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Computer Based Courseware in Learning Mathematics: Potentials and Constrains

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Abstract

Computer Based Learning (CBL) in teaching and learning process is becoming a phenomenon in the educational field. CBL serves to establish more effective learning situations than traditional teaching methods. However, research studies show that most teachers do not make use of CBL to contribute and further improve the quality of learning environments. This paper discusses the potential of CBL and its' constrain regarding this issue which is focusing on the barriers of integrating the technology in the teaching and learning process among the Malaysian teachers and also in learning Mathematics.

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Keywords- Computer Based Learning; technology; Mathematics.

1. Introduction

In general, Mathematics is a compulsory subject for all the primary and secondary school students in Malaysia. Nowadays, educators take opportunities to harness the power of computer technology in helping students to learn Mathematics. Using computers to help students to learn Mathematics through the use of courseware is becoming common in Malaysia. There is much educational software available for teacher to use in teaching and learning. Some of them are even free in terms of money and downloadable through the Internet known as freeware (Teoh, 2009). CBL in Malaysia has emerged as an instructional technology with the potential to overcome the limitations

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of traditional media in supporting the prospect to provide learning environments with strong visual elements (Nordilah, 2010). Nevertheless, it is not to replace traditional educational methods which are usually carried out by chalk and talk (Nordin and Fatimah, 2011).

Eventhough CBL is being implementing, teachers still remain central to the teaching and learning process (Martin, Khaemba and Chris, 2011). Computer is just an additional aided learning tool for teacher in some areas that require more attention. The educational software in the market is an alternative method to assist teacher in teaching, apart from the traditional way of teaching (Noordin and Fatimah, 2011). Therefore, CBL become most exciting innovation in the educational technology. CBL is a set of programming instructions which is used in instructional process to develop certain predefined skills for the students' mastery over the subject content. It generally refers to a specific programmed which is designed to teach (Vansia, 2012).

2. Computer Based Learning in Malaysia

Computer based learning refers to the use of the computer as a tool for facilitating and improving instruction. CBL programs use tutorials, drill and practice, simulation and problem solving approaches to present topics and to test the student's understanding. CBL uses a combination of multimedia element which is combination of text, graphics, sound and video in the learning process. It is especially useful in distance learning situation. It is also integrated the use of Internet or intranet in the process of teaching and learning. According to Lee (2012), CBL improves students' attitudes, motivation and academic achievement.

The history of CBL in Malaysia starts from the year of 1999. In 1999, Smart School was commenced. It is a learning institution that has been systemically reinvented in terms of teaching and learning practices and school management in order to prepare children for the information age. Most of the teaching and learning practices in Smart School have been carried out through ICT initiatives. The Smart School solution package includes ICT-enabled learning courseware for Bahasa Malaysia, English, Sciences and Mathematics. Presently, the whole courseware package has been distributed to all Smart Schools in Malaysia. It was aimed to produce analytical and creative students with widespread use of computers in school. Its concept was to develop thinking students with information technology tools playing an important role in the teaching and learning process (MSC, 2007).

In 2003, courseware became one of the support tools in the *"Implementation of Teaching Science and Mathematics in English"* program which known as PPSMI. PPSMI is an initiative to teach Science and Mathematics subjects in English rather than Bahasa Malaysia. The purpose of this initiative is to allow students to be better connected to the rest of the world, as English is a universal language. It will allow students to move seamlessly shift from their primary and secondary education into international tertiary institutions. In 2009, Education Minister announced the abolishment of PPSMI. According to the Deputy Prime Minister Tan Sri Muhyiddin Yassin, PPSMI will be abolished in 2012 after discovering that the policy failed to achieve the objective of improving students' proficiency in English while it (policy) has also affected the performance of students, especially in the rural areas.

3. Potential of CBL in Learning Mathematics

There are recent studies reveal that CBL serves to establish more effective learning situations than traditional teaching methods which involve teacher presentation, question and answer techniques, and discussions (Ragasa, 2008). The use of computer in conjunction with effective teaching strategies has great potential in the teaching and learning process (Hoon, Chong and Azilah, 2010). According to Lee (2010), the courseware constructed in her research showed positive effect on students. She claims that CBL improves students' attitudes, motivation and

academic achievement. In addition, the research conducted by Janier, Afza and Wan Fatimah (2008) is also receives a positive feedback too.

The reason for this is that the CBL enables the students to progress at their own pace and provides them with appropriate alternative ways of learning by individualizing the learning process (Hoon, Chong and Azilah, 2010; Ong and Ruthven, 2010; Mudiana, *et* al., 2011). Moreover, Vansia (2012) stated that CBL has ability to provide quantifiable and instantaneous feedback for its users. Besides, CBL motivates students to learn better by providing them with the immediate feedback and reinforcement and by creating an exciting and interesting atmosphere (Sharina, Fatimah and Mazyrah, 2010).

There a lot of research been conducted to prove the positive effect of CBL in learning mathematics. Research conducted by Liao (2007) proved that CBL had a positive effect on individuals by comparing 52 research studies carried out in Taiwan in his meta-analysis study. In 2009, Mahmud, Arif and Lim (2009) created a courseware called 'G-Reflect'. The focus of their study was to develop and evaluate a courseware, 'G-Reflect' on students' achievement and motivation in learning Mathematics. The courseware was developed using Geometer's Sketchpad (GSP) software. The research indicated that students were motivated in learning mathematics and performed better than students taught in the conventional method. He further suggested the mathematics' topics that suitable to use the GSP software in teaching and learning activities in the secondary school Mathematics syllabus such as Translation, Rotation, Dilation, Polygons, Perimeter and Area, Coordinates, Graphs of Function, Circle, Trigonometry and Linear Equations.

In the same year, Teoh and his colleagues (2009) study the cognitive effects, in terms of the gain scores and time-on-task of a computer courseware by using mastery learning and collaborative strategies. A total of 262 Form Four students interact with two Matrices courseware. The students were randomly selected from four suburban secondary schools. For each school, three classes were chosen randomly. They are randomly assigned to the Computer-assisted Cooperative Learning (CCL) treatment, Computer-assisted Mastery Learning (CML) treatment, and Computer-assisted Cooperative Mastery Learning (CCML) treatment. All students had not been exposed to the topic of Matrices. The whole lesson on Matrices took four to six hours to finish. Students took a test after each subtopic. Students in CML complete all formative tests or quizzes independently. If CML students fail, they would receive supplementary instruction and corrective activities immediately until the requirement is met. Students in CCL and CCML groups undergo all designated cooperative learning activities. CCL students received no corrective activities but if CCML students fail, they will receive supplementary instruction and correction activities immediately after each question until the requirement is met. Each student in CCML must wait until all members in the group have achieved the level of 80%. The achieved students are encouraged to help the others. This study showed that, CML and CCML are effective learning tools. If the time allocated for the learning process is longer, CCML would be the most ideal strategy otherwise CML is generally preferred in the learning process.

Furthermore, in 2010, S-Reflek courseware was developed by a researcher (Lee, 2010) to enhance the achievement of the higher lever thinking and the motivation in learning Mathematics of the student. S-Reflek was developed by using Geometer's Sketchpad program which allowed students to learn the topic of Reflection, a Mathematics Form 2 subject, using hands on and minds on. The research applied Problem Based Learning (PBL), an active learning's strategy which supports the constructivism theory. Through PBL, students would learn based on problems given and they would solve the problems with the aid of computer software. This would give students the opportunity to explore knowledge in their own pace. A number of 180 respondents were involved in this study. The research showed that PBL with S-Reflek increase the students' level in mastering the topic of reflection and improved their achievement. Students were able to explain in details about the concepts of reflection after the learning process and master higher lever thinking after the learning process. Thus, the

learners' motivation level was considered as high motivation. To sum up, the application of PBL strategy with S-Reflek showed positive effect on students.

Next, in 2011 a research carried by Noordin and Fatimah (2011) utilised the Van Hiele's levels for teaching and learning Lines and Planes in 3 Dimensions. Based on an early study, students had been identified of having problems in visualising figures. To overcome this problem, a multimedia courseware was developed based on a framework that utilised Van Hiele's Geometric model for visualizing 3D models. A testing was conducted with 60 high school students aged 14-year old to measure the courseware's effectiveness as an aid for visualising 3D models. The results showed that the students had demonstrated the ability to visualise and enhance their understanding on the topic after learned using the courseware.

In the same year, the research of Zuraini and Fatimah (2010) evaluated on the effectiveness and usability of a 'Li2D' courseware. The interactive learning environment provided by 'Li2D' enabled students to visualize the movement of the locus and steps in constructing the locus. A total of 63 Form Two students were involved in the study. The students were divided into two groups which are control and experimental. The experimental group had to interact with 'Li2D' courseware as part of the learning activities while the control group used the conventional learning methods. Usability evaluation was accomplished based on four constructs of usability, which were efficiency, learn ability, screen design and satisfaction. The research also conducts an evaluation on the multimedia elements. The results showed that the experimental group performed better than the control group in understanding the Loci in the topic of Two Dimensions. In a nut shell, from several recent studies above proved that the use of computer in conjunction with effective teaching strategies has great potential in the teaching and learning process.

4. Constrain in applying CBL in Mathematics

Integrating technology in teaching has been a challenge to teachers since they need to make effective use of it in order to develop student's independent learning skills and enhance students' learning. It also influences the way mathematics is taught and learn. In addition to that, it provides the way for developing independent learning skills and an alternative for learning. For instance, to solve a problem in mathematics, students need to explore ideas, see the relationship between concepts and finding a solution to a problem. With the advancement of multimedia technology, the problems can be solved (Lee and Kim, 2012; Zuraini and Fatimah, 2010). However, research studies show that most teachers do not make use of the potential of ICT to contribute to the quality of learning environments, although they value this potential quite significantly (Smeets, 2005).

The Malaysian government believes that using courseware can increase student engagement and motivation, providing students with a greater level of individualised instruction (Barrow, Debraggio and Rouse, 2008; Chong, Horani and Daniel, 2005). The Ministry's Technology Education division had prepared Smart School courseware for self-directed learning, individually-paced, continuous and reflective. Students thought that Smart School courseware was attractive, highly interactive, and usable and it has a potential to replace the conventional teaching and learning materials but the surrogate user especially the teachers had thought otherwise (Jaafa, 2008). Therefore, in order to achieve better result, some courseware need for improvement and development for future utilisation (Murni, 2006). In addition, it was found that only 12% of the 609 students claimed to have frequent use of Smart School courseware in school (Jaafa, 2008). According to the research conducted by Lee (2010), the findings revealed the need for improvement in mathematics courseware for future utilisation as individual differs in traits such as skills, aptitudes and preferences for processing information and applying in real world situations.

There are lots of barriers for teachers to integrate ICT in teaching. To begin with, the findings from Goktas, Yildirim, and Yildirim (2009) indicate that a majority of teachers believe that the main barriers for integrating ICT are lack of in service training, lack of appropriate software and materials, and lack of hardware. Furthermore, teachers are lack of access to computers and negative attitudes toward the integration of technology in teaching (Chong, Horani and Daniel). Some of them fear of change (Mishra and Koehler, 2006). In fact, many teachers still fear using ICTs, and thus they are reluctant to integrate them in their teaching (Martin, Khaemba and Chris, 2011). They have contributed to the limited impact of computer-based learning tools (Kay and Lauricella, 2011).

According to the report of "Integrating ICT-Based Content in Teaching and Learning Mathematics", MSC Malaysia (2007) believes that there is not enough time and that there is too much content to cover for examination require consideration on what really matters in teaching. It is also supported by Kay (2011) and Goktas, Yildirim and Yildirim (2009) that time constraints is one of the factors teachers are unwilling to integrate ICT in teaching. Beside, studies and observations in schools provide consistent evidence that teachers show minimal or inappropriate use of ICT applications in mathematics teaching and learning at all levels (MSC, 2007). Only a few teachers are confident in using a wide range of ICT resources. Then, the limited confidence affects the way the lesson is conducted (Martin, Khaemba and Chris, 2011).

Moreover, according to Lee (2010), many instructors claim that the courseware is ineffective for certain students. The researcher claims that courseware has some strong factors that may de-motivate the learners (Lee and Kim, 2012). Some of the factors are unattractive presentation, boring style of writing, undefined/ambiguous learning objectives, irrelevant content, content that is too simple or too complex and too much to grasp in one go (Lee and Kim, 2012). The next barrier is the interface designs that fail to support learning and also presents unattractive presentation (Norfadilah, 2010). According to Norfadilah (2010), interface design for existing courseware should be improved to support the quality of learning experiences. It includes the level of interactivity and the availability of the interfaces to interact with the users. As suggested by Samah *et* al. (2011), the interactivity function should be considered by instructional designers in order to develop learning materials. So that external conditions of learning such as feedback and attentions devices will be meet the students' need. Besides that, the lack of knowledge about the role of interface design by the designers in the development process is also the reasons that most acknowledged (Norfadilah, 2010).

Yet, sometimes the problem is the way the courseware is used as a tool for teaching and learning (Bortolossi, 2012). The way CBL is applied in teaching and learning can affect its effectiveness. Therefore, new studies are needed to clarify the effect of CBL in contemporary students' environment (Hassan, 2008). Besides, it is needed to study the courseware whether it meets the requirements before it is being used (Mutalib, 2008). In fact, CBL allows the educators to expand their repertoire of methods, tools and strategies beyond those that are frequently used in the classrooms. So, in relation with that, the courseware needs to be tested (Mudiana, *et* al, 2011).

5. Conclusion

From the discussion above, it is shows that computer technology and developed courseware give significant effects on students' learning especially in Mathematics. However, there are many problem faces from many aspects such as from teachers, from the courseware itself and so on. Thus the question of what are the effective criteria for computer based mathematics learning courseware remain unanswered. However, The Ministry's Technology Education division had prepared courseware using the Smart Schools budget of RM53 million (Chong, Horani and Daniel, 2005). Since the Malaysian government has contributed lots of money and afford in integrating ICT in education, the question is worth answering. So, to better understanding what are the main construct of the aspects to be concerned to design and develop the mathematics learning courseware need to be investigated. When the effective criteria have been identified, it is hope that the learning courseware will be designed and developed that best fit the needs of all parties and furthermore can be used as a tool for teachers in order to teach mathematics in school.

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