Filling the Gap between Intelligent Tutoring Systems and E-Learning Systems

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Abstract. The application and development of e learning and distance education via the Internet and Intelligent Tutoring Systems (ITS) has been growing inexorably, in recent years. Both systems have strengths and weaknesses. Intelligent Tutoring Systems are typically domain septic and rely on concise knowledge modelling and learner modelling. The goal of the research in the area of Intelligent Tutoring Systems is to build computer-based tutors that achieve the effects of learning individually with a human tutor, while E-learning systems suffer from defects mainly related to the relative absence of the teacher and, therefore, the difficulty of adapting teaching to the level and behaviour of the learner. This paper provides possibilities for convergence of these two areas, and describes two of our experiences in providing an Intelligent Tutoring Systems style approach to eLearning systems.
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1-Introduction

Computers have been used in education for more than three decades. Computer-based training (CBT) and computer-aided instruction (CAI) were the first such systems deployed as an attempt to teach using computers. Today's Computer-based training has two important branches 1) E-Learning System and 2) Intelligent Tutoring Systems. It is well known that one-on-one human tutoring is much more effective than traditional classroom instruction, both types of systems tries to do this.

E-learning collaborative learning is becoming an increasingly popular educational paradigm as more individuals who are working or are geographically isolated seek higher education. As such students do not meet face to face with their peers and teachers, the support for collaboration becomes extremely important. The term e-learning brings to mind several core concepts; learning activities supported by Web technologies including learning management systems (LMS) such as Moodle, etc., conferencing and discussion systems, and rich multi-media content. E-learning applications fall into a broad qualitative spectrum, and critics have attacked these products for having a lack of pedagogical and psychological validity, as well as an absence of controlled evaluations.

By comparison, Intelligent Tutoring Systems have mostly been focusing on supporting and scaffolding of problem solving in learning. Typically they have been built on specialized, rich knowledge representations, and use cognitive diagnosis and user modeling techniques to respond to the needs of the learners. Two approaches to building intelligent tutoring systems are the well-established model-tracing paradigm and the relatively newer constraint-based paradigm.

Until quite recently, employing Web technologies has not been a major focus of two approaches to building intelligent tutoring systems. Only a few Intelligent Tutoring Systems use technologies such as adaptive hyper-media [2] or meta-data and knowledge management [3, 4].

This suggests that there should be gains from integration and collaboration between the two branches. Despite this, the cultural differences between the two branches has led to little cross-fertilization of ideas and technologies. This paper discusses this topic as follows: Section 2 examines the differences between common Intelligent Tutoring Systems and e-learning environments. This is followed in Section 3 by a discussion of our experiences with two different systems that aim to fill the gap between these communities, Section 4 concludes the work by identifying specific challenges that exist, and potential ways to address these challenges.

2-Differences

E Learning collaborative learning is becoming an increasingly popular educational paradigm as more individuals who are working or are geographically isolated seek higher education. As such students do not meet face to face with their peers and teachers, the support for collaboration becomes extremely important. E learning Systems fall into a broad qualitative spectrum, and critics have attacked these products for having a lack of pedagogical and psychological validity, as well as an absence of controlled evaluations' learning systems, are a mostly technology-driven enterprise so far mostly worked on by institutions aimed at higher education and workplace training. Table 1 provides a coarse distinction of the main features of eLearning systems.

Main features of E-Learning Systems
organizing learning & presenting material
massive content
content crafted by normal authors
potentially collaborative authoring
several ontologies, content-based
simple feedback
pre-scripted feedback
service approach
scalability and reuse important
dont attention to personal needs : Language, Capacity, Complexity, Comprehension level

Table 1. Features of typical eLearning systems

Intelligent Tutoring Systems has grown out of artificial intelligence (AI), cognitive psychology, and education and has typically focused on the creation of specialized research systems which are domain dependant and mostly aimed at school education. As the area has been mostly one driven by research, implementations tend to be unique in the features they provide, contain hand-crafted ontologies developed by a small group of developers, and lack interoperability between one another. E-learning systems, on the other hand, are a mostly technology-driven enterprise so far mostly worked on by institutions aimed at higher education and workplace training. This community tends to be more risk-adverse,any how One of the major challenges of e-learning is learner autonomy. Adaptive e-learning will improve the use of platforms by offering courses tailored to the results, behaviors, tastes ...of learners, unconsciously; and Intelligent Tutoring Systems motivating factors are interoperability through standardization (for instance, the IMS specifications, see below) and wide-scale deployment. Thus the thrust of traditional eLearning research is the issue of reuse, interoperability of components, integration with organizational software, and authoring of content. Table 2 provides a coarse distinction of the main features of Intelligent Tutoring Systems. It must be noted that many instances of exceptions to this classification are beginning to emerge as efforts (such as ours) are initiated to reduce the boundaries between Intelligent Tutoring Systems and eLearning Systems.

Main features of Intelligent Tutoring Systems
aiming at improved learning
restricted content
carefully crafted content
single author/designer
fix abstract domain ontology
elaborate feedback
some feedback generated
tightly integrated components
few generalizable solutions
attention to personal needs : Language, Capacity, Complexity, Comprehension level

Table 2. Features of typical Intelligent Tutoring Systems

2-1 Technologies in e-learning

A standalone e-learning systems to one that operates on the World Wide Web. We focus on one product of this effort, a Web-enabled architecture as extension of a widely-used standalone e-learning architecture.LMS as a type of e-learning systems contains functions for managing authors, instructors, administrators, and learners in courses (e.g., roles, passwords, etc.), connecting learners together for example by discussion forums and chat systems, and providing and managing access to content (e.g., access rules, quizzes, etc.). These systems generally offer a very simple level of monitoring and feedback mechanisms – instructors can usually see only a coarse-grained view of what content students have accessed (or discussions students have engaged in) and students typically can obtain pre-scripted simple feedback or limited branching to alternate content resulting from instructor created quizzes.

These systems use the Web, Sementic Web and browsers for delivery and allow for learning which is independent of time, place, and pace. Both hypermedia and multimedia are used to help motivate learners, though it has been suggested that this may neither last nor result in deep learning as the grip of the new media evaporates. Still, psychological research suggests some value of multimedia for attracting attention and for grasping complex information through multiple sensory chan- nels. In addition to the rich content provided by these systems, there is a strong potential to leverage Web-technologies for personalization and adaptation, and there is a growing awareness for Intelligent Tutoring Systems importance to eLearning [7].

A standard is a set of recommendations emanating from a representative group of users gathered in a forum, such as the IETF (Internet ENGINEERING Task Force), W3C (World Wide Web Consortium), the LTSC (Learning Technology Standards Committee) and the IEEE. Standardization of learning objects hold the promise to make reusability of learning material easier. The standards are aimed at solving a number of problems including the description of technical, administrative, and pedagogical aspects of content (e.g., IEEE LOM [8]), the interconnections between content and learning actors (e.g., IMS Learning Design [9]), the aggregation and ordering of content for deployment (e.g., IMS Content Packaging [10]), and how content should be sequenced for the the learner (e.g., IMS Simple Sequencing [11]).

The standardization process has been largely influenced and governed by commercial interests and tries to be completely comprehensive, which makes the standards simultaneously large and cumbersome yet failing to include specific needs. In particular, the metadata as well as much of the technology usage have not yet been targeting deep learning and are not much informed by empirical psychological results [12]. In addition to standards-compliant learning materials, a number of other Web technologies hold great promise. For instance, the use of XML, XSL, XSLT and the Resource Description Framework (RDF) serve the separation of structure, presentation, and semantics and they provide a rich and extensible layer.

Web services based on XML are clearly becoming the choice for system-to-system integrationand could help specialized Intelligent Tutoring Systems components attain a higher level of interoperabil- ity. Web services typically require developers to provide strict definitions of the functionalities that can be requested from a stand-alone application living on Intelligent Tutoring Systems server. This is typically done in a blackbox manner, where a wrapper around domain tools (e.g., an equation solver or a computer algebra system) is generated and exposed to the world. Unlike the typical glassbox Intelligent Tutoring Systems system such as the physics problem solver in Andes, blackboxes are often more difficult to use when the goal is to generate feedback based on human problem solving spaces. For instance, computer algebra systems compute solutions in steps and by algorithms that typically are different from human problem solving behavior.

The lack of adaptivity to individual learners is the main shortcoming of traditional e-learning approaches. Customizing feedback or limiting learner options is based on fairly superficial knowledge, typically the answer given to a question in a quiz. Guidance for learners must be completely scripted by authors with no run-time inference or subtle adaptation based on individuals' actions. The task of selecting content for presentation to the learner is left to authors or to the learners themselves. More successful forms of adaptivity have been in adjusting presentation style to specific devices or to dichotomic learning styles,some eLearning developers have become aware of the downfalls of current technologies. However, the idea of 'diagnosis' does not belong yet to the common ground.

2-2 Intelligent Tutoring Systems

Intelligent Tutoring Systems are educational programs that assist students in their learning by adaptively providing pedagogical support. Typically the "intelligent" in Intelligent Tutoring Systems refers to:

(1) a problem solving system that can assist and help to produce feedback and hints to learners;

(2) model tracing that predicts the learner's current mastery and likely next step in order to scaffold problem solving;

(3) knowledge tracing that assesses the learner's abilities and concept-mastery in order to release new exercises or topics to learn;

and finlly,

(4) tutorial dialogues for scaffolding problem solving.

Certainly, the literature reveals many more ideas that have been proposed in Intelligent Tutoring Systems research such as tools for inquiry learning and for collaborative learning.Being able to argue with a student to convince her or him about the rationale of tutoring hints is an important component of pedagogy[1].

Intelligent Tutoring Systems research has a long record of student modeling, of appropriate responses to students' problem solving activities, of collaborative learning techniques. It offers a range of techniques for macro- and micro-adaptation [14] which adapt both what is presented to the learner and how it is presented. Many Intelligent Tutoring Systemsrealize (pedagogical) ideas and technologies that are informed by empirical results from cognitive and pedagogical psychology, e.g. on cognitive models, self-explanation, or the zone of proximal development. Moreover, controlled experiments belong to the arsenal of methods practiced in the Intelligent Tutoring Systems community.

The e-learning systems follows " one size fits all " approach. where all the learners are provided with same learning content. But the learners' requirements and goals dynamically change over time which can't be addressed by the traditional approach. Using Intelligent Tutoring Systems techniques an alternative to the traditional e-learning approach, where learning objects can be provided dynamically as per learner preferences and needs. An e-learning system with the provision of adaptability, will act as a virtual teacher who is giving individual care to each learner. Providing adaptability is a notion which considers the learner characteristics such as his preferences, knowledge levels, learning style, interest, goal, learner performance etc.

3- Filling the Gap of Two Systems

It's our believe Intelligent Tutoring Systems (ITS) can be more open and reusable while preserving their useful existing features and e-learning systems can be made more intelligent too. For example, Sementic Web technologies can be employed to enhance adaptivity technologically, to reuse in teroperable components, and to make systems more widely available and maintainable. Intelligent Tutoring Systems techniques can be used to make adaptation truly beneficial for learning, to provide student modeling, tutorial dialogues and other useful ideas and tools developed over years. Student modeling can be defined as the process of gathering relevant information in order to identify and represent the knowledge state of a student.In an ideal case, the model of a student should illustrate his/her knowledge, preferred learning strategies, areas of interest besides that of instruction, preferred presentation style, level of concentration and so on.

Several techniques for student modeling have been developed for particular domains,we can use these techniques in e-learning systems and made them more intelligent.

As e-learning goes through an explosion of adoption, more and more systems are integrating Intelligent Tutoring Systems (ITS) research into traditional e-learning environments. This integration need some level of adaptation and personalization while recognizing the specifications and standards of the broader e-learning community.

One way for filling the gap is use of ontology in education systems. we advocate authoring intelligent instructional systems by engaging authors in knowledge modeling rather than knowledge engineering. We propose building education systems by creating task ontology (which models pedagogy) and domain ontology, which represents each individual domain.

Our Purpose is to develop authoring tools for authoring Intelligent Tutoring Systems (ITS) domains. It consists of three parts.

1) A graphical editor for creating the ontology (e.g. Protégé-Owl) in particular, this editor attempts to graphically visualise the entire model in a clear, graphical manner.
2) Constraint generator, it parses the ontology and creates constraints for testing the student solution based on the concepts in the ontology.A constraint generator creates the required constraints from the concepts in the ontology. The resulting constraints form a domain model that can be used to provide highly specific feedback that is tailored to the individual student's misconceptions, and to drive the pedagogical process. Constraint generator seeks to minimize the authoring effort by requiring the author to model only states, rather than solution paths.
3) Workflow generator, sometime the author must manually create production rules that represent a general model of a task (e.g. Solving an equation).

We Purpose using OWL technology in this model, OWL gives you an XML syntax to express statements about properties, classes and relationships. A benefit of OWL is that it facilitates a much greater degree of inference making than you get with RDF Schemas. All of the elements/attributes provided by RDF and RDF Schema can be used when creating an OWL document.Using OWL to define an Ontology in our model has some benefits: 1) Extensible: much easier to add new properties. Contrast with a database adding a new column may break a lot of applications 2) Portable: much easier to move an OWL document than to move a database.

4- Challenges and Opportunities

Opportunities are opened up by the growing quantity of learning material that has been tagged and annotated using standards (e.g. OWL, XML and RDF) and that is available via the Web. Intelligent tutoring systems can benefit from employing an extensible and reusable knowledge representation scheme that is accessible for other systems as well. This includes the formats but also the concrete metadata that characterize an instructional item or learning object. The Web as a knowledge base could and should be employed in inquiry learning, especially if strong semantic search facilities can be provided. This is how many students now learn anyway.Although our work aims at filling the gap between Intelligent Tutoring Systems and e-learning systems, Nevertheless, it is clear that the task of building an ITS based on e-learning system is still large and a number of challenges still exist.

Student model is extremely difficult: The task of building a student model is extremely difficult and laborious, due to huge search spaces involved. Various approaches to dealing with the intractability of student modeling have been introduced. Self recommends such design of the interactions that information necessary for building a student model is provided by the student, and not inferred by the system. Also, it is not useful to be able to identify misconceptions in the student knowledge that cannot be dealt with by the tutor. An ITS should model only what it is capable of using in order to generate remedial or other pedagogical actions.

Extensibility: The majority of e-learning specifications use XML to aid interoperability. And we know OWL gives us an XML syntax to express statements about properties and classes, above and beyond what you can make with RDF Schema.In theory, this allows vendors to extend specifications in a conforming fashion by introducing new elements and attributes within their own namespaces. In practice however, vendor extensions to XML documents tend to break when imported into other e-learning applications. This is actually a side effect of using XML in a structural fashion. the relationship of one element to another is based on a hierarchy called the Document Object Model (DOM). Introducing new elements to ”wrap” existing elements reorders the hierarchy exposed by the DOM, and thus typical structural querying languages such as XPath tend to have problems. Research attempts at automatically acquiring knowledge for ITSs have met with limited success.

Domain Ontologies:Acquiring the domain knowledge is a task that requires a major portion of the time and effort when building an ITS. Researchers have been exploring ways of automating the knowledge acquisition process since the inception of ITSs with limited success. Research attempts at automatically acquiring knowledge for ITSs have met with limited success.

5- Conclusion

It is well known that e learning Systems not provide the same kind of individualised attention that a student would receive from a human tutor as they do not reason about the domain and the learner. This has prompted research in the field of intelligent tutoring systems.The goal of our research is to provide working systems that increase the efficiency of teaching and at the same time are effective for learning and pedagogically as well as cognitively sound. Therefore, they have to take advantage of Intelligent Tutoring Systems and Web-technologies. Although our work aims at filling the gap between Intelligent Tutoring Systems and e learning systems, it is clear that a number of challenges still exist.

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