Poster: Situation-Based E-Learning in Software Engineering

Using software engineering-related metadata to improve self-empowered learning

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ABSTRACT

Self empowered learning is a great challenge for professionals in software engineering. Due to everyday work, there is often no time or need for complete courses or textbooks on a broad topic. This challenge leads to multiple approaches like learning objects, micro learning and learning nuggets. Critical part of these approaches is to provide metadata to each resource in order to place the resource in context, enabling the learner to easily retrieve resources and the lecturer to reuse the material. Metadata definitions like LOM or IMS-LD are however defined on a generic level, suitable for education in general, without considering specific domain characteristics. Additionally, much of the available learning material focuses on acquisition of knowledge, rather than the empowerment to perform new tasks in the learners current situation. In this paper we present a preliminary model to describe the software engineering specific context of learning material that can be used to extend existing metadata definitions in learning management systems.

CCS CONCEPTS

• **Social and professional topics** → **Software engineering education**; • **Applied computing** → **Education**; *Interactive learning environments*; *E-learning*;

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1 INTRODUCTION

Education for software engineers is traditionally based on books, (online-)courses and trainings. To get familiar with comprehensive topics, these techniques seem feasible as they allow for well-defined didactics and guidance. However, it is challenging that information is either learned long before or after it is needed. One approach to cope with such situations are small and independent learning units (so called nuggets [3]) that are consumed instantly, address a very specific topic, and can be used independently from a constraining course context. Since a single nugget cannot provide much context, the learner has to be familiar with flanking knowledge. The challenge for self-empowered learning is therefore to have flexible learning environments providing learners with context knowledge. Standards like learning object metadata [8] or IMS-LD [1] address these issues and allow annotation with keywords or relations between units. But since these formats are developed for general applicability in education, they cannot provide the expressiveness of domain-specific semantics.

In this paper, we propose a metadata model for organizing nuggets within learning environments for the Software Engineering (SE) domain. The general approach is based on the *Berner Modell* [6] to support not only knowledge acquisition but the ability to act in daily work. The model is developed in the context of "IT&me", a funded project aiming for a learning platform for female IT-experts in various life conditions. The contribution of this paper is manifold: The domain-specific semantics of the metamodel can be used to retrieve and recommend nuggets based on the learner's situation, rather than just statistic probabilities. It also enhances features used in LOM or SCORM [2], where learning units are combined to a learning path by explicit sequences. Moreover, the model can help lecturers when creating content. Since nuggets have to be very small and tailored for a specific topic, lecturers can use the metadata to break down their content appropriately.

2 RELATED WORK

Our approach is closely related to the *Berner Modell* [6], a didactic method focusing on competencies of the learner. It takes existing competencies, resources, motivation and circumstances into account and proposes a method to plan and create appropriate

learning units. It also defines multiple level of competencies on which we base our approach. Interesting is the use of morphemes as smallest meaningful unit of content. Good morphemes provide content that can be used in different learning scenarios, which was also the goal of *DialogPlus* [4]. In this paper, content is split into nuggets, which are slightly bigger than morphemes. Challenging is the use of reusable learning objects [5] when applied to self empowered learning. An approach to tackle this is described by Henning et al. [7] where learning paths are generated automatically, rather than by a lecturer. Interesting about this approach is that it does not enforce those paths but recommends them based on input from lecturers and semantic annotation of the content. Annotation of the content and enabling activity based learning as proposed by Margaryan et al. [9] are the main challenges addressed here.

3 SITUATION MODELING

Our approach focuses on teaching techniques and activities in SE rather than a new programming language. Providing them to the learner instantly requires making the learning units easily accessible and reflecting the very specific working task of the learner. We identified two challenges when using complete courses. First, since there are many different SE activities like *testing* or *specification* containing common tasks, there is much redundancy. Vice versa, many tasks like *timeboxing* can be used in different situations, even though they are not specified by any parent process. We therefore propose to loosely couple the nuggets in order to achieve reuseability and to enhance existing material by recommending related techniques. Second, experts also need training for specific activities ad-hoc. This calls for content that is tailored to a specific situation and can be easily found.

Centerpiece of our model is the **activity** itself. An activity is used to process some kind of **input** in order to achieve a **goal** respectively to produce an **output**. Requirements engineering, for example, can roughly be described as an activity that transforms a written or discussed problem into a set of managed software requirements. Activities involve multiple **stakeholders** and are conducted by at least one responsible **role** like *requirements engineer* or *scrum master*. An activity can be composed by a set of sub-activities like *interview stakeholders* or *document requirements*. This way, activities can establish a hierarchy down to fine-grained tasks like prioritizing. Beside that, we differentiate between activities like *daily scrum* and specific techniques like *timeboxing* that are used to conduct the activity.

Activities typically have **predecessors** and **successors**, whereby the interfaces between them are the corresponding inputs and outputs. Inputs and outputs can be written results of an activity like specification documents or code. In addition, some of the required inputs and outputs reside as **tacit knowledge** in the stakeholders minds [10]. Since tacit knowledge is often not considered in learning material, we include it in the model so that lecturers will reflect on it when creating nuggets. Choosing the appropriate technique may differ depending on whether the involved stakeholders incorporate specific mindsets like scrum values or total quality [6]. As well, changing a mindset can be the result of an activity. So we add mindsets as possible types of inputs and outputs in our data model.

4 APPLICATION

Creating new content for a topic is a complex task and differs when using various media and targeted levels of competence. The content for a textbook has to be serialized and partitioned into consecutive chapters. Nuggets are however required to be much smaller than chapters. Decomposition of a topic therefore differs in our approach not only by content order but also in terms of media diversity and the required metadata. To help lecturers derive metadata for their content, we developed a form sheet that can easily be used without a specific tool. We found it also suitable in workshops as it fosters creativity and collaboration. Containing fields for each element in the situation model, it provides a streamlined way to gather and document required information. Especially in the slicing phase this documentation helps to identify more granular or outline lectures.

5 CONCLUSIONS AND FUTURE WORK

The model has been integrated into the e-learning system used in our project. This enables us to experiment with new recommendation algorithms and more flexible ways to define learning paths. Till now, the model suited our need for describing context for our learning units. However, as we have developed this model upon examples of SE process knowledge, we will evaluate if it still holds when topics change. Regarding the main challenges described above, we will test if the use of domain specific metadata improves self-empowered learning. We will do so by evaluating if learners can find relevant content more easily and by reviewing the resulting learn paths with educators and practitioners.

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REFERENCES

[1] 2003. IMS Learning Design v1.0 Final Specification. (2003).
[2] ADL. 2004. *Sharable content object reference model (SCORM) 2004.* Technical Report. Advanced Distributed Learning.
[3] Chris Bailey, Mohd T Zalfan, Hugh C Davis, Karen Fill, and GrÃąinne Conole. 2006. Panning for Gold: Designing Pedagogically-inspired Learning Nuggets. *Educational Technology & Society* 9, 1 (2006), 113–122.
[4] Hugh C. Davis and Karen Fill. 2007. Embedding blended learning in a university's teaching culture: Experiences and reflections. *British Journal of Educational Technology* 38, 5 (9 2007), 817–828.
[5] Ian Douglas. 2001. Instructional design based on reusable learning objects: applying lessons of object-oriented software engineering to learning systems design. In *31st Annual Frontiers in Education Conference. Impact on Engineering and Science Education. Conference Proceedings*, Vol. 3. IEEE, 1–5.
[6] Hans. Furrer and Akademie für Erwachsenenbildung. 2009. *Das Berner Modell : ein Instrument für eine kompetenzorientierte Didaktik.* Hep-Verlag, Bern.
[7] Peter A Henning, Florian Heberle, Alexander Streicher, Andrea Zielinski, Christian Swertz, Jürgen Bock, and Stefan Zander. 2014. Personalized Web Learning: Merging Open Educational Resources into Adaptive Courses for Higher Education. In *UMAP Workshops*.
[8] IEEE. 2002. IEEE Standard for Learning Object Metadata. (2002).
[9] Anoush Margaryan, Betty Collis, and Andy Cooke. 2004. Activity-based blended learning. *Human Resource Development International* 7, 2 (6 2004), 265–274.
[10] Ikujiro Nonaka, Ryoko Toyama, and Noboru Konno. 2000. SECI, Ba and Leadership: a Unified Model of Dynamic Knowledge Creation. *Long Range Planning* 33, 1 (2 2000), 5–34.