© *The Journal on Information Technology in Healthcare* 2009; **7**(4): 233–243

Social Networking for Learning Object Repurposing in Medical Education

Eleni Kaldoudi, Nicolas Dovrolis, Stathis Konstantinidis, Panagiotis Bamidis**

School of Medicine, Democritus University of Thrace, and * School of Medicine, Aristotle University of Thessaloniki, Greece.

ABSTRACT

Today there is an abundance of up-to-date highly specialised medical educational content created by medical and health related academic institutions and available in digital format on the internet. Such educational content includes learning objects of conventional types, content unique in medical education and a variety of alternative educational content types, either reflecting active learning techniques and tacit knowledge building experiences and/or stemming from newly introduced Web 2.0 technologies. Such content is often shared among different educators and is enriched, adapted and in general repurposed so that it can be re-used in different contexts. This paper discusses educational content and content repurposing in medical education, i.e. changing a learning object initially created and used for a specific educational purpose in a specific educational context in order to fit a different new purpose in the same or different educational context. It presents different repurposing contexts and an overview of the current state on content repurposing. Finally, it proposes a novel approach to content repurposing via social networking of learning objects.

INTRODUCTION

During the past ten years we have experienced the development of the so called 'information society', characterised by mass information seeking and based on the distribution of pre-defined and standardised digital data, mainly via the internet. Current and emerging trends in information systems and communication services mark the shift towards a 'knowledge society', that is, a society based on knowledge as a value. This emphasises cognitive advancement and consequently involvement of each individual. The growing use of the internet not only modifies quickly and habitually the way people work but also leads the race in this educational revolution. The emerging Web 2.0 paradigm however is promising to bring about yet another

Correspondence and reprint requests: Eleni Kaldoudi, Assistant Professor, School of Medicine, Democritus University of Thrace, Greece. E-mail: kaldoudi@med.duth.gr.

new situation, where the conventional human mediator as well as the electronic mediator in the face of the internet and the web is replaced by virtual dynamic communities of peers that learn and advance together.

Continuous advances in medicine and biological sciences is leading to an ever expanding core knowledge relevant to medical practice[1]. Medical academic institutions are increasingly required to invest in order to enrich their curricula by developing highly specialised courses and corresponding educational content. Educational content in medicine addresses both aspects of medical education, namely theoretical instruction and clinical apprenticeship. Thus it includes a broad range of learning object types and is customarily produced by a variety of sources. Its uniqueness lies in the fact that it is produced by academics and clinical teachers based on accepted scientific knowledge, as well as by clinicians and researchers in the field, be it the hospital, the medical ward or the clinical and/or research laboratory[2]. Another important factor that adds to the complexity, variability and uniqueness of medical educational content is the growing penetration of active learning approaches in medical education[3]. Contemporary medical education, to a large extent is centred on case-based or problem-based learning and other small group instructional models, collaborative organisations to support student-faculty interactions, and technology-enhanced educational tools. Furthermore, new integrative curricula structures are proliferating in the form of multidisciplinary block courses in the basic sciences, blended clerkships (combining two or more specialities into one clinical experience), and integrated clinical experiences in multidisciplinary healthcare settings. Under the above considerations, educational content in medicine corresponds to a wide variety of objects. These include[4,5]:

- Conventional educational content types also used in other areas, such as lecture notes, books, lecture presentations, examination questions, practicals, scientific papers, graphs, images/videos, algorithms and simulators.
- Educational content types unique in medical education, such as teaching files, virtual patients, evidence based medicine documents, objective standard clinical examinations, clinical guidelines, anatomical atlases, electronic traces of images, etc.
- Alternative educational content types, either reflecting active learning techniques (extensively used in health education) and/or stemming from newly introduced Web 2.0 technologies, such as problem/case based learning sessions, serious games (2 dimensional/3 dimensional – 2D/3D), web traces, wikis, blogs/discussion forums, etc., including the notion of medical expert instruction in whichever form this may be presented.
- User generated content, closely related to the above category of active content types, referring to the collection of user interactions with an active learning content item, which by itself can be later used as an educational item of its own, for example to highlight common mistakes and misconceptions/misconducts, good and bad habits, behavioural trends, etc.

Considering the state-of-the-art nature of medical educational content, it is imperative that such content can be repurposed (i.e. a learning object initially created and used for a specific educational purpose in a specific educational context is changed in order to fit a different new purpose in the same or different educational context), enriched, and embedded effectively into respective medical and other related scientific curricula, clinical practice and continuing education, as well as public dissemination and awareness.

This paper discusses different perspectives of content repurposing in medical education, and gives an overview of the current state in the field of educational content repurposing. Finally, the paper presents a novel approach for capturing the repurposing of medical learning objects in collaborative educational networks. Repurposing of learning objects is described using metadata which can be edited collaboratively in a social network, either by the instructor, or the student (and eventually even by software itself). The social network is also used to capture and depict the relationships amongst different repurposed medical learning objects. The ultimate goal is to provide a conceptually different approach to learning object search and retrieval via 'social' associations amongst learning objects.

CONTENT REPURPOSING IN MEDICAL EDUCATION

The term 'repurposing' means changing a learning object initially created and used for a specific educational purpose in a specific educational context in order to fit a different new purpose in the same or different educational context. Medical educational content repurposing can be of a variety of types:

- **Repurposing in terms of the actual content**. In order to account for state-of-the-art developments and/or address different educational contexts, the need arises to add content or mutate content of a learning object, integrate content from different learning objects, fuse different learning objects, reorganise existing content, or a combination of the above.
- **Repurposing to different languages.** Although many higher education institutions in Europe often use educational resources written in non-native languages (mainly English), and while some courses (especially at the postgraduate level) may also be taught in English, the rule is that higher education is and should be delivered mostly in the native language. This is especially a mandate in healthcare, as acquired knowledge should be finally communicated to the patient.
- **Repurposing to different cultures**. Common experience shows that there is also a demand for content localisation. In the case of medical, and scientific content in general, this mainly refers to different legislation and local medical regulations, different laboratory test reference values and units as well as different medical requirements of various ethnic groups. Moreover, we should also consider the cultural differences among different user groups within the same national healthcare system.

- **Repurposing for different pedagogical approaches**. Pedagogical cultures present in healthcare education range from conventional lecturing to clinical practice and a variety of active learning methodologies. All of these educational approaches would require the same content to be presented in a different way, e.g. a lecture presentation and notes for the conventional teaching approach should be restructured and repurposed to be presented as, for example, a list of questions and answers or as a series of real world problems, or a collection of interactive teaching files in the case of a more active learning episode.
- **Repurposing for different educational levels**. A common reason for repurposing is to address different educational objectives in terms of difficulty or educational level. In this case content needs to be adapted to match different pre-requisites and consecutively different learning outcomes. In medical higher education, apart from the obvious undergraduate and postgraduate levels, we also have to consider residents, speciality training and continuing life-long education during medical practice.
- **Repurposing for different disciplines or professions**. Healthcare education addresses a multitude of professions, ranging from medical doctors and nurses to laboratory technicians, scientists and administrators. Thus, the same educational content often needs to be adapted in order to be delivered to an audience of a different professional background.
- **Repurposing to different content types.** As described previously, contemporary medical education exhibits a considerable variety of content types. Thus a common aim of repurposing is to change a learning object from one type to another. For example, a lecture presentation to a didactic problem, or course notes to a presentation and so on.
- **Repurpose for different technology**. Finally, we should account for changes to a digital learning object that affect its technological characteristics, such as digital format, digital size and quality (e.g. for images), metadata description scheme, computer platform, etc.

Although not formally addressed as such, educational content repurposing is what any educator is routinely engaged in when preparing a new educational experience, including the educational content. Customarily, when an educator sets the context and goals of a new educational experience, he/she will review existing content and/or search for new relative content and then repurpose and reorganise content to fit the purpose of the new educational experience. Therefore, in medical education and in education in general, the notion of repurposing becomes a central requirement.

Apart from this simple requirement to easily create new content for a different educational context, the common needs that push for research into the field of content repurposing include the following:

- Automatically repurpose learning objects

- Keep track of a learning object evolution, in order to (a) give credentials to original authors and sources, and provide information that may have implications for the object's quality, validity, specificity, etc; (b) record and resolve intellectual property rights issues of content as it is being repurposed and reused; and (c) update a learning object, or a fragment of it, when its parent object is updated, changed, terminated, etc.
- Provide a different view in learning object search and retrieval via associations created during repurposing

The structure of an educational object that is repurposed may not necessarily change, but the key differences should be emphasised, described and organised in terms of a variety of tags, including time evolution, and other attributes. In order to allow for content repurposing we have to view content in terms of autonomous learning objects (LO) that are described via appropriate metadata. The purpose or the goal of each LO in a particular learning context should be stated, including the learning context itself, learning approach, the audience, learning objectives, relationships to other LOs and delivery context.

Learning Objects, as independent units of educational material targeting 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. In general, the purpose of e-learning standards is to provide standardised data structures and communication protocols for e-learning objects and cross-system workflows. E-learning standards can be organised into various general categories including metadata standards that specify the metadata used to describe LOs' attributes, such as the authors, title, and languages[6]. Such descriptions can be published along with the LOs to facilitate their search and retrieval. Currently, the IEEE LOM (Learning Object Metadata) XML scheme seems the most prominent standard for describing learning objects (IEEE 1484.12.1-2002)[7], as it derives from a number of related standardisation initiatives. LOM defines a wide range of metadata to classify and characterise LOs, which include: overall description (cataloguing, annotations, and associations and relationships with other LOs), technical data (file size, format, installation/usage descriptions), educational data (educational purpose, learning objectives, classification), and management data (intellectual property rights). However, there are no generally accepted conventions for properly describing learning objectives or the learning context, and although attempts have been made (such as CLEO – Customized Learning Experience Online, and Educational Markup Languages) these only capture some of the semantics; thus more complex models are needed[8].

Using a standard such as LOM is not always easy, as:

- Filling in all the data requires effort.
- Not all data is relevant and useful to a particular author and/or LO prospective user.
- Many different metadata sets exist, with a considerable overlap.

- Some attributes are subjective, but a number of them are objective, e.g. difficulty. Some other attributes have predefined values, which themselves are objective, and there is great difficulty in achieving universal consensus about what they should mean.
- Thus, different communities give different meanings and use different descriptions (e.g. extensions/alterations to the standard, such as Healthcare LOM, etc), really breaking down the notion of the standard.

Considerable research work has targeted the automatic learning object repurposing. For example, the common case of creating a new PowerPoint presentation out of a repository of related presentations[9]. In this work, the text of the PowerPoint (slides, notes pages, etc) is extracted and stored as text. Text is then parsed and augmented with tags which are used to annotate each word with its syntactical form. This approach allows users to dynamically extract similar LOs, query by example and document-level similarity checking (at document, at topic and at a slide level). With a similar target, the ALOCOM (Abstract Content Model) project created an ontology for LOs and their components (types of components and relationships based on an ontology of the structure of the learning content)[10]. This ontology is then used to build a framework that disassembles PowerPoint presentations. These components are reorganised into more meaningful object types (e.g. definitions, examples, references, introductions, summaries) in an automatic way. Analogously to the ALOCOM work, the TRIAL-SOLUTION project defines an ontology for learning objects that includes mathematical categories like definition, theorem, proof, or example, with the goal to create and deliver personalised teaching materials that are composed from a library of existing documents on mathematics at undergraduate level[11]. The perspective of domain specific ontology for learning object management is commonly adopted. A prominent example is the ARIADNE project, which has put a lot of effort to enable LO sharing and re-use, but has resulted in a complex and hard to use guideline as it basically reflects the metadata standard rather than the characteristics, aims and requirements of the end user[12].

CONTENT REPURPOSING IN COLLABORATIVE, SOCIAL NETWORKS

In this paper, we propose a different metaphor to manage learning object repurposing, following the emerging paradigm of Web 2.0. The term Web 2.0 encompasses a whole new meaning and a collective emergent behaviour of the use of internet technologies, tools and applications that create networks and communities of users (both humans and programs). One of the representative applications of Web 2.0 is social networking websites that focus on creating online communities of individuals who publish their content and activities whilst exploring others content and activities. Such sites cover a variety of topics and provide most of the Web 2.0 tools and technologies for users to interact, such as wikis, blogs, etc. As a consequence

an astonishing number of simple or more sophisticated social networking sites are currently emerging ranging from mere casual social networking to collaborative web bookmarking and searching, school teacher rating, collaborative document and spreadsheet editing, etc. A striking example that fully realises the Web 2.0 paradigm is **Delicious** (http://delicious.com/), a collaborative bookmarking website, that allow users to share their bookmarks, create their own tags and dynamically organise bookmarks (on any possible topic and within any context, including educational subjects and contexts), thus creating a vibrant bookmark folksonomy, i.e. a system of classification derived from the practice and method of collaboratively creating and managing tags to annotate and categorise content that evolves over time. The tags themselves are chosen arbitrarily. They do not correspond to any schema and therefore can have different meanings from one user to the next.

The proposed social network can be viewed as two distinctive and interacting networks. The first one is a network of persons, including authors, potential authors and final users of learning objects (students, or teachers or others, e.g. educational managers). The second is a network of published learning objects. The network of persons is functioning in a way similar to other social networks. Persons can interact with each other via their personal blogs, declare friends and create their own interest groups. At a different level, learning objects themselves create an equivalent social network with interactions with other learning objects as well as with persons. These interactions are variable and dynamic, thus creating an evolving, user centric and goal oriented organisation of objects and persons, based on social dynamics.

From the point of view of the objects' social network, interactions are more complex. Each object is described by a variety of fields that capture its basic characteristics as well as features pertaining to repurposing. Basically such fields include:

- Author and author details
- Date of creation (after the LOM data element 2.3.3 Date)
- Keywords, that may be free user defined tags (after the LOM data element 1.5. Keyword)
- Language (after the LOM data element 1.3. Language)
- Description, that is free text and may also contain user defined tags (after the LOM data element 1.4. Description)
- Type, i.e. exercise, simulation, questionnaire, diagram, figure, graph, index, slide, table, narrative text, exam, experiment, problem statement, self assessment, lecture, etc (after the LOM data element 5.2. Learning resource type)
- User role, i.e. teacher, author, learner, manager, etc. (after the LOM data element 5.5. Intended End User Role)
- Audience level, i.e. undergraduate, postgraduate, resident, specialist, public (after the LOM data element 5.6. Context)
- Audience profession, i.e. medical, nursing, biology, informatics, administration, engineering, etc.

- Audience culture, i.e. ethnic or national group reflected in the content
- Copyright (after the LOM data element 6.2. Copyright and other restrictions)

The LO itself can be a resource in a Learning Management System (LMS), another repository, a resource on the web etc., and its location is stated by the field URL (Uniform Resource Locator), (after the LOM data element 4.3. Location), or it can also be an associated file or files uploaded in the social network itself.

The organisation of LOs is dynamically created in three different distinctive levels, as shown in Figure 1. A mostly straightforward organisation is created via the group 'my learning objects' that each author creates to include all learning objects he/she has created, either as the principal author or as the result of repurposing. Then, a second complex and dynamic organisation is created based on the user generated tags that have been declared for each of the LO description fields. Finally, a third type of organisation is a hierarchical one, describing the repurposing history of each object. Upon creation, each object declares other objects from which it has been repurposed, thus creating a group of 'parents'. At the same time, each object exhibits a group of 'repurposed to' objects, as 'children' objects. This group is dynamically created whenever a new object is created as a repurposed instance of an existing one. Learning objects profile in the social network also includes a blog, for author comments and most importantly for comments from users, including other authors and/or students and teachers that have used the object and can comment on its value, quality, repurposing potential, etc.

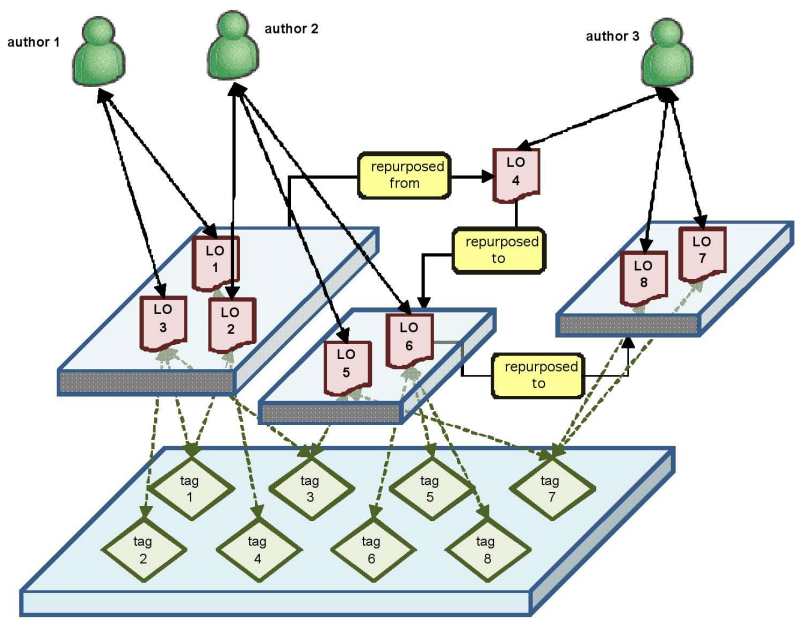

Figure 1. *Three level LO organisation in the proposed social network*

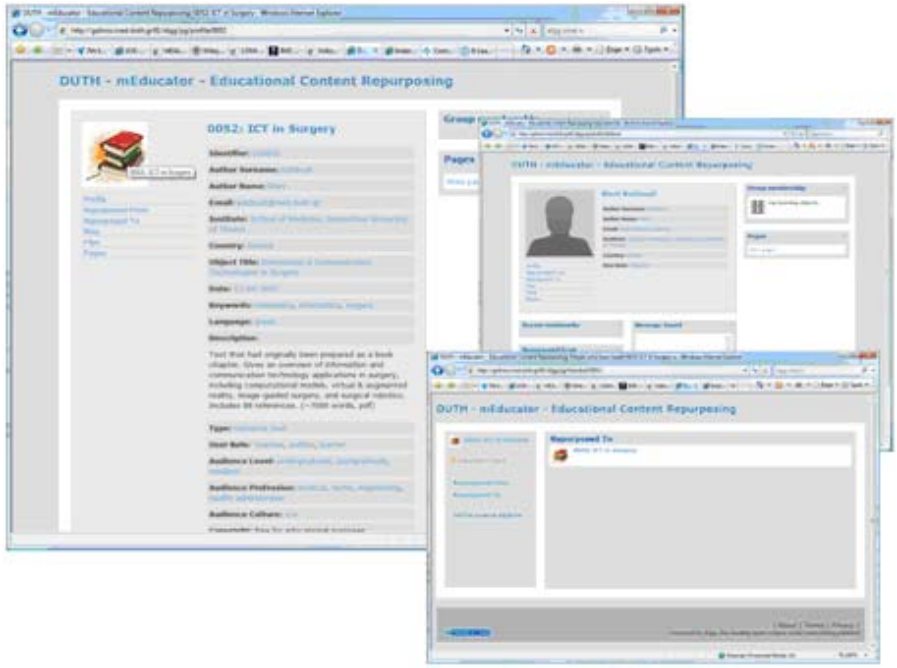

Figure 2. *Representative screens of the LO social network, showing an object's profile, an author's profile and the objects that were created by repurposing this object*

The current deployment of this learning objects social network is implemented on http://galinos.med.duth.gr:81/elgg/ using the Elgg open source social engine (http://elgg.org/). Elgg was first announced in 2004, and provides the necessary functionality to build a social networking site, either public or within an intranet. The software has its own plug-in architecture, and supports a number of open standards including RSS (Rich Site Summary), which is used throughout Elgg, LDAP (Lightweight Directory Access Protocol) for authentication (soon to support OpenID), FOAF (Friend of a Friend), and XML-RPC (Extensible markup language – Remote procedure call protocol) for integration with most third-party blogging clients. Elgg runs on a combination of the Apache web server, MySQL (My Structured Query Language) database system and the PHP interpreted scripting language. Figure 2 shows some representative screens of the social network.

DISCUSSION

Technology-supported educational interventions are usually successful when specific training requirements are aligned with the learning potential created by and the educational use of technology. Thus, requirements for flexible, adaptive and

ubiquitous online content sharing should evoke notions, practices and technologies from respective state-of-the-art evolutions of the Web. The recent web revolution under the collective term Web 2.0 where the user is considered as a contributor, rather than a passive recipient, together with other artifacts of collaborative educational environments, provide multiple facets of what is known as user-generated content. Such educational content is created by participation and collaboration as an emergent product of human education-centred interactions.

The proposed approach of learning objects social networking has been deployed in order to study learning object repurposing in medical education with the recently initialised European Best Practice Network 'mEducator: Multi-type Content Repurposing and Sharing in Medical Education', under the eContentplus 2008 program. The ultimate goal is to provide an alternative view of learning content organisation, management and sharing for use and re-use across healthcare institutions, via 'social' associations amongst learning objects with emphasis on their repurposing history and associations.

ACKNOWLEDGMENTS

This work is funded in part under the project 'mEducator: Multi-type Content Repurposing and Sharing in Medical Education', supported by the eContentplus 2008 program, Information Society and Media Directorate-General, European Commission (ECP 2008 EDU 418006).

REFERENCES

1 Papaioakeim M, Kaldoudi E, Vargemezis V, Simopoulos K. Confronting the problem of ever expanding core knowledge and the necessity of handling over-specialized disciplines in medical education. *Proceedings of ITAB 2006*, Ioannina, Greece, 25–27 October 2006.
2 Kaldoudi E, Vargemezis V, Simopoulos K. Information and communication technologies in medical undergraduate education. *Journal for Quality of Life Research* 2004; **2**: 33–37.
3 Jones R, Higgs R, de Angelis C, Prideaux D. Changing face of medical curricula. *Lancet* 2001; **357**(9257): 699–703.
4 Kaldoudi E, Bamidis PM, Pattichis C. Multi-type content repurposing and sharing in medical education. *Proceedings of INTED2009: International Technology, Education and Development Conference*. Valencia, Spain: International Association of Technology, Education and Development.
5 Bamidis PD, Kaldoudi E, Pattichis C. mEducator: a best practice network for repurposing and sharing medical educational content. *Proceedings of the PROVE 2009: 10th IFIP Working Conference on Virtual Enterprises*. Thessaloniki, Greece, 7–9 October 2009
6 Devedzic V, Jovanovic J, Gasevic D. The Pragmatics of current e-learning standards. *IEEE Internet Computing* 2007; **11**: 19–27.
7 IEEE. Final 1484.12.1-2002 LOM Draft Standard http://ltsc.ieee.org/wg12/20020612-Final-LOM-Draft.html.
8 Rehak DR, Mason R. Keeping the learning in learning objects. In Littlejohn A (ed.), *Reusing Online Resources*, Routledge, 2003: 20–34.

9 Zaka B, Kulathuramaiye N, Balke WT, Maurer H. Topic-centered aggregation of presentations for learning object repurposing. *Proc. of World Conference on E-Learning in Corporate, Government, Healthcare, & Higher Education (E-Learn)*, Las Vegas, USA, 2008

10 Jovanović J, Gašević D, Verbert K, Duval E. Ontology of learning object content structure. *Proc. of the 12th International Conference on Artificial Intelligence in Education*. The Netherlands, Amsterdam, 2005: 322–29.

11 Lenski W, Wette-Roch E. (2001) The TRIAL-SOLUTION approach to document re-use principles and realization. *Proc. of Workshop on. Electronic Media in Mathematics*, Coimbra, Portugal, 2001.

12 Najjar J, Klerkx J, Vuorikari R, Duva, E. Finding appropriate learning objects: an empirical evaluation. In *Research and Advanced Technology for Digital Libraries, Lecture Notes in Computer Science*, Volume 3652/2005, Springer Berlin, Heidelberg: 323–35.