Computers & Education 55 (2010) 1287–1299

Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

Programmed instruction versus meaningful learning theory in teaching basic structured query language (SQL) in computer lesson

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ARTICLE INFO

Article history:
Received 2 December 2009
Received in revised form
27 May 2010
Accepted 29 May 2010

Keywords:
Evaluation of CAL systems
Multimedia/hypermedia systems
Interactive learning environments

ABSTRACT

The purpose of this study was to investigate the effects of two different methods on primary school teacher candidates' academic achievements and attitudes toward computer-based education, and to define their views on these methods. Both the first experimental group, programmed instruction (PI), and the second experimental group, meaningful learning (ML), included 36 students separately. While a significant difference was found between the groups regarding academic achievements, no significant difference was found between the groups' attitude scores. There was no significant difference between the academic achievements of the students according to their genders in both groups. In addition, while there was no significant difference between the pre-test and post-test attitudes of students in the PI group, a significant difference was determined in the ML group. Generally, in the PI group, students considered the method effective but boring. Besides, students in the ML group had positive views on the method.

1. Introduction

In recent years, rapid changes in computer technology have made computers a common supporting material in teaching environments and life in general (Chou, Yu, Chen, & Wu, 2009). Computer-based teaching (CBT) plays a very important role in teaching and learning scientific concepts. Computers have a meaning in terms of their capacity to store and quickly analyse data, and they make it possible that preparing research reports quickly and sharing scientific information with the world (American Association for the Advancement of Science [AAAS], 1993; Bork, 1985; Crisp & Ward, 2008; Fernandez, Simo, & Sallan, 2009; Kose, 2009; National Research Council [NRC], 1996; Reimer, Brimhall, Cao, & O'Reilly, 2009). By means of computers, abstract concepts and information can be concretised, experiments that cannot feasibly be implemented can be simulated, and feedback can be automatically given to students. Thus, students' learning experience can be improved, and a more meaningful and permanent learning environment can be created, using computers (Clark & Mayer, 2003, p. 60). The rapidly evolving internet and multimedia technologies have improved learning environments and changed educational institutions. In general, these educational changes occurred by way of CD-ROM, Internet or intranet (Clark & Mayer, 2003, p. 13). This technology revolution has affected all levels of education, including the higher education system (Groves & Zemel, 2000). Academics in higher education use Microsoft PowerPoint presentations, mail groups, and distance education studies (satellite links, interactive TV), sound and images in their lessons in addition to traditional teaching methods. In these ways, they distribute and develop information during their teaching by incorporating technological developments into their lessons with the help of computers. In general, the process of distributing the information is described as technology-based teaching (Bachman, 2009). The demand for a CD-based multimedia learning environment has increased somewhat in recent years (Steadman, Nash, & Eraut, 1992). In terms of students these materials may be interesting because of including the multimedia components. Information presented only via text is non-interactive, but CD-based multimedia software provides a visual and functional learning environment for students (Klinger, 1999). Thus, it can foster students' learning (Dunsworth & Atkinson, 2007).

CD-based multimedia software applications are discussed in the context of "hypertext" and "hypermedia" in the scientific literature. Educational hypertexts usually include graphical overviews, conveying the structure of the text schematically with the aim of fostering comprehension. In the software large amounts of textual information can be divided into specific units according to their features, and hypertext can provide electronic links among these units (McKnight, Dillon, & Richardson, 1996). Hypertext readers can access the different

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doi:10.1016/j.compedu.2010.05.026

sections of a text in a self-determined manner (Salmeron, Baccino, Canas, Madrid, & Fajardo, 2009). Dillon and Jobst (2005) stated that hypermedia learning environments are computer-based tools where the information is presented as a series of nodes that can be selected by the user (Greene, Bolick, & Robertson, 2010). The interactive feature of hypermedia learning systems make it possible for a user to choose what to learn, the sequence in which the material will be accessed and the time spent in each node of information (Rezende & Barros, 2008). Hypermedia is a more advanced form of hypertext in which, in addition to textual information, links to elements such as videos, graphics, sounds, etc. are included. Also, hypermedia has an electronic structure in which users are directed with windows on the computer screen and can activate interactive processes. In this context, using the features of hypermedia and hypertext in teaching software is very important due to the contributions of these technologies to learning.

A significant goal in computer-based teaching is to embed the educational technology into the program (Holzinger, Kickmeier-Rust, Wassertheurer, & Hessinger, 2009) in a way that students will accept. Therefore, students' attitudes toward computers are of crucial importance (Davies & Brember, 2001; Teo, 2006). Fishbein and Ajzen (1975) stated that one's attitude toward an object is an important predictor of subsequent behaviour. Attitudes toward computers are thought of as an indicator of the acceptance of new technologies, which includes the tendency to learn or use them (Myers & Halpin, 2002). As more tasks involve human–computer interaction, computer literacy should become more and more positively correlated with both occupational and personal successes (Shapka & Ferrari, 2003). Many studies evaluated teacher and student attitudes toward the 'new technology' so the learner's experience could be enhanced and where appropriate, improved (Garland & Noyes, 2008). Research has found that computer attitudes play a key role in influencing the extent to which students accept the computer as a learning tool and in determining the likelihood that computer will be used in the future for learning and study. In other words, students' attitudes, whether positive or negative, affect how they respond to the materials presented in an instructional setting and learning environment. Attitudes have long been recognized as important predictors of individual differences in many educational endeavors (Teo, 2008). According to Meelissen and Drent (2008), Teo (2006) and Yıldırım (2000), for those to whom the computer represents an unpleasant and anxious experience, mastering the appropriate skills could prove to be difficult and this anxiety may take the form of hostility, fear, and/or resistance; these are attitudes, which may inhibit the acquisition of computer skills much as mathematics anxiety can inhibit achievement in this subject (Teo & Noyes, 2008). Levine and Donitsa-Schmidt (1998) and Yu and Yang (2006) stated that numerous studies point to a positive correlation between positive attitudes towards computers and learners' success in both the subject matter learned and the use of communication technologies (Simsek, 2008). Training in technology or computer-related courses are very important in order to provide pre-service teachers with the essential skills and knowledge for integrating technology into teaching as well as to strengthen positive attitude towards computers (Pamuk & Peker, 2009; Papastergiou, 2010).

2. Programmed instruction (PI)

The teaching machines approach, which underlies programmed instruction (PI), first emerged in Peterson's studies of Pressey's *self-scoring testing device* (Peterson, 1931). Peterson observed that students who studied with a *self-scoring testing device* showed a higher level of performance than other students (Burton, Moore, & Magliaro, 1996). Little (1934) performed an academic experiment using test machines for one group and drill machines for another group and observed that the students who used the drill machines showed better performance than both control students and the other experimental group. In addition to these studies, Skinner claimed that providing immediate feedback to students via teaching machines would support learning, and, in 1958, he developed a more advanced learning machine that was similar to Pressley's (Burton et al., 1996). While Skinner argued for the necessity of students' responding to questions by typing, Pressley argued for choosing the right answers to multiple choice questions. Skinner (1958) further indicated that responses should not be easy to reach but composed of many small steps (Burton et al., 1996). In assessments of programmed instruction, Skinner thought that students should be interrogated with a stimulus problem, then receive feedback, and finally internalise and structure their responses (Crosbie & Kelly, 1994). The elements making up programmed instruction are described below:

1. *Distinctive Units*: This element consists of separating knowledge units into distinctive parts in such a way that one knowledge unit leads into the next (Skinner, 1968).
2. *Small Steps Principle*: Students proceed with their own learning by taking into account their prior knowledge (Skinner, 1968).
3. *Active Participation Principle*: At the stage of consolidating the information given in each knowledge unit, an exercise or a question is provided. This item helps students both internalise the knowledge and also examine whether they have understood the material. Thus, the question can "jump-start" the mental process, and learning is actualised.
4. *Simultaneous Correction Principle*: Learners need to know whether their actions are correct in order to be successful and satisfied. Thus, they must compare their answers to the exercises with the correct answers before moving on to the next step.
5. *Processing of Learning Principle*: The process of learning will increasingly narrow on the key topic. Progress in learning is gradual and logical. However, the learning can be accelerated. In other words, more and more complex behaviours can be exhibited; the degree of difficulty will be increased gradually.
6. *Individual Rate Principle*: The students set the pace according to their own individual learning rates. Failure in lessons is not a problem. In this way, programmed instruction aims to eliminate the troubles created by differences in knowledge and ability among classmates. Individual learning can take place through this principle.

3. Meaningful learning (ML)

Meaningful learning has been discussed in the literature for over 30 years. It is most commonly described as the intentional connecting of new information to anchored ideas or prior knowledge, particularly if the new knowledge is personally relevant and experiential (Perlman, Weston, & Gisel, 2008). According to the meaningful learning (ML) theory, the most important factor influencing the learning process is the students' existing knowledge (Ausubel, Novak, & Hanesian, 1978). Teaching should be planned related to this factor (Ausubel, 1968). Ausubel noted that the key is to make learning meaningful. If the learning can take place effectively in a short time, a large amount of information can