ITS02 - International Conference on Intelligent Tutoring Systems, Young Researchers Program, Biarritz, June 5-7, 2002.
pp. 29-31

External Representation Of The Student's Knowledge In A Web-Based Learning Environment

Riccardo Mazza
University of the Italian Switzerland
Faculty of communication sciences
Via G. Buffi, 13 CH-6900 Lugano – Switzerland
riccardo.mazza@lu.unisi.ch

Abstract: Web-based learning environments have become very popular and are used widely in universities and big companies. This great success is due to several remarkable advantages of learning using computer-based educational tools. However, from the tutor's perspective, the physical distance between tutor and learner could give rise to a problem of evaluating the student's current state of knowledge. In this paper we propose a simple model to create an external representation of the computer's system beliefs about each student in the class. Without changing the tools used by the tutor to create and deliver their courses, we propose a structure of a tool which is able to represent, in a very comfortable and intuitive way for the tutor, the actual state of knowledge of the whole class of students.

keywords: student modeling, web based learning environments, external representation of knowledge

Introduction

Web-based learning environments are a kind of software which has reached great popularity in universities and colleges all over the world. They enable teaching using computer mediated communication (CMC) tools wired by an Internet connection. First environments where produced in 1995 - 1997 as spin-off projects in some universities, and today most popular products are WebCT and BlackBoard. Thanks to their features, students are free to study with no limits of time or space, and tutors can take advantage of CMC tools for creating discussion groups, shared exercises, and delivering multimedia content.

If, on the one hand, this new way of delivering lessons can bring new advantages, like asynchronous learning [1], collaborative learning [4], on the other hand it leads to new problems from the point of view of the tutor's work. In particular, the lack of direct interaction between the tutor and the students could generate some problems. One of the well known problems in distance education from the tutor side is the lack of check of the students' knowledge. It was pointed out that because of the lack of nonverbal elements in CMC (gestures, facial expressions, etc.), it is very hard for a tutor to know what sort of concept each student is currently working on, and the level of comprehension he or she has achieved for that concept.

Even if some environments like WebCT provide a single page that allows the tutor to check the activity of students (in particular the history of the visited pages, the number of posted messages in discussion, the marks he/she received for the quizzes provided by the tutor and automatically graded by the system), this information is presented in a format that is very uncomfortable for the tutor to derive assertions from the state of knowledge of the students. In fact, with the term "knowledge" we are not referring to the grade that the students achieved in a particular exercise, but to the level of mastery of each skill that each student achieved studying in that course.

Student modeling in educational systems

What lacks in today's commercial web-based learning environments is a process of student modelling. This process gathers relevant information on the course's activity and creates a system's belief about the knowledge achieved by students. This representation is called student model.

Student model is already used as main component in Intelligent Tutoring System (ITS) and Web-based Adaptive and Intelligent Educational Systems (AIES) [2], but these systems are used only in very specific and

limited cases. In fact, even if they are very sophisticated environments, that have the great advantage of providing personalized tutoring, from the tutor's perspective they require a great effort for the authoring of the teaching material. The most significant limitations of these systems is that they can be developed for only few topic areas, like engineering and mathematics, since they need to represent, in an expert system, the complete knowledge of the subject area. Moreover, many of them are domain dependent. Because of these limitations nearly all prototypes of this kind of systems remained as experimental tools.

Architecture of the system

The student model can be a hidden component of a complex system like in ITS and AIES, or can be externally available for inspection to students and/or tutors. The latter case is referred to in literature as *inspectable student models* or *scrutable student models* [5], and is mainly used by students in order to promote reflections by themselves. We think that an external representation of the student model available to tutors can also be useful to assert some facts about the students of the course.

My approach in solving the problem is to integrate in the instructional learning environments a representation of the overall state of knowledge of the class of students. In fact, from a pragmatic point of view, the concrete state of the art of commercial tools are environments where the content materials are static HTML pages. In this way, it is very easy for a tutor that wants to create an on-line course to convert his/her material produced, for instance, with a word processor in HTML format, and put this material on-line very quickly. Instead of force the tutor to use (and learn) another system, I propose a tool, which runs in conjunction with a commercial web based learning environment and it is able to represent, in a very comfortable and intuitive way for the tutor, the actual state of knowledge of the whole class of students.

In the following figure is represented the overall architecture of the system.

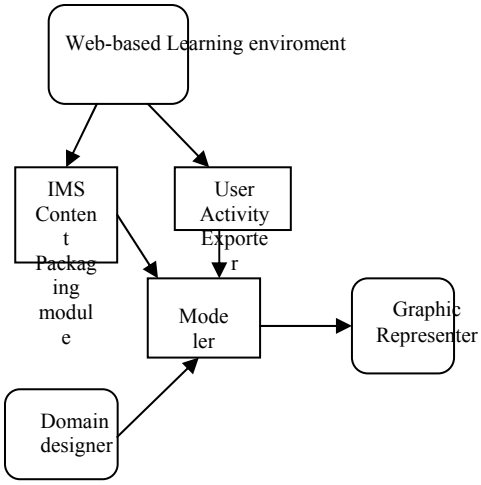

Figure 1: Architecture of the system

The system uses the IMS exchange data format provided by many commercial tools able to export learning material, quizzes and tests in packaged IMS Content Packaging and IMS Question and Test Interoperability XML standard format. A *user activity exporter*, is a module able to export in XML format each specific action executed by each student, (like the history of the page visited, the marks that students received for each quiz, messages posted and so on); obviously this module depends on the particular learning environment we use. The *domain designer* module is a tool that can be used by the tutor to describe the domain model of the course, in terms of *concepts*. Each concept is associated to a set of pages and quizzes of the course. There are no relations or dependencies among concepts in this representation of the domain. The *Modeler* is the part of the system able to create a representation of the user's knowledge of the concepts of the course, starting from the domain provided by the domain designer and the user activities on that domain. The logic used in this module is to utilize user activities to diagnose the level of understanding and mastery that the learners acquire immediately after a concept has been discussed. The underlying assumption that we use for the modeler is that if the learner achieves a high mark on a quiz, and he/she visited the pages related to a concept several times, then the level of

mastery of the learner on that concept is positively affected. The modeler will be implemented using a Bayesian belief network. The *Graphic Representer* is the part of the system able to display in a graphical format the knowledge representation produced by the modeler.

Student model is largely simplified if compared to other sophisticated environments, but the big advantage of this application is the ability to run in conjunction with the existing distance learning platform, that we are using to provide our course, without changing the content or the structure of our course. Tutors continue to use the distance learning tool in the same way, without forcing them to use a further authoring tool, as required by a ITS or a AIES.

Conclusion and future work

This work is only in its early stages and some of the modules depicted in Figure 1 have not yet been implemented. The student model is largely simplified in order to allow a simple authoring of the domain. The system will be more usable as the authoring of the course is simplified. Information about the knowledge of the entire class could be useful to the work of the tutor in order to:

- assess the learner's knowledge
- keep track of those students that are having problems with the study (e.g. are too slow or too fast, during the study of the course)
- discover what concepts in the course are harder to understand

Future work will be focused on implementing the tool and testing it in a real on-line course.

References

[1] ANDRIOLE S.J., LYTLE R.H. 1995. Asynchronous Learning Networks: Drexel's Experience. Monsanto, CA. *T.H.E. Journal*, 23:3 pp.97-101.

[2] BRUSILOVSKY P. 1999. Adaptive and Intelligent Technologies for Web-based Education. *Künstiche Intelligenz, Special issue on Intelligent Systems and Teleteaching* 4: 19-25

[3] DE BRA, P., RUITER, J.P. 2001. AHA! Adaptive Hypermedia for All. *Proceedings of the WebNet Conference*, pp. 262-268.

[4] DILLENBOURG P. 1999. *Collaborative-learning: Cognitive and Computational Approaches*. Oxford-Elsevier.

[5] HOLDEN S. AND KAY J. 1999. The scrutable user model and beyond. *Proceedings of 9th International Conference on Artificial Intelligence in Education*, Le Mans, France July 19--23

[6] HOLT P. AND DUBS S. AND JONES M. GREER J. 1994. *The state of student modelling. In: Student Modelling: The Key to Individualized Knowledge-Based Instruction*, Springer-Verlag.

[7] NAKAMURA M., TAKEUCHI A. AND OTSUKI S. 1996. Roles of Student Models for Assisting Group Learning. *Proceedings of the 5th International Conference on User Modeling* Kailuna-Kona, Hawaii, USA.

[8] TSINAKOS AVGOUSTOS A., MARGARITIS KOSTANTINOS G. 2000. Student Models: The transit to Distance Education.

[9] WEBER, G., SPECHT, M. 1997. User modeling and adaptive navigation support in WWW-based tutoring systems. *Proceedings of User Modeling '97* (pp. 289-300).