Applying the Agent Metaphor to Learning Content Management Systems and Learning Object Repositories

Christopher Brooks, Scott Bateman, Gord McCalla, Jim Greer

Advanced Research in Intelligent Educational Systems (ARIES)
Department of Computer Science
University of Saskatchewan
Saskatoon, Saskatchewan S7N 5C9 Canada
cab938@mail.usask.ca, scott.bateman@usask.ca,
mccalla@cs.usask.ca, greer@cs.usask.ca

Abstract. This paper presents a systems approach to facilitate effective learning object acquisition through the use of communications, modeling, and the agent metaphor. By changing the emphasis that is usually placed on metadata creation and interpretation (which can be problematic) we instead focus on the pragmatics of end use data facilitated through agent negotiation.

1 Introduction

The phenomenal rise over the last decade in the use of e-learning systems, in both formal and informal educational settings[1], has begun to bring traditional learning groups and e-learning researchers closer together. Correspondingly, the amount of learning content available freely (or at minimal cost) has increased tremendously.

Despite this increase in the use of e-learning systems, the acquisition, evaluation, and then repackaging of instructional material remain a significant hurdle in the development of online courses. To remedy this, groups of traditional learning researchers have investigated and put into place several different flavours of learning object repositories – typically centralized data stores of content that include descriptive, standardised metadata. While holding out some promise, this approach has recently been criticized as often resulting in incomplete or incorrect metadata [1]. Further, this content usually has to be marked up manually by humans from standardized metadata sets that tend to be very large and contain vague or even fairly useless terms. Moreover, it is assumed that the consumer of the metadata will be a human being (say an instructional designer or a teacher putting together a course) so the metadata tends to be in human readable form. Finally, the approach ignores the importance of the context of end-use of the learning object, in particular the critical

[1] See for instance, http://www.ivc.illinois.edu/pubs/enrollment/Fall_04.html

role that individual differences in learners plays in the success or failure of the interaction between learners and the learning object. Since the metadata sets are void of descriptions based on actual observed interaction of the learning object with real learners, and there is no role for flexibility or adaptivity during the actual learning process.

We argue that fundamentally what is needed is an integration of techniques from "technology-based research", aimed at providing e-learning systems with more flexibility and adaptivity to individual learners in actual end use. This would limit the dependence on standard vocabularies of metadata terms, and reducing the human effort required to make learning object repositories useful. The key to our approach is the use of computational agents to represent the e-learning delivery tool (a pedagogical agent), as well as the learning object repository (a repository agent). The agents essentially act as brokers of content, negotiating contextually sensitive interactions between the various parties in a learning situation. We believe that once agents are introduced, there will be a number of benefits including an increase in the amount of personalization available, the reduction of time spent developing new courses, and an enrichment of the metadata that is associated with learning objects.

2 An Agent-Oriented Approach to Learning Object Workflows

A traditional workflow for learning objects sees an instructor creating a learning design (either formally or informally), acquiring learning objects that fit this design (usually from learning object repositories), and packaging these objects for delivery to students (usually aiming such packages at a course management system where each student will see the same content). How successfully an instructor can do this depends on a number of factors, including their firsthand knowledge of the kinds of students who might be taking the course, the amount of time an instructor has to search through content, and the diversity of the students taking the class.

There are a number of issues with this kind of learning object workflow. First, the need to access multiple repositories increases the amount of time an instructor must spend to build a list of candidate learning objects for a particular purpose. Once a set of candidate objects has been built, it still takes a fair amount of time for an instructional designer to evaluate the suitability of those resources for a given objective. Even if these resources are annotated with metadata (which often they are not), the designer needs to absorb this information, consider the value of the metadata given the context of the publisher of the metadata, and finally make a decision as to which object fits the circumstances best. Our anecdotal observations suggest that instructors spend a minimal amount of time looking at metadata records, and then being to review the learning content directly.

We believe the use of an agent-oriented architecture would allow for a reduction in the amount of time it takes for an instructor to put together a course, an increase in the amount of personalization that can be accomplished, and an enrichment of metadata within learning object repositories. Consider the case of a student trying to complete a class in Artificial Intelligence. In both the traditional and our approach an instructor would create an instructional plan of concepts and competencies they

would expect a student to learn. This plan, unlike the traditional approach, would need to be codified into a machine understandable format and passed into the instructional design agent within the learning environment. The instructional design agent would then be responsible for understanding the plan and interacting with learning object repositories to obtain the appropriate content.

In order to provide personalized content, the designer agent would need to have an understanding of the learner for which it is trying to adapt, achieved through an interaction with the learner model the system maintains (either explicitly, though questionnaires, or implicitly through observations of interaction). Once the instructional design agent has understood the learner, an interaction with agents representing repositories can begin to find material of relevance to the learner. This interaction, unlike the traditional approach, is not just a query, but a negotiation between the repositories and the content management system, handled by the agents. In this negotiation both agents provide any information it sees as relevant and can omit that which is believes is unimportant or unreasonable.

At each step in the negotiation process, any two agents reason over the data they have and, apply business rules to try and achieve their goals. For the pedagogical agent the primary goal is to find material that will help this particular student to learn enough to complete the objectives stated in the task plan. Secondary to this, however may be the desire to reduce the amount of time it takes the learner to learn, the amount of financial cost of a learning object, or a reduction in the physical size of a learning object to increase performance. A repository agent, on the other hand, likely has a number of different goals depending on the institution it represents. Corporate repositories may have financial compensation and customer loyalty as significant goals, as well as desire to evaluate the effectiveness of material which is meant to be co-published in a traditional fashion, while institutional or community repositories may seek to provide low cost in-house developed material.

5 Conclusion

The key to the agent approach is to incorporate reasoning and negotiation into the computational methods used to support learning objects. The focus changes from finding universal standardized ontologies to describe content, to understanding the workflows underlying interaction strategies between agents to actually carry out various pedagogical and communication tasks. Re-use of learning objects is achieved by reasoning in context, from taking into account how learning materials are actually used, and from making individual differences among learners a key aspect.

References

1. N. Friesen, Final Report on the "International LOM Survey", tech. report Document 36C087, Canadian Advisory Commiittee for ISO/IEC JTC1/SC36, 2004.