

Applying Multi-Intelligent Adaptive Hypermedia
to Online Learning

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Abstract: While the Theory of Multiple Intelligences has been applied in classrooms, demonstrating that learners benefit from multiple entry points and multiple representations of material, this study examines whether the Theory of Multiple Intelligences can be applied to online learning. The study was conducted in three stages: user characterization, prototype development, and formative evaluation. Adaptive text presentation and adaptive multimedia presentation modify content based on a stereotype user model, characterizing users by technical background and most developed intelligences. Implementing Entry Point Framework and multiple representations, the prototype uses explanation and page variants for content adaptation. The formative evaluation indicates that further application of the Theory of Multiple Intelligences, Entry Point Framework, and multiple representations will improve the prototype, offering multi-intelligent content presentations, moving toward “anyone, anyhow” learning.

Introduction

Advances in adaptive hypermedia technology and Web-based asynchronous communication provide the technology foundation for online learning environments, which not only deliver content in a time- and distance-independent manner but which also adapt content according to a user model based on cognitive theory and educational methodology. This study addresses the research question: Can the cognitive Theory of Multiple Intelligences be used to support adaptation in an online learning environment?

The research is built on theories of cognition and learning, educational methodologies derived from these theories, and technologies to construct an artifact embodying these methodologies (Fig. 1). The technology foundation is based on user modeling and adaptation technologies in educational hypermedia (Brusilovsky 1998) as well as multimedia technologies and asynchronous, self-directed learning in Web-based environments (Harasim 1999). In addition, prior work in Intelligent Tutoring Systems (ITS) underlies the development of educational adaptive hypermedia applications (Goettl, Half, Redfield, & Shute 1998).

The cognitive Theory of Multiple Intelligences (Gardner 1983/1993) and the learning theory of constructivism (Bruner 1986) form the theoretical foundation for the study (Fig. 1). The application of the Theory of Multiple Intelligences in classroom environments has demonstrated that individuals with varying sets of most developed intelligences benefit from the use of multiple entry points and multiple representations of material when learning new subject matter (Gardner 1999). The prototype developed for this study forms the basis for an “anyone, anyhow” approach to online learning, seeking to eliminate constraints due to varying development of intellectual faculties through the use of these educational methodologies.

Methodology

In order to answer the research question, the study was conducted in three parts:

- 1) Development of understanding goals and user characterization based on the three most developed multiple intelligences and technical background of each participant
- 2) Development of prototype learning framework and two prototype learning modules
- 3) Formative evaluation of multi-intelligent adaptive hypermedia learning modules

Through online questionnaires, participants were asked to provide data for the development of individual characteristics based on the three intelligences that appear to be the most developed in each individual. A user model was developed based on the most developed intelligences and technical background of each learner.

Learning outcomes were defined for learning modules on Legacy Systems Integration for technical participants and on an Overview of Web and Internet Technology for non-technical participants. The learning modules were then designed based on the understanding goals developed through the Teaching for Understanding Framework (Perkins 1998). Participants were asked to use the online learning modules through the Web-based multi-intelligent adaptive hypermedia learning framework and comment on their learning experience, providing feedback for the improvement of the prototype learning modules and framework.

Prototype Development

In designing the research study to answer the research question of whether the cognitive Theory of Multiple Intelligences can be used to support adaptation in an online learning environment, a prototype was designed for a multi-intelligent adaptive hypermedia learning environment (Fig.1). Two prototype learning modules were developed - one for a technical audience and one for a non-technical audience. In the formative evaluation stage of the research study, participants provided feedback on the prototype learning modules.

A stereotype user model was developed as a database containing the three most developed intelligences and the technical background of each participant. Content and link adaptation methods and techniques from adaptive hypermedia technology are used to deliver content. Through adaptive text presentation and adaptive multimedia presentation, the prototype employs attribute values in the user model to modify the content of the learning module pages so that the content presentations activate each user's three most developed intelligences. The method of explanation variants and the adaptive hypermedia technique of page variants provide support for multiple representations and different entry points, depending on user characteristics.

Formative Evaluation

The study focuses on online learning for an adult population, using research subjects 17 years of age and older. Of the 34 participants in the first stage of user characterization, 33 participants completed the study, using one of the learning modules and providing feedback on areas in which the prototype learning modules can be improved. The feedback received from participants is suggestive of the usefulness of applying the Theory of Multiple Intelligences to online learning. Based on participant feedback, the prototype can be improved by allowing for multiple levels of technical proficiency, adapting to the level of understanding by providing more explanations for novice users and more challenging content for advanced users. To address difficulties in determining the most developed intelligences, the prototype can be improved by making the user model adaptable, allowing users to examine and update their user attributes. This would allow the individual to serve as the authority rather than the questionnaires, as recommended by multiple intelligence theorists (Armstrong 1993/1999).

Participants, particularly those with well-developed Bodily-Kinesthetic Intelligence, requested more interaction and online testing. Other participants, particularly those with highly developed Naturalist Intelligence, suggested the use of metaphors in the presentations. Users, particularly those with well-developed Spatial or Musical Intelligence, found the animated graphical presentations helpful and suggested greater use of graphics, animation, and sound effects in the content presentations. In addition, overview information, upfront instructions, and examples were requested to help users achieve their understanding goals.

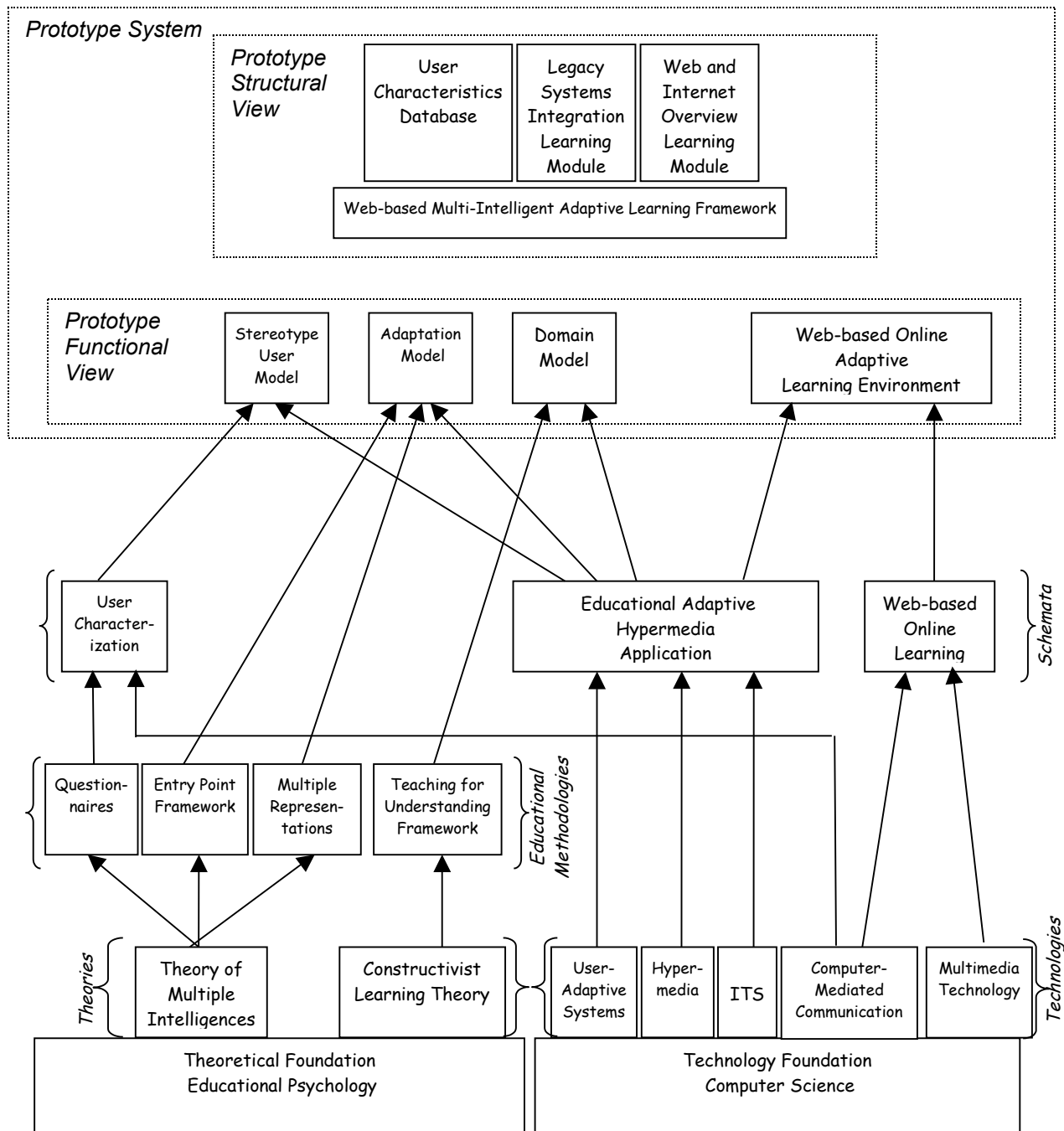


Figure 1: Foundations and Components of Multi-Intelligent Online Learning

Assumptions and Limitations

Questionnaires were used to develop the user characterizations in terms of the three most developed intelligences. These self-report questionnaires make two assumptions:

- 1) Participants can answer questions with an understanding of their own skills
- 2) Answers can be used to determine a participant's three most developed intelligences.

The prototype learning modules incorporate only a small subset of the potential representations and entry points that can be used for explanation variants of the subject matter. A limitation of developing a multi-intelligent adaptive hypermedia schema is that each variant must be individually designed by a person knowledgeable in the subject matter, in the educational methodologies of multi-intelligent approaches, and in Web and hypermedia technologies. The prototype is necessarily a simplification of the design for fully multi-intelligent learning modules.

Significance of Study

Feedback from the formative evaluation indicates that improvements can be made to the learning modules and framework by increasing the use of the Entry Point Framework and multiple representations educational methodologies based on the Theory of Multiple Intelligences so that modules embody fully multi-intelligent approaches to content presentation. An affirmative answer to the research question and the instantiation of the Theory of Multiple Intelligences in the prototype user and adaptation models demonstrate the feasibility of building a personalized online learning environment that considers differences among individuals in thinking and learning. The prototype forms the basis for the development of an "anyone, anyhow" approach to online learning, with the study indicating improvements that can be made in the multi-intelligent adaptive hypermedia approach to increase accessibility to "anyone" through greater use of multi-intelligent "anyhow" approaches to content delivery.

Further Information and Demonstration

Prototype multi-intelligent online learning modules are available for demonstration and trial purposes at: <http://www.brainjolt.com>. Further information on the research study is also available on the website.

References

- Armstrong, T. (1993/1999). *7 kinds of smart: identifying and developing your multiple intelligences*. NY: Plume.
- Bruner, J. (1986). *Actual Minds, Possible Worlds*. Cambridge, MA: Harvard University Press.
- Brusilovsky, P. (1998). Methods and Techniques of Adaptive Hypermedia. In P. Brusilovsky, A. Kobsa, & J. Vassileva (Eds.), *Adaptive Hypertext and Hypermedia*. Dordrecht, NL: Kluwer Academic.
- Dara-Abrams, B. (2002). *Applying Multi-Intelligent Adaptive Hypermedia to Online Learning*. Ph.D. Dissertation, Union Institute & University, <http://www.brainjolt.com/>.
- Gardner, H. (1983/1993). *Frames of Mind: The Theory of Multiple Intelligences*. NY: Basic Books.
- Gardner, H. (1999). *The Disciplined Mind: What all students should understand*. NY: Simon & Schuster.
- Goettl, B., Half, H., Redfield, C., & Shute, V. (Eds.). (1998, August). *Intelligent Tutoring Systems. 4th International Conference*, San Antonio, TX. Berlin, Germany: Springer-Verlag.
- Harasim, L. (1999, September). A Framework for Online Learning: The Virtual-U. *IEEE Computer*. Retrieved June 16, 2001, from the World Wide Web: http://www.telelearn.ca/g_access/news/r9044.pdf
- Perkins, D. (1998). What is understanding? In M.S. Wiske (Ed.), *Teaching for understanding: Linking research with practice* (pp. 39-57). San Francisco: Jossey-Bass.