A CONCEPTUAL FRAMEWORK FOR THE ENHANCEMENT OF KNOWLEDGE TRANSFER: AN INTEGRATION OF INTERACTIVE DISTANCE LEARNING TECHNOLOGIES WITH AUTOMATED PRESCRIPTIVE ASSESSMENT METHODOLOGIES

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ABSTRACT

This paper describes a conceptual framework which may make training and education programs more effective and efficient by integrating automated prescriptive assessments with interactive distance learning technologies. The anticipated results include: (1) determination of individual needs by an automated prescriptive assessment process, and (2) providing students with the most appropriate curricula. The concept of operation for the proposed automated prescriptive assessments concept includes participant identification, enrollment, automated prescriptive assessment, course activities, asynchronous events, and performance assessment as well as program evaluation. Implementing the automated prescriptive assessments concept entails an analysis of training tasks for evolving training requirements feedback from established courseware users. The analysis provides a listing of training objectives (terminal objectives and learning objectives) and corresponding questions.

BACKGROUND

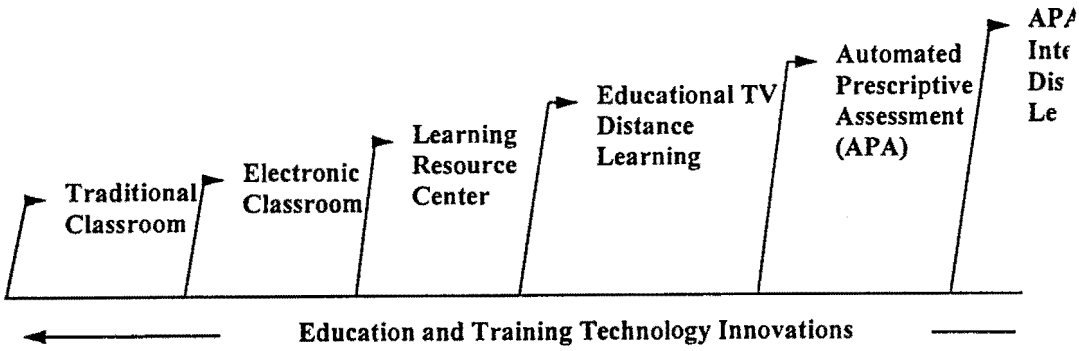
Technological breakthroughs in educational systems performance and functionality produce new products and create mass market opportunities. A new education medium typically experiences initial popularity in public and private education institutional settings then becomes available in the home or office, offering convenience, control, and economic benefits. Visual storytelling began as the theatrical play; evolved into the silent film, the talkie, and television; and is now available as a rented videotape or on a pay-per-view cable channel. Early television supplemented radio with visual images. The VCR allows consumers to control the content and timing of their television viewing experiences. Audio compact disks (CDs) and CD players provide sound quality, durability, and accessibility superior to tapes and phonograph records. At least 20 million CD units were sold within seven years of introduction despite initial prices in excess of $1,000 (adjusted for inflation to current dollars) and the absence of an established industry infrastructure (McCarroll 1988; Standard & Poor's 1996). Affordable personal computers with user-friendly, interactive features significantly broaden the fields of education and training.

Consumers demonstrate a strong preference for interactive entertainment. U.S. consumers spent more on interactive, coin-operated arcade games than movie tickets despite the fact that movies are more realistic than arcade games (Standard & Poor's, 1996; Robert Morris Associates, 1994). Although video game consoles and typical personal computers offer only limited graphics performance, more than 36 million households in the U.S. use interactive education software. Over time, training/education institutions or office markets have the potential to exceed their public counterparts. In 1994, U.S. consumers spent approximately $21 billion on videotape rentals and purchases for home or office use, substantially more than the approximately $5.4 billion spent on movie tickets. It stands to reason that a multimedia interactive automated prescriptive assessment process would succeed in the training and education markets.

Education and training technology innovations collectively contribute to the formation of a continuum of knowledge transfer enhancements (Figure 1). Where traditional learners once attended scheduled classes to the exclusion of other pursuits, many contemporary learners are engaged in work and personal activities as well. In our fast-paced world, a need exists to broaden the array of approaches to effective and efficient instruction. Distance learning technologies coupled with advanced software tools provide interactive multimedia approaches that address the need. In addition, distance learning technologies provide increased capabilities to reach multiple, geographically-dispersed locations with high-quality, real-time interactive instruction.

An automated prescriptive assessment used in an interactive distance learning environment offers a new concept in education delivery techniques and suggests an unlimited potential. The phrase "automated prescriptive assessment" as used in this paper is defined as a systematic process to assess potential learners in a content area and to subsequently prescribe their individualized curricular education or training program requirements based upon the assessment.

Figure 1. A Continuum of Knowledge Transfer Enhancements



Education and training technology innovations produce significant benefits, both concrete and abstract, that can help institutions achieve their most important strategic initiatives such as learner satisfaction and decreased total cost to transfer knowledge. Justifying new innovations is typically less than systematic and mainly focused on quantifiable gains. While quantifiable benefits are important, the abstract can also help make a case for innovations. Concrete benefits include increased productivity, reduced cost to transfer knowledge, and lower maintenance costs. Abstract benefits relate to learner satisfaction, decreased frustration with job requirements, and generally higher morale. These abstract benefits can help reduce turnover, which will reduce costs, improve performance, and enhance production quality. Automated prescriptive assessment tools can provide return on investment to institutions willing to accept the risks associated with investments in education and training technology innovations.

THE CHALLENGE

People want to learn and improve their knowledge and skills, but are typically inhibited because of limited time, schedule conflicts, budget constraints, traffic congestion, limited parking, crowded classrooms, set course sequences, and the occasional indifferent teacher, or an abrasive administrative person. The prescriptive assessment concept may alleviate some of these constraints and serve as an alternative way to enable experts to disseminate information quickly and effectively through distance learning technologies.

THE OBJECTIVE

The proposed concept's primary objective is to develop an automated prescriptive assessment for use in interactive distance learning environments that brings information and ideas to the learner. The prescriptive assessment concept would permit learners to "see and touch" course and lesson content at their convenience using a combination of proven technologies: instructional systems development, interactive courseware, teletraining, and the Internet. The prescriptive assessment concept would provide a realistic computer-based study/learning environment for a pretest based upon curricular objectives. The assessment and prescribed individualized curriculum ameliorates learner knowledge on a personal basis and in tune with proven adult education tenets. Finally, the prescriptive assessment concept fulfills learner requirements and expectations, to learn what is needed based upon the learner's unique knowledge and skill levels at the time of assessment.

Creating an automated prescriptive assessment requires interfacing and maintaining an assertive interactive multimedia standard and generating support for the standard. Considerations for promoting automated prescriptive assessments in an interactive distance learning environment include:

- Developing interactive courseware capable of operating with cable and telephone networks and other delivery vehicles
- Executing business models based on nonrestrictive software licenses bearing royalties and active technical support for both hardware and software
- Extending automated prescriptive assessments and interactive distance learning technologies through strategic partnerships with leading hardware, software, and media content providers, foundations, and government support agencies.

THE CONCEPT

Automated prescriptive assessment in an interactive distance learning environment would provide learners full use of courseware, administrative services, and resources. The concept may be achieved with commercial off-the-shelf technologies and proven interactive multimedia courseware development tools. Automated prescriptive assessment in an interactive distance learning environment would provide access to all students and consequently expand the implementing institutions' student base.

Although this paper discusses combining distance learning technologies with interactivity methodologies as the basis for an automated prescriptive assessment process, incorporating interactive multimedia must be

done cautiously. We cannot be charmed simply by the lure of new technology and become distracted from achieving the overarching goal of effective and efficient transfer of knowledge.

The concept of operation for the proposed automated prescriptive assessments concept includes participant identification, enrollment, automated prescriptive assessment, course activity, asynchronous events, and performance assessment as well as program evaluation. Implementing the automated prescriptive assessments concept entails an analysis of education and training tasks for evolving requirements feedback from established courseware users. The analysis provides a listing of objectives (terminal objectives and learning objectives) and corresponding questions.

- Participant Self-selection and Enrollment

Any individual with interest in the content material may enroll. Participants would contact the university and acquire the enrollment package in person, by U.S. Mail, or electronically. Floppy disks, CD-ROMs, and other support materials could be included in the initial package. Participants would then enroll using interactive screens.

- Automated Prescriptive Assessment

An interactive instrument based upon course objectives and content would be used to assess a participant's knowledge. The software would automatically generate a file on the participant's computer. This file would feature a hierarchical presentation of a participant's strengths and weaknesses relative to course objectives and content. Participants may review this file during each new study/learning session, thus providing effective learning guidance.

- Course Activity

Participants would access interactive multimedia courseware via CD-ROM or the Internet. Once distributed, the lessons would be archived on the course's Web site. Preparation could include a reading assignment using hypertized text on the CD-ROM. Interactive multimedia would guide a participant through learning, skills acquisition, and practice sessions. Students would be required to read and respond to e-mail at least once per week. Full-class discussions could take place via the class electronic distribution list. Small group discussions could break off from full-class discussions as students identify common interests and concerns.

- Asynchronous Events

To provide human interactions the curriculum may permit or require asynchronous events to round out the learning experience. At predetermined intervals during the course or at the participant's discretion, the instructor/expert is accessed using appropriate communication software. Using interactive screens, participants communicate questions, comments, and assignments to the instructor, who responds a few hours or days later. This feature would also compile participants' questions and comments as well as provides course cohesion and collaboration.

- Performance Assessment and Program Evaluation Instruments

Embedded questions and performance assessment instruments would challenge participants and record progress. Students could take the course exam as soon as they are ready. They could request and receive the exam via e-mail or download it from the course's Web site. These features maximize virtual campus capabilities.

In the traditional instructional paradigm, the learner's progress is measured according to an instructor's test schedule. The instructor/expert rewards or admonishes the learner according to his or her performance. Normally, testing reflects the instructor's learning style. In newer learning models, the learning evaluation is accomplished by self or peer review (under institutional guidance) at the time of content or task mastery. The total work environment is motivating and engaging for learners. Traditional testing remains important, but ceases to be the sole means of performance assessment. If a course curriculum requires written assessment instruments, participants may write them electronically by using interactive screens.

Additionally, it is important to note that despite all the interest and growing distance learning activity, little research evidence exists to support claims for the effectiveness of Web-based instruction. However, some important conclusions have been reached (Charp, 1997):

- The Web deals easily with colorful graphics and pictorial material, handles full-motion video and animations, and supports high-quality video, all of which are accessible with commonly available hardware and software.
- Bandwidth is still too low to meet all requirements for audio and video; until ISDN lines or other access means are commonplace, limitations will persist.
- Success of use depends more on people-related components – such as training – than on technology itself.
- The source of content is dynamic, as compared to static texts published on a certain date.
- "Self-directed learning" and "life-long learning" have become achievable goals.
- The effort involved in providing quality educational material is expensive. A universally-accepted compensation mechanism is not yet in place.

SELECTED DESIGN GUIDELINES

Because distance learning via the Internet is still in its infancy, few design guidelines exist for delivering training on the Web. A major constraint for all three types of Web-based training is the bandwidth available for transferring the Internet files. For example, if a 500KB Shockwave file is being transferred through a modem, it will take substantially more time than if it is transferred through a T1 line with a direct connection. In either case, the response time will probably not be as fast as it would be from a CD-ROM or resident hard drive.

When the Web was originally conceived, it provided hypertext documents with links to graphics, sounds, and video files. The interactivity was limited to navigating from one document or file to another. The recent increase in Internet capabilities has significant implications for instruction and training. To better understand the implications, it may be helpful to classify Internet-based instruction.

One way to classify instruction delivered through the Internet is to focus on the amount of interactivity and the computational requirements that are needed to create the courseware. Using these criteria, Internet-based instruction can be divided into three categories.

Type I information is sent from a remote computer (server) to a browser on a local computer (client) which formats and displays the data. Type II interactivity is based on a request from a client computer, additional programs are executed on the remote server to generate unique, tailored responses. Type III includes computer programs that are passed to the client computer from the remote server. The client computer has extensions which allow the programs to be executed locally.

- Type I

Type I instruction uses the standard features of Internet browsers to display hypertext documents with links to images, sound, and video. With Type I instruction, the user can be guided through a traditional Web page with sections of text, graphics, and links. It is also possible to present students with simple multiple-choice interactions by creating hyperlinks to pages with appropriate feedback. There are many examples of this type of instruction on the Web. For instance, the "Interactive Technologies" tutorial was created by the instructional technology program at the University of South Florida. Created as a resource for Florida's K-12 educators, this tutorial contains information about videodiscs, CD-ROM, Photo-CD, and CD-I.

Another example of Type I instruction is "Anatomy of an Eye" available at:

http://www.netscape.com/comprod/products/navigator/version_2.0/frames/eye/index.html

This program incorporates Hypertext Markup Language (HTML) frames to provide feedback and branching on the same screen. Using HTML, links and feedback can be included that will branch the student to another point on a page, a different page, or a multimedia component.

- Type II

To create more sophisticated interactions on the Web, at least Type II instruction must be employed. Here, the server runs a program via a method called the Common Gateway Interface (CGI) and sends unique information depending on a response the user has made. Possible features in Type II programs include database lookup and searching, clickable areas (hotspots) on images, evaluative feedback, and the creation of dynamic Web documents. In another program created at the University of South Florida, forms are used to accept user inputs and generate feedback. In a Jeopardy-type game called the "Puzzle Peril," the student is presented with true-false, multiple-choice, and fill-in-the-blank questions. Each question is generated dynamically by the server's CGI which reads the question and correct answer from a database. Then, a separate program evaluates the student's response, provides feedback, and tallies the student's score. This all combines to create very sophisticated interaction, close to the type commonly seen in traditional off-line computer-based instruction. "Puzzle Peril" can be accessed at:

http://www.coedu.usf.edu/fcit/game/

Some CGI programs can be obtained and used without requiring the author to learn to program. This is the case when using server-side image maps to create hot spots on images. More often, however, these programs must be created for each individual application. This usually involves familiarity with the server's operating system, knowledge of programming, and a great deal of time spent programming and troubleshooting.

Although Type II instruction can provide rich interaction types, there are additional limitations. For example, Type II instruction may slow server systems down due to extra computational demands. Also, many service providers limit the extent to which Web authors can utilize CGI-based applications.

- Type III

Type III instruction is the most complicated, and also has the most potential for delivery of instruction via the Web. A program is written in a form that can be sent via the Internet. This form differs from normal executable code in that it is usually platform-independent, and it contains additional Internet links and

security features. This allows the same program to be run on a computer running Windows 95, Macintosh OS, or UNIX. Because of the security features, the user can also be reasonably certain that the program does not contain malicious code or viruses. Security and platform independence are key advantages to this type of instruction that make it a viable means for distributing programs on the Web.

Java is a language that has recently garnered a great deal of attention. Using Java, the programmer creates small, compiled programs called "applets" which are sent over the Internet and can be incorporated into Web pages.

To experience an example of a Java application which allows the user to build and test digital circuits, access the following URL address:

http://www.lookup.com/Homepages/96457/digsim/load.html

CONCLUSION

Automated prescriptive assessment has the potential to integrate educational technologies and will implement a distance learning, interactive multimedia experience that should broaden the educational spectrum for both institutions and individuals. The proposed concept provides all learners electronic access to interactive multimedia courseware, administrative services, and institutional resources. An electronic mode of delivery is a good choice for a course of a specialized nature where few people in one locality might be interested in taking it at any point in time. Co-teachers and guest speakers can participate from anywhere in the world. Lastly, although something is lost when you give up the face-to-face interaction between instructors and students, the increased opportunities for interaction via electronic mail help to compensate for this disadvantage.

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