EXPLOITING THE LEARNING OBJECT PARADIGM FOR SUPPORTING WEB-BASED LEARNING COMMUNITIES

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ABSTRACT
Since the early stages of the World Wide Web, Web-based learning communities have been constantly developed online. Among the primary objectives of their members has been to share digital learning resources and increase the community’s collective knowledge by communicating and collaborating online. Therefore, several web-based tools have been developed to allow the community members to exchange experiences and ideas. Moreover, research has shown that active learning is facilitated when the learners have the opportunity to interact with the actual learning material. Taking this into account, a number of tools have been developed, which allowed the community members to collaboratively discuss and annotate the learning content. At the same time, the sharing of digital learning resources has been boosted the last few years by the emergence of innovative learning and web technologies. One of the major contributions on this area has been the learning object paradigm, which defines learning material in terms of independent and self-standing objects that are predisposed to reuse in multiple instructional contexts. In this paper, we discuss how the learning object paradigm can be exploited to support the objectives of the web-based learning communities and we demonstrate the advantages of this approach.

KEY WORDS
Web-based learning community, learning object, collaborative annotation, educational metadata, application profile

1. Introduction
Since the early stages of the World Wide Web, Web-based learning communities have been constantly developed online. The communication and collaboration among their members have flourished based on the innovative technologies and tools which the Web has freely offered [1]. Among the primary objectives of the web-based learning communities have been the exchange of digital learning resources and the increase of community’s collective knowledge around a specific theme/topic through communicating and collaborating online [2][3]. Therefore, several web-based tools and environments have been developed to allow the members of the web-based learning communities to communicate and exchange experiences and ideas aiming to increase their common understanding and knowledge. Moreover, research [4][5][6] has shown that active learning is facilitated when the learners have the opportunity to interact with the learning material. Within this context, a number of tools have been developed, which allowed the community members to collaboratively discuss and annotate the learning content. At the same time, the sharing of digital learning resource has been boosted the last few years by the emergence of innovative learning and web technologies. One of the major contributions on this area has been the learning object paradigm, which defines learning material in terms of independent and self-standing objects that are predisposed to reuse in multiple instructional contexts [7]. Towards this direction, numerous learning object repositories have been developed worldwide and have been used in combination with educational metadata in order to support web-based communities in identifying, retrieving, sharing and exchanging learning objects [8]. In this paper, we discuss how the learning object paradigm can be exploited to support the web-based learning communities and to enhance their functionalities and operations. More specifically, we demonstrate the way that learning objects and educational metadata can be manipulated in order to effectively store how digital learning resources are collaboratively discussed, annotated and evolved by the community members in order to formulate the community knowledge. To this end, we present a learning object metadata application profile, which aims to describe the community-enhanced versions of learning objects, which have been collaboratively annotated by the community members. Finally, we present a prototype web-based environment, which utilizes the proposed approach to support web-based learning communities and we describe its main functionalities and use cases.

The present paper is structured as following: first, we examine the concept of web-based learning communities,
presenting their key characteristics and functionalities. Secondly, the notions of learning objects, educational metadata and application profiles are reviewed and we analyze how their utilization can be affected in the context of the web-based learning communities. Then, we present the proposed learning object metadata application profile (the WBLCP profile) and we elaborate on how it can encompass the community-specific characteristics of the learning objects. Finally, we present a prototype web-based environment, which was developed to help us evaluate the proposed approach.

2. Web-based Learning Communities

Web-based learning communities have emerged from the convergence of two separate types of communities: the web-based communities and the learning communities. Both of them have certain distinctive characteristics, which are partially inherited to the web-based learning communities. In this section, we present the key definitions and the basic properties of web-based, as well as learning communities.

Web-based communities have been one of the most common types of online communities, since the emergence of Internet. They have been defined as groups of people who share common interests and needs and who come together online [9]. They first appeared when Internet users started carrying out public discussions long enough and with sufficient human feeling to form online webs of personal relationships [10]. According to Johnson [11], these communities facilitate collaborative learning, so that the collaborative knowledge of the community is, eventually, greater than any individual knowledge of its members. In this context, learning communities are formulated aiming to support the processes of social construction of meanings, critical evaluation of others’ work, and collaborative creation and sharing of knowledge [3]. A learning community is characterized by the willingness of its members to share resources, accept and encourage new membership, regular communication, systematic problem solving and preparedness to share success [2]. According to Nachmias et al. [12], a learning community can be defined as a novel educational system based on the combination of three components: a community (social dimension), hosted by an appropriate environment (technological dimension), and embodying advanced pedagogical ideas (educational dimension).

Following the rapid expansion of the World Wide Web and the ongoing integration of Internet use in everyday activities, different types of web-based communities have been created to satisfy different needs of the participating individuals. Among them, a significant number of web-based learning communities have emerged, where members use web-based tools to facilitate their participation, communication, and collaboration aiming to contribute and share learning resources, as well as, to reach common learning goals.

Based on the above discussion, we can conclude that the basic characteristics of web-based learning communities are:

- Their members use web-based tools as means of communicating and collaborating.
- They share and exchange digital learning resources.
- They aim at improving their knowledge about the community’s domain of interest.

3. Tools for Supporting Web-based Learning Communities

The tools which are typically employed to support the web-based communities can be roughly divided into three major categories [13]:

- Asynchronous communications, including email, mailing lists, bulletin boards and news groups
- Synchronous communications, such as chat rooms and internet relay chat (IRC)
- Virtual worlds, such as Multi-User Domains (MUDs) and MUDs Object Orientated (MOOs).

In the context of web-based learning communities, the aforementioned web-based tools are usually embedded into more integrated systems, such as a Virtual Learning Environment (VLE) or a Learning Management System (LMS) in order to enrich the delivery of e-learning content with communication and collaboration features for the enrolled learning community members. In the following paragraphs, we present some indicative examples of such systems and of the tools that they provide for community support:

- VCampus Corporation (www.vcampus.com) utilizes the “PowerBlend Blended Learning” concept which provides various communication and collaboration options to its users, including discussion boards, live chat and shared whiteboards.
- Centra (www.centra.com) is a software application that enables online business collaboration, communication and learning. More specifically, Centra provides support for synchronous web conferencing, including chats, whiteboards and video teleconferencing.

Similarly, the majority of commercial e-learning systems provide community-support features, which are either synchronous, such as online chat, or asynchronous, such as discussion boards. According to Hardaker and Smith [14], the use of discussion boards can be effective; however, without strong link and reference to the material under discussion the dialogue can quickly drift away from relevancy and into argument and trivialities. Furthermore, research results [4][5][6] have shown that people tend to learn more effectively when they are able to interact in some way with the learning content. This is why we should consider providing tools which allow not only the communication and the collaboration among the web-based learning community members, but also permit the exchange of ideas, experiences and practices based on the observation and interaction with the learning content. By combining the knowledge and competences of the web-
Based on the above discussion, innovative web-based tools have been developed in order to support and promote the communicative and collaborative functions of web-based learning communities. A significant number of these tools is based on the principle of collaboratively annotating learning content. According to Glover et al. [15], by developing a system which allows users to share contextualized annotations with other learners, it is anticipated that a network of learners with a greater understanding of the underlying learning material can be formed. Some indicative examples of such tools are presented in the following paragraphs:

- The CASE environment [15] has been developed to allow users to add an additional layer of information to the Web learning content in the form of collaborative annotations. The developers of this system expect that by allowing the community members to collaborate on the learning material, the quality of learners’ online discussion will be improved through the integration of the learning context directly into the content design.

- Mole [16] is a system which combines exploratory learning with hypertext based material and collaborative learning through the use of annotations. Mole was designed to enable learners to take an active role in their learning by facilitating online annotation of the hypertext notes.

Nevertheless, there is still much which needs to be investigated to better understand how learning communities are developed and maintained, as well as, the ways in which different learning technologies can be used to support this [17]. In this context, the following section presents how the learning object paradigm can be employed to support and promote the functions of web-based learning communities, such as the sharing and exchange of learning resources, as well as, the construction of the community collective knowledge based on collaborative annotations.

4. The Learning Object Paradigm

The learning object paradigm has emerged during the past few years in order to accommodate the need for sharing and exchanging reusable learning resources on the Web. According to Wiley [18], a learning object can be defined as any digital resource that can be reused to support learning. Another definition from Polsani [7] defines a learning object as an independent and self-standing unit of learning content that is predisposed to reuse in multiple instructional contexts. Within this context, learning objects are accumulated in repositories and described with educational metadata [8], so that the interested parties are able to search, discover and retrieve the desired learning objects in an efficient and effective way. A key tool for this purpose is educational metadata. Next, we discuss educational metadata and application profiles and we examine how they promote the utilization of learning objects.

The educational metadata was built upon the notion of metadata that has been used to facilitate the discovery of digital resources since the early years of the World Wide Web. In general, metadata is “structured data about data”. In the context of resource discovery, descriptive metadata is a characterization that aims to represent the content of the resource. In the e-learning domain, due to the emergence of the learning object paradigm a number of initiatives were launched aiming towards the definition of a commonly accepted way of describing the learning objects with metadata. As a result, the Learning Technology Standards Committee (LTSC) of the Institute of Electrical and Electronics Engineers (IEEE) formed a working group to study and develop an accredited standard for Learning Object Metadata (LOM). This lead to the publication of the IEEE Standard 1484.12.1-2002 Learning Object Metadata in June of 2002. Nevertheless, a static metadata model, such as the IEEE LOM could not fully accommodate all possible requirements from different e-learning applications and the various needs of different educational communities. This fact has gradually lead to the emergence of the “application profile” concept. Application profiles have been used well before the emergence of educational metadata mainly for the adjustment or the combination of standards in order to meet application-specific needs. In IEEE standardization committees for learning technology, a "standards profile" is defined as "a technique of referencing (in contrast to defining) technical specifications... permitting the creation of a bundle of standards, each one tailored, extended, or constrained to meet the needs of the committee developing a standards profile... The point of using standards profiles is to reuse existing standards wording without having to recreate the words..." [19]. Furthermore, for Duval et al.[20], an application profile is an assemblage of metadata elements selected from one or more metadata schemas, and the purpose of an application profile is to adapt or combine existing schemas into a single package that is tailored to the functional requirements of a particular application, while retaining interoperability with the original base schemas. Based on the above definitions, we can conclude that an application profile is a customization of one or several standards to meet the needs and the requirements of a specific application in hand. In our case, the application field is web-based learning communities.

5. Towards Supporting Web-based Learning Communities

Figure 1 depicts an abstract diagram, which explains why and how the learning object paradigm can be used to support web-based learning communities.
As we can see, in a typical learning community scenario, a community member regularly offers to the community “raw” learning objects, which he/she has constructed or discovered on the Web. The offered objects can be, then, cooperatively discussed and annotated by the community members. As a result, the members’ knowledge is imprinted on the learning objects’ annotations, formulating the community’s collective knowledge. Thus, when a member discovers and draws a learning object from the community’s collective knowledge, the object includes the members’ collaborative discussions and annotations, namely, a potential capture of the collective knowledge of the community members on this particular learning object. Furthermore, the aforementioned process can help the contributors of learning objects to improve their understanding on the use of the particular learning object and possibly motivate them to construct and offer new “enhanced” learning objects to the community, based on the initial “raw” ones. This way, all the members can retrieve and offer “knowledge” from/to the web-based learning community and at the same time they contribute in building the community collective knowledge, which is reflected in the learning objects’ collection and the corresponding annotations created by the community members.

In the following paragraph, we will analyze thoroughly how exactly we can extend and exploit the learning object paradigm in order to support the web-based learning communities.

5.1 Exploiting the Learning Object Paradigm

Based on the previous discussion, learning objects can be seen in a whole new perspective in the context of web-based learning communities. More specifically, the community-enhanced learning objects can encompass the additional information layer, which is formulated by the collaborative discussions and annotations. This way, when a community member discovers and retrieves a learning object, it will contain the collaborative annotations and discussions, which capture and represent the community collective experiences. Furthermore, the community-specific learning object can be somehow linked with the original learning object. For example, there may be one original learning object, which will be collaboratively discussed and annotated by many communities. Therefore, each community will be able to produce one or more evolved versions of the original learning object by inserting community-specific annotations and discussions. In order to be able to track those different versions of a particular learning object, we can create a versioning in learning objects’ collections.

Hence, we can conclude that there is a need for imprinting an additional layer of information on the learning objects’ collections of the web-based communities. This layer comprises of:

1. The collaborative discussions and annotations of the learning object which are inserted by the community members.
2. The versioning information, which can be utilized to identify the original, as well as the community-enhanced versions of the learning object.

As it is expected, this additional layer of information can be imprinted on the educational metadata of the learning objects. Towards this end, we have predefined an application profile, specially adjusted to accommodate the aforementioned needs. Next, we present the Web-Based Learning Communities (WBLC) Application Profile and describing how it can capture the community-specific information of the learning objects.

5.2 The WBLC Application Profile

For our purpose, the base model, selected as the foundation of the educational metadata application profile, is the well-recognized educational metadata standard IEEE Learning object Metadata [21]. IEEE LOM consists of seventy six (76) individual elements which are encompassed into nine (9) main categories: General, Lifecycle, Metametadata, Technical, Educational, Rights, Relation, Annotation, and Classification. The design of the proposed application profile, which should capture the community-specific characteristics of the learning objects, was based on two main principles:

(i) Embedding community annotations in educational metadata records.

First of all, the category “annotation” of the IEEE LOM standard was selected in order to host the discussions and the comments of the community’s members about a learning object. In addition, some adjustments and extensions were made to the elements of the “annotation” category, so that the identity of the member, as well as, the identity of the web-based learning community could be determined. Therefore, a new element, called “community”, was added in order to identify the web-based learning community and the child “member_id” was appended in the “entity” element in order to determine the identity of the member of this community that authored the annotation. A visualization of the aforementioned adjustments and extensions is shown in Figure 2.
(ii) Employing learning object versioning in educational metadata records.

The versioning of learning objects was implemented through the utilization of the “lifecycle” and “relation” categories of the IEEE LOM. The “version” element of the “lifecycle” category has been used to include the version number of the learning object (Figure 3).

Additionally, the vocabulary of the “kind” element of the “relation” category was extended with the values “is version of” and “has version” in order to enable the connection of the various versions of the original learning object (Figure 4).

The resulted relationships among the different versions of learning objects are depicted in Figure 5.

6. Case Study: The eLand Web-based Environment

In order to evaluate the aforementioned approach, we have developed a web-based environment which provides the means for the web-based learning community members to discuss, comment and collaborate on a certain learning object. More specifically, the web-based environment supports the asynchronous communication of the community members and is organized around the “conference” concept. Every web-based learning community offers a number of conferences, which were initiated by individual members (“initiators”) in order to demonstrate a certain learning object. The other community members can join the conference (“participants”) in order to communicate and collaborate by inserting discussions and comments about the demonstrated learning object. The screenshot presented in Figure 2 depicts the developed web-based environment.

As we can see, the web-based environment comprises of three distinct areas: the Learning Object Player, the Comments and the Discussions areas. The Learning Object Player is responsible for the display of the conference’s learning object. The displayed learning object can be any type of digital learning resource, e.g. text, hypertext, image, sound, video and interactive objects like java applets and flash animations. The Discussion area enables the display, insertion, reply and search of discussions, namely generic observations concerning the whole of the learning object. On the other hand, the Comments area enables the display, insertion, reply and search of comments, that is observations concerning a specific part or frame of the learning object.

In order to better understand the aforementioned functionalities, we describe, next, an indicative usage scenario of the web-based environment. The scenario involves a web-based learning community of teachers, which communicate and collaborate through our environment in order to learn how to use educational software in their classrooms. Let us suppose that a certain teacher has found a chemistry lab simulation in the Web and he wishes to share this digital learning resource with the rest of the community. In this stage, the resource has little value for the community members, since it contains little information about the community’s domain of interest, namely the usage of the chemistry lab simulation in the classroom. However, if a teacher initiates a conference about this learning object, the collaborative discussions and comments of the community members will provide added value to the object, since they will possibly contain useful information about the various ways that the chemistry lab simulation can be used in the classroom. Furthermore, this kind of communication and
collaboration may motivate a conference participant to construct and provide an evolved learning object based on the original “raw” learning object. For example, a teacher could provide a video demonstrating an integrated chemistry experiment, which is based on the chemistry lab simulation and aims to educate the students about a specific chemistry principle.

7. Conclusion

In this paper, we have presented an approach for exploiting the learning object paradigm in order to support web-based learning communities. The members of the web-based learning communities draw and offer “knowledge” from/to the community in the form of learning objects, namely digital resources that can be reused to support learning. However, the actual community knowledge is expressed and captured, while the members collaboratively discuss and annotate the available learning objects by employing their knowledge in the community’s domain of interest. In addition, the process of discussing and commenting usually results in community-enhanced versions of learning objects, which encompass the community knowledge that emerges from the members’ collaborative discussions and comments. Based on the above ascertiations, we have proposed our approach of exploiting the learning objects paradigm in order to support the purposes and the objectives of web-based learning communities. In this approach, we manipulated the IEEE Learning Objects Metadata standard in order to embed community annotations and employ versioning in learning objects’ collections. Finally, we have presented a web-based environment, which implements the proposed approach in order to capture the annotations of the community members and to track the evolution of the community learning objects.

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References: