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EFFECTIVENESS OF VIDEO ENHANCEMENT ON e-LEARNING

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Effectiveness of Video Enhancement on e-Learning

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Abstract

Information technology can provide an effective and efficient learning environment, and as a result, life-long learning is now a reality. We are witnessing a growing use of e-Learning systems both as supports to traditional educational institutions and to corporations providing on-the-job training. The challenge is how to use information technology to improve the learning experience. This paper addresses the possible added value of video presentations in e-learning software. It shows, on the basis of empirical research, that students find a learning environment supported with video presentations more useful. Their intrinsic motivation to learn the subject matter had a significantly positive effect on their satisfaction with the availability of video presentations. Although our e-learning environment improved students' performance, video presentations had no significant effect on their performance on exams, however.

Introduction

There is an increasing expectation that information technology will enhance the learning and teaching process. This expectation is based on the notion that information technology, by supporting interactive instruction, will encourage students to be more responsible for their own learning. It is argued that information technology can help students learn the elementary and fundamental issues, thereby freeing faculty to work with them on the more complex aspects of their course. Furthermore, such technology can contribute to a more effective and efficient assessment of learning than can be provided by traditional means, and it can improve the feedback of assessment into educational design. In this endeavor, the design of information technology should be based on well-grounded theories of learning processes (Alavi and Leidner, 2001; Hannafin and Rieber, 1989; Leidner and Jarvenpaa, 1995). For example, Hannafin and Rieber (1989) caution, "The emergence of computer-driven 'hybrid' technologies ... has spawned unprecedented interest, yet advances in technological capability alone no more improve instruction than sharpened pencils improve prose." More than a decade later, a research essay by Alavi and Leidner (2001) calls for greater depth and breath of investigation into technology-mediated learning. It seems that in spite of the large number of reported research findings, we know little about the effective means of applying and managing information technology in support of the learning process. This is mainly due to the intricacy of the task at hand, for the dynamic nature of the interaction between the environmental factors (i.e., instructional strategy and information technology) that affect the learning process is complex (Alavi and Leidner, 2001; Leidner and Jarvenpaa, 1995).

For example, let us consider the usefulness of dynamic visuals such as video presentations and simulation when used in support of learning. Video presentation is used routinely in support of classroom lectures to enhance the learning process. In addition, it is reported that:

> Video and audio streaming is gaining momentum in the corporate sector as companies continue to realize the benefits Web casting offers in regard to applications such as training and product promotion. Jupiter Media Metrix analyst Billy Pidgeon says the market for these Webcasting services among the top 1,000 U.S. companies will reach $2.8 billion in 2005, up from only an estimated $290 million this year. Much of that growth will serve to rescue media streaming companies such as Digital Planet, which were originally geared for consumer applications. Other companies that create the platforms and infrastructure for media streaming--such as Microsoft, Real Networks, and Akamai Technologies--also stand to benefit from the growth (Richmond, 2001, p.B6).

Inclusion of video in support of learning is expensive, and this means that we must make sure that it benefits the learner. This paper presents the findings from an empirical investigation into the effectiveness of video in a computer-based tutoring environment.

Computer-based tutoring (CBT) systems have been used in diverse learning environments to enable the learner to self-pace in acquiring the pertinent materials. In such systems, feedback is a critical part of effective learning, and it is expected that active involvement will lead to more effective learning than will passive involvement. CBT systems are generally based on the stimulus-response-feedback views of learning that are associated with the objectivist model of learning (Leidner and Jarvenpaa, 1995; Montazemi and Wang, 1995-a). Thus, CBT can be viewed as enhancing the cognitive information processing of learners by tailoring the learning process to individual needs (Leidner and

Jarvenpaa, 1995; Montazemi and Wang, 1995-b). The learner is guided by the CBT system so that he or she reaches the predefined learning materials built into the system. Therefore, CBT systems can be developed for learning environments with a well-defined structure, pre-defined learning objectives and possible solutions to the learner's enquiries. Multimedia technology can enrich the learning experience by making it possible to present the learning materials in different formats. The question raised in this paper is whether inclusion of video presentations in a CBT system is useful to the learner. To this end, two hypotheses are postulated and empirically tested.

The remainder of paper is structured as follows: Section Two provides a review of research findings related to the usefulness of dynamic visuals to the learning process. In Section Three, the basic theories on multimedia learning and human perception are used to postulate two hypotheses in regard to the usefulness and effectiveness of dynamic visuals in support of the learning process. A CBT system called *E-Tutor* is used to test these hypotheses. Section Four outlines the methodology adopted in this investigation. Section Five presents the results. A discussion and an overview of the implication for practice and future research close the paper.

On the Usefulness of Dynamic Visuals on Learning

Effective presentation of instructional materials, whether it be in the form of text, picture, charts, graphs, diagrams, animation, films, etc. is an important facet of the teaching process. As a result, multimedia educational systems are rapidly growing in popularity because they enable us to provide a variety of presentation modes in support of the learning process (Heller et al., 2001). In particular, interactive multimedia systems with dynamic visual presentations are becoming popular because they can provide an enriched learning environment by facilitating the acquisition of pertinent materials. Dynamic visuals that have been embedded in CBT for improved learning can be classified as movies and simulations. We can distinguish movies and simulations in the following way: animations, videos, time-lapse photography and other motion pictures that are the same each time they are viewed are classified as movies; and graphics, tables, or other output generated by running a computer program under student control are classified as simulations (Pane, 1994). In the latter, the visual results are subject to any changes that the student makes to the simulation program, and thus may be different each time they are viewed.

A number of investigators have examined the effect of dynamic visuals on learning (Chanlin, 2000; Pane et al., 1996; Rieber, 1990; Velayo, 2000). Rieber (1990) summarized the results of 13 empirical studies investigating the role of animated graphics in computer-based instruction. Rieber suggests that "generally, animation has been used in instruction to fulfill or assist one of three functions: attention gaining, presentation, and practice" (p.77). In addition, Park and Hopkins (1993) identified five important instructional roles of dynamic visuals:

1. As an attention guide, the dynamic visual can serve to guide and direct the subject's attention.

2. As an aid for illustration, dynamic visuals can be used as an effective aid to represent the structural and functional relations among components in a domain of knowledge.
3. As a representation of domain knowledge, movement and action can be used to effectively represent certain domain knowledge.
4. As a device model for forming a mental image, dynamic visuals can be used to represent system structures and functions that are not directly observable (e.g., blood flowing through the heart).
5. As a visual analogy or reasoning anchor for understanding abstract and symbolic concepts or processes, dynamic visuals can make abstract and symbolic concepts (e.g., velocity) become more concrete and directly observable.

The question arises whether dynamic visual has any effect on students' learning. To answer this, Park and Hopkins (1993) produced a research summary of 25 studies and concluded that:

> The research findings do not consistently support the superior effect of dynamic visual displays. The conflicting findings seem to be related to the different theoretical rationales and methodological approaches used in various studies (Park and Hopkins, 1993, p. 427).

More recently, Pane et al. (1996) evaluated a multimedia educational software system (called "Advanced Computing for Science Education") that included text, graphics, animation and simulations. When compared with a comparable informational control environment that used text and still images, they found little evidence that the dynamic presentations enhanced student understanding of the lessons. They concluded, however, that "perhaps movies and simulations are more motivating, so students will spontaneously spend more time with them even outside a structured laboratory setting, and learn more" (Pane et al, 1996, p.12).

Traditionally, designers of instructions have had two categories of outcomes in mind: those directed toward cognitive goals, and those related to the attitude of the learner. Student achievement related to cognitive goals has been the paramount objective of most instructional activities. However, it may also be important to recognize the need for establishing attitudinal goals and for planning activities that are designed to facilitate the learning process. Thus, one of the major goals of instruction involving media should be the development of positive attitudes (Simonson, 1985; Simonson and Maushak, 1995). Although the strength of the relationship between attitudes and achievement is unclear (Zimbardo and Leippe, 1991), it seems logical that students are more likely to remember information, seek new ideas, and continue studying when they react favorably to an instructional situation or when they like a certain content area. Nonetheless, despite its importance in the learning process, there is no scientific assessment of student perception on the usefulness of dynamic visual media and their effect on learning. This vital research question is addressed in this paper.

The Objective of this Investigation

The basic question raised is "How do dynamic visuals in the form of movies embedded in a CBT system enhance learning?" As mentioned above, previous investigations did not find significant improvement in students' learning outcomes (i.e., improved exam scores) when dynamic visuals were added to the CBT systems. Missing from these studies is some consideration of the internal psychological processes through which learning occurs (Alavi and Leidner, 2001). The contention of Alavi and Leidner in regard to technology-mediated learning (TML) is that:

> To be useful, TML research questions need to be formulated in terms of the way in which technology features can engage psychological processes of learning that will in turn result in the desired learning outcomes (Alavi and Leidner, 2001, p. 4).

Dynamic visuals can be embedded in CBT systems in the form of multimedia learning instructions. Multimedia learning occurs when students use information presented in two or more formats – such as text, figures, and movies. Figure 1 summarizes a dual-coding theory of multimedia learning (Mayer and Sims, 1994). It offers a three-process account of how visually and verbally presented material might be integrated in the learner's working memory. On the top left portion of the figure, a verbal explanation, such as an oral narration, is presented to the learner. Within the working memory the learner constructs a mental representation of the system described in the verbal explanation. The cognitive process of going from an external to an internal representation of the verbal material is called *building a verbal representational connection* (or verbal encoding). On the bottom left portion of the figure, a visual explanation is presented to the learner, such as film. Within the working memory the learner constructs a mental representation of the visually presented system. The cognitive process of going from an external to an internal representation of visual information is called *building a visual representational connection* (or visual encoding) and is indicated by the second arrow. The third arrow denotes the *construction of referential connections* between the two mental representations, that is, the mapping of structural relations between the two representations of the system. For example, in understanding an explanation of how intranet and extranet work, the learner can build referential connections between visual and verbal representation of essential parts, actions, relations and principals in the communication system.

Figure 1

In this research, our measurement for CBT system's learning outcome is the learner's improved performance and affective reactions to the usefulness of movies. We use exam scores as a measure of the student's mastery learning of the pertinent learning materials. A student's affective reactions to the usefulness of movies is based on the Technology Acceptance Model (TAM) that has emerged as a powerful and economical means of representing the antecedents of system usage through beliefs about two factors: the perceived ease of use and perceived usefulness of an information system (Davis 1989, 1993; Davis et al., 1989, 1992; Taylor and Todd, 1995). The practical utility of TAM stems from the fact that ease of use and usefulness are factors over which a system designer has some degree of control (Taylor and Todd, 1995). This in turn provides insight to the designer of CBT systems as to where efforts should be focused. In this research, the effect of presence and absence of dynamic visuals in a specific CBT system is of interest. To this end, the following hypotheses are postulated:

HYPOTHESIS 1: Inclusion of dynamic visuals in a CBT system improves the learner's perception regarding the usefulness of the system.

HYPOTHESIS 2: Inclusion of dynamic visuals in a CBT system improves the learner's mastery of the material to be learned.

An effective assessment of these hypotheses requires us to take into account the moderating effect of the learner's motivation and self-regulated learning behavior which are important aspects of learning and academic performance (Corno and Mandinach, 1983; Como and Rohrkemper, 1985).

Self-regulated learning includes the student's metacognitive strategies for planning, monitoring, and modifying cognition (Corono, 1986; Zimmerman and Pons, 1986). Self-regulated learning consists of two components: (a) cognitive strategy and (b) self-regulation. Different cognitive strategies have been found to foster active cognitive engagement in learning and to result in higher levels of achievement (Weinstein and Mayer, 1986). Self-regulation, on the other hand, refers to the student's ability to manage and control the handling classroom academic tasks. For example, capable students who persist at a difficult task or block out distractions (i.e., noisy classmates) maintain their cognitive engagement in the task, and so are able to perform better (Corno, 1986; Corno and Rohrkemper, 1985).

Students must be motivated to use strategies to regulate their cognition and effort (Pintrich, 1988, 1989). Research findings suggest that students with a motivational orientation involving goals of mastery, learning and challenge, as well as a belief that the task is interesting and important, will engage in more metacognitive activity, more cognitive strategy use and more effective effort management (Ames and Archer, 1988; Meece et. al., 1988, Nolen, 1988). The theoretical framework for conceptualizing student motivation is an adaptation of a general expectancy-value model of motivation (Pintrich, 1988, 1989; Pintrich and

DeGroot, 1990). The model proposes that there are three motivational components that can be linked to the components of self-regulated learning: (a) an expectancy component, which includes the student's belief in his or her ability to perform a task (i.e., self-efficacy), (b) a value component, which includes the student's goals and beliefs about the importance and interest of the task (i.e., intrinsic value), and (c) an affective component, which includes the student's emotional reactions to the task (i.e., test anxiety).

Methodology

A CBT system called *E-Tutor*, developed in support of O'Brien MIS textbook (2001) was adopted to test the stated hypotheses. E-Tutor enables each student to test his or her knowledge of the lessons to be learned. Textbook materials are embedded in the E-tutor in the form of hypermedia that present text, pictures, figures and movies. We have developed two versions of E-Tutor: both versions had the basic textbook materials (i.e., text, figures, tables and pictures). However, one version had 80 dynamic videos in form of AVI files, called here E-Tutor (with video), and the other without dynamic videos, called here E-Tutor (without video). The dynamic videos that were embedded in the E-Tutor (with video), provided further definition or examples to support various parts of the text of the lessons being studied. These videos are expected to add value to the instructor's explanation of the materials. Thus, McGraw Hill have included them in the instructor's CD ROM that accompanies their MIS textbooks. The question posed through our hypotheses is whether such learning materials in the form of dynamic videos are useful to the learning process when embedded in a CBT system.

Experimental Design

We used a 2x2 factorial with one between-subjects factor and two repeated trials to assess the usefulness of dynamic visuals. The between-subject factor was the presence or absence of the dynamic visuals in the form of AVI videos embedded in a CBT system. A dependent variable was the usefulness of the dynamic visuals as a support to the learning materials.

Subjects

Fifty-one students registered in a basic Management Information Systems course at the MBA level were asked to participate in this investigation by completing the following steps for 5% extra credit towards their final grade. Student participation was optional and they could drop out at will. Forty-eight students completed the experiments.

Procedures

I. There were four multiple-question exams for the students to take. Each exam was to cover 3-4 chapters of the textbook materials. It was decided to assess the usefulness of the E-Tutor for the second half of the textbook materials. This made it possible for the students to assess better the effect of introducing a CBT such as E-Tutor to support their learning processes.

II. A 44-item questionnaire to assess the Motivated Strategies for Learning (Appendix A) was administered when the class had covered half the textbook and taken two multiple-question exams. By covering about half of the textbook materials and completing two exams, students were expected to have a better understanding of their interest in the subject matter.

III. A half-hour hands-on demonstration of E-Tutor use was done to make sure that all students were familiar with the way the system functioned.

IV. Students participating in this investigation were required to use E-Tutor to prepare for the two scheduled exams. Students were randomly placed into two groups (Table 1). Each student in one group received a CD that contained E-Tutor (with video), and each subject in the other group received a CD that contained E-Tutor (without video). Our exams were completed in two phases to assess the effects of dynamic visuals embedded in the E-Tutor within and between groups.

Table 1

V. Phase 1 of our assessment of the stated hypotheses was performed as follows. Subjects were asked to complete the assigned chapters in order to prepare for the scheduled third multiple-choice exam. They were required to complete the pertinent chapters in E-Tutor. In addition, subjects who had access to E-Tutor (with video) were required to view all the pertinent videos. E-Tutor kept track of each student's progress through the lessons and saved it in a "working file". To make sure that all the subjects completed the assigned tasks, they were required to upload their working files to a site. This upload included captured data about the date that the assigned chapters were completed, as well as the video files -- for students with E-Tutor (with video) -- that were viewed. Two weeks after receiving the E-Tutor CDs, students took a scheduled exam that consisted of 50 multiple-choice questions covering the assigned chapters of the textbook. Prior to viewing the questions, they completed a questionnaire to assess the usefulness of E-Tutor in support of related learning materials for the exam (Appendix B).

VI. Phase 2 of our assessment of the stated hypotheses was similar to phase 1, except that subjects who used E-Tutor (with video) in phase 1 exchanged it for E-Tutor (without video). Those with E-Tutor (without video) exchanged it with E-Tutor (with video). Two weeks after exchanging the E-Tutor CDs, students took an exam consisting of 50 multiple-choice questions and covering the assigned chapters of the textbook. Prior to viewing the questions on this exam, as in phase 1, subjects completed a questionnaire designed to assess their perceived usefulness of videos. The significance of phase 2 was to compare and contrast the effects of possible changes in perception of the subjects who did not have access to videos in phase 1 as opposed to having access to them in phase 2 and vice versa.

Questionnaire Validity and Reliability

Perceived usefulness, self-regulated learning and student motivation was assessed by means of structured questionnaires reported in the literature to be pertinent, reliable and valid. Nonetheless, the reliability and validity of the questionnaires was also assessed. One measure of construct validity is the extent to which each item of a questionnaire correlates with the total score (Kerlinger, 1973). The correlation between the score for each item (question) and the total usefulness score was 0.65 to 0.84 (all significant at $p<0.001$)(Table

3). Correlation between the overall score for motivation with 22 pertinent items showed that items 1 and 22 were not significantly correlated (alpha >0.05). We removed these two items from the subsequent analysis. Correlation between overall score for self-regulated learning and the 22 pertinent items (i.e., items 23–44 as depicted in Appendix A) showed that three items 26, 27 and 37 were insignificant. Thus, these three items were removed from the subsequent analysis. The statistics for the final questionnaires used in the subsequent analysis are shown in Table 2.

Table 2

The data were further analyzed using factor analysis (principal component analysis) to establish convergent and discriminant validity (Table 2). The factor analysis for usefulness questionnaire scores in exam 3 and exam 4 showed one orthogonal factor with eigenvalues above 1.0 accounting for 97.18% and 99.18% respectively, with item communality ranging between 0.84 and 0.88. The factor analysis for "motivation and self-regulated learning" showed two orthogonal factors with eigenvalues above 1.0, together accounting for 76.4% of the variation, with item communality ranging between 0.63 and 0.87.

The Cronbach alpha reliability score for the three questionnaires was 0.83 to 0.91 (Table 3). These values are well within the thresholds suggested by Nunnally (1978). Thus, the questionnaires can be used as acceptable instruments for subsequent analysis.

Table 3

Test for Random Assignment

To test for random assignment of subjects to the two groups, the following analysis was performed. The ANOVA test was used to assess subject performance for the first and second multiple-choice exams (Table 4) to find out if there were any differences between the two groups regarding their domain knowledge. The result of the ANOVA test demonstrated no significant difference between the two groups: $F = 1.104$ ($p = 0.299$) for the first exam and $F = 0.648$ ($p = 0.425$) for the second exam. We also used ANOVA to test possible differences between the two groups in regard to the subjects' "motivational beliefs" and "self-regulated learning strategies". The results of ANOVA test showed no significant difference between the two groups: $F = 0.079$ ($p = 0.971$) for the motivational beliefs and $F = 0.035$ ($p = 0.991$) for the self regulated learning strategies.

5. Results

Hypothesis 1 states "Inclusion of dynamic visuals in a CBT system improves the learner's perception regarding the usefulness of the system". The average score for the E-Tutor usefulness (Table 4) in the phase-1 test was: with video = 30.24 and without video = 27.64, and for the phase-2 test: with video = 30.91 and without video = 28.39. We used ANOVA to assess within and between subject difference in regard to the E-Tutor's usefulness with and without videos in support of learning. Two possible moderators of student "motivation and self-regulated learning" were included in the analysis as blocking factors. The results of ANOVA test demonstrated that there was a significant difference about the perceived usefulness of dynamic visuals embedded in E-Tutor among the groups (Table 5). Post hoc Bonferroni test showed that the group with access to dynamic visuals perceived E-tutor to be more useful than did the other group in both phase 1 test and phase 2 test (Table 6). There was no significant difference in regard to the usefulness of E-Tutor when both groups had access to E-Tutor with the same capability (i.e., both had access to E-Tutor with video or without videos). Analyses also showed that subjects' motivation to learn had a significant moderating effect on their perception of the E-Tutor usefulness to enable them learn the pertinent reading materials (Table 5). However, subjects' self-regulated learning had no effect on their perceived usefulness of E-Tutor.

The above analysis provides sufficient evidence that the difference in the perceived usefulness of the E-Tutor is due to the presence or absence of dynamic visuals. Therefore, based on the results of this experiment, the stated hypothesis cannot be rejected.

Tables 5 & 6

Our hypothesis 2 states; "Inclusion of dynamic visuals in a CBT system improves the learner's mastery of the material to be learned." We used ANOVA to assess possible variations in student performance based on scores on each of the four exams. Two possible moderators of students' "motivation and self-regulated learning" were included in the analysis as blocking factors. The ANOVA test showed (Table 7) that there was a significant difference between the subjects' performance as evidenced by their scores on the four exams (F =

19.27, $p = 0.001$). Subsequent analysis demonstrated that there was a significant difference between scores on exams 1 and 2 versus exams 3 and 4. This indicates that E-Tutor had a significant positive effect on the students' mastery of the material to be learned. However, we found no significant difference between the scores for exams 3 and 4. We performed ANOVA test to assess the possible effect of presence and absence of videos for the two groups' performances in exams 3 and 4. The results (Table 9) of this analysis showed that there was no significant difference between the scores on exams 3 and 4 with and without video ($F = 0.55$, $p = 0.65$). This indicates that although availability of video was perceived to be useful in students' learning processes, it had no effect on their mastery of the material to be learned based on their exam scores. Thus, hypothesis 2 cannot be supported.

Tables 7, 8 & 9

Discussion

Inspired by the advent of new information and communication technologies, use of technology-mediated learning environments is on the rise. The number of online courses offered through academic and professional institutions is evidence of this. Although research related to technology-based learning has been with us for more than 30 years, we are still at an early stage of knowing how to effectively apply technology in support of learning. In this endeavor, textual material is supplemented by still images, animation, video sequences, and/or sound sequences. The objective is to produce an enhanced learning environment in which students will be able to learn and understand more effectively. This research shows that students find a learning environment with video presentation more useful. Furthermore, it shows that students' intrinsic motivation to learn the subject matter had a significant positive effect on their satisfaction with the availability of video presentation. Based on this, we can conclude that students with higher interest in the subject matter would have found the added information gleaned from video presentation more satisfying. One would expect that the added information from video presentation should have a positive effect on the students' learning performance. However, added functionality of video presentation had no significant effect on performance in exams. That is, the addition of the video presentation to the text did not produce significant gains in students' ability to answer questions on it.

Of course, these findings are limited by the characteristics of the test environment as follows. First, E-Tutor is designed to support text-based procedural knowledge to improve student mastery learning of MIS. Therefore, the effect of video presentation on learning might be different when used in support of declarative knowledge. Nevertheless, Pane et al. (1996) also found video presentation to have no effect on students' acquisition of declarative knowledge. The second limitation of our findings concerns the characteristics of our subjects who were MBA students registered in a basic MIS course. Video presentation may enhance learning in advanced courses that require in-depth knowledge of subject matter (e.g., specialization in IT, Marketing, or Economics) for problem solving.

Nonetheless, these findings provide a good base for deciding to use video presentation as part of a CBT system in support of mastery learning. Students find the added functionality of video presentation to be useful, but its learning effects are insignificant. We found that students' intrinsic motivation has a moderating effect on their perceived usefulness of the added functionality of video presentation. Future research should find it interesting to assess the long-term effect of video on students learning and student motivation to pursue the subject matter further.

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Figure 1

A dual coding model of multimedia learning (Mayer and Sims, (1994))

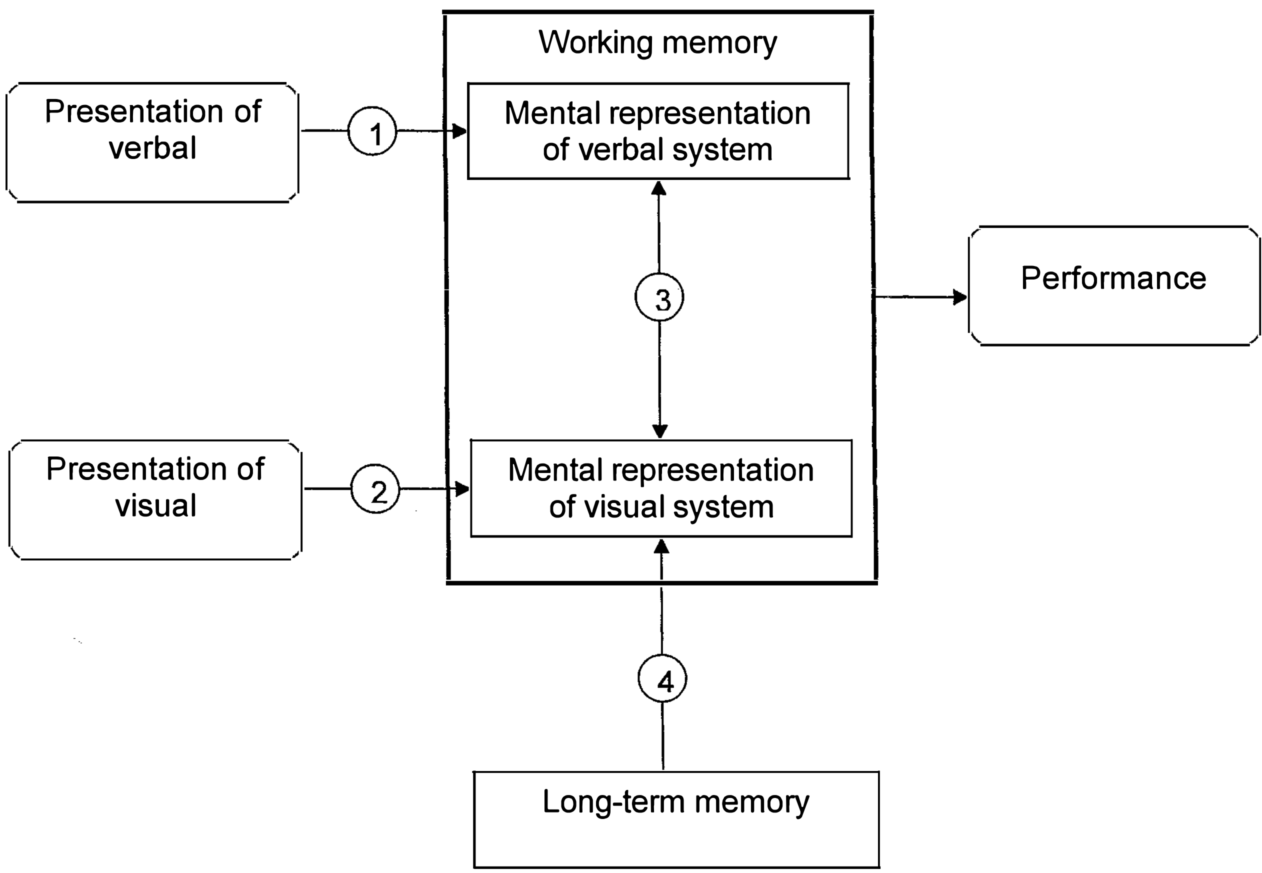

Table 1

Assignment of the subjects to the two test groups

	Phase 1 assessment	Phase 2 assessment
Subject with access to E-Tutor (with Video)	25	23
Subjects with access to E-Tutor (without video)	23	25

Table 2

Validity of the Questionnaires

Questionnaire	Correlation Coefficient (all significant at alpha < 0.01)	Factor Analysis Item communality range
Usefulness (Phase 1 test)	0.65 – 0.84	0.84 – 0.88
Usefulness (Phase 2 test)	0.68 – 0.90	0.86 – 0.95
Motivation	0.51 - .88	0.65 – 0.89
Self-regulated learning	0.50 – 0.77	0.59 – 0.76

Table 3

Reliability of the Questionnaires

	Cronbach alpha
Usefulness (Phase 1 test)	0.83
Usefulness (Phase 2 test)	0.88
Motivation	0.91
Self-regulated learning	0.86

Table 4

Descriptive Statistics of the Research Variables

Variables	Group 1 Mean (Variance)	Group 2 Mean (Variance)
The first multiple choice exam	79.13% (3.65)	77.04% (3.15)
The second multiple choice exam	78.80% (5.01)	77.80% (5.73)
The third multiple choice exam	85.92% (2.82)	85.82% (2.41)
The fourth multiple choice exam	87.60% (2.66)	85.92% (3.48)
Motivational beliefs	91.44 (21.62)	93.35 (16.14)
Self-Regulated Learning Strategies	102.96 (18.42)	101.65 (20.96)
Usefulness of the E-Tutor for phase-1 test	30.24 (2.42)	27.64 (2.12)
Usefulness of the E-Tutor for phase-2 test	28.39 (1.92)	30.91 (2.65)

Table 5

Analysis of Variance for the Usefulness of E-Tutor with and without Dynamic Visuals*

Source	D.F.	Sum of squares	Mean square	F-ratio	F prob.
Between groups	3	169.78	56.59	10.99	0.001
Within groups	92	473.62	5.15		
Motivation	1	20.93	20.93	4.28	0.041
Self-regulated learning	1	0.058	0.058	0.01	0.913

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