A Social Network for Learning
Supporting Collaborative Learning based on the Ontology for Educational Knowledge

Peter Hubwieser and Andreas Mühling
TUM School of Education, Fakultät für Informatik, Technische Universität München, München, Germany

Keywords: Social Network, Learning, Ontology, Educational Knowledge.

Abstract: We aim to develop a social network that is based on a specific *Ontology for Educational Knowledge* (OfEK), intending to support and enhance learning processes by connecting students with other people who are able to collaborate with them, to help or to give advice in any critical situation. The basic idea is to digitalize all relevant curricula, educational standards and organisational circumstances of the major school subjects (e.g. Mathematics, Physics, Chemistry, Languages) in the German speaking countries according to our OfEK. Hereby we will create a coordinate system that allows students to define their current position in terms of learning content or educational standards respectively in order to join a learning community that is in a comparable situation regarding the intended knowledge.

1 INTRODUCTION

According to the well accepted constructivist paradigm, learning always has to be considered as social process in some respect (Ben-Ari, 1998). It has turned out that learning is more efficient and sustainable, if it happens in a collaborative way (see e.g. Gokhale, 1995). To this purpose the learner has to join or even to build a community that has similar learning objectives. As long as learning happens in the classroom, the community is at least present apparently (but not always very effective, unfortunately). A soon learning takes place outside any classroom, this community is no longer approachable directly.

It is self-evident that the building of learning communities might be supported by social networks like *Facebook*, all the more because children and adolescents spend much time there and because a mass of people is connected by them, e.g. some hundred million people by Facebook. Nevertheless, the existing "general-propose" social networks build their communities mostly by some kind of "friendship"- or "I like it"-relations that are too unspecific for building well customized learning communities that are needed for effective collaboration. Although there are several specific social networks that claim to support learning in some way, but we did not find one yet that consequently applies the modern Semantic Web technologies to bring people together who might help each other when concrete learning problems arise.

A substantial obstacle to this intention seems to be the following: there are many people active in the Internet that seek for help for quite different problems in school, at university or during an in-service training course. On the other hand there might be also a mass of people who is able to give advice or even courses that might help some of these "seekers". But it seems nearly impossible to bring them together effectively for a specific learning context.

For this purpose, we aim to develop a specific social network (*MyLearnSpace*) that is open to anyone, but by registering themselves using a pseudonym, the users are categorized following our *Ontology for Educational Knowledge* (OfEK, see Hubwieser and Bitzl, 2010), for example according to their country, school type, grade, age-group etc. Additionally, we will incorporate information about the organisation of schools and subjects, knowledge, curricula, standards etc. according to OfEK. By this way, we are able to connect many learners who are in a comparable situation regarding a topical learning process.

For the moment we are planning to implement the system only in German language.

Hubwieser P. and Mühling A..
A Social Network for Learning - Supporting Collaborative Learning based on the Ontology for Educational Knowledge.
DOI: 10.5220/0004169502980301
In *Proceedings of the International Conference on Knowledge Management and Information Sharing* (KMIS-2012), pages 298-301
ISBN: 978-989-8565-31-0

2 THEORETICAL BACKGROUND

As already described more detailed in (Hubwieser and Bitzl, 2010), the theoretical background for the educational knowledge is formed by the *Berlin Model* that was developed by Heimann, Otto and Schulz (see Uljens, 1997). Following this model the design of educational lessons has to start with the consideration of certain *preconditions*: socio-cultural preconditions (e.g. the legal requirements for school education, didactic approaches as well as IT infrastructures in schools), anthropogenic preconditions (e.g. age, gender, pre-requisite knowledge or social status). Based on this, the teacher has to make his/her decisions about the four main aspects of a lesson: *intentions, content, methods and media*. Finally the *consequences* of the course or the lesson have to be considered, regarding the (anthropogenic) learning progress of the students as well as more global (socio-cultural) consequences.

According to the taxonomy of (Anderson and Krathwohl, 2001), we regard learning objectives as a combination of a certain type of *knowledge* (partitioned into factual, conceptual, procedural and metacognitive knowledge) and an observable *behaviour* specification called cognitive process.

3 EXEMPLARY USE CASE

Let us assume that a student in grade 9 of a Bavarian grammar school (e.g. the 8-year lasting Gymnasium) has a serious problem with the calculation of square roots during his or her homework. Let's call the student Billy and assume that he is male. Following a conventional strategy, Billy would ask his parents, look in textbooks, call, mail or chat with a classmate, search in Google, looking for additional information.

The vision of *MyLearnSpace* is that Billy is connected at every moment to all registered users that are learning in a comparable knowledge area. E.g. Jill and Ben. Nevertheless, the connected users might be learning in a different organizational context, which has to be taken into account. Jill might be dealing with square roots of complex numbers, while Ben has to understand that the length of the diameter of a unit square is square root of 2. Apparently Jill is working in a much more demanding part of this knowledge area, while Bens problem is quite easy to explain. In order to manage these differences, *MyLearnSpace* is taking all additional information about the learning process into account, which will be described in the following section.

In order to present the learning peers and all suitable information, the system is organized in *TopicRooms*, each of them dedicated to a specific knowledge area (see figure 1).

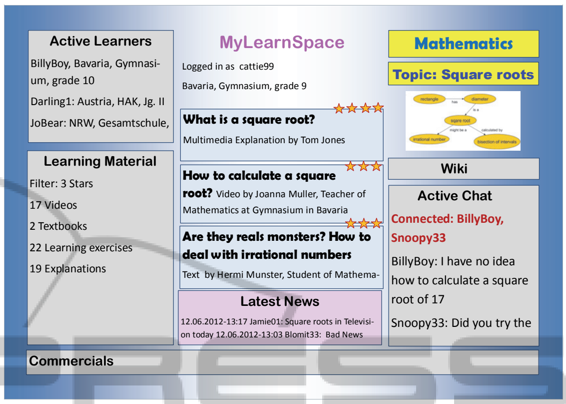

Figure 1: Prototypic screenshot of an *TopicRoom*.

4 THE ONTOLOGY

As described in (Hubwieser and Bitzl, 2010), we have developed a specific ontology for the description of educational processes, which can be partitioned into the following main components:

- *Knowledge Dimension*, describing the type of knowledge according to the categories of (Anderson and Krathwohl, 2001): Factual, Conceptual, Procedural and Metacognitive,
- *Subject Domain Knowledge*, representing the granularity as well as the notional and logical structure of the substantial knowledge area by knowledge elements and associations,
- *Cognitive Process Dimension*, where the information about the degree of difficulty is located,
- *Learning Objectives*, described by granularity and prerequisite structure,
- *Methodology* for the teaching and learning methods,
- *Context* for all organizational information about grades, classes, school type, subject organization, country/State and directions of study and finally
- *Media*, where the possible or applied hard- and software systems, textbooks etc. are stored.

4.1 Complexity

The most serious problem for the implementation will be the considerable complexity of the system. In order to offer a structure that respects the learning context in a sufficient detailed way, we have to distinguish the educational systems of the 16 German states, Austria and Switzerland, which results in 18 political units. Each of these systems comprises at least three different school types (restricted to general education): primary schools, grammar schools and main/middle-schools. The schools run from grade 1 up to grade 12 or 13. Within these types of schools we plan to support the most demanding 15 subjects (at least in the long run): Mathematics, Physics, Biology, Chemistry, German Language, Foreign Languages (English, French, Latin, Spanish, Italian), Computer Science, Geography, Social Science, History, Economics.

The granularity of the *TopicRooms* in *MyLearnSpace* is planned to be tailored to about one main topic of the regarded subjects, which are typically about 10 per year and curriculum. For example, the curriculum for Mathematics in grade 10 of the Bavarian Gymnasiums comprises 10 main topics, e.g. *irrational numbers and square roots*, *quadratic and hyperbolic functions* or *systems of equations with 3 variables*. The knowledge structure of these topics will be represented by a collaborative concept map, see (Hubwieser & Mühling, 2011). According to our investigations of concept maps, we expect these “topic maps” to consist typically of about 40 nodes and about 100 edges.

We have to offer one *TopicRoom* per main topic of each curriculum. If we assume that the set of main topics is the same for each subject over all political units, we have to set up about 13*10 = 130 spaces over all grades per subject. Therefore it would be wise to start with some few selected subjects, e.g. Mathematics, Physics and Biology. Within each of these subjects we would have to consider up to 18 different contexts (maximal one per political unit).

4.2 The Tools

MyLearnSpace will offer a variety of tools that support the collaboration and offer information. Each of these tools will provide a specific set of data for each *TopicRoom:*

The *Topic Wiki* will collect and connect all the knowledge that is available in the community around the respective topic. Depending from the quality that is assessed periodically by the community, it might be necessary to set regulations for the writing access.

The *Actual Chat* offers the possibility to exchange information with peers synchronically, *Postings* and *Blog* present the most interesting information and material that was submitted most recently. Information about the current activities (e.g. in the TV) could be posted to the *Twit.* The *Formula Editor* will provide features to write Mathematical formulas in all windows, while the *Material Browser* will support the search of the most helpful documents or multimedia files.

Of course, there is a need for a *rating system* that assures at least a certain level of quality of the content. We will implement a system that offers the learners as well as the supporters a choice of 0-5 stars according to their subjective valuation. There will be an option to suppress all content that is rated not yet at all or below an adjustable threshold, e.g. 3 stars. Additionally there will be a kind of ”I like it” button that can be pressed at all elements. The number of pressing will also contribute to the rating of an element.

From each *TopicRoom*, there will be access to our concept mapping tool *CoMapEd* (Concept Map Editor), which is already in use at this moment. This platform was developed in order to support our studies of concept maps according to the following design objectives:

1. It should be possible to use on as many systems as possible, as easy as possible.
2. The data should be stored centrally, in order to allow assessing it.
3. The software should be able to restrict the set of concepts and edge labels to a pre-defined set, if so desired by the assessment designer.
4. Users should be able to come back to the system to continue working on their map.
5. Users should be able to export the map in order to use it personally, if they desire.
6. The software should allow the researchers, to score the edges of the concept maps.
7. The software should allow flexible export on the backend in order to pass the data to other tools that are used for our research.

The idea to use software in the creation of concept maps goes back right to the “inventor” of concept maps, Novak. His CMAP tools provide a standalone software solution for drawing a concept map (Novak, 1990). Gouli et al. developed the tool COMPASS (Gogoulou et al., 2005) that can be used both from the learner perspective and as an assessment tool. Also, it allows incorporating the users in the assessment process (e.g. by having them rate concept maps of other users). It is unclear, in how far COMPASS would meet requirements 2-7, but as it is a stand-alone program, we felt that we can do better concerning requirement 1 by using a browser-based solution. In (Taricani and Clariana, 2006) software called KNOT is used to analyse concept maps. However, the software doesn't provide a way of drawing them.

A map is assigned a short URL ("slug") that the participants can use to come back to their map as often as they wish. The changes of the map are recorded by the site, making it possible to analyse the creation process of a map, a factor that has not been researched extensively so far.

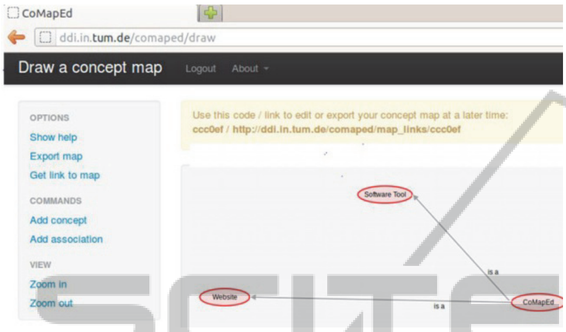

Figure 2: Drawing a concept map within *CoMapEd.*

5 CONCLUSIONS AND FUTURE WORK

Despite the fact that many people spend much time with describing their own activities currently (e.g. in Facebook), we are convinced that the time will come when this will get boring. We suppose that this point will be reached lately when all adolescents will find their parents in Facebook. This will be the time when student will start to look for other activities in the Internet, and we hope that learning might be attractive enough to get many of them as users into our system.

Anyway the development and evaluation of the system and the activities of the users will be a very interesting research field. We will use this project to sample data about the leaning process of the communities, e.g. about the concept mapping processes. Additionally, the system offers a platform to search for interview partners or to conduct surveys mong students in all German speaking countries.

The realization of the project will start shortly, with the help of students that are willing to do the programming work on the prototype as lab work.

REFERENCES

Anderson, L. W. and Krathwohl, D. R., (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. New York: Longman.

Gogoulou, A., Gouli, E., Grigoriadou, M., & Samarakou, M., (2005). ACT: a web-based adaptive communication tool. In: *CSCL '05, Proceedings of the 2005 conference on Computer support for collaborative learning: learning 2005: the next 10 years!* (pp. 180-189). International Society of the Learning Sciences.

Gokhale, A. A., (1995). Collaborative Learning Enhances Critical Thinking. *Journal of Technology Education*, *7*(1).

Hubwieser, P., & Bitzl, M., (2010). Modeling Educational Knowledge: Supporting the Collaboration of Computer Science Teachers. In J. L. G. Dietz (Ed.), *Proceedings of the International Conference on Knowledge Engineering and Ontology Development (KEOD) 2010. 25.-28. October 2010.* Valencia, Spain.

Hubwieser, P., & Mühling, A., (2011). Knowpats: Patterns of Declarative Knowledge: Searching Frequent Knowledge Patterns about Object-orientation. In *Proceedings of the International Conference on Knowledge Discovery and Information Retrieval. Paris, France, October 26 - 29* (pp. 358–364). ScitePress.

Leake, D. B., Maguitman, A., Reichherzer, T., Cañas, A. J., Carvalho, M., Arguedas, M., (2003). Aiding knowledge capture by searching for extensions of knowledge models. In: *K-CAP '03, Proceedings of the 2nd international conference on Knowledge capture* (pp.44-53). New York, NY, USA: ACM.

M. Ben-Ari, (1998). Constructivism in computer science education. *ACM SIGCSE Bulletin*, *30*(1), 257 -261.

Novak, J. D., (1990). Concept mapping: a useful tool for science education. *Journal of Research in Science Teaching*, *27*(10), 937–949.

Taricani, E. & Clariana, R., (2006). Technique for Automatically Scoring Open-Ended Concept Maps. *Educational Technology, Research and Development*, pp. 72–84.

Uljens, M., (1997). *School didactics and learning: A school didactic model framing an analysis of pedagogical implications of learning theory*. Hove: Psychology Press.