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ISSUES OF COMPETENCY AND CONSTRAINTS IN THE DEVELOPMENT OF INTERACTIVE MULTIMEDIA COURSEWARE (IMC)

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ABSTRACT

An instructional-sound Interactive Multimedia Courseware (IMC) that is interactive and effective contributes greatly to learning. Good IMC have multimedia components such as text, graphics, animation, video and audio in the courseware to generate interest, motivation and effective learning. It is carefully planned and developed to achieve targeted learning objectives. This study involved a group of university students (n= 94) who are student teachers of The School of Education and Social Development in a public university in Sabah, East Malaysia. They were required to develop IMC (a module) for teaching secondary school students. They were also requested to report on the number of multimedia components that they used in their IMC and also list constraints they faced throughout the period of IMC development. Findings revealed that 93.6% of the subjects used all the multimedia components namely the integration of text and graphics with animation, video or text in their IMC. It also showed that level of students' IMC programming skills was low in some area such as audio, video and animation production. Given such results, it recommended that institutions of higher learning should provide more multimedia hardware and software to facilitate IMC production and to upgrade the level of multimedia programming skills of student teachers.

Keywords: Interactive multimedia courseware, multimedia competency, constraints

INTRODUCTION

The use of Interactive Multimedia Courseware (IMC) in Malaysia for teaching and learning has increased rapidly after the introduction of 86 smart schools in Malaysia since 1999. One of the teaching methods for the smart schools was the distribution of IMC for students. The use of IMC in teaching and learning was first initiated by Universiti Tun Abdul Razak (UNITAR) which is the country's first virtual university.

In this study, subjects who are student teachers of a computer and multimedia course (TT00703 Computer and Multimedia in Education) participated and produced IMC for teaching and learning in secondary schools. It also provided important feedbacks to the course lecturer on the students' level of multimedia programming skills and the constraints that they have faced during the development of their IMC.

BACKGROUND AND LITERATURE REVIEW

Multimedia Components for Teaching and Learning

Recent studies show that Computer-Aided Instruction (CAI) provides a significant opportunity to improve the quality of teaching profoundly and cost-effectively. It has been reported that CAI brings about a 50 percent increase in retention, a significant improvement in the learning rate, an increase in course completion, and a decrease in the overall cost of education, particularly when distance learning is involved (Schwier & Misanchuk, 1993).

According to Shelly et al. (1994), multimedia is the integration of two or more communications media such as text and sounds, plus still and moving pictures to convey ideas. It is built around the premise that anything words can do, words with sounds and pictures can do better. For higher education, these features in IMC, can supplement course content and activities in innovative ways (Liou, 1994). This view was in agreement with Mayer (2005) that computer-generated animation offers a potentially more powerful medium for presenting visually based information to learners. By combining graphics with text, multimedia learning promises deeper learning in students. Carefully designed IMC that are consistent with how people learn and can aid learner greatly (Mayer & Sim, 1994). With multimedia, teachers can tap the power of visual and verbal forms of expression in the service of promoting student understanding.

The activities propagated in the IMC are designed to achieve student-led and student-centered type of discussion. These are of top priority because they enhance peer learning under the observation and guidance of the lecturer. Another reason that supports student-cantered learning is the encouragement of forming learning teams (Klemm, 1998). When students engage and discuss in a cooperative or collaborative manner, the quality of the output in the assessment part of IMC will improve.

In science subjects, such as physics, multimedia-rich materials could be of significant benefit in aiding the visualization of complex physical processes and concepts. The use of hyperlinks in a multimedia presentation allows students to control the sequence of concepts presented (Reynolds & Anderson, 1992). Interaction between the student and the computer can engage the student more fully and lead the student to an understanding of the ideas being covered rather than merely presented.

Incorporation of video sequences and animations into IMC and the availability of these to individual students for self-study purposes would be a major opportunity for teachers to tackle the many misconceptions that students have and which are difficult to address within the limitations of chalk, textbook and overhead projector. The availability of a wide selection of animations and video clips (e.g. YouTube) make IMC more interesting.

The development of quality computer graphics is essential to presenting visual ideas clearly. Three-dimensional animated computer graphics are especially useful in simulating real situations in semi-immersive virtual reality. Two-dimensional graphics development can consist of scanned images or computer-generated images.

Voice and music are types of audio that can be incorporated in an IMC. Spoken words (e.g. narrated voice) are processed in the auditory or verbal channel (Mayer, 2003). The amount of processing that can take place within each information processing channel is very limited and

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therefore learners may be able to mentally activate only about a sentence of the narration at any one time. There are many software packages available such as Wave Studio, to record sound with a computer.

Cognitive theory of multimedia learning suggested that meaningful learning depends on how the learner selects relevant aspects of sound and images, then organizing them mentally and finally integrating them. This is called active learning that allows learning to be stored in long-term memory. This view is also well-received by well-known psychologist, Piaget, who found that student fits new learning experience into existing ones through assimilation or changes the original schema into new experiences via accommodation (Mayer, 2005).

Animation is a highly effective tool for illustrating a concept (Roblyer, 2003; Mayer, 2005). The purposely-created motion can also illustrate processes and real-life or virtual environment. But, unfortunately, learners can only able to mentally activate for about ten seconds of the animation at any one time. Mayer (2005) found that instructional design methods that promote deeper learning in one media environment such as text and illustrations also promote deep learning in other media environments like narration and animation.

Constraints in Developing IMC

The effectiveness of multimedia-based instruction in learning depends on how learning materials in the form of various multimedia components such as text, graphics, audio, video and animation across various media are designed and integrated (Fleming & Levie, 1993; Najjar, 1998). However, creating some of these learning objects are not easy especially video and animation.

The flexibility gained by presenting material in the form of IMC comes at a price. Schwier and Misanchuk (1993) stated that producing interactive multimedia modules requires a great deal of programming to accommodate a variety of student responses. Developing graphics, animations, video, and sound consumes a great deal of time, and these additions require huge amounts of computer storage space. Ultimately, this means that each lesson cannot exhaustively cover a subject and retain the features which distinguish them from textbooks. While developing the software, a balance between desirable flexibility and the available computer resources must be carefully considered.

Although there may be problems or obstacles in using multimedia in higher education, it does not appear to be a pedagogical basis for student's resistance to the technology at all levels of institution of higher learning and schools.

AIMS OF THE STUDY

The purpose of the current study is to determine the efficacy of using IMC in student's learning. In particular, it sought to answer the following research questions:

Research Question I

How many multimedia components were used by the student teachers in their IMC?

Research Question II

What was the level of students' IMC programming skills?

Research Question III

What were the constraints in IMC development?

PROCEDURES OF THE STUDY

Sampling and Procedure

This study involved a sample of 94 university undergraduates who are student teachers in 2nd, 3rd and 4th years, taking TT00703 Computer and Multimedia in Education course, in SESD. The composition of the subjects was 26 males (27.7%) and 68 females (72.3%). Feedbacks from the subjects also revealed that 72.3% of the subjects have no prior knowledge on multimedia. This showed that they have not studied multimedia during their schooling days. Also, 92.6% of the subjects have a computer at home. This indicated they would not have any problems completing the IMC project at home without depending on the university's ICT facilities.

All students enrolled in this multimedia course were required to complete the development of an IMC at the end of the course. The students' IMC projects were developed using web pages authoring tools such as MS Frontpage or Macromedia Dreamweaver. From time to time, the subjects were required to consult the course lecturer if they have any problems on IMC development.

Instrument and Data Analysis

The main instrument used in this study was a questionnaire created as self-assessment tool for the subjects to provide feedbacks on this multimedia course. It was divided into four parts. The first part surveyed on the subjects' background. Part B assessed the availability of the five foremost multimedia components namely text, graphics, audio, video and animation.

Part C was a self-assessment tool for the subjects to evaluate their own multimedia programming skills learnt from this multimedia course. The last part requested the subjects to rank five most important constraints that they encountered while developing the IMC. A total of 16 constraints were listed in this questionnaire. All the data were encoded in the Statistical Packages for Social Sciences (SPSS) 17.0 for analysis. However, only descriptive statistics were used in this study to report the findings.

ANALYSIS AND RESULTS

Multimedia Components

The subjects were advised to integrate as many multimedia components as possible in the IMC according to their level of multimedia programming skills that they had acquired in the course. Findings revealed that 88 of the 94 subjects (93.6%) used all the multimedia components (text, graphics, audio, video and animation) in their IMC. Many educational technology researchers recommend the use of all the components as rich and lively presentation of multimedia materials as pointed out by Mayer (2005).

The survey also revealed that 84.6% and 96.7% of the subjects respectively used animated fonts and text as means for interactions or hyperlinks to various links with learning content. This is important because interactive text can motivate learning greatly. Moreover, text in a form of buttons and hyperlinks was also being used for providing learning inputs and feedbacks for electronic exercises as propagated by behaviorist educationists. A sample of the colorful text with links is shown in Diagram 1 below.

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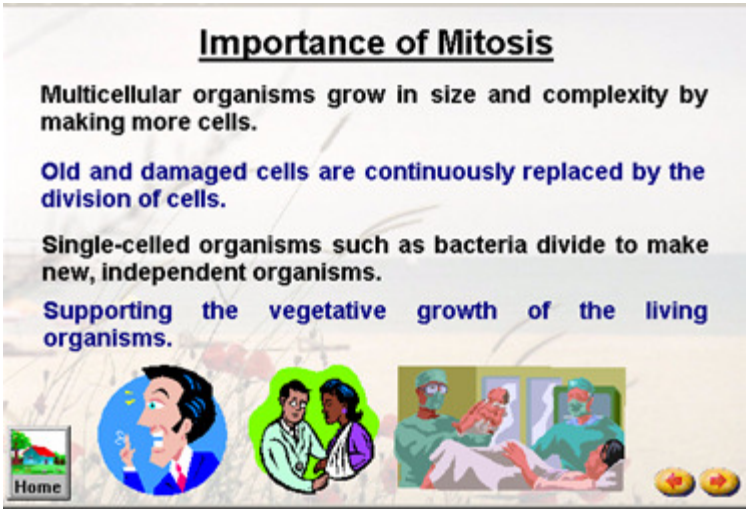

Diagram 1: Sample text found in one of the IMC produced by one of the subjects on Mitosis, a discipline in Science

Out of 94 subjects, 79 of them (85.9%) used graphics for animation purposes. Most of the graphics being used in the project were those downloaded from internet and from clip art library especially from Microsoft. Being able to create useful movement or animation for the imported graphics added attractions and motivation for potential users of the IMC. This fact was supported by the ARCS Motivational Model (Keller, 1999). The model stated that the roles of graphics and animations or simulations are to attract, motivate and to reduce boredom in multimedia materials presentation.

Out of 94 subjects, 82 of them (93.2%) said that they used audio for entertainment, mainly played as background music for the exercise section of the IMC. The presence of music as entertainment can help reduce tensions when answering questions. About 61.9% of them used audio as a mean for relaying information. This was mainly done using narrated texts such as recorded speech or passages and even audible feedbacks as responses to users' input in the exercise section.

Only 27.7% and 44.8% of the subjects respectively used video in their multimedia project. The low usage of video indicated the difficulty in getting such resources. For example, it is relatively difficult to get video from the market for a particular mathematic topic. It would be easier to animate some of the mathematical processes than from video. On the other hand, getting video from 'video recordings via video camcorder' will also incur extra cost for the subjects for purchasing video capture card, video editing software and even for the organized recordings itself.

Findings also revealed that 68.1% of the subjects used animations in the IMC. This was not surprising because many animated objects for learning could be found and downloaded easily from the web. However, it needs a lot of computer graphics skills, patience and animation production skill to create complex animation. Diagram 2 below shows a sample of a 20-layer cell animation created by one of the subjects.

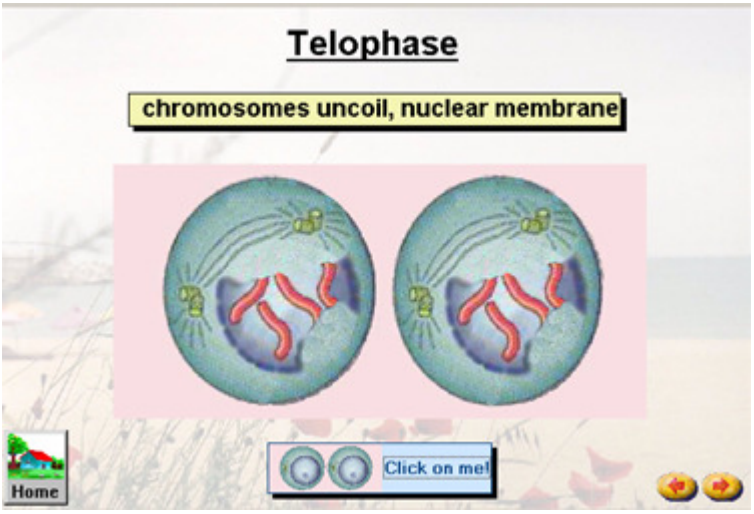

Diagram 2: A sample of a 20-layer cell animation created by one of the subjects on telophase stage of mitosis, a discipline in Science

Multimedia Programming Competency among Student Teachers

Multimedia programming skills is one of the most important factors for IMC production. Without the required skills for producing multimedia components will result in the low quality of the produced IMC. Table 1 shows the comparisons between the percentages of subjects who did not use multimedia components in their multimedia project with the percentages of those who rated themselves as poor and very poor in the respective multimedia components. The table suggested that certain multimedia components such as audio and video showed a high percentage of subjects (22.5% and 64.8% respectively) who did not use them due to high percentage who rated themselves as poor and very poor (31.9% and 41.5% respectively) in their programming skills.

Table 1: Percentage comparisons between multimedia components that were not used in the multimedia project with their programming skills (*n*=94)

Multimedia components that were not used in the IMC	**%**	**Self-rated programming skills**	**%**
Text	9.4	Poor and Very Poor	3.2
Graphics	14.1	Poor and Very Poor	19.1
Audio	22.5	Poor and Very Poor	31.9
Video	64.8	Poor and Very Poor	41.5
Animation	31.9	Poor and Very Poor	17.0

For graphics components, only 26 out of 94 subjects (27.7%) rated themselves as good and excellent in their skills. However, 19.1% of them indicated that they were poor and very poor in graphics skills since these were not taught in this multimedia course. According to the course lecturer, a handful of them learnt graphical software such as Adobe Photoshop or CorelDraw, all by themselves. Only simple skills such as inserting graphics or downloading graphics from internet were taught.

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For audio components, only 26 out of 94 subjects (27.7%) rated themselves as good and excellent in the skills. However, 30 out of 94 subjects (31.9%) said that they were poor and very poor in audio production. This was probably accurate because they only know how to record or digitized a recording of their narration using sound recorder provided by Windows Operating System which includes converting MP3 audio into wave audio files.

Out of 94 subjects, 20 of them (21.3%) rated themselves as good and excellent in producing video clips for the IMC project. However, 41.5% of them rated themselves as poor and very poor in such skills. It was the highest percentage of the subjects who lacked the skills among all the multimedia components. This finding was not surprising as some of them could not cope with the lessons in producing video. The skills such as video cutting and pasting and later on combining each video clips were no easy task and time consuming (Schwier & Misanchuk, 1993). Therefore, few subjects incorporate video into their projects.

For animation components, only 35 out of 94 subjects (37.3%) rated themselves as good and excellent in the skills. However, 17.0% of them indicated that they were poor and very poor in animation skills. As creating animations were difficult, most of the subjects mainly used downloaded animated gif for their IMC.

Constraints of IMC Development

Table 2 lists the constraints faced by the subjects with a rank from 1 to 5 while completing the IMC project. The worst constraint faced by them was the insufficient multimedia skills to develop the multimedia CD. About 29.8% agreed to this in the self-assessment survey. The easier multimedia skills were those related to text and graphics insertion and modifications. However, audio, video and animation production were pretty tough and required students' dedicated interest and attention when they were taught.

Table 2: Constraints in the completion of the IMC project according to rank (*n*=94)

Constraints according to ranking	Frequency	%
Rank 1: Insufficient multimedia skills to develop my CD	28	29.8
Rank 2: Difficult to integrate text, graphics, audio, video and animation into my project	24	25.5
Rank 3: Difficult to produce video	19	20.2
Rank 4: Difficult to plan suitable activities for the selected topic	13	13.8
Rank 5: Lack of financial ability to purchase hardware like CD writers / scanners / pen drive / multimedia software, etc	11	11.7

About 25.5% stated that the second ranked constraint was the difficulty they faced when integrating text, graphics, audio, video and animation into their project. For example, in the integration of an audio file to play as background music, the students must not forget to first put a copy of the file in the respective project folder that they were working with (Shelly et al.,

2011). Failure to do this would result an error during "run mode" and the audio file will not be activated.

The third constraint was the difficulty to produce video. About 20.2% admitted this impediment. This finding proved that video clips production was a difficult process given that it required students to search for compatible video format, cut, edit, paste and render combined clips into a single clip.

Out of 94 subjects, 13 of them (13.8%) indicated that the fourth constraint was the difficulty to plan suitable activities for the selected topics of their IMC project. Suitable activities depend on the objectives or learning outcomes of selected topics. They need to plan a sound instructional design of the lesson that includes various teaching strategies that are suitable for IMC.

Subjects' multimedia projects indicated that most of the students used multiple-choice questions as a mean to gather users' feedbacks on the effectiveness of their learning content which is consistent with behaviorist approach. Constructivist approach was quite lacking because they did not understand that they could also include exercises such as group discussion, e-mailing activities, online forum (e.g. use Web 2.0 tools) and other related collaborative social activities.

Findings also showed that 11 out of 94 subjects (11.7%) ranked financial constraint as the fifth constraint. Multimedia computer hardware and software are extremely expensive. The consequence was that students used pirated software as a substitute (Shelly et al., 2011). Such practices were not recommended given that some ethical issues can possibly surmise.

CONCLUSION AND RECOMMENDATIONS

As IMC was effective in promoting learning among students of various subjects and disciplines, institutions of higher learning should take the lead in conducting more research in the use of multimedia. This study managed to demonstrate that student teachers who are studying multimedia were capable of producing IMC and as such, these initiatives should be continued by all institutions of higher learning. Constraints to the development of IMC must be overcome so that more IMC can be produced by student teachers to improve teaching and learning when they are posted to secondary schools in the near future.

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