Exploring the development of adaptable learning objects. A practical approach.

Voula Gkatzidou
Teesside University
s.gkatzidou@tees.ac.uk

Elaine Pearson
Teesside University
e.pearson@tees.ac.uk

Abstract

Changes in legislation, an emphasis on widening participation and the increasing reliance on online techniques for learning and teaching have contributed to improved opportunities for students with disabilities. The need to cater for the needs and preferences of the individual learner is presenting significant challenges for the learning designer. This research suggests a solution that is based on the principle that learning content can be generated from adaptable aggregations of learning objects and media components. This paper describes the concept of an authoring tool (LOTTI) that supports the design of adaptable, reusable and pedagogically rich learning objects using proven learning patterns and capitalises upon the recent focus of metadata standards for adaptability. We explore its potential within an accessibility service that maps the learners' profiles requirements against the learning objects features.

1. Introduction

In the present landscape of learning technology, learning paradigms require new forms of educational resources that utilise new technologies, as learning is becoming more and more independent of time, distance, computing platform, and classroom size. The increasing demand for new educational approaches and pedagogies, and the growing emphasis on the need to cater for the needs and preferences of the individual learner are shifting the focus to the concept of learning object personalisation and customisation to student needs [9]. In the academic setting it is usually teaching staff who are largely responsible for the production of their own electronic resources, and while some embrace the challenge of new technologies with enthusiasm and accept the need for accessibility, other over stretched academics may regard the requirement to produce accessible online courses as a burden they have neither the skills nor the time to tackle [2].

The purpose of this paper is to explore the potential of adaptability and to identify the practical boundaries of transformable content by examining the case for learning patterns as a design method for adaptable learning objects and investigating their use to pedagogically enrich the standardisation process. We begin by investigating the use of metadata standards and specifications for adaptability and articulate the principles that need to be applied to the design of learning objects to ensure adaptation. This paper introduces a learning object authoring tool, which offers support to the author in creating fully inclusive materials by suggesting correct behaviour and place pedagogical emphasis on the design and development of the learning objects. To conclude, this paper describes the potential of this authoring tool within an adaptation service that delivers learning objects, adapted to suit the diverse needs of learners.

3. Learning adaptation standards and specifications

Despite the proliferation of adaptation approaches in their representation and utilisation within different systems reported in literature [4], we argue that this is one of the major stumbling blocks that stand between adaptation and the e-learning mainstream today. The lack of standards compliance is mainly due to the lack of sufficient support for adaptive and adaptable behaviour in existing e-learning standards. The role of metadata has so far enabled the retrieval of learning resources; there is however a gap in the research on ways to employ metadata to promote the accessibility and adaptability of learning objects.

The IMS AccessForAll project proposes an adaptability model for digital resources that attempts to match resources and services to users' needs and preferences [7]. There are two AccessForAll specifications: the Accessibility for Learner Information Package specification (AccLIP) that expresses the learner's accessibility needs and preferences and the AccessForAll Meta-data specification (AccMD), which fully describes accessible learning content and its ability to match a learner's preferences. While these metadata represent a truly enabling option, our approach is also converging to the concept of specifying the learning object contents using both descriptive and semantic metadata to precisely describe their composition and achieve an adaptable delivery process.

IEEE computer society

4. Designing adaptable learning objects

Multimedia learning objects delivered in distributed formats differ from standard web pages in that they may consist of rich content each of which may need to be adapted in different ways, in order to make them accessible [5]. To this point, the majority of literature and applications related to development of learning objects have focused primarily on technological attributes, metadata standards and system specification issues such as levels of granularity and ensuring interoperability [1]. Although we acknowledge the importance of these issues, our approach stresses that it should not be at the expense of pedagogical effectiveness. In order to ensure that the design challenges for reusable and adaptable learning objects are not in conflict, we propose the use of design patterns that support the creation of learning objects. Our approach suggests the use of patterns as more appropriate for learning designers with no programming expertise, engaging this audience through providing accessible descriptions that also allow flexibility in implementation.

5. Learning Object Tutor Tools Interface (LOTTI)

The Learning Object Tutor Tools Interface (LOTTI) is an authoring tool for academics to aggregate and produce learning objects. It provides the framework for the design of pedagogically rich and interactive learning objects, with the aid of learning design patterns, allowing the designer to create and appropriately label retrievable, re-usable and adaptable learning objects [5]. LOTTI provides a straightforward and intuitive way for an academic with limited programming experience, to create adaptable learning objects, by separating the design process into two steps; the first one consists of building a learning object template which encloses the deep general structure of the object while the second one involves adding specific learning content to the template [3]. The authoring process begins with a library of pedagogical design patterns being presented to the designer. Once a template has been selected, authors can add different subject specific content to produce a learning object.
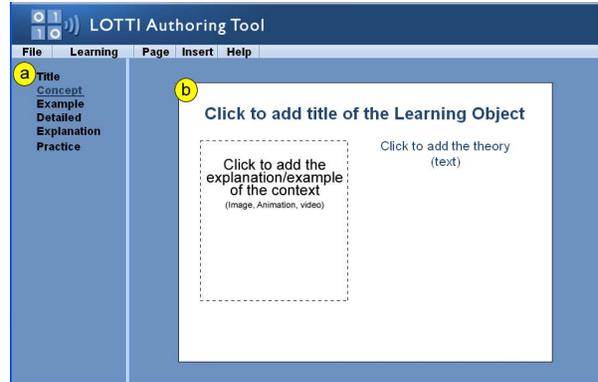

Figure 1. LOTTI authoring tool screenshot

LOTTI's main interface consists of a number of panels; *the learning pattern panel* (Figure1a) illustrates the structure of the learning pattern that is being employed for the design of the learning object, in the form of a template. In this example, above (Figure 1) the designer is applying the award winning EASA leaning object design pattern [3]. The *learning object panel* (Figure1b) shows the list of the media components of the learning object. As the designer imports a new file onto the learning object, this will be shown in the learning object overview window, in the appropriate page (depending onto which page the designer has imported the file). When the learning designer imports a learning object component the system prompts the designer to assign an alternative resource, outlining the limitations of the file type to the designer and suggesting predefined alternatives to these types of content to the user. For example, when the designer imports a text file, then the tool, in a form of a wizard pop-up window, explains the limitations of the text modality and suggests a number of equivalent or alternative resources, an audio equivalent, or a graphical representation of the text file. If the designer chooses to assign an alternative resource to the primary one, then the tool automatically assigns the appropriate metadata to it, describing it as an 'alternative to' the primary resource. LOTTI also employs IEEE Learning Object Metadata [6] metadata to provide descriptive metadata on the component structure of the learning object, which is then packaged in accordance with the IMS Content Packaging [8] specification to facilitate export to a repository.

6. TAS Accessibility Service

This research acknowledges that the complexity of multimedia learning resources and the diverse needs of disabled students require an approach that supports the adaptation of the resource at the point of delivery. For this reason, we propose a Transformation, Augmentation and Substitution (TAS) service that is

endowed with methods to deliver learning objects that can be adapted to suit the diverse needs of learners [5].
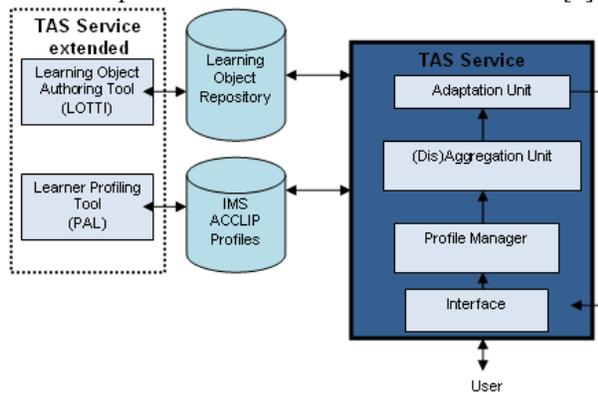

Figure 2. TAS System Architecture

When the user requests a learning object through the Interface, the system interrogates the Profile Manager, and retrieves the user's profile. The request is then passed onto the Dis/Aggregation Unit, which fetches the requested learning object from the repository, unpackages it and defines a correspondent adaptation strategy, based on the learner's profile and the available alternative components. The strategy, along with the media that need conversion is forwarded to the Adaptation Unit, which performs the necessary adaptations as specified by the strategy and upon their completion, returns the learning object to the user, via the Interface. LOTTI is integrated within the extended TAS service, as a stand-alone application. A profiling mechanism is also required to form part of the extended service. For this reason we have developed a profiling tool (PAL) that allows users to create and manage their profile of needs and preferences in IMS AccLIP. Although these two components are not part of the adaptation service itself, the functionality of the TAS is dependent on the existence of the user profiles, accessibility metadata and equivalent alternative resources. In pragmatic terms, if the alternative resources are not made available, then substitutions and augmentations can only be hinted at. The service might indicate this lack e.g. the need for captions, an audio description or a video transcript, but it cannot provide it if not already available.

7. Conclusions

This paper has captured the requirements of developing accessible and adaptable learning objects, by introducing our adaptation model and discussing a novel authoring tool and its potential within an adaptable and personalised environment. While LOTTI on its own is a useful tool for the creation and retrieval of adaptable learning objects, we have begun to consider its potential as part of a complete learning environment. It is possible to realise a development

framework for an open source Adaptable Personal Learning Environment (APLE) [10] that provides a learning experience, which adapts to the needs and preferences of individual learners, regardless of any disabilities they may have or the context in which they are working.

9. References

[1]Bannan-Ritland, B., Dabbagh, N., & Murphy, K. (2000). Learning object systems as constructivist learning environments: Related assumptions, theories and applications. In D. A. Wiley (Ed.), *The instructional use of learning objects*. Retrieved November 30, 2003, from http://reusability.org/read/chapters/bannan-ritland.doc

[2] Bennett, S., Hewitt, J., Kraithman, D., & Britton, C. (2003). Making Chalk and Talk Accessible, Proceedings of the 2003 conference on Universal usability. Vancouver, British Columbia, Canada

[3] Boyle, T. (2003). Design principles for authoring dynamic, reusable learning objects. *Australian Journal of Educational Technology*, 19(1), pp. 46-58.

[4] Brusilovsky, P. (2003). Developing Adaptive Education Hypermedia Systems: From Design Models to Authoring Tools. In Authoring Tools for Advanced Learning Technologies by Murray, T., Blessing S., & Ainsworth, S. (Eds.), Kluwer AcademicPublishers, NL.

[5] Gkatzidou, S. & Pearson, E. (2009). A transformation, augmentation, substitution service (TASS) to meet the needs and preferences of the individual learner. IEEE International Conference of Advanced Learning Technologies (ICALT). Riga, Latvia.

[6] IEEE Standard for Learning Object Metadata (LOM).Retrieved November 2009. Available online: http://www.ieeeltsc.org/wg12LOM Retrieved: 29/01/09

[7] IMS. (2004). IMS Global learning AccessForAll project. Available online: http://www.imsglobal.org/accessibility Retrieved: 29/01/09

[8] IMS. (2004). IMS Content Packaging Specification. Available online: http://www.imsglobal.org/content/packaging Retrieved: 29/01/09

[9] Milosevic, D., & Brkovic, M. (2007). Adaptive Learning by Using SCOs Metadata. *Interdisciplinary Journal of Knowledge and Learning Objects,* Vol 3, pp 163-174

[10] Pearson, E., Green, S., & Gkatzidou, S. (2008). *Enabling Learning For all Through Adaptable Personal Learning Environments.* Paper presented at the Australasian Society for Computers in Learning in Tertiary Education Conference (ASCILITE). Melbourne, Australia.