

Agents, Profiles, Learning Styles and Tutors

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Introduction

For decades educators have recognized that learners bring a variety of *degrees of knowledge* and of *learning preferences* to learning environments. These recognized differences in learning preferences have given rise to a number of strategies which have resulted in limited success in creating learning environments in which the strengths of the user are used to enrich the learning experience. The failure of this knowledge to provide marked improvements in the instructional delivery process is often attributable to the fact that the implementation of these strategies is performed with one individual acting in the role of facilitator. That is, one teacher, who by definition has a preferred learning style, is often expected to attend to the myriad learning styles of an entire class. Research has shown that to address these differences in this manner is a task for which most humans are unable to perform.

However, to request such a functionality from a computer is a task to which it is well suited. That is, to ask a computer to deliver instruction in an unbiased none prejudicial way involves only the correct programming of the computer to perform this action. Allowing the computer to deliver instruction to learners based on their unique differences takes advantage of the impartial nature of computers.

Previous attempts to employ the use of technology in education have resulted in practices which simply transfer teaching and learning in a form already used in the classroom to a computer (Alexander, 1996). To expect gains in the transfer of knowledge under these circumstances is an exercise in futility.

The lesson that should be learned from these past practices is that new technology can best be utilized by not attempting to fit it in, in terms of other media, but rather to examine the capabilities afforded by the new technology and using them appropriately. The realization of these capabilities should then be used to fashion a learning environment in which these tools are only used whenever they enhance the learner's ability to learn, visualize and understand complex concepts (Alexander, 1996).

Motivation for a New Design

Hypermedia learning environments, by definition, possess characteristics that traditional instruction methods do not and indeed cannot exhibit. However, the current paradigm for designing hypermedia learning environments is solely based on traditional methods of instructional delivery. These methods simply involve the transfer of linear instruction to a non-linear medium. The design of effective hypermedia learning environments which utilize the unique capabilities of hypermedia should result in instruction as good as or superior to traditional modes of instructional delivery.

The Role of Hypermedia Learning Environments

Educational entities are charged with the unique mission of providing a learning environment in which the experiences and potential of a student are to be considered in providing them with the most rewarding learning experience possible. The paradox is that current attempts to obtain this mandate are achieved by placing learners in an environment in which they are forced to accommodate and assimilate the learning style of one primary facilitator, the classroom teacher. Unfortunately, this model is also the basis and standard for the delivery of networked instructional delivery via the computer.

To study the relationship between learning styles and student learning via hypermedia, a networked hypermedia learning environments was developed which takes into consideration the unique learning profile of each user.

These learning profiles corresponded to the preferences employed by a user as they are assimilating and learning new information. In an agent-like fashion, these learning profiles are incorporated into the hypermedia presentation of the material to be learned by the user. The result is the production of a learning environment which considers the uniqueness and strengths of each user. This is in sharp contrast to the current mode of instructional delivery on the World Wide Web (WWW) which is typically based on the familiar mode of the teacher as dispenser of knowledge without regard to the learning preferences of the varied learners.

Designing A Technology Driven Learning Environments

Learning environments that make use of technology are not designed to mirror the physical classroom in which the teacher is the dispenser of knowledge. Instead, this new technology is designed to facilitate learning in a manner that is actually better than what occurs in traditional classrooms (Turoff, 1995). After several decades of sporadic use by a few innovative teachers, information

technology resources and technology based learning activities are fast becoming an integral part of the instructional process (Green, 1995).

Ease of use and access were once the metaphors for good learning environments that made use of technology. These requirements are now the standards rather than the exception, and are insufficient to exclusively guarantee that students will have a positive educational experience. To insure that learners are not drowned in a massive display of information, a mechanism must be employed to allow learners to navigate through the substantial amounts of information available to them as a result of access to technology.

In order to have the far reaching effects that are intuitively inherent in computerized learning environments, learners must be provided with effective and efficient tools for organizing the enormous amount of data they are required to decipher. To most educators, the successful marriage of learning and information acquisition is the desired goal for employing educational technology.

The Current State of Hypermedia Instruction

Students and teachers becoming overwhelmed with information is the number one complaint of network facilitated information. A wealth of information is now accessible through electronic network sources. Although the ability of learners to access this information is a welcomed addition, it has brought along with it a series of second order problems. These problems have resulted in the opposite effect of the original intent of providing access to such information for the user. Instead of presenting learners with an environment in which their learning potential is increased, research has shown that the massive amount of information that learners must navigate through has resulted in demands that actually reduce the learning promise of educational networks (Jacobson & Levin, 1993).

The ultimate goal of education is to create independent, motivated thinkers. However, hypertextual learning environments have the inherent problem of creating environments in which the learner becomes "lost in hyperspace" (Eklund, 1995). Navigational tools have been created to help alleviate this problem.

The tools as identified in the research include *punctual, structural and historical aids* (Stauffer, 1996; Dalgarno, 1995). These tools are designed to offer users navigational tools that will provide them with a means of traversing through the program without feeling like they are in a maze of information from which there is no clear path.

Although a variety of navigational tools are available to learners in hypermedia learning, research has shown that learners typically continue to navigate the information in a linear fashion similar to that of a book's organization (Eklund, 1995).

Researchers (Eklund, 1995) have recommended a number of features that are designed to improve the value of browsers and subsequently the WWW for educational purposes.

Punctual Tools allow the user to move from one location to another within the hyperspace.

- a. Links provide a means of moving to an alternate destination within the information space usually with some indication of the destination.
- b. Help buttons provide the learner with assistance.

Structural tools allow the user to obtain a perspective on their position by using the following aids.

- a. Overview maps are tools designed to allow the user to zoom out to obtain a more global picture of what the connections between the nodes and links are like.
- b. Fisheyes are mechanisms that are the converse of overview maps and allow the user to zoom in on a particular node.
- c. Filters are tools that help the users sort through the nodes by reducing the complexity of the links that are shown to exist between the nodes.
- d. Indexes are designed to provide a means for displaying the hyperspace in a hierarchical format. (Eklund, 1995)

User-centered Design (UCD) Educational Systems

Although cognitive theorists are keenly aware of the fact that personal characteristics make the same teaching method effective for some and ineffective for others, an effective means of incorporating this knowledge into hypermedia instruction has not occurred. That is, the knowledge of how we learn and the utilization of technology to improve and affect how we learn has not been realized using current implementations of hypermedia learning environments. Developing a mechanism for utilizing the knowledge of cognitive science to deliver hypermedia instruction in a manner which complements the strengths of the learner was the goal of the design of the “smart” hypermedia learning system.

The “Smart” Hypermedia Learning System Model

In the domain of computer science, differences in student learning styles are explained using the discipline of cognitive science. The combination of the disciplines of computer science and cognitive science provide the foundation for the “smart” hypermedia system design.

The corresponding function and explanation of the components are given in the following sections.

Components of the System

The representation of the model is pictured in Figure 1. The corresponding components necessary to realize the model are given in the following sections.

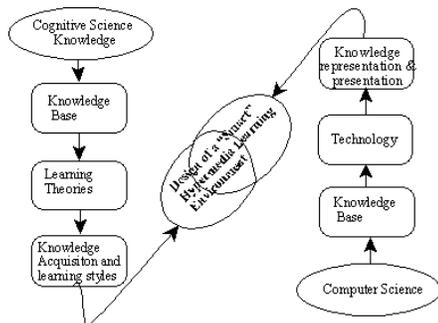


Figure 1: Representation of model for the design of a “Smart” Hypermedia Learning Environment.

Profile Assessment

The creation of an online survey to access the learning preferences of the user is the initial task in creating the “smart” hypermedia learning environment. This instrument (Learning Style Inventory) consists of the set of questions which will help the system create a learning profile of the user. (See Figure 2)

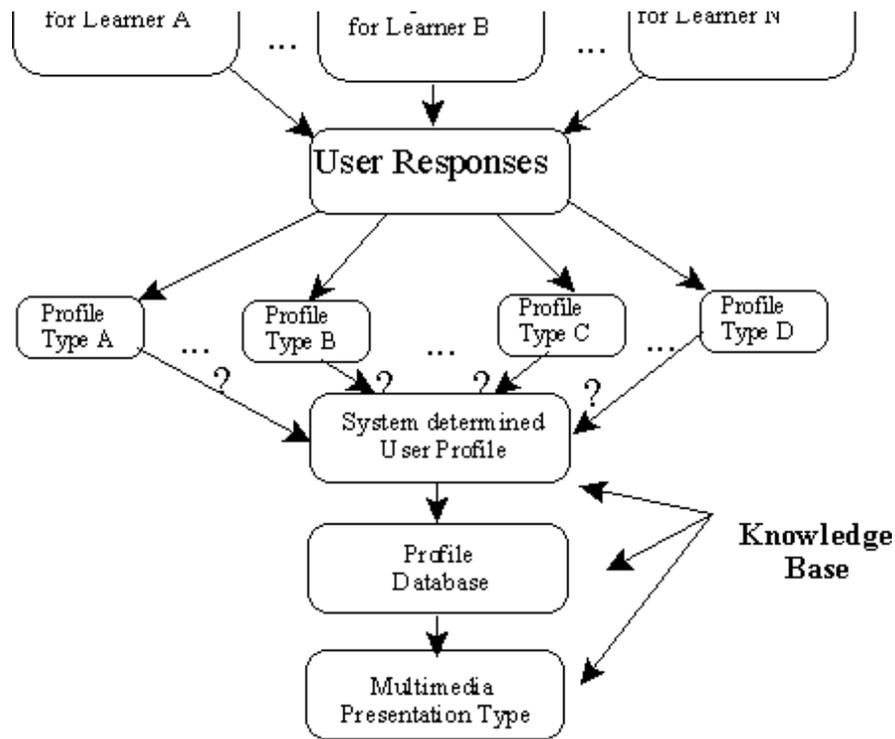


Figure 2 - Diagram of the schema for user profiles

This diagram shows a model in which the system is capable of using any learning styles instrument (LSI) to obtain learning preferences for a user. Once this determination is made, the system then identifies the appropriate number of different learning profiles based on the selected LSI. For example, if LSI A is chosen, the number of learners classified using this schema is some number “x”; however, if a different instrument is chosen, the classification of learner profiles may be a value “equal to”, “greater than”, or “less than” the number for LSI A. The questions chosen to identify the learner profiles should be clear enough for the level of the user to comprehend. That is, a survey instrument developed for a freshman group should be considerably easier to read and comprehend than those developed for a graduate group.

The Learning Style Model

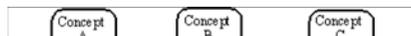
The learning style model provides the system with the framework for identifying which elements in a hypermedia environment are most helpful for a particular user. That is, for a given profile type the model advocates that certain multimedia elements are best suited for presentation of information for a specific learner. Although the model used in this study was based on a specific Learning Style Inventory, any multi-dimensional classification of learners may be used. These multiple dimensions are used to provide a mapping of multimedia elements for the respective user. The multimedia elements included in the system may include any of the available technology elements which are compatible with the target population.

The mapping of multimedia and hypermedia elements and the corresponding learning styles is based on the characteristics which are identified for different learner profiles. The mapping of multimedia elements for different learning styles are definable for any chosen LSI (Learning Style Inventory).

The Concepts Parser

The concepts which are used in the system are stored and form the materials component of the knowledge base of the system. The concepts may be from any subject or discipline. The concepts are parsed using the “smart” hypermedia learning system and presented to the user according to the multimedia presentation type (See Figure 4). These presentation types have a one-to-one correspondence to the user’s profile type.

In order to provide the appropriate multimedia presentation, the system parses a concept file identifying those elements which are appropriate for the identified user profile.



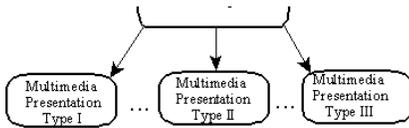


Figure 3 Parsing of concepts by “Smart” Hypermedia Learning System

The Concept Delivery Cycle

The concept delivery cycle for the presentation of the topics delivered by the learning system is shown in Figure 4.

The activities which take place during each phase of the cycle are as follows:

Initialization phase

Profile Acquisition

During this step the learning system creates the user’s learning profile by evaluating the responses on the virtual survey. An appropriate profile type is assigned based on the assessment given by the selected learning style model.

Topic Selection

During this step, the system retrieved the selected materials from the concepts knowledge base which were relevant to the topic chosen by the student. These instructional units are then sent to the script management system to be prepared for the user.

Presentation phase

Parse concept file

During this step the system invokes the parser cgi-program which identifies which portions of the file should be displayed for the specific learner profile.

Match multimedia elements

The learner’s profile is matched with the multimedia presentation type. Presentation of the selected topic with the matching profile type and corresponding multimedia elements are displayed during this phase.

Specifically, during this phase the system:

- C Retrieves the selected topic concepts from the subject knowledge base

- C Presents the concepts based on the student’s learning profile from the learning profile knowledge base using the corresponding multimedia elements from the technology type knowledge base.

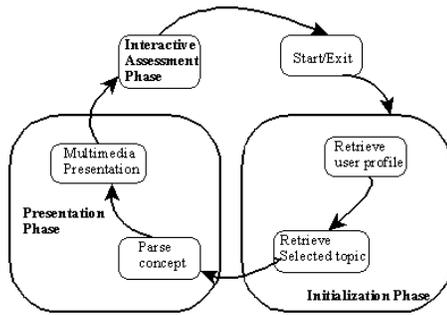


Figure 4 - The Concept Delivery Cycle of the Learning System

Interactive Assessment phase

This component of the delivery cycle is designed to mirror the interactions of a learning environment in which constant checks are being made by the facilitator to measure the effectiveness of the presentation. This component performs the following functions:

- C Interactively questions learner's understanding of concepts studied
- C Allows students to review concepts as needed

In addition to this internal assessment tool, external assessment in the form of learning checks may be given to participating groups in order to measure the effectiveness of a system.

In summary, this learning environment incorporates the knowledge from learning style theories with computer technology in a hypermedia setting. The multiple facets of multimedia are to be used to enhance the presentation of any subject matter by the use of a system which uses learner profiles stored in a knowledge base to identify the most effective use of multimedia to present the selected subject matter. This is done by creating a "smart" agent which uses knowledge bases, user profile, subject matter and multimedia presentation types to create, in real time, a web-based presentation of information for a given user. The presentation is terminated with an interactive assessment routine.

Although there is no consensus among learning theorists regarding a "taxonomy" of learning styles, there is wide agreement that individuals learn differently and that the delivery of instruction in a manner which best suits the user's preferred mode of learning will maximize the effectiveness of the instructional delivery sequence. Also, there is widespread belief that learners will use multiple learning styles, to varying degrees, even though they generally prefer one method over another. Creating a hypermedia learning system capable of presenting information with these attributes was the primary impetus for this research.

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