Collaborative Authoring of Learning Elements for Adaptive Learning Spaces

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Abstract: The *Software Organization Platform* (SOP) intends to support specific software engineering activities such as experience management, requirements engineering, or project management. Wiki pages can be easily used by a transformation engine to produce so-called learning elements. Learning elements are the building blocks of adaptive *learning spaces*, which enhance experience application and understanding in software engineering. This paper shows how learning content is collaboratively authored in the MediaWiki-based SOP in order to generate adaptive learning spaces. The authoring tool, which is embedded as an extension in SOP itself, helps the authors to annotate the learning elements with keywords from the SWEBOK ontology (available in OWL). In addition, a vocabulary manager supports the development of a pre-defined metadata set for annotating learning elements. The authoring environment is a promising technology for solving the problem of "closed content corpus" and uses the advantages of ontologies and semantic relationships in Wikis.

1 Introduction

Web 2.0 concepts (e.g., collaboration, sharing), features (e.g., tagging, folksonomies), and tools (e.g., Wikis, Blogs) support quick and easy sharing of knowledge as well as the creation of learning content in a software organization. Web 2.0 is not only a special technology, but also an umbrella term referring to a class of Web-based applications that make the most of the intrinsic advantages of the Web as a platform. They get better as more people use them by capturing network effects; they harness collective intelligence through user-generated content; they enable collaborative work, and they deliver rich user experiences via desktop-like interfaces [1, 2]. The Software Organization Platform (SOP) connects collaborative generation (i.e., quick and easy page creation and linkage) and semantic annotations (e.g., tagging) of content via a Wiki. In the spirit of Web 2.0, individuals become not only information consumers but also producers. The development of semantic technologies (e.g., Semantic Web techniques, such as OWL, SPARQL, and Web 2.0 techniques, such as tagging, folksonomies, and microformats) offers several possibilities for semantically annotating information and relating chunks of information. Hence, semantic technologies will dramatically change the future development of Adaptive Hypermedia Systems (AHS) and Adaptive Educational Hypermedia Systems (AEHS) in particular. However, AEHS have a common problem that limits the reusability of their adaptive functionality and content. This limitation is due to the design of these systems: The learning resource is usually intertwined with the logic for generating adaptive learning experiences. In addition, adaptive hypermedia systems have worked on a closed set of documents [3, 4]; The documents are fixed at the design stage of the system, and alternations or modifications to the adaptivity are difficult. This closed corpus problem explains why it is difficult to work in an open environment like the Web and profit from the innovations made in the Web 2.0 era. Therefore, new authoring approaches should fulfill the following requirements: separation of adaptivity and content; release of authors (i.e., the software developer or the knowledge engineer) from adaptivity modeling, and easy and flexible annotation of learning content.

To address these problems, an AEHS has been developed to produce so-called context-aware *learning spaces* for enhancing experience reuse and knowledge acquisition in software engineering [5]. The aim of this paper is, first, to show how collaboratively created Wiki content can be transformed into learning content and, second, how it can be annotated by using keywords from an OWL ontology.

2 Vocabulary Management and Learning Content Authoring

Fig. 1 illustrates the process of learning content authoring and learning space generation in SOP. SOP is based on the Semantic MediaWiki [6] and intends to support specific software engineering activities, such as experience management, requirements engineering, or project management. From a technical point of view, a learning space consists of a hypermedia space with linked pages. A learning space follows a specific global learning goal and is created based on context information about the current situation and the context description of an experience package. The learning space is presented technically by means of linked Wiki pages within SOP (step 4). In the following, the first three steps related to authoring will be detailed. A detailed description of how decision models adapt the learning space to the current context (steps 4 and 5 in Fig. 1) can be found in a main conference paper [5]. SOP has shown its usefulness for easy content creation in the past; information about products, processes, roles, groups, customers, organizations, and tools is collaboratively described in the Wiki (step 1). In order to classify these core Wiki pages, Wiki categories (syntax: `[[Category:`*`categoryName`*`]]`) are used to classify the Wiki pages into multiple freely named categories. In addition, by using the features of the Semantic MediaWiki, specific semantic relationships (syntax: `[[`*`relationshipName`*`::`*`wikiPageName`*`]]`) can be defined between instances of the Wiki pages and categories. These relationships are required in the adaptation process to produce context-aware learning spaces. The Wiki pages are stored in the MediaWiki base. Besides these Wiki pages, other kinds of information can be extracted from the Wiki for learning purposes, e.g., definitions, explanations, conclusions, etc. SOP offers an extension to transform these Wiki pages into so-called learning elements, which are the building blocks of learning spaces (step 2). The requirement of easy annotation of learning elements is fulfilled by a set of pre-defined values and metadata attributes for classifying learning elements being offered. This metadata set is defined in SOP by using the *Vocabulary Manager* (see Fig. 2.).

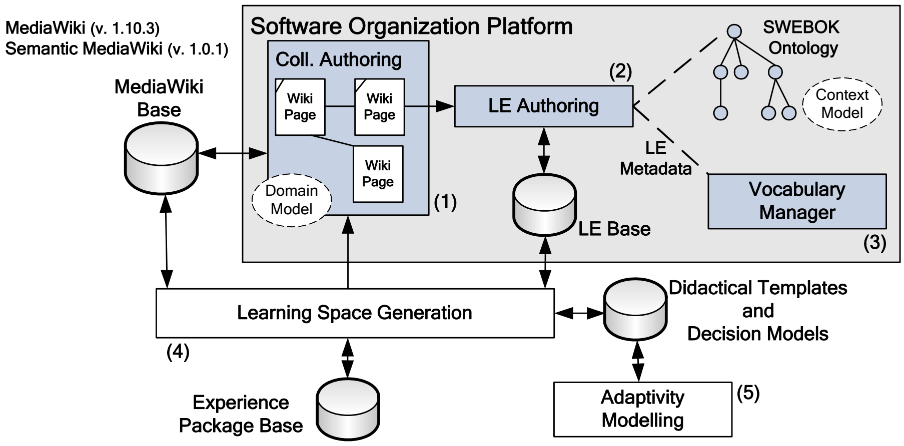

Fig. 1. Software Organization Platform

This SOP extension (step 3) allows creating, editing, and deleting metadata attributes as well as related values (e.g., attribute: illustration; values: example, counter-example).

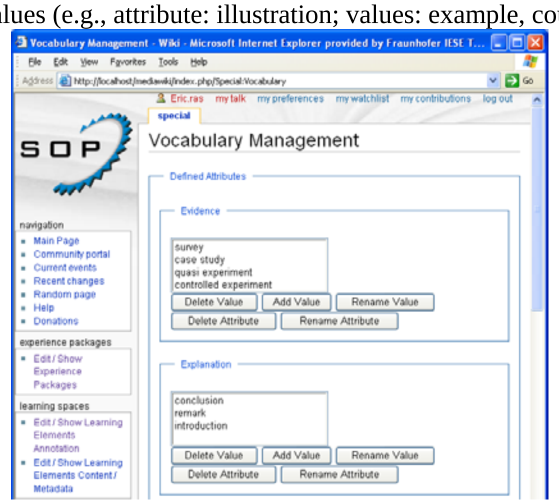

Fig. 2. Vocabulary Manager

In addition to the classification of learning elements, keywords can be used to annotate the learning elements. These keywords are retrieved from a software engineering domain ontology (i.e., an extended ontology based on SWEBOK [7]), from which the semantic relations are also used for the generation of the learning space [5].

The *competence manager* determines the structure (i.e., schema) and the content of the MediaWiki base and is responsible for conceptually developing the context model and the domain model. The *knowledge engineer* has a lot of domain knowledge in terms of packaging and analyzing content. His main task is to extract and annotate content for learning spaces and to instantiate the domain model. The role of the *adaptive instructional design modeler* is to develop instructional design models for selected learning scenarios and to specify variants of the learning space, i.e., to develop the variability model [5]. Hence, the instructional designer must have a strong pedagogical background, knowledge about how to model variants by means of decision models, and knowledge about adaptation methods and techniques.

3 Conclusion

In this approach, the separation of adaptivity modeling and content authoring ensures that both adaptive functionality and content can be reused independently. The software engineer does not have to bother about modeling the pedagogical structures and the adaptivity itself – this is done by the adaptive instructional design modeler. The OWL ontology, which reflects the software engineering concepts and relationships, helps the knowledge engineer to annotate learning elements on the one hand, and supports the generation of the learning space on the other hand. In the future, evaluations need to be done to investigate the usage and acceptance of the authoring tools. Results of the learning space approach can be found in [5, 8].

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