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The Effects of Using Educational Software in the Computer-Assisted Instruction (CAI) Method to Increase Adult Learners' Achievement

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Abstract

The aim of this study was to investigate the effects of traditional teaching instruction (TI) versus computer-assisted instruction (CAI) using educational software in an educational software design course. This study was conducted at a higher education institution in Jordan using a quasi-experimental and non-equivalent control group design. Educational software was developed to investigate the difference between two groups that were given a pre-test and a post-test to measure their achievements in the course.

Abstrak

Tujuan kajian ini ialah untuk menentukan kesan pengajaran tradisional berbanding pengajaran berasaskan komputer menggunakan perisian pendidikan di dalam kursus reka bentuk sofwer pendidikan. Kajian ini dikendalikan di institusi pengajian tinggi di Jordan dengan menggunakan satu kuasi-uji kaji dan reka bentuk kumpulan kawalan tak setara. Perisian pendidikan yang dibangunkan untuk menentukan perbezaan antara dua kumpulan diberikan pra ujian dan pos ujian untuk mengukur pencapaian dalam kursus.

Introduction

A person who consider as an adult should has a responsibility for his own actions and start being more a productive citizen. That made him different from children in having more social purpose and more individuality (McClusky, 1971). They make individual contributions, and then organise these contributions to fit their social needs (Knowles, 1994). Pedagogy is derived from the Greek word "paid", meaning "child". Pedagogy literarily means the art and science of teaching children. The pedagogical method of teaching focuses on teachers and assigns the full responsibility on the teacher for making all decisions about what to teach, how to teach and when it will be learned. This method focuses on educational instruction as a teacher-directed process (Knowles, 1990). Knowles' goal was to formulate an adult learning theory taking into account what he knows from his experience and from research about the unique characteristics of adult learners. In the mid-1960s, he was first exposed to the term "andragogy" by an Yugoslavian adult educator, who was attending a workshop at Boston University. The term "andragogy" means the art and science of helping adults learn (Knowles, 1984). According to Knowles (1990), andragogy was built on five assumptions about adult learners, which make them different from children:

- Self-concept: The adult learner moves from being a dependent toward being an independent person.
- Experience: As a person matures, he/she gains more experience which becomes an increasing resource for learning. Blair (1997) concluded that good adult educators must consider adult students' experiences during planning and teaching.
- Readiness to learn: The readiness of an adult to learn is related to the development task of his/her social role.
- Orientation to learning: As a person grows and matures, his/her time perspective changes from future application of knowledge to immediacy of application. His/her orientation toward learning shifts from being subject centered to problem centered.
- Motivation to learn: Adults are internally motivated learners.

Knowles (1994) indicated that in some situations in adult education, we could use the pedagogical strategy. For example, adult learners entering

into a new area or content without any previous experience in the content, that need to be taught via the pedagogical model of teaching. In this situation, the instructor should do everything possible to help increase the learners' responsibility for their own learning and to become more independent learners. After that, the instructor could shift to andragogy and self-directed learning to help the learners reach their learning goals.

There are three immediate reasons for self-directed learning. First, there is some evidence that some people passively wait to be taught by their teachers; second, taking self-control of one's life will positively reflect on one's psychological development; third, to be a successful learner, one need to take the responsibility of one's own learning and be part of the process (Knowles, 1975). According to Smith (2002), Knowles developed a five-step model for self-directed learning: diagnosing learning needs, formulating learning needs, identifying learners' material resources for learning, choosing and implementing appropriate learning strategies and evaluating learning outcomes.

Computer-Assisted Instruction (CAI)

College students learn better when lectures are delivered with CAI rather than without. The results of the study showed no significant difference in student achievements between a group of students taught solely via lectures and another group taught via lectures accompanied by CAI. However, the time spent by the teacher on task teaching the control group (using only the lecture method) was more than that spent on the other group (Tjadan & Martin, 1995). Using traditional instruction plus CAI should be considered a sound alternative to traditional instruction alone; it helps students to engage their various senses and learn interactively. The combination of the two teaching methods leads to meaningful learning (Akour, 2004). Using CAI to teach undergraduate and postgraduate medical students may benefit them. They could learn cardiology from the use of text, images, sound, animation and video clips (Coonar, 1995).

The usage of artificial intelligence techniques in the development of tutoring programmes for undergraduate students is considered a good model for an intelligent system (Bottino, 1985). The use of computer applications as a tool to assist instruction is believed to be an effective

method for enhancing memorisation and increasing higher order cognitive skills (Renshaw & Taylor, 2000).

Ohio State University started the process of evaluating the CAI project that has been used in the College of Medicine. It recommended that it has been possible to distribute and lower the cost of using CAI, through increasing project efficiency and utilisation and eliminating duplication of efforts (Weinberg, 1973). Using computer applications to teach medical students is a unique tool to enhance their learning. It improves clinical problem solving skills but it cannot replace "bedside" teaching (Klar & Bayer, 1990). Nursing education programmes use CAI to increase nutritional knowledge and understanding of diabetes management (Herriot et al., 2003). The use of computers in education provides effective learning for students with a minimum use of resources (Pangan & Bednar, 1999). Nursing faculties believe that health courses should incorporate more computer applications strategies. However, they face some difficulties using these strategies because of scarce resources and the limited time on the part of teachers to change their teaching strategies (Kelley & Kopac, 2001). Thus, some factors influence the success of the CAI implementation process. These factors are divided into four categories: students, the environment, the medium and the subject. It should be noted that a rapid change in technology means that the use of the medium for teaching cannot be the same for a long period of time (Matta & Kern, 1989).

Most computer science (CS) students are taught how to write software in a professional way but no attention is given by computer science programmes to the content of a created product. It is recommended that CS programme plans should include topics such as the computer and society, the design of educational software, ethical issues of software designs and the psychology of human-computer interaction (Caftori & Paprzycki, 1996).

Educational Software Design

Using video-based laboratories allows students to slow down or speed up their study time depending on their needs. Associated computer tools, such as educational software, allow students to analyse observed events by making measurements on a single frame of video, exploring the structure

of actions and examining patterns and emotions (Rubin et al., 1996). Software designers need to recognise that their designs reflect their assumptions in varying educational contexts. Their approach should focus on linking real world experience and their expression to the structure of the environment. Designers have to recognise learner needs and their learning styles. Consulting educational experts consider it very important to propose steps that may have an impact on the final product (Squires, 1999: Higgins & Boone, 1993).

The characteristics of a learner, screen design, feedback and supporting devices are features to follow when assessing a piece of educational software (Higgins & Boone, 1993). To define the quality of a certain educational software, some criteria to be used such as: the presenting information should be appropriate for a particular audience, there are clear software directions and instructions, learners understand the constraints of the use, the software motivates and encourages learners to make decisions; there is also a proper way to assess the students' learning progress (Persichitte, 1995). The lack of information that is provided to parents when selecting educational software to help their children's learning process can lead to bad decision making on their part when selecting commercial educational software for a purchase (Higgins & Boone, 1993).

The use of hyper-linking within the educational software can address different topics that help science students to learn. For example, software that studies the cell should present the whole organisation of the cell, the cell at the molecular level and the physical interaction of the cell. This software allows teacher to use it for independent mastery learning or as classroom resources (Mackinnon et al., 2002).

The Purpose of the Study

Due to the increase use of educational software in higher education, the researchers hypothesised that good educational software designed with multimedia computers is a more effective tool to foster the students' learning process. There are different types of educational software that support the learning process, such as drill and practice, tutorials, simulations, instructional games and problem solving (Persichitte, 1995).

The purpose of this study was to examine the effectiveness of traditional instruction (TI) alone versus computer-assisted instruction (CAI) using educational software to examine the achievement of adult learners in a course called Educational Software Engineering. The specific questions answered by this study were:

- Is there a significant difference between the effects of TI and CAI on adult learners' achievement in the Educational Software Engineering course?
- Are there any gender differences on adult learners' achievement in Educational Software Engineering, when using the CAI designed educational software?
- What is the effect of interaction between treatment (use of CAI) and gender difference on adult learners' achievement in the Educational Software Engineering course?

The following assumptions are made about the study:

- CAI would raise students' achievement.
- TI alone is not the best choice to teach students about computer networks and components.
- Effective educational software promotes a good learning experience for adult students.

Method

Sample

The present study was conducted at Al al-Bayt University in the first semester in 2007. It examined the two teaching methods TI and CAI. The sample of the study consisted of college students at one higher education institution in Jordan. A random assignment of participants to control and experimental groups was not feasible. Participants of this study were 36 students who had enrolled in the Educational Software Engineering course (913) that has to be taken by all computer education major students as part of their graduation requirements. The main course objective was to learn about designing educational software and computer hardware components. All participants who were selected for the study came from the same

academic background. The sample was divided into two groups of 18 for each group: the control group which used the TI approach and the experimental group which used the TI plus CAI approach. The research process used the pre-test/post-test control group design.

Instrumentation

To achieve the aims of the study, educational software was used. When the software was designed, several components were taken into consideration:

- The software was appropriate to meet adult students' learning needs.
- The content of the software supported the course objectives.
- The instructional presentation of the software focused on using different multimedia that support learning.
- A software manual was made available to assist the adult students.
- The feedback included in the software was consistent and clear.
- The software provided students with the ability to support assistive devices, such as text-to-speech technology.
- An assessment test was designed at the end of the software to help students evaluate their learning progress.

The Achievement Test

The researchers used an achievement test to measure the students' achievement on the educational software design and computer hardware component according to the course objectives. The test consisted of 25 multiple-choice items. Each item had four alternatives, one of which was the correct answer. The pre-test was given to ensure that the control group was similar to the experimental group in their previous knowledge of the course on educational software design.

To ensure the validity and the reliability of the achievement test, a panel of four experts in educational software design reviewed the test items and offered suggestions to enhance the test validity. To assess the reliability of the test, a pilot study was implemented. Two weeks later, the same test was re-administered to the same subjects. The results were correlated

using Pearson's formula and the score was 0.84 which indicated a good reliability.

Treatment

The control group was taught by the traditional way of teaching. The instructor used class discussion and the lecture method to teach the students about the process of designing and evaluating educational software. An attempt was also made to introduce students to the computer software and hardware components. On the other hand, the experimental group was taught using CAI. The instructor designed the educational software using flash software. The software included different multimedia tools to support student learning: pictures, video clips, animation and sounds were used in the software design. The main objective for designing this software was to teach about computer software and hardware components in an interactive way.

Results

Means and standard deviations for pre-test and post-test scores for the experimental and control groups in the achievement test are reported in Table 1. A pre-test and post-test control group design utilising the analysis of covariance (ANCOVA) was used for this study using the pre-test scores as a covariate. The independent variables were treatment and gender while the dependent variable was achievement in the software design course.

The independent t-test analysis showed that there was no statistically significant difference between the mean scores of the experimental and control groups with respect to pre-knowledge ($t = 0.209$, $df = 34$. $p>0.05$).

Table 1 Means and Standard Deviations (SD) for Pre-test and Post-test Scores

		Pre-test		Post-test	
Group	N	Mean	SD	Mean	SD
Experimental group	18	7.39	2.91	13.50	3.45
Control group	18	7.17	3.43	10.16	2.93

After treatment, the effects of the two modes of instructions on students' achievement in the software design course were determined using the

Analysis of Covariance's (ANCOVA) by controlling the effects of the pre-test scores as covariates. The summary of analysis is as follows:

Table 2 The ANCOVA Summary (Group vs. Achievement)

Source	Sum of squares	df	Means square	F	P
Pre-test	212.977	1	212.977	51.11*	0.000
Method of instruction	67.665	1	67.665	16.239*	0.000
Gender	1.817	1	1.817	0.436	0.514
Method X gender	0.627	1	0.627	0.151	0.701
Error	129.173	31	4.167		

The analysis indicated significant effects for the covariate pre-test scores, [$F(1, 31) = 51.11$, $p < 0.05$]. The results also revealed significant treatment effects [$F(1, 31) = 16.239$, $p < 0.05$]. The students in the experimental group demonstrated better performance (adjusted mean = 13.45) over the control group students (adjusted means = 10.69).

Where gender was concerned, the data indicated no significant difference between the performance of males and females [$F(1, 31) = 0.036$, $p > 0.05$]. In addition, no significant interaction between treatment and gender on achievement was demonstrated [$F(1, 31) = 0.151$, $p > 0.05$].

The present study indicated no significant mean difference between males and females with respect to achievement in the Educational Software Engineering course and no significant interaction between gender and treatment, $p > 0.05$. These findings suggest that using educational software is likely to be effective for teaching both males and females in the course. The CIA created such a learning environment that both males and females could find equal opportunities to practise with materials and render instructional feedback.

Conclusions and Discussions

The main aim of this study was to investigate the effectiveness of traditional instruction (TI) alone versus TI plus computer-assisted instruction (CAI) using educational software to promote adult learners' achievement. The study showed progress on the part of the experimental group which used the educational software and this was reflected

positively in the adult students' achievement in the Educational Software Engineering course.

The significant difference in the performance of the experimental group of students could be attributed to the use of different multimedia in the software design which motivated students and gave them a chance for drill and practice in the course. This finding is consistent with that of many other studies. Educational software offer students opportunities, for example, for them to construct their learning process, render instructional feedback and being able to cope with a complex environment, using a simulation method. The use of educational software could increase student learning and improve their achievement (Squires, 1999). Marsh and Kumar (1992) stated that hypermedia used to design educational software provide learners with many benefits such as an active learning environment, a wide variety of resources, integration of science and technology and offer students the opportunity to study a specific topic at different levels.

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