Online Medical Informatics Education: Efforts to Realign Classic Approaches with new Developments

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Abstract

As technologies of information and communication are integrated incrementally with all facets of everyday life, it is reasonable to expect a penetration into educational procedures as well. This is also true for the case of Medical/Health Informatics. In this paper, we describe our approach to facilitate the provision of online medical informatics modules with all those tools (Moodle) and standards (SCORM, HealthcareLOM) required so as to allow for a proper electronic provision of our modules. The effort is made against the traditional and ineffective concept of simply converting the classical learning material into its corresponding digital form; it is rather attempted here to fully follow the whole educational process by trying to achieve the educational objectives and learning outcomes in parallel to creating and structuring the digital material. Web 2.0 technologies are also incorporated into this process.

1. Introduction

A few years ago, the International Medical Informatics Association (IMIA) agreed on international recommendations in health/medical informatics education [1]. These were centred on the educational needs for healthcare professionals to acquire knowledge and skills in information processing and information and communication technologies, under a three-dimensional framework. IMIA recommendations divided learning outcomes into three levels of knowledge and practical skills, namely, introductory, intermediate and advanced. Furthermore, the knowledge and skill levels were classified into domain areas of knowledge and skill.

The Laboratory of Medical Informatics at the Medical School of Aristotle University of Thessaloniki (AUTH), Greece, offers undergraduate courses in Medical Informatics to medical students since 1990. Along the guidelines set by IMIA, two post-graduate level programs were designed in 1998 to lead to the acquisition of both MSc and PhD degrees [2]: one of them was more "technical" leading to degrees in "Medical Informatics", while the other was more "Medical" leading to degrees in "Medical Research Technology" (this has been redesigned and renamed into "Medical Research Methodology" in 2004). Both our undergraduate courses (Medical Informatics I, II), as well as, the courses we run within the latter post-graduate program (Medical Informatics, IT & telematics in healthy care quality) are offered to Medical students and are, therefore, blended with a proper "user-and-application orientation" concern.

During the last decade, however, there has been an enormous expansion of available knowledge, and a clear demand for new techniques that can penetrate into and enhance the educational procedures. Information and communication technologies (ICTs) have geared an explosion of online Education by facilitating the use of e-learning environments and standards [3]. It is imperative that programs and courses designed back in 1998 need to be revisited not only with the notion of technological advancement driving the field of Medical Informatics itself and thereby requiring updating, but also due to the fact that courses need to follow developments in online learning, continuing medical education, global education, social computing (Web 2.0), sharing teaching material etc.

The aim of this paper is to show the approach we have followed in shaping our courses on Medical Informatics properly by using open e-learning

platforms/environments, as well as, educational standards that allow for the interoperability of teaching materials. In addition, student interaction and participation is enriched through the use of Web2.0 technologies. This approach is demonstrated through an example providing some details of a module on Electronic Health Records offered to post-graduate medical students at AUTH.

2. Methods, Tools and Material

2.1 A different approach on Education

In contemporary years, there is an inherent interplay between technological innovation and shifting perceptions: new technologies are initially introduced as solutions to problems, and slowly but surely, the integration of technology into one's mind leads to a fundamental perception change brought about by new technology [4]. To this extend, the introduction of e-learning technologies had the same effect. Initially the use of these new technologies consisted of almost copying existing courses and transferring them from the classroom to the Web [3]. However it is vital to replace the static reuse of content delivery by an immersive learning process through interactivity and enabling technologies; the latter will lead to delivery through context.

2.2 Useful Tools and Standards for Online Education

Of course, the educational process starts with the design of the module (or course or seminar) itself, continues with the selection of teaching methods or strategies that will accommodate the design requirements, continues with the development of the content, and finishes with the evaluation (of the teachers and the students in general).
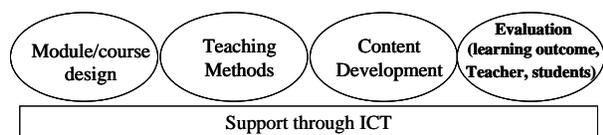

Figure 1: ICTs should support every step of the educational process.

Nowadays, any contemporary material that is going to be used for online courses or seminars should be fulfilling requirements such as Interoperability, Accessibility, Reusability, Durability, Maintainability and Adaptability, so that the material remains credible,

up-to-date and tracks changes and developments of medical techniques and standards through time. Central to this activity is the employment of the emerging e-learning standard, namely, SCORM, Shareable Content Object Reference Model [5]. SCORM has been designed as a set of eXtensible Markup Language (XML) based specifications that can define, manage, access and deliver modular educational objects so that they are easily shared among different e-learning management systems. There are numerous e-learning platforms that fulfil the aforementioned requirements, but one of the most competitive and highly evolved open source one is Moodle [6].

Furthermore, the educational material uploaded to the learning platform should be created either by designing and implementing the SCORM package, or by the use of SCORM editors that create the SCORM Packages through a user-friendly interface. One of the most well known open-source SCORM editors is "eXe" an eLearning XHTML editor [7]. Language support is important herein. Since only the eXe editor supports Greek language, it has been selected in the case of this work.

Finally, a growing interest has been noticed for the last generation of Web-based collaboration ware (known as Web 2.0 tools), namely wikis, blogs and podcasts; these are highly adopted for health-related professional and educational services online [8].

2.3 Enhancing the reusability of the Created Content

Learning Objects (LOs), as independent units of educational material targeting to specific training needs, constitute one of the main research topics in the e-learning community. Many research initiatives in the field address the issue of LOs' reusability, via designing standards (official or de facto), specifications and reference architectures. Types of e-learning standards and specifications include among else the following: (a) metadata standards, addressing attributes used to describe LOs, such as IEEE-LOM, HealthcareLOM (extension of LOM to healthcare), Ariadne Metadata Specification (which provided input to LOM), Dublin Core, etc.; and (b) packaging standards, regulating assembly of LOs and complex units of learning, such as IMS Content Packaging/Learning Design, SCORM and HealthcareSCORM (extension of SCORM to healthcare supplementing the requirements for medical education that are not included in the existing IEEE LOM by a Healthcare Metadata category using custom vocabularies) [9], [10].

3. Implementation

An illustration of the process we follow to achieve the educational procedures shown in Figure 1 is further explained in Figure 2.

Healthcare LOM consists of 10 categories, each describing a certain group of metadata. For example, the "General" category provides general information of the LO, such as the title, the content outline, the keywords or phrases describing the object and the location of the LO. Information about what is the expected lifetime of the object and when new updates should be provided and the contributors are defined in the "lifecycle" category. The element denoting that, this LO is SCORM conformant, exists in the "technical" category.
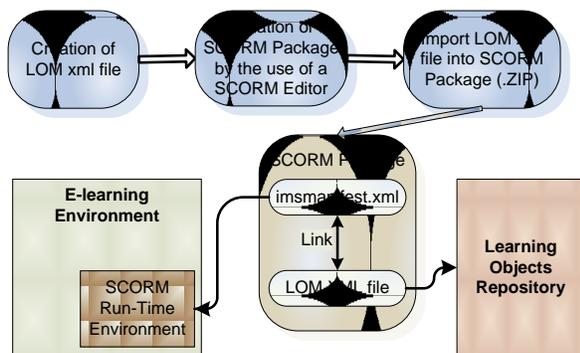

Figure 2: Overall roadmap in describing a module using Healthcare SCORM, and SCORM editors (eXe in our case) and E-learning environments (Moodle in our case).


```xml
<?xml version="1.0" encoding="UTF-8"?>
<lom xmlns="http://ltsc.ieee.org/xsd/LOM" xmlns:xsi=
"http://www.w3.org/2001/XMLSchema-instance" xmlns:hx=
"http://ns.medbiq.org/lom/extend/v1/" xsi:schemaLocation=
"http://ltsc.ieee.org/xsd/LOM healthcarelom.xsd">
    <general>
        <identifier>
            <catalog>URL</catalog>
            <entry>http://kedip.med.auth.gr/lomiedu/course/view.php?id=26</entry>
        </identifier>
        <title>
            <string language="en">EHR (Electronic Health Record)</string>
        </title>
        <language>en</language>
        <description>
            <string language="en">Types of Hospital Information Systems (HIS) & The different kinds of HIS goals</string>
        </description>
        <description>
            <string language="en">Definition of EHR - terminologies & Paper vs electronic HR : relative merits</string>
        </description>
        <description>
            <string language="en">EHR contents (types) & Data vs information</string>
        </description>
        <description>
            <string language="en">Managing the EHR (functions/operations) - prerequisites (infrastructure, network) & Structuring the EHR - different kinds of organizing the EHR</string>
        </description>
        <description>
            <string language="en">Integrating the EHR within the HIS & Examples of HIS and use of EHR</string>
        </description>
        <description>
            <string language="en">Structured Data Entry in EHRs & Describing the knowledge base in EHRs</string>
        </description>
        <aggregationLevel>
            <source>LOMv1.0</source>
    ...
    ...
    <educational>
        <description>
            <string language="en">Basic module in Medical Informat an postgraduate course intended for medical science students (e.g Medical Research Methodology/Technology, general educational progr residents, etc)</string>
        </description>
            <descri...
            <descri...
        </description>
        <interactivityType>
            <source>LOMv1.0</source>
            <value>mixed</value>
        </interactivityType>
        <learningResourceType>
            <source>LOMv1.0</source>
            <value>exercise</value>
        </learningResourceType>
        <learni...
        <interactivityLevel>
            <source>LOMv1.0</source>
            <value>high</value>
        </interactivityLevel>
        <semanticDensity>
            <source>LOMv1.0</source>
            <value>high</value>
        </semanticDensity>
        <intendedEndUserRole>
            <source>LOMv1.0</source>
            <value>learner</value>
        </intendedEndUserRole>
        <contex...
        <typica...
        <difficulty>
            <source>LOMv1.0</source>
            <value>medium</value>
        </difficulty>
        <typicalLearningTime>
            <duration>PT12H30M</duration>
            <description>
                <string language="en">lecture: 2-4 hours (dependin educational context), video: 10 min, discussion: 1-2 hours, readin
    ...
```

Figure 3: XML Metadata used in the description of the EHR module

The most interesting category is "educational" where the educational and pedagogic characteristic of the LO are described. Within this category we described the Predominant mode of learning, the resources types of the LO and the languages used, as well as, information about the prospective learning hours, the way that it should be apportioned within the sub-modules of the LO, the teaching methods & strategies and comments on how this object is to be used by an educator other than the creator. Figures 3 and 4 illustrate how these metadata are utilized for one of our modules (EHR). Last, but not least, we have incorporated Web 2.0 tools within the SCORM descriptions as shown in Figure 5.

4. Conclusions

Learning Objects, as independent units of educational material targeting to specific training needs, constitute one of the main research topics in the e-learning community. Many research initiatives in the field concern the issue of LOs' reusability. However, not much is found on these grounds in the Medical Informatics community, within which, in turn, much is reported along medical informatics standards and their educational value [11]. It is only recently that such efforts have appeared [9] geared by MedBiquitous - a non-profit, international group of professional medical and healthcare associations, universities, commercial, and governmental organizations dedicated to advancing healthcare education through technology standards that promote professional competence, collaboration, and better patient care.

Therefore, there is a strong need for articles like the present one that illustrate the approach followed in order to merge technological and standards evolutions in education with advancements in the field of medical informatics, so as to offer higher quality programs/courses. In fact, this has been the main aim of our effort. Currently, this approach is being evaluated within our post-graduate Medical Informatics course to medical students. Active student involvement is sought through participating in discussion forums and wikis/blogs (e.g. commenting on a hospital information systems paper), thereby fulfilling some of the learning outcomes set by the educators. At this point, it has to be mentioned, that one of the current inefficiencies of our approach lies exactly with that. There are no pre-defined metadata to be used as learning outcomes (competencies) and therefore, we are just utilizing the mere educational objectives descriptions. It is expected that the upcoming availability of the IEEE Reusable

Competency Definitions (RCD) and the Simple Reusable Competency Map Standards for Learning Technology [9] will resolve this problem.
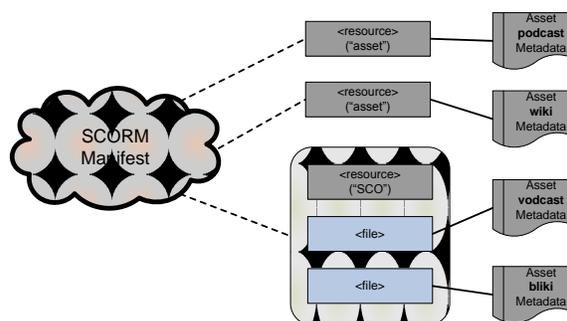

Figure 5: Asset Metadata for Web 2.0 tools in SCORM.

5. References

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MODULE: Title of the Module	`<general>` `<title>` `<string language="en">Title</string>` `</title>`				
creator `<lifecycle>` `<contribute>` `<role>` `<value>author` `</value>` `<entity>BEGIN:` `VCARD\nFN:BamidisPanagiotisEND:VCARD` `</entity>`	name, institute and email	**languages of instruction** `</educational>` …. `<language>en</language>` `<language>gr</language>` `</educational>`	principal environment within which the learning and use of this object is intended to take place, e.g. undergraduate preclinical, undergraduate clinical, postgraduate, residency, continuous education, etc	**type** `</educational>` `<learningResourceType>` `<source>LOMv1.0` `</source>` `<value>` exercise` `</value>` `</learningResourceType>`	e.g. exercise, questionnaire, figure, index, exam, problem statement, simulation, diagram, graph, slide, experiment, self assessment, presentation slides, worksheet, video, reading material, exam sheet, graph, etc.

copyright
`<copyrightAndOtherRestrictions>`
`<source>LOMv1.0</source>`
`<value>educational objective</value>`
`</copyrightAndOtherRestrictions>`
	whether copyright or other restrictions apply to the use of this object	**learning outcomes**
		`<classification>`
		`<purpose>`
		`<source>LOMv1.0`
		`</source>`
		`<value>educational objective</value>`
		`</purpose>`
		`<description>`
		`<string language="en">`
		Description of learning outcomes`</string>`
		`</description>`
			what students will know and be able to do as a result of engaging in the learning process of this specific educational object	**instructions for use**
				`<educational>`
				`<description>`
				`<string language="en">`
				instructions for use
				`</string>`
				`</description>`
					comments on how this object is to be used by an educator other than the creator

teaching methods & strategies
`<educational>`
`<description>`
`<string language="en">`
Educational context description
`</string>`
`</description>`
	lecture, discussion, case study, problem solving, etc	**educational context**
		`<educational>`
		`<description>`
		`<string language="en">`
		Educational context description
		`</string>`
		`</description>`
			principal environment within which the learning and use of this object is intended to take place, e.g. undergraduate preclinical, undergraduate clinical, postgraduate, residency, continuous education, etc	**instructions hours / workload**
				`<typicalLearningTime>`
				`<duration>`
				PT12H30M
				`</duration>`
				`<description>`
				`<string language="en">`
				General description of LO time distribution
				`</string>`
				`</description>`
				`</typicalLearningTime>`
					approximate or typical time it takes to work with this object

educational goals and objectives
`<classification>`
`<purpose>`
`<source>LOMv1.0`
`</source>`
`<value>educational objective</value>`
`</purpose>`
`<description>`
`<string language="en">`
Description of goals
`</string>`
`</description>`
	broad purposes or goals – although in general goals should be aspirational at a higher course level, in this case the goal can be more specific and achievable	**keywords**
		`<general>`
		`<keyword>`
		`<string language="en">`
		keywords or phrases
		`</string>`
		`</keyword>`
		`<keyword>`
		`<string language="en">`
		keywords or phrases
		`</string>`
		`</keyword>`
			keywords or phrases describing the object	**indicative bibliography**	a list of basic references and/or other related educational resources

content outline
`<general>`
`<description>`
`<string language="en">`
content outline
`</string>`
`</description>`
	description of the content of the educational object	**target institute & course**
		`<healthcareMetadata>`
		`<healthcareEducation>`
		`<targetAudience>`
		`<audienceCategory>`
		Audience category
		`</audienceCategory>`
		`<profession>`
		`<string language="en">`
		target profession
		`</string>`
		`</profession>`
		`</targetAudience>`
			institute and specific course the object will be incorporated in – indicate a name of the person responsible to incorporate the object into the curriculum	**life cycle**
				`<lifeCycle>`
				`<version>`
				`<string language="en">`
				1.0`</string>`
				`</version>`
				`<status>`
				`<source>`
				LOMv1.0`</source>`
				`<value>`*lifetime description of the object* `</value>`
				`</status>`
					what is the expected lifetime of the object – when new updates should be provided

Figure 4: Metadata used in our approach by use of Healthcare SCORM.