deductions. To date, many studies have reflected on the success of Geometers' Sketchpad (GSP) implementation in the teaching and learning of Mathematics (Meng et.al, 2011, Johari et.al, 2010, Eu, 2013, Garofalo et.al, 2004, McClintock et.al, 2002, Almeqdadi, 2000, Ismail et.al, 2011).

Developing 21st century skills among students has called for a lot of students' led education, rather that teachers' led approach in classroom (Ramli et.al, 2013). A list of skills have been identified to be developed among students in meeting the requirement of 21stcentury skills. Among the skills identified are ability to build knowledge, being IT literate, able to solve problem and be innovative, able to self-regulate and collaborate with people with effective coomunication skills. (Trilling et.al, 2009; Cloud, 2010; Rotherham et.al, 2010, Ramli et.al, 2013). It is expected through this project, the students are to show that they have developed these skills to stay competitive in the industry.

III. Objective

The objective of this study is to confirm that there is a relationship between the uses of Geometers' Sketchpad (GSP) in the teaching of Mathematics at secondary school with the development of 21st century skills among the students. By confirming that it is indeed possible to develop those skills with the help of Geometers' Sketchpad (GSP) as the teaching tool, academicians can plan and strategize the integration of this tool in their teaching and learning as well as design suitable assessments that utilize this tool.

This study seeks to answer the following research questions: Is Geometers' Sketchpad (GSP) instrumental in developing 21st century skills among students?

III. Methodology

A test was designed to utilize Geometers' Sketchpad (GSP) in the teaching of a secondary level Mathematics syllabus in a national secondary school. Tests were conducted on 56 students aged between 16-17 years. The tests investigated the students' demonstration of 21st century skills after the use of Geometers' Sketchpad (GSP) in the teaching and learning process. As part of the study, an observation and an interview were conducted on the students to establish whether or not 21st century skills have been developed in the process. The topic taught was Trigonometric Functions from the component of Trigonometry in the Form Five Mathematics syllabus. The duration of the experiment went for 8 weeks.

IV. Results

The following observations have been made by the project team member who is also the teacher of the subject in discovering the attainment of 21st century skills among the respondents. The skills observed are:

1. **Knowledge building and use of ICT for learning**: It has been established that students have developed a strong understanding and ability to share the technical knowledge with peers while using Geometers' Sketchpad (GSP) in the teaching and learning process. Substantial skills in handling the functions that come with Geometers' Sketchpad (GSP) are evident. Students were also seen performing Google search in exploring the tools and watch YouTube clips to understand the product better.
2. **Problem solving and innovation:** It has been observed that students demonstrated a development of problem solving ability and with that came creativity in handling issues. The workaround given by the students in solving the problems they have encountered have been innovative.
3. **Self-regulation:** This skill is demonstrated through the students' ability to keep to the due dates stipulated for their class exercises and assignments. There have not been any requests for extension.
4. **Collaboration:** The assessment and the practical activities in this project have ensured a high level of collaboration among students. Throughout the process it is evident that students have worked very closely together during this project. There have been great demands for commitments from all students in this project to participate actively.
5. **Skilled communication:** With great demand for collaboration came the needs for effective communication. Students have shown a commendable improvement on their

communication skills in effective sharing of knowledge as well as managing questions asked during knowledge sharing.

An interview was conducted on the 56 students involved on their learning experience. Table 1 describes the summary obtained which suggested experience that leads to the development of 21st Century Skills.

Table 1. Students Views on the Project

21st Century Skills	Strongly Disagreed	Agreed	Strongly Agreed
Group work/collaboration: It can be time consuming and challenging to know and get used to the team members as some of them are not close friends.	-	71%	29%
Project Management/Self-Regulation: You needed to keep track of the project deliverable and if need be to negotiate the time extension with the teacher	-	-	100%
Subject Matter Knowledge/Technical Knowledge: Students knowledge on the syllabus have been improved	-	-	100%
IT Skills: Students have developed a strong IT skills in the process.	-	-	100%
Communication Skills: Students have developed good communication skills in the process	-	65%	35%

V. Conclusion

From this study, it is evident that there is a strong relationship between the use of Geometers' Sketchpad (GSP) in the teaching of Mathematics at school and a development of 21st century skills among students. By confirming on that fact, educators can continue working on finding the best ways to incorporate the tool as part of the teaching and learning activities and to respond positively to the demands coming from the 21st century employers.

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