E-Learning – Using XML technologies to meet the special characteristics of higher education

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ABSCTRACT

In this paper we claim that the current approach to learning objects and metadata standards is counter productive for the integration of e-learning in higher education. We explain why higher education is different with regard to E-learning and we suggest an approach that avoids the use of global standards and favors an approach of an evolving set of metadata tags for an evolving community of practice. We demonstrate how XML technologies and some minimal technical help for the participating teachers can provide the required foundation for a productive process of integrating E-learning in higher education.

Keywords: E-learning, learning objects, XML, metadata, XML namespace, higher education.

1. INTRODUCTION

E-learning in higher education is based nowadays mainly on the use of commercial platforms to deliver E-learning such as WebCT, BlackBoard, HighLearn etc. Most teachers are using these platforms as dissemination tools for learning materials that they had already prepared. These platforms serve as an electronic substitute for non-electronic teaching routines. The prevalent way to use ICT lacks interaction possibilities that are so necessary for meaningful learning. It usually lacks either one or both interactions between the learner and the learning materials and interactions among the learners. The most cited reason for not developing adequate instructional material to integrate in E-learning is economic. The idea of a repository of learning objects seems a good answer for this problem; reusable learning objects that can be shared can ease the burden on the individual teacher. Learning objects, as will be discussed later in this paper, are in principal a good idea but require agreeing upon metadata definitions to enable effective retrieval of desired learning objects. Various standards that were developed are too complicated for a teacher to deal with, and many times the effort to embed a retrieved object in the overall instructional unit is still very much effort consuming. We believe that the right way to go for integrating E-learning in higher education is not by enforcing standards, but by having individual teachers and evolving communities of practice develop their own metadata schemes. We believe higher education is different with regard to E-learning and we will elaborate in this paper on the differences and their implications for integrating E-learning in higher education. In this paper we suggest a methodology based on using XML technologies to support teachers; and we also discuss the implications of our approach for better addressing students' learning needs.

2. WHY HIGHER EDUCATION IS DIFFERENT WITH REGARD TO E-LEARNING

A lot has been written about E-learning and how it might change education. Most of it is from an economic viewpoint, looking mainly at implications for training and life long learning. The training industry is motivated by profit considerations and teachers or instructional designers often do not do the respective decision-making. The K-12 education is motivated by other concerns but is centralized and quite tightly controlled with regard to E-learning integration. The academic world is different, teachers have the freedom to design and redesign their courses according to their conceptions of the subject matter and how it should be taught. This issue is vital to the academic world and has implications regarding the ways E-learning can be integrated in higher education. Successful integration of E-learning in higher education will happen only when it can serve the needs of the individual teacher. Teachers in higher education are almost fanatic about their academic freedom and want to have educational impact through the way they design a course, especially if it is an introductory or a major course in their research area. This does not mean that higher education teachers are willing to devote a large portion of their time to the design of the courses they teach. They would like to make by themselves the major decisions regarding the content and not waste too much time on details regarding presentation, drill and practice materials etc. Teachers of higher education usually see research as their most important activity, while teaching should be inspired by the research and is somewhat secondary. So along with the concern about the courses' content design, teachers of higher education would like to have the opportunity to search a qualified repository for relevant examples, simulations, exercises etc., to incorporate within their course. This means that the availability of a pool of relevant learning objects, as will be described later, seems very appealing to the needs of higher education teachers.

Much of the learning materials for higher education have to be updated frequently, not totally most of the times and the portion differs according to the subject matter. This fact requires modularity and flexibility in the course material organization and design. A framework that helps the teacher to continue using the suitable material, modify some materials and combine new learning materials is required. Moreover, higher education teachers are expected nowadays to employ new learning methods, methods for active learning, simulations, collaborative learning, use of ICT etc. The integration of new methods requires also flexibility in the design and management of learning materials.

The trend today in Israel and also in other countries is to open the opportunities for higher education to a wider population. Higher education turns to be a minimal requirement for much of the jobs today. This trend means that the heterogeneity within a class and among classes within the same institute increases dramatically. This fact suggests another requirement for flexibility, a flexibility that enables modifications and adaptations of learning materials for various populations. Same topics should be addressed in different levels; there is a need for a battery of examples with varying levels of details and there is a need for many solved exercises.

A higher education teacher today uses a variety of learning materials in variety of media and usually modifies his courses often according to dynamically changing circumstances. This ongoing process requires sophisticated ways to organize and retrieve even a teacher's own learning materials. This new characteristic of higher education calls for an effective organization of learning objects such that learning objects can be combined easily and can be shared to ease the burden of supplying a multitude of examples, solved exercises etc. for the diverse target populations of students. Developing computer (and communication) mediated learning materials is effort consuming and not always goes well with the research oriented agenda of the higher education teachers.

All of the above mentioned requirements of higher education call for relatively simple, commonly used and flexible tools that teachers can use with some technical support to develop, modify, reuse and share learning materials.

3. LEARNING OBJECTS, METADATA AND STANDARTS

Learning objects is a concept of technologically based instructional design inspired by the object-oriented programming and design paradigm. Object orientation highly values the creation of "objects" that can be reused in multiple contexts. This is the motivating idea of learning objects, to enable the design of small instructional components that can be reused in different learning contexts or courses. This reusability can be employed by the same teacher or instructional designer or by others. Learning objects are actually digital entities deliverable over the Internet, a fact that makes the sharing easier and more natural. To enable sharing there is a need for storing such objects along with metadata that enables the desired retrieval.

In the past years there have been considerable efforts in the computer-mediated learning field towards standardization of metadata elements to facilitate a common method for identifying, searching and retrieving Learning Objects (LOs). Recently, a consensus has emerged among the various bodies spearheading these efforts - including the IEEE Learning Technology Standards Committee (LTSC) [9] Learning Object Metadata Working Group, the IMS Global Learning Consortium, Inc. [7], and the Dublin Core Metadata Initiative - on what these common metadata elements might be. Other similar projects are ARIADNE (Alliance of Remote Instructional Authoring and Distribution Networks for Europe) [2] that has already an established community using their Knowledge Pool tools. They have regular events and are particularly focused on sharing interoperable learning objects and exchanging LOM records. The EUN [4] continue to work closely with member states on several projects that help schools collaborate and use e-learning in the classroom. A lot of attention is being drawn to CELEBRATE, a project examining learning content management systems for schools and evaluating the pedagogical impact of interoperable learning objects. The ADL Technical Team [1] recently announced the release of the ADL SCORM (Sharable Courseware Object Reference Model) new version that includes a range of enhancements including a "Sequencing Engine" that implements the IMS Simple Sequencing Specification and a SCORM Navigation Data Model that enables content navigation controls.

With all these worldwide efforts, the question is what next, and how it can be used for higher education. Duval [3] outlined in a recent paper a research agenda for learning object metadata. He suggests the term "repurposing" to replace the term "reuse" that is used often with regard to learning objects. He claims it makes the intention more specific. This is true but this brings up some other educational concerns. Such concerns were nicely described by Willey [12]. Instructional designers of learning objects problematically focus on removing as much context as possible in order to maximize the reuse of the learning objects they create. A paradox arises because modern learning theorists are increasingly emphasizing the preeminence of context in learning. The simple concatenation or sequencing of decontextualized educational resources does not produce a meaningful context for learning. While economically sensible, the drive toward decontextualization may actually be counterproductive from the standpoint of student learning. Polsani [11] suggests that for any digital object or media asset to acquire the status of a LO it should be wrapped in a *Learning Intention*, which has two aspects: form and relation. A media asset or a digital object can become a LO only when it is incorporated into a *form* and provides a *relation* to itself as LO in order to facilitate the understanding of that object. Therefore a LO is a totality that combines its digital element and an exposition.

4. A PARADIGM FOR INTEGRATING E-LEARNING IN HIGHER EDUCATION

Many higher education institutes adopt an E-learning paradigm that deals mainly with course management and accessibility of learning materials for the students. There should be much more benefit for integrating ICT in higher education both for the teachers and for the students. We explained in a previous chapter why higher education requires a different methodology for moving to a wider use of E-learning. We emphasized the fact that teachers in higher education expect a lot of autonomy in choosing and designing their learning materials. We also stressed the need for flexibility of modification and replacement of parts of the learning materials in order to adapt to various populations, various goals and relevant updates of the learning materials. We believe that higher education teachers want to share learning materials, but only when they themselves define the use, or other teachers they know and respect. This means that any repository of learning materials and any method to tag them should evolve from the teacher own needs and those of his close community of practice.

XML technologies seem to provide an open-ended range of solutions for adopting E-learning in higher education. XML is a language of tags that enables the tagging of content elements for the Internet. The pool of tags that one employs is defined by a schema that enables to distinguish (automatically) between adequate tags and other strings. Our plan is that this schema will be defined gradually according to the various possibilities that teachers employ in their online courses. It is an incremental bottom-up approach. The set of useful tags is expected to evolve through the teachers' experience with online learning and the expected (and encouraged) interactions and influences within the teachers' community. The advantage of our approach is that the metadata tags, which is the principal concept of XML, evolve from the teachers' conceptions, as opposed to metadata tags defined, and so forced on, by external experts. This methodology enables the teachers to develop a course according to their own conceptions, expressed by their choice of metadata tags, for their further reuse. We do not strive to compliance with some standardization efforts. We can use them for some inspiration, source of requirements or terminology; an inspiration and not constraints. We want the teachers to use their own tags and maybe get some consensus among themselves on some sets of tags. Big standardization projects are motivated by the idea of publishing learning objects, while we are motivated by supporting teachers in using XML technology in a way that enable reuse of existing learning materials and enable easy modification and immediate testing for adaptation to different levels of students and for easy production of different versions of a course. We purposely suggest XML technologies and not an authoring tool that employs XML or some mainstream educational metadata schemas. We are convinced from our experience that most higher education teachers will prefer to define the metadata tags by themselves for their own reuse and would not like to constrain themselves with metadata standards. They also would like to structure the course according to their conceptions without adhering to predefined templates. Higher education teachers are interested in sharing learning materials, but only with teachers they know and can negotiate metadata tags with, tags that express their common understanding. XML technologies enable the modular creation of learning materials at different levels of granularity in a way that supports both individual reuse, and reuse and sharing by an evolving community of practice. As more teachers are joining the process the pool of examples grows and the dictionary of tags expands. XML technologies enable also the separation between content and presentation, which is also very important for higher education teachers that want to control the content totally without getting too much involved in style creation details. Style sheets can be used for dealing with the presentation. The flexible rendering of the learning materials (by XSL files) enable experiments with screen designs, navigation concepts etc.

The paradigm we suggest includes the view we just described of the bottom up incremental process and also how it should be supported by higher education institutes. The idea is to provide the teacher with open and flexible facilities to put his course on the web. Technical help accompanies this on request. The teachers are also provided with various facilities to share and negotiate possible tags with other teachers. More details on the incremental process can be found in Kanovsky and Or-Bach [8].

For the long run we envision further use of XML technology for dynamically generating interactive course adapted to the student's goals, preferences, capabilities, and knowledge; as demonstrated for example in the ActiveMath learning environment [10] and in a web-based language learning system [6].

5. EMPLOYING NAMESPACE FACILITY OF XML IN OUR PARADIGM

In accordance with our proposition a teacher has to choose his own tags for creating metadata description of his learning materials. A teacher adds tags to his learning materials for its further processing by software. The teacher’s choice of a tag use and its name is guided by three main reasons for tags employment. The first reason is for having a visual representation of learning objects. Only marked pieces of learning materials may be displayed in different ways in any necessary future situation or may be invisible for some purpose, for example for different level of students or different didactical aims etc. The second reason is for having a logical representation of the learning objects. A marked piece of learning materials may be automatically extracted for indexing, for the creation of a set of examples, for creating a dictionary of terms, for referencing and so on. The third reason is future reuse of learning materials. A marked piece of learning materials may be retrieved

```
1. <?xml version="1.0" ?>
2. <lecture from="OOP with Java"
3.  number="3" lastModified="12/12/2001">
4. < title>Class and Object Inheritance.</ title>
5. <section id="1">
6. <def on="13">Object</def> An instance of
7. <def on="12">class</def>.
8. </ section>
9. <section id="2">
10.  <def on="12">Class </def>
11.   for <see ex="22">2D points</see>.
12.  <def on="12">Class</def>
13.  of <see ex= "22">Line</see>
14.   and <see ex="22"> Rectangle </see>.
15.  </section>
 …
```

Fig.1. Part of XML documents as created by teacher. Line numbers are provided only for reference.

```
1. <?xml version="1.0" ?>
2. <prj:lecture prj:from="OOP with Java"
3. ik:number="3" prj:lastModified="12/12/2001"
4. xmlns:ik="http://www.yvc.ac.il/ik/Java@yvc/"
5. xmlns:prj="http://www.yvc.ac.il/ELearnPrj/"
6. xmlns="http://www.yvc.ac.il/ik/Java@yvc/">
7. <prj:title>Class and Object
Inheritance.</prj:title>
8. <prj:section id="1">
9. <def ik:on="13">Object</def> An instance of
10.  <def ik:on="12">class</def>.
11.  </prj:section>
12.  <prj:section id="2">
13.  <def ik:on="12">Class </def>
14.  for <see ex="22">2D points</see>.
15.  <def ik:on="12">Class</def>
16.  of <see ex= "22">Line</see>
17.  and <see ex="22"> Rectangle </see>.
18.  </prj:section>
…
```

Fig.2. Part of XML documents for namespace use illustration. Line numbers are provided only for reference.

and used in some other context or may be replaced in the current context.

Tag name has to reflect the reason of its use. Tag attributes are used for providing additional information about a piece of information marked by the tag. For example on Fig.1 at line 2 there is tag *lecture*, which describes that the document is some lecture materials. The tag attribute *from* has a value "OOP with Java" and indicates which course this lecture is from. Another attribute of the tag *number* is for the lecture numbering, and so on.

Efforts of teachers have to be supported by a technical team in order to enable respective software systems to understand the tags that were introduced by the teachers. In this process the technical support group and the different kinds of software have all to deal with a number of sets of tags created by different teachers, or adopted from some learning objects standards. This problem of tags recognition has an effective solution by the use of XML namespace mechanism.

Fig.2 depicts part of a XML document after it has been processed by the technical team. In this example two namespaces are used. At line 4 a namespace-prefix *ik* is defined, which is associated with a private namespace of the teacher "http://www.yvc.ac.il/ik/Java@yvc/". At line 5 a namespace-prefix *prj* is defined, which is associated with a namespace of a project or area that the lecture belongs to, which is "http://www.yvc.ac.il/ELearnPrj/". At line 6 a tag is defined (not a tag attribute) without a namespace prefix, so it belongs to the same namespace as *ik* belongs to (due to line 6 defenition). Now any tag or attribute, which is approved by the project team (or group of teachers involved) has the prefix *prj*, and has the same meaning for any teacher's document. From the other hand a tag with prefix *ik* or without namespace prefix has a status of the "private" tag of the teacher.

On top of supporting the teachers through the creation of XML files, a major responsibility of the technical team is to enable reusability of learning materials. The support for the individual teacher should promote the reusability of learning materials by the same teacher (e.g. an example that demonstrates several principles, an exercise that serves also as an exam item etc.). For reusability among teachers, which can make E-learning commercially attractive, the technical team should look carefully into the tag's name "dictionaries" of the individual teachers, check for parallel notions and initiate meaning negotiation processes between teachers. Such processes, beside enabling a common dictionary, are very important for the college ongoing process of making sure learners are getting a coherent and relevant view of their field of study. As a result the set of such tags will be in project's common namespace. Indeed this is a process of bottom-up, local standards creation of learning objects.

6. DISCUSSION

Our approach for integrating E-learning in higher education emphasizes support for the teacher as opposed to support for the institute, because teaching in higher education is based intentionally on the individual teachers who are experts and researchers in the area they teach. Development of learning materials for E-learning is effort consuming, so the idea of reuse is very appealing. Several bodies developed standards regarding the metadata that is required to enable retrieval for effective reuse of learning objects. Governments around the world are spending large sums of money on initiatives that promise the development of learning objects, learning objects metadata and learning objects repositories. It seems sometimes that technology is the driving force, not teaching or learning. Friesen [5] describes some problems with this trend and suggests that they arise from the juxtaposition of narrow technical and specialized concepts with the general and varied dimensions and contexts of learning. We suggested a paradigm that involves the teacher in the design and the definition of metadata tags to ensure more influence on the respective teaching and learning. Moreover, when teachers gradually develop their vocabulary of metadata tags, a learning community of practice evolves.

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