Utilizing Learning Styles for Interactive Tutorials

Magnus Aase

magnus.aase@kongsberg.com
Birger Ruuds vei 12, 3610 Kongsberg, Norway
Phone : +47 97588545

Franz Kurfess

fkurfess@csc.calpoly.edu
California Polytechnic State University, Computer Science
Department, San Luis Obispo, CA, 93407, USA
Phone / Fax :   +1-805-756-7179 / +1-805-756-2956

Abstract

Developing successful Web-based learning environments has shown to be a challenging and difficult endeavour [7][11] that requires knowledge from multiple domains like pedagogy, psychology, knowledge engineering, software engineering, and Web technologies. Their lack of individual preferred ways of instruction is a challenge we address in this paper.

We introduce a Web-based learning environment that teaches concepts from Artificial Intelligence to college students. This environment is intended to be used as a complementary tool for the standard lectures. By adapting the instruction and learning material to the individual student's learning style the tutorial gives the student a personal learning experience and it was our expectation that the tutorial would increase the user's knowledge and interest about the topic. Results and feedback were gathered from the students.

1: Existing Systems

Web-based learning systems are primarily used by academic institutions and corporations [1]. WebCT [12] is a commercial course management system for higher education. WebCT provides utilities, components and tools to develop and maintain a virtual university. Some examples are: course builder, course appearance, student manager, file manager, course homepage, assignments, quiz and surveys. Blackboard [2] began as collaboration among a team of students and faculty at Cornell University in 1996**.** Blackboard is a similar web-based product also used worldwide.

2: Learning Styles

The idea that people learn differently is venerable and probably had its origin with the ancient Greeks.

Educators have, for many years, noticed that some students prefer certain methods of learning to others. These dispositions, referred to as learning styles, form a student's unique learning preference and aid teachers in the planning of small-group and individualized instruction [10]. According to Felder & Silverman [6], learning styles are "characteristic strengths and preferences in the ways we take in and process information". There are a lot of discussions about what learning styles are and at which level of cognitive abstraction to describe these. Curry's Onion Model [4], describes these different levels. The outer layer of Curry's model examines instructional preference. The middle layer of Curry's model concerns an individual's intellectual approach to assimilate information and encompasses many of the currently popular learning style theories. The inner layer of Curry's model examines cognitive personality style, addressing an individual's approach to adapting and assimilating information. This layer is considered to be an underlying and relatively permanent personality dimension. The Felder and Silverman Learning Style Model [6] overlaps the middle, information processing layer, and inner, cognitive personality layer and uses 4 dimensions (see Table 1) to define a persons learning style (Active/Reflective, Sensing/Intuitive, Visual/Verbal, and Sequential/Global)

3: Accommodating Learning Styles

Except for Intelligent Tutoring Systems [3], [17], there has been little research on software systems that accommodate the needs and learning preferences of individuals separately. The few studies carried out have shown mixed results [5],[8],[9], hence further studies need to be carried out. No guidelines or previous systems could be identified for applying learning style theory developing computer-based tutorials. Thus we

decided to explore possibilities offered by the different learning style models, starting with Felder and Silverman's learning style model [6]. The next step was to outline an approach that accommodated the different learning styles within this model in an online learning environment. The online learning environment, the ITT, has two major components, the ITT framework, and the learning material based on the domain knowledge. The users of the online system register and create their own profile, containing their learning styles, to which the system would adapt. Their specific learning style is made up by taking an online questionnaire developed by [6]. The learning material is developed according to the different learning styles described by the [6] and integrated in the tutorial. Visual learners get more learning material with diagrams and illustrations than the verbal learner, who gets more text-based material. The active learner will be given more opportunities for interaction than the reflective learner who will get more question-based and material containing critical analyses. The sensory learners receive facts, glossaries and previous work by other students, while the intuitive ones are presented with abstract material and hyperlinks leading to other sources. Table 1 illustrates the preferences and dimensions in the Felder & Silverman model.

Definitions	Dimensions		Definitions
Do it	Active	*Reflective*	Think about it
Learn Facts	*Sensing*	*Intuitive*	Learn Concepts
Require Pictures	*Visual*	*Verbal*	Require reading or lecture
Step by Step	*Sequential*	*Global*	Big Picture

Table 1: Preferences in the Felder & Silverman model

4: The Interactive Teaching Tutorial

The framework for the prototype, the Interactive Teaching Tutorial (ITT) uses Microsoft's ASP for Web scripting when, presenting learning material based on the user's learning style. By progressing through the folder structure for the learning material on a web server, it presents the files and folders as hyperlinks for the student. For implementing the ITT learning material, several media were utilized: diagrams, video lectures, PowerPoint slides, Java applets, text, sample code, audio and animations. The ITT Framework is illustrated in Figure 1.

4.1: Interfaces

Two different interfaces are implemented, a student interface and an interface for the instructor. Both interfaces require a username and a password for login. The first time students are using the system they register and complete the Felder & Silverman's learning style questionnaire. A profile is created and stored in the user's profile in the profile database. The user navigates through the Web pages to learn the class material maintained and updated by the instructor. The menu pages are dynamically generated based on the classes and modules available. The interface for the instructor can display quiz results from the users. The instructor logs on as an administrator and has access to quiz results retrieved from the quiz database. The purpose of this interface is to examine how the different types of learners perform after using the tutorial. Each quiz shows individual total score, score for each question, quiz averages, and performance from each different learning style group.
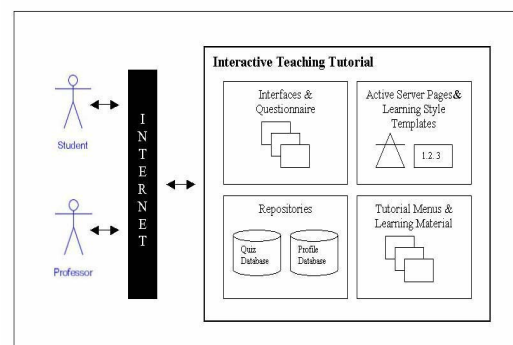

Figure 1: The ITT Framework

4.2: Learning Style Templates & Profiles

The learning style template describes, for example, the sequence in which the material will be presented in the tutorial for a given learning style. The profiles contain information about individual users such as username, password, first name, last name, email address, user ID number, and the result from the Learning Style Questionnaire.

4.3: Learning Modules

The learning module contains all the learning material for the tutorial and the menu module presents all available classes. The class modules contain all the learning material for a specific class. Each concept module contains learning material, a toolkit, a tutorial, preferences and a discussion group.

5: Results

The primary goal for this paper was to investigate how learning style theories from education and pedagogy could be applied developing a web based learning system.

A class with 25 students was surveyed and feedback was gathered to see if this prototype was useful and interesting to use as a complementary tool for class. The majority of the students agreed that if the tutorial was available for the Artificial Intelligence class, they would have used it to become more familiar with the class concepts and to test themselves. They found the ITT useful, and seemed to enjoy using it. They also found the tutorial, even in its partially implemented form, useful as a reference tool and would like to have access to this kind of learning environments to accompany the standard classroom lectures. Students whose first language was not English found the video clips of the instructor explaining the search algorithm, accompanied by semi-animated PowerPoint slides, especially useful because the could view them repeatedly, and at their own speed. Most criticism was targeted at the obvious implementation deficiencies of a first prototype, and the relatively unsophisticated design of the Web pages. Some students also reported that the categorization of their learning style did not fully match their own observations about their learning preferences.

6: Conclusion

This paper has presented a prototype, the ITT, utilizing the Felder & Silverman [6] learning style to investigate the theory of improved effectiveness for student learning. In summary, a process and a framework were developed to achieve experience integrating learning styles in an educational software system.

The learning style models studied were originally developed to improve class instruction. Hence, implementing these in a computer-based teaching tutorial seemed to be a difficult endeavor. One of the main challenges was not to come up with suggestions for mapping learning styles to different learning material and presentation forms, but to make sure these forms were of high quality and actually useful for the students.

In hindsight, more time should be spent trying to discover what each different type of learner really prefers. To approach this, repeated usability tests as part of the implementation process and a larger performance study would be needed. Hence, this would evolve into a new learning style model, which would be more suitable for a computerized learning environment.

7: References

[1] UC Berkeley Extension Online http://learn.berkeley.edu/index.html

[2] Blackboard Homepage www.company.blackboard.com

[3] C. Burger and K. Rothermel, *"A Framework to Support Teaching in Distributed Systems"*, University of Stuttgart

[4] Curry L. *An Organization of Learning Styles Theory and Constructs*. ERIC Document 235 185. (1983)

[5] Diaz, David P., Cartnal, Ryan B. *Students' Learning Style in two classes: Online Distance Learning and Equivalent On-Campus,* College Teaching, Fall 1999, Vol. 47 Issue 4, p130

[6] Felder R.M. (2000) Index *of Learning Styles (ILS)*.Available from <www2.ncsu.edu/unity/lockers/users/f/felder/public/ILSpage.html>

[7] Jarc, Duane J. "*Assessing the Benefits of Interactivity and the Influence of Learning Styles on the Effectiveness of Algorithm Animation using Web-Based Data Structures Courseware",* PhD Dissertation, George Washington University, May 16, 1999

[8] Grasha, A. *Integrating Teaching Styles and Learning Styles with Instructional Technology,* College Teaching, Winter 2000, Vol. 48 Issue 1, p2, p9

[9] Howell, Dusti, *Elements of Effective E-Learning: Three Design methods to Minimize Side Effects of Online Courses*, College Teaching, Summer 2001, Vol. 49 Issue 3, p87

[10] Kemp, J. E., G. R. Morrison, and S. M. Ross. 1998. *Designing effective instruction* (2nd ed.). Upper Saddle River, N.J.: Prentice-Hall.

[11] Ross, Jonathan L., Schulz, Robert A. *Using the World Wide Web to Accommodate Diverse Learning Styles.* College Teaching, Fall99, Vol. 47 Issue 4, p123, 7p, 4 charts

[12] (WebCT, 2002) WebCT Homepage www.about.webct.com