HOW DO WE KNOW, THEY KNOW? IMPROVING THE ASSESSMENT OF KNOWLEDGE TRANSFER AND RETENTION WITH TECHNOLOGY

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ABSTRACT

This study used a computer-based, intelligent tutoring system, interactive multimedia instruction (IMI) program to measure the rate of knowledge transfer and memory retention among college students enrolled in several college courses. The learning system program, which automates the student assessment process, and measures both, the rate of knowledge acquisition, and retention, was used to deliver introductory level subject matter material to the students. After a six week hiatus, the students were tested again on the same material. This study demonstrated that student memory retention could be increased with an appropriate technological intervention, while providing an accurate, integrated, and individualized evaluation of the learner's progress.

INTRODUCTION

Educators throughout the nation are struggling with the challenge of using technology to enhance the learning processes for their students. To date technology has failed to deliver on its promises, in part because educators have not been able to integrate computer technology within their curricula effectively; and in part because they do not have easy to use software to accomplish the mission [6]. Over the past several years, student performances, as measured by test scores, have made negligible gains in spite of the presence of computers in nearly every classroom [2].

One of the most promising genres of educational software in use today is that of the computer-based interactive multimedia instruction (IMI) program. Educators can choose from hundreds of IMI software offerings, many of which can deliver rich media and stunning graphics. Despite the numerous offerings, IMI has showed a scarcely measurable positive impact on student outcomes. Nearly every offering of educational software shares the same problems: They are complex, resource hungry, and expensive [3]. They do not integrated well with existing curriculum, and they do not address the basic learning needs of students [6].

The Purpose of this Study

This study was designed to investigate the feasibility of using a newer generation of computer-based interactive multimedia instruction (IMI), and assessment program, to determine if the recent advances in both software capability, and applied learning theory, incorporated in IMI software's algorithms would improve students' course outcomes.

The focus of the study was concentrated specifically on the results of the level of learning achieved and memory retention demonstrated over a significant passage of time. A scientifically designed, computer

mediated, intervention methodology, was used as a supplement to regularly scheduled classroom instruction. The program used in this study measures the rates of student knowledge acquisition and retention attained over an extended period of time. This IMI program was used in several college level courses.

This study achieved a higher degree of investigative synergy by utilizing a learning algorithm built upon the foundation of two separate streams of research: (i) Addresses the first three stages of Bloom's Taxonomy of Learning [1]. Bloom's taxonomy delineates six distinctive levels of knowledge acquisition within the cognitive domain, and identifies the attributes associated with each of the learning levels referenced. (ii) Addresses Ebbinghaus' curve of forgetting [4]. Ebbinghaus proposed that memory retention could be improved by exposure to a systematic repetition of the fundamental materials and concepts studied. The resulting time-staggered repetitions, and retention-monitoring process, forms the basic constructs of the automated learning algorithm, embedded in an IMI program called Total Recall Learning (TRL).

Knowledge Acquisition, Memory Retention, and Recall

Many researchers, [4] [5] [7] [8] [9], have studied the workings of memory in an attempt to understand the process of how knowledge progresses from working memory, to short-term memory, then on to long-term memory. Several of the teachers involved in the above cited studies reported a certain level of disappointment in their students' inability to retain even the most basic of the courses' fundamental concepts by the end of a term of study. Ebbinghaus' seminal work in memory studies [4], demonstrated the beneficial impact that repeated exposure to studied material has on long-term memory retention. The concept of flashcards was used to implement this learning system, but the tracking and presentation of the material in a systematic fashion was much too complex to be of practical use. Leitner [5] developed a pragmatic, operational methodology to automate the time-staggered presentation of learned materials to students, to help them achieve higher levels of memory retention. These processes, in that era, were cost prohibitive, and therefore not readily available for implementation.

The Educational Challenge

Educational organizations are faced with a plethora of systemic problems; limited contact hours, constrained resources, and an inability to customize engaging curricula that can effectively hold students' interest. Technology can provide workable solutions for some of these problems. The use of an automated monitoring tool that measures both, the rate of the knowledge retention (i.e., the curve of forgetting), and an assessment of the individual's progress through the studied material (i.e., the learning curve), can provide a more accurate, integrated, and individualized evaluation of a learner's progress [7].

A New Approach in Interactive Multimedia Instruction and Assessment

The software programs used for this study were subject matter specific, and were designed to incorporate the beneficial results of the above mentioned studies. The Total Recall Learning (TRL) software program is based on the well-founded and widely accepted learning practices, memory studies, and training theories, provided by Ebbinghaus, and Leitner.

The TRL learning methodology provides continuous feedback to the learner, on several levels of interest. The software monitors learning performance and assessment on a real-time basis and includes pre-learning and post-learning assessments. Learning results are available to the student, and when

applicable to the teacher or other interested parties, via printouts of score sheets or by e-mail. The assessment reports can be provided remotely to course proctors or others managing the learning activities.

TRL tracks each learner's performance by monitoring the…

number of questions still to be presented for the first time
number of questions in the learning process
number of questions fully learned (Total Recall)
number of questions processed (per session)
number of questions recalled (per session)
number of questions missed (per session)
recall rates (cumulative: short-term and long-term)
current memory level of questions (cumulative)
current session totals (all learning results)
cumulative totals (all learning results)
response time (per question)
total time spent (per session)
total time spent (cumulative).

The Total Recall Learning program is an IMI software developed to address the basic needs cited by the previously mentioned studies. The program offers a simple, but effective solution to the challenge of wresting real productivity and learning gains from existing computer technology.

The authors of this study have selected for observation the first three levels of Bloom's taxonomy [1]: (i) Knowledge, (ii) Comprehension, and (iii) Application, as the domains in which the greatest gains in student performance were most likely to be achieved. It is the impression of the researchers that an increase in course goal outcomes can be attained at a very low per unit software cost, with no additional investment required in specialized hardware or infrastructure. Also of importance to educators, is the use of an IMI offering that is wholly dependent on the existing curriculum for scope, sequence, and content. According to Reid, [8] this feature makes course integration easy to achieve, and provides students with a consistent exposure to the content.

The Total Recall Learning IMI was selected by the researchers for this study because the program is easily accessible to educators, it is inexpensive, it has the ability to apply proven learning techniques to any curriculum hosted on a PC based platform. Its interface, navigational method, and content importation features are as easy to use as a MP3 player/recorder.

The anticipated result is that educators, equipped with the TRL IMI tool or an application similar in nature, could offer students an enriched learning supplement that will provide each with an equitable opportunity to achieve mastery of a curriculum at their own pace, and within the traditional time frames allotted. The most promising benefit might be the increase of academic performance for all students who use technology in conjunction with their traditional study tools and routines.

The Study Method, Participants and Procedures

The students in four College level courses (N=180), who used the TRL system program, in addition to regular classroom instruction, comprised the participants in this study. The TRL system was

implemented using approximately 500 fundamental questions and concepts identified by the instructors as being basic items that the students should know in each of the courses observed. The study evaluated scores achieved, and measured levels of retention, as well as providing a correlation with the course grade.

Preliminary Outcomes

The learning of fundamentals increased at a steady rate for the first half of the course and then stabilized. The retention of facts at separate test intervals in the second half of the course produced consistent results. The correlation of performance on the TRL system and the overall course grade was very high, indicating that the use of the IMI system improved academic performance without increasing training time.

The study demonstrated that student retention could be raised with a technology intervention, and can be individualized for each student, cost effectively. The measurement of learning and retention by an automated system can provide much insight into students' progress, areas of difficulties, rate and pace of learning.

Recommendations for Further Research

More controlled experiments are being conducted to demonstrate the applicability of this model to a wider variety of different subject areas and different student ages. It would be of great interest to these researchers to test these methodologies within a corporate training environment, and to test its applicability as a self-directed training tool, offered independently of a structured classroom curriculum and setting.

REFERENCES

[1] Bloom, B.S. (Ed.) (1956). Taxonomy of educational objectives: The classification of educational goals: Handbook I, cognitive domain. New York ; Toronto: Longmans, Green.

[2] Clark, D. (2002). Psychological myths in e-learning. Medical Teacher, Vol. 24, No. 6, pp. 598-604.

[3] Clark, R. C., & Mayer, R. E. (2003). E-learning and the science of instruction. San Francisco: Jossey-Bass.

[4] Ebbinghaus, H., (1885/1964) Memory: A contribution to experimental psychology. New York: Dover.

[5] Leitner, S., (1972). Learning how to learn. Feisburg im Beisgau: Herder Verlag

[6] Mayer, R. E., & Moreno, R. (2003). Nine ways to reduce cognitive load in multimedia learning. Educational Psychologist, 38(1), 43-53.

[7] Reid, D., (2001). Knowledge retention in computer-based training. (Master's Thesis, University of Calgary, 2001). Proquest Information and Learning, UMI.

[8] Reid, D., Jacobsen, D. M., & Katz, L. (2005). An investigation of computer generated knowledge retention activities in computer-based training with adult learners. Journal of Learning Design, 1(1), 77-85

[9] Schachter, D., (2001). The seven sins of learning and memory. Boston: Houghton Mifflin Company.