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Formulating a success model for the implementation of Geometers' Sketchpad (GSP) for the teaching of Mathematics in Malaysian High Schools

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ABSTRACT

Geometers' Sketchpad (GSP) has been the official teaching and learning tool for technical subjects in the Malaysian educational landscape since 2002. However the usage varies from one educational institution to another, mostly influenced by the level of acceptance among the users. Though studies have proven the many advantages GSP has to offer in teaching and learning, there have been many accounts of poor implementation resulting in the tool ending up as a white elephant. Users' willingness to accept and adopt the tool have been identified to be the main reason for the poor implementation of GSP at schools. This study will investigate ways to ensure successful implementation of the tool. The objective is to construct an integrated success model that can serve as a guideline for a successful implementation of GSP at secondary schools. The model will consider constructs from Davis' Technology Acceptance Model and Tornatzky's Technology, Organization and Environment Framework. In consideration of the educational nature in which GSP is to be implemented, the Constructivism learning theory by Piaget will also be considered.

Keyword: Technology Acceptance, Technology in Education, Geometres' Sketchpad

1. Introduction

With the advancement of technology in almost every aspect of our life, the use of IT in education has gone beyond its infancy stage. The use of computer based tool in teaching and learning has dated more than two decades ago, and educators today are blessed by so many options to choose from when it comes to selecting a tool to assist teaching and learning. From the employment landscape, technology supported tool has been seen as the enabler in meeting the employers demands for graduates who are employment ready. (Trilling et.al, 2009, Cloud, 2010, Rotherham et. al, 2010). The use of technology supported tool as part of teaching and learning activities at schools provides students with an avenue to train them to become IT savvy graduates, problem solvers and team players.

For many years Geometers' Sketchpad (GSP) has been used as the official teaching tool in supporting the teaching of technical subjects at all levels in Malaysia. Technical institutions from primary to tertiary are given the liberty to design ways to use this tool according to their needs. (Meng et.al, 2011, Johari et.al, 2010)

Despite getting the support from the Ministry of Education where local schools and tertiary institutions are provided with the licenses, training and services (Ramli et.al, 2014) for the use of GSP, the implementation of the tools within schools and universities does not necessarily report back a flying colour success.

Reports have shown various GSP underutilization stories at schools. (Ramli et.al, 2014, Eu, 2013, Meng, 2012, Teoh et.al, 2005). Among the reasons identified are the reluctance of the

main players to adapt to using the tools. Teachers complains that using the tools adds more to their workload as they have to learn and stay updated with the many versions of the tools. The technology phobic may feel apprehensive about demonstrating their inadequacy of handling IT before their students and those who prefer the traditional chalk and talk may feel their routine has been interfered with.

This study will provide insights on the factors that may influence the success of the use of GSP in the teaching and learning of Mathematics at secondary school level and the results is hoped to help develop a conceptual framework that can be used as a guideline for a successful implementation of GSP in enabling a more effective and efficient teaching and learning of Mathematics at national schools.

II. Problem Statement

The use of GSP at school levels in Malaysia mainly focuses on the teaching of Mathematics. While studies have agreed on the effectiveness of GSP in the teaching and learning of Mathematics (Meng et.al, 2011, Johari et.al, 2010, Eu, 2013, Garofalo et.al, 2004, MClintock et.al, 2002, Almeqdadi, 2000, Ismail et.al, 2011), there have been evidence of issues that leads to the poor utilization of this tool at schools. (Ramli et.al, 2014, Eu, 2013, Meng, 2012, Teoh et.al, 2005) Empirical study has identified a few factors contributing to this problem. The main reason identified is teachers' reluctance in making use of the tool as part of their teaching instruments. (Eu, 2013, Meng, 2012, Teoh et.al, 2005). Ramli et.al (2014) suggested that the reason for teachers' being reluctance may be due to the fact that they see taking up GSP may slow down the teaching and learning process as they have to make the time to learn and design its integration as part of the subject delivery. With Malaysia's education culture being exam-oriented (Ismail et.al, 2011, Bismillah, 2008), Ramli et.al (2014) asserted that there is a pressure among the teachers to finish the syllabus on time.

Students' attitude towards accepting GSP has been investigated in a study by Ramli et.al (2014). Three concerns have been identified to affect their acceptance of the tool, namely, their ICT competency that may hamper the effective use of the GSP tools in their learning. In addition to that, they are also worried that more hours are added to their learning time if they were to undertake the tool. The English language proficiency is also identified as the hindering factor, given that the tool operates in English. These findings are mostly repeated in many studies determining students' concerns in integrating technology as part of their learning process. (Ramli et.al, 2014, Eu, 2013, Meng, 2012, Teoh et.al, 2005).

Another contributing factor in securing the success of GSP has been established to be the need for an ICT policy (Ramli et.al, 2014) that can govern the implementation and maintenance of the tool at schools. A good IT infrastructure to house the tools and competent technical staff to provide the necessary technical support are also imperative.

III. Research Objectives

The aim of this study is to establish how GSP can be successfully implemented for the teaching of Mathematics at the national secondary school level. Looking at the problem statements, it can be suggested that the issues with GSP underutilization need to be addressed not only from the perspectives of the users but also from the organizational and infrastructure perspectives. Hence, the two main objectives for this study will be:

Understanding the users' attitudes and acceptance towards integrating GSP in the teaching and learning activities. The users in this study will be the teachers, the students and the IT technicians.

Understanding technical and organizational factors from the education institutional/schools perspectives towards integrating GSP in the teaching and learning requirements.

The focus of this research will be on determining the influencers and the barriers for the utilization of GSP tool in the teaching and learning activities for the Mathematics subject at the national secondary schools.

An integrated success model will be developed taking into consideration the users' behavior and organizational requirement for the implementation of GSP at school. Technology Acceptance Model (TAM) originated by Davis (Chuttur, 2009) and Technology, Organization and Environment Framework by Tornatzky and Fleischer. (Tornatzky et.al, 1990) are to be considered for the development of this integrated model. In addition to that, Contructivism learning theory originated by Piaget (Wadsworth, 1996) will also be used in the development of the success model.

To test the proposed research model, a quantitative survey using questionnaire will be adopted as a method for data collection. The units of analysis of this study will be the teachers, students and school administrators of Malaysia's secondary schools. The preliminary survey will be conducted on selected schools to obtain information regarding the usage of GSP in the teaching and learning of Mathematics. The list of schools will be accessed from the Ministry of Education.

IV. The rationale behind the choice of model and theory

Research conducted on the use of GSP at schools have shown many factors that affect the users drive in adopting the tool. They may be receptive of the idea however they do not necessarily have the will to make the effort in fully integrating the tool as part of the routine.

Studies on acceptance of technology focusing on users' attitudes and usage behaviours have dated back to at least the last two decades. Various models and frameworks have been developed to study the motivation factors leading to the acceptance of technology among its users. (Oliviera et.al, 2011) Among the earliest is Technology Acceptance Model by Davis (TAM) (Chuttur, 2009) which has been used as the theoretical basis for many empirical studies of user technology acceptance and adoption. This model has since been improved and extended to enhance its applicability to different technology acceptance scenario. (Pai et.al, 2011). This research will use the original model as the foundation to investigate users' attitude and behavior towards GSP. This is due to the fact that this model has been used extensively in many research within educational context. (Stols et.al, 2011, Gu et.al, 2013, Fluck et.al, 2013). The two constructs from this model; perceived ease of use and perceived usefulness are very applicable to be used in studying the GSP implementation scenario. Technology Acceptance Model (Chuttur, 2009) defined perceived ease of use suggests that users are inclined to use the technology if they feel that the technology is easy to be handled and perceived usefulness gives an idea that the technology is indeed useful and could help with carrying out the job.

In catering for the organizational needs, the TOE framework by Tornatzky and Fleischer (Tornatzky et.al, 1990) has been chosen as the base for this research for the relevant types of constructs it carries to support the investigation pertaining to organizational readiness in adopting technology. The TOE framework looks at technological implementation from three

perspectives, namely technological, organizational, and environmental perspectives. Technological perspective refers to the technical applications used in the organization, organizational perspective covers the organization size, management and resources, and environmental perspective looks at the government policies and competitors.

This study will also consider Constructivism learning theory originated by Piaget (Wardsworth, 1996) to further enhance the development of the success model. This learning theory is chosen as it promotes ways of teaching and learning that lead students to develop their own understanding by doing hence most suitable in supporting the development of 21st century skills among students.

While there have been various research investigating the best way a technology can be integrated in an educational setup, there have not been one that integrate the components from the perspectives of users behaviour and attitude, the organizational's technical and management aspects and a particular learning theory. This study proposes that these three dimensions are to be integrated into a model aiming at establishing the major influences in the adoption of GSP in the teaching of Mathematics at secondary schools. The result is hoped to help ensuring a more successful implementation of the tool at the schools. These three factors are hypothesized as presented in Figure 1:

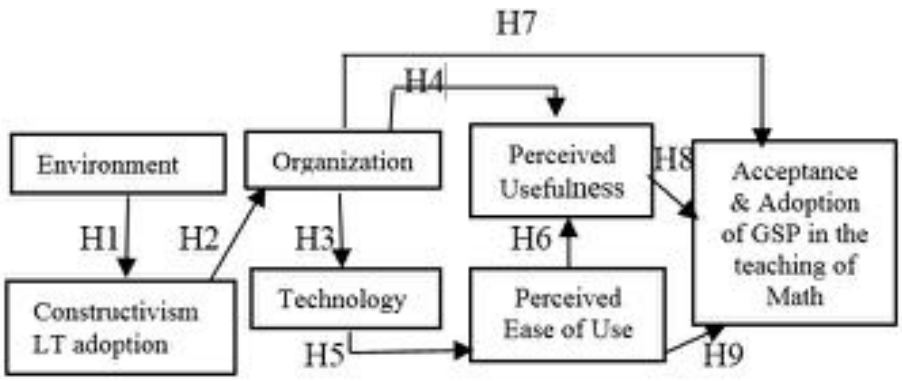

Fig. 1. A proposed integrated success model for GSP implementation in the teaching of Mathematics at secondar schools

IV. The Hypothesis

Based on the model illustrated in Figure 1.0, the following hypotheses are proposed based on the constructs available in Davis' Technology Acceptance Model, Tornatzky's Technology-Organization-Environment Framework and Piaget's Constructivism learning theory.

H1. Higher needs from the nation for graduates with 21st century skills will result in higher adoption of Constructivism Learning Theory in the national education direction
H2. Higher level of Constructivism Learning Theory integration in the national education direction will result in higher adoption of the theory in teaching and learning approach at schools
H3. Higher level of organization's awareness on the use of technology in supporting Constructivism will result in higher possibility in obtaining and implementing the technology (in this context GSP)
H4. Higher level of support, awareness and direction on the use of GSP from the school management will result in higher perceive of usefulness among the users

H5. Higher quality of GSP tool used will result in higher perceived ease of use among the users
H6. Higher perceived ease of use will result in higher perceived usefulness among users
H7. Higher organization support and readiness will results in higher acceptance and adoption of GSP
H8. Higher perceived usefulness will result in higher acceptance and adoption of GSP
H9. Higher perceived ease of use will result in higher acceptance and adoption of GSP

V. Methodology

As a preliminary study, comprehensive literature studies on technology in education focusing on Geometers Sketchpad implementation in the teaching of Mathematics at schools, the determinants, issues and success factors will be critically studied. TAM and TOE models will be studied to see how they can fit in the implementation of GSP at schools. In addition, various studies on Constructivism Learning Theory will be explored.

An integrated success model for the implementation of Geometers' Sketchpad (GSP) in the teaching and learning of Mathematics at the national secondary schools will be developed and formulated based on the outcomes of the preliminary study conducted.

To test the proposed research model, a survey research using questionnaire (hardcopy and online) will be adopted as a method for data collection. The unit of analysis for this study are teachers, students and school administrators of Malaysia's secondary schools. The preliminary survey will be conducted on selected schools to obtain information regarding the usage of GSP in the teaching and learning of Mathematics. The list of schools will be accessed from the Ministry of Education. The main survey to test the model will be conducted on selected secondary schools nationwide which are using the GSP in their teaching and learning activities.

VI. Conclusion

The result of this study will be useful in providing insights on the determinants influencing teachers', students' and schools' acceptance and adoption of GSP as part of the teaching and learning tools for Mathematics.

The integrated model, which will be the first to adapt constructs from TAM, TOE and Constructivism Learning Theory first is also hoped to serve as a guideline for a successful implementation of GSP in schools which is in line with the needs identified in the Malaysia's Education Blueprint 2013-2025 under leveraging ICT to scale up quality learning across Malaysia (Malaysia Ministry of Education, 2012).

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