CREATING MEDICAL RELATED LEARNING RESOURCES USING REPURPOSING PROCEDURES AND SEMANTIC WEB FUNCTIONALITIES

Ştefănuţ Teodor, Dorian Gorgan
Technical University of Cluj-Napoca, Computer Science Department
Cluj-Napoca, Romania

Nikolas Dovrolis, Eleni Kaldoudi
Democritus University of Thrace, School of Medicine
Alexandroupoli, Greece

Stefan Dietze
L3S Research Center, Germany &
The Open University, The Knowledge Media Institute, Milton Keynes, UK

ABSTRACT

The development of new, high quality e-Learning resources has become increasingly important in medicine, as the online learning approach is used in most of the disciplines, specialities and teaching levels. Either a theoretical presentation or a clinical case, the creation process of any valuable didactical material involves a lot of effort and usually high costs. Research and educational communities in medicine, as well as in other disciplines, have tried different approaches on maximizing the quality of the resources while maintaining the costs at a low level or even reducing them. Most promising solutions used at present involve materials sharing between different content providers (either automatically or based on human content editors) and the creation of new materials based on already existing ones, in an approach named repurposing. However, the application of these methods raise another issue related with how to identify relevant resources, how to codify the changes one makes in order to create the new materials and how to integrate all the new available resources without creating confusion (ex. some repurposed materials seem to be duplicates of the initial ones). In this paper we suggest some solutions to these problems based on social networks and semantic web functionalities.

KEYWORDS

semantic web, social networking, repurposing, e-Learning.

1. INTRODUCTION

The eLearning platforms are very widely used in the present, in different domains, as a feasible alternative to the most of the classical teaching techniques. Medical related fields are no exception to this trend, expanding each day to new specialities and incorporating new learning materials, either theoretical or clinical studies. One of the best motivations for the extensive use of eLearning applications is their ability to provide teaching resources in a flexible, cost effective and scalable manner, replacing the well-known face-to-face didactic approach. Although it is not possible yet to entirely replace the classical pedagogical methods, these applications have a significant contribution to the improvement of information exchange between instructors and learners (and between learners) through solutions that enable synchronous (text based chat, voice and video conferences, collaborative sessions, etc.) and asynchronous communication (forums, emails, off-line messages, etc.).

During the last few years, in the medical field have been developed a large amount of teaching resources, especially due to the increasing number of cross-domain research projects. As a result, the classical curriculum is very often outdated, so more and more specialists and students are acquiring last minute information from the online e-Learning applications. The amount of available data over the Internet allows

almost any trainee to study a specific subject with very little involvement from the teacher. As a result, the role of the teacher as a mediator between student and knowledge has been affected, being significantly reduced and mostly transformed into a supervising activity. At the same time, the quality of the internet materials is often poor and some of the results presented are insufficiently documented.

Some of these problems have been addressed through the Web 2.0 paradigm that changed essentially how people are interacting over the internet. Making use of social networks, the e-Learning systems managed to provide some mechanisms for content evaluation and control, reducing the amount of poor resources (Australian Flexible Learning Network, 2012). However, together with the new efforts of automate content sharing between different providers and with the consequently increase of available materials, the effort of identifying the good and valuable ones has become significant.

The development of new materials has also become a very costly activity, due to the high standard requirements in information quality, user interaction techniques or data presentation methods (images, videos, interactive 3D models, simulators etc). Reusing some of the already existing high quality materials in order to create new ones, has proven to be an effective solution (Wang et al, 2007), but implies often an extensive research for identifying these resources.

As a proposed solution, in this paper we present a method of describing and sculpting the profile of a teaching resource through the blend of its social attributes and web semantic capabilities. We will make use of these enhanced descriptions in the context of creating new resources based on the repurposing approach. Presented solution aims the improvement of resources retrieval and reuse mechanisms by medical specialists without advanced technical knowledge in their efforts to create new high quality learning resources.

2. RELATED WORKS

In the past few years, scientific community, especially from medical domain, has involved many efforts and resources in the development of eLearning technologies and materials. At first, the development efforts have been isolated and focused on independent solutions, having as a result separate functionalities and learning materials that could not be shared with other applications or users without important modifications. As this was a major setback for teachers who were bound to a specific eLearning system with limited functionalities and did not had the ability to easily distribute their materials into new platforms, the researchers developed standards for content packaging and sharing, like Learning Object Metadata - LOM (IEEE, 2002), IMS Content Packaging (IMS, 2004), Sharable Content Object Reference Model – SCORM (ADL, 2009) and others.

The integration of new types of data presentation has required also the development of new user interaction techniques, for a more efficient information analysis. For example, applications like eTrace (Gorgan et al, 2007), Web-Trace (Giordano and Leonardi, 2007) or Dokeos (http://www.dokeos. com/) have researched on graphical annotation based user interaction with teaching materials, while other platforms are experimenting on voice based communication.

Although in the resource presentation part of the e-Learning systems and in data sharing capabilities important advancements have been recorded, tools specialized in creating learning resources are very few. Most of the applications used in medical teaching materials development have been created for other purposes (ex. HTML editors, image processing applications, 3D modelling software, etc.) and require technical skills from their users or are restrictive and limited in functionalities (i.e. it is very difficult to specify the available student interaction techniques). At the same time, none of these resources provide a solution for creating new materials through repurposing or for managing and describing the repurposing process.

3. REPURPOSING CONTEXTS

Next to the lower production costs, the creation of new materials based on the repurposing approach has also the benefit that it can provide automatically valuable information about the new resource in terms of context, quality, related domains and specialities, pedagogical approaches and so on. Nevertheless, not any

transformation process preserves any or all of these attributes, so it is necessary to define the possible relations that can occur between the two types of resources (original and repurposed one).

During the mEducator project (mEducator, 2012), the research had revealed the following main repurposing contexts that are involved in creating new medical teaching resources (Kaldoudi, Dovrolis, Konstantinidis and Bamidis, 2011):

- Changes in the content itself
- Repurposing to different languages
- Repurposing to different cultures
- Repurposing for different pedagogical approaches
- Repurposing for different educational levels
- Repurposing for different disciplines or professions
- Repurposing to different content types
- Repurposing for different technology
- Repurposing for people with different abilities
- Repurposing to Educational Content

Usually, when creating a new resource through repurposing procedures, more than one of these contexts is used at the same time. Saving and tracking this information in the resource metadata description, together with some specification about how the changes that have been applied will provide valuable information about the new material: quality, user interactions, pedagogical approach etc.

Moreover, through the repurposing history it can be easily identified how and where a resource has been used to create a new one or what series of transformation have been applied to which resources in order to obtain the current version of a certain learning material. To some extent, repurposing history codifies also information related to similar resources through the idea of common ancestor, enabling a very specific exploratory search that could return quickly relevant results.

4. CREATING NEW RESOURCES THROUGH REPURPOSING

The process of creating new teaching resources through repurposing procedures involves usually a certain level of technological knowledge from the trainers. Depending on the complexity of the representations included in the materials (videos, 3D modelling, serious games etc.) their creation could require even an IT specialist rather than a medical one. All these reasons determine a higher cost for teaching material creation and also represent a very important issue when comes to the development of highly interactive resources that could present better some types of information.

For some of the types of repurposing mentioned above we propose a solution that allows a medical specialist to reuse previously created elements (images, videos, 3D models, interactive quizzes etc.) in new resources, without the necessity of low level technical intervention. The profile of our target user has the following main characteristics:

- is a medical specialist that intends to create e-learning content for his/her trainees
- knows the basic concepts of teaching materials and e-learning environments, including basic understanding of user interaction types, pedagogical approaches, information presentation methods, etc.
- has no (or very little) technical knowledge about technologies like HTML, CSS, XML, JavaScript, etc. or concepts like distributed databases, mash-ups, web services and others
- has medium level computer operating skills that include internet browsing, basic knowledge about file formats (ex. image formats), files management operations, etc.

In order to create a new teaching material through repurposing procedures, it is necessary to follow a few general steps:

- Search and acquire existing learning materials
- Repurpose found material
- Describe the new resource through mEducator Metadata Schema

4.1 Search and acquire existing learning materials

Searching for existing learning materials can be a challenging task due to the large amount of available information over the Internet and also because of the difficulty in quickly identifying relevant and good quality resources. Addressing these issues, in mEducator project has been developed a metadata description schema (MDC, 2012 & Mitsopoulou et al, 2011), specialized on describing medical teaching resources, that enables the educational content from the domain to be discovered, retrieved, shared and re-used. The schema addresses different aspects of the resource, from general elements (ex. title, description, authors, reference to the resource) to pedagogical aspects (learning outcomes, knowledge level, pedagogical approach, etc.), specialized technical information (media types included, technical recommendations) and also repurposing related data (what resources have been used in the creation of this resource).

Based on this schema, in the mEducator project has been developed an e-Learning platform for sharing medical educational content, named Metamorphosis+ (Dietze et al, 2011). This application has been implemented based on ELGG Social Network Engine (Elgg Foundation, 2012) in order to benefit from the social characteristics that can provide valuable information about the quality of a resource (Kaldoudi, Dovrolis, Giordano, Dietze, 2011) (ex. how was rated by the users, what kind of resources are similar, etc.). In order to maximize search results relevancy, the metadata descriptions are enriched with semantic information gathered from Linked Data Cloud (LOD) and stored in a SESAME RDF framework (Dietze et al, 2012 & Yu et al, 2011), as can be seen in Figure 1.

As a result, any resource from Metamorphosis+ Platform has a profile created from blending the social information with semantically enriched data. This complex representation allows better search results and enables new ways of data harvesting like exploratory search based on similar attributes of the resources (Marchionini, 2006). When a specific resource is considered appropriate (ex. image, video, 3D model, serious game etc,), the user has the possibility to save the direct reference of the material, which is usually a URL.

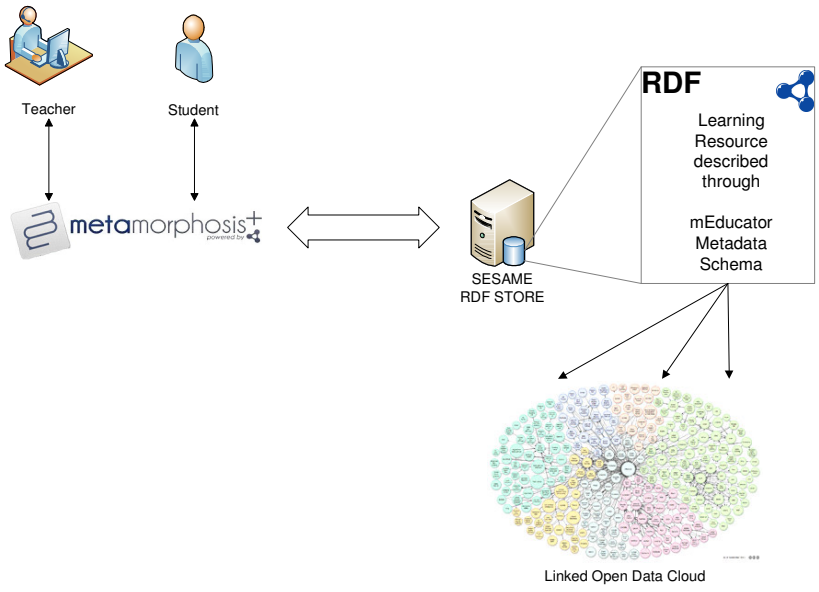

Figure 1. Metadata description contains semantic information from LOD and is blended with social information from Metamoprhosis+

4.2 Repurpose found material to create new learning resources

After the required existing material has been identified, the trainer can login into the eGLE application (Ştefănuţ et al, 2010) that will provide the necessary functionalities for data retrieval, and visual information representation.

The visual structure of an e-Learning Resource described in eGLE is presented in Figure 2. At the template level the general format attributes for all the content is specified (default text size and colour, background settings, etc.). On the next level, the visual structure has patterns, which are logical containers that represent one row into the template and group related information: picture and its' description, 3D model and a related video presentation, etc. One pattern can hold one or more tools, which are the atomic elements of the eGLE visual structure.

Each tool provides a specialized interface for data retrieval (ex. over HTTP, from an FTP connection, from a web service etc.) data type presentation (image, video, 3D model, text, etc.) and implements specific user interaction techniques (ex. graphical 3D annotation, text formatting functionalities, etc.). All trainers have the possibility to create new patterns and add tools to them through drag and drop interaction. Later, the patterns can be reused as many times as necessary either in the same resource or in different ones (see Figure 2).

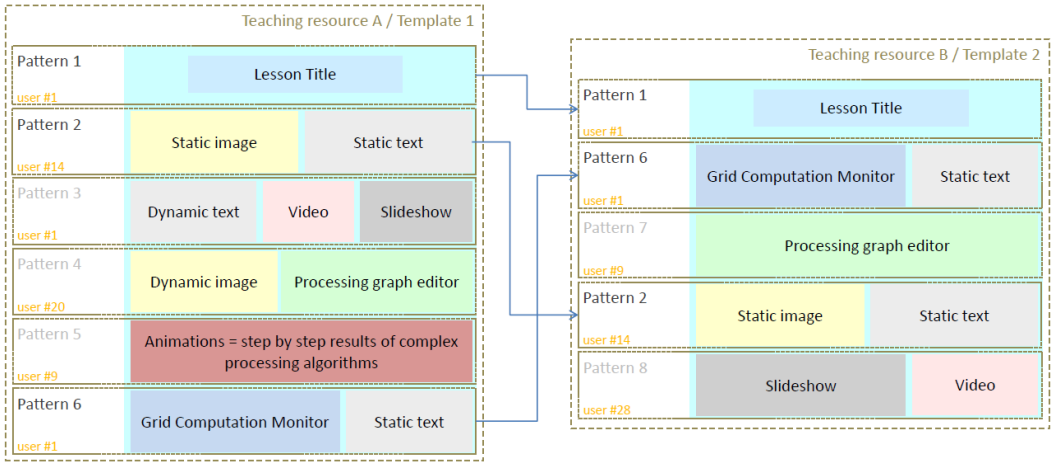

Figure 2. Repurposing content in eGLE Application

Through eGLE functionalities, the teacher has the ability to retrieve automatically the resources found at the previous step by providing only the identifier in the form of an URL. Then, the platform allows the integration of this content in any section of a learning resource, the reuse of the data in the same or in different materials, and offers the ability of selecting different user interaction techniques over the same content, even in the same resource. For example, if the same 3D model is integrated in a material in three different sections, for each section the trainer can specify different user interaction techniques: no interaction for the first instance (the user can only view the model), visualization control for the second (the user can change zoom level, rotation or translation) and graphical annotation based user interaction for the third instance.

4.3 Describe the new resource through mEducator Metadata Schema

After the creation process has been finalized, the teacher has the possibility to publish his new resource towards his colleagues by describing it through mEducator Metadata Schema. This purpose can be easily

achieved through Metamorphosis+ application as it provides the visual interface and the necessary mechanisms to create a complete resource description:

- mEducator schema taxonomies integration (for defining media types, resource types, learning outcomes etc.)
- dedicated interface for creating semantic connections towards the LOD in the keywords, disciplines and discipline speciality properties. The terms will be selected by the user from specific ontologies, while the connection details (reference numbers etc.) will be automatically handled by the application
- specialized user interface for creating repurposing related connections between the resources, for defining repurposing contexts and describing the changes that have been made.
- the possibility to reference other learning resources as companions, using only their URL

Through this metadata description, the resource will be indexed into the platform and will be made available to the other users with an initial set of information and with some properties "inherited" from the original resources. This profile will be enriched through social characteristics over time, building the complete description of the resource.

5. CONCLUSION

The development of new medical e-learning resources through repurposing methods represents a solution for creating valuable and high quality resources at lower costs. One of the major challenges on this approach is to identify relevant materials that can be reused. For this purpose we have presented Metamorphosis+ application that blends the social information about a resource with semantically enriched data, for a more relevant search results organization.

At the next development phase the trainer needs to apply the repurposing activities on the selected elements, action which usually requires advanced technical knowledge. As a possible solution we have described eGLE application, that offers specialized functionalities for data retrieval, user interaction setup and information presentation. Furthermore, the platform allows the medical specialist to define his own layout and control its structure in an interactive and visual manner, without requesting any technical knowledge.

One of our main research directions in the present is represented by the automatic integration of Metamorphosis+ social and search capabilities with eGLE functionalities aiming to create a specialized development environment that will assist all medical trainers in creating new e-Learning teaching resources.

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