

Inquiry-based learning for meta-cognitive training in semantic open learning space

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Abstract: This research's objective is to train learners' meta-cognitive skills in self-directed learning of history. Learners use a learning environment that provides support and regulates their learning processes using inquiry-based learning. Learners use the system to learn in an open learning space reinforced with semantic information. All the provided support is generated automatically using this semantic open learning space. The support is provided in the form of inquiry questions generated by the system. These questions are designed to direct learners to new information and trigger history thinking.

Keywords: Inquiry Based Learning, Self-directed Learning, Meta-Cognitive Training, History Learning, Question Generation, Semantic Open Learning Space, Adaptive Learning Support

1. Introduction

In self-directed learning, learners without the necessary skills have difficulties planning their learning. In an open learning space, such as the Internet, learners can easily become overwhelmed by the quantity of information available. To be able to achieve learning outcomes on the same level as classroom learning, learners need to acquire self-regulation skills.

Learners can be given inquiry in a learning environment, which can be used in a self-directed learning situation. Inquiry-based learning can support learners during self-directed learning by giving them smaller objectives. Giving inquiries to learners also make learners think about what they learned. In history, inquiry is also used in classroom to encourage learners to form an opinion (Husbands, 1996).

We previously proposed a novel learning environment to enhance self-directed learning in the domain of history learning using semantic web techniques (Jouault and Seta, 2013). Our system provides a learning environment to build a concept map while learning, in an open space, about a specified historical period. The originality of our system is that it uses a natural language open learning space (Wikipedia) reinforced by semantic information from two sources, DBpedia and Freebase. This process creates a "semantic open learning space" used by the system. The system can provide content-dependent questions depending on the learner's knowledge level. The generated questions are design to direct learners to new information but also to make them think about what they learned.

In this paper, we discuss the possibility of using our system to enhance meta-cognitive skills in self-directed learning of history. We designed a new version of our system that is not only aimed at improving domain understanding but also improving learners' history learning skills. By implementing inquiry-based learning support into our system, we hope to lastingly improve the learning processes of learners in self-directed learning of history.

2. Related Work

To support learners in self-directed learning, systems, such as the Navigation Planning Assistant (Kashihara and Taira, 2009), which provides an environment for describing learners' learning plans and states of understanding to prompt their self-regulation in an open learning space, have been developed. The limitation of this system, however, is that its support is content-independent due to the difficulty in working with natural language information on the Web. Of course, this problem can be overcome by preparing the learning materials in advance. This is the case of the Betty's Brain system (Biswas, Roscoe, Jeong and Sulcer, 2009) which involves using a concept map in learning by teaching environment. However, preparation requires a considerable amount of time even for constructing a

closed learning space. It is not possible to use the same method in an open learning space because there is too much material. In our system, the quality of semantic information is not as good as manually prepared information, but the process can be applied automatically for every concept. Therefore, it can be applied to an open learning space.

In meta-cognitive training using inquiry-based learning, the Web-based Inquiry Science Environment (WISE) (Slotta, 2004), which also provides support in self-directed learning but in the science domain. Learners using WISE gather information to answer a science inquiry. Learners are trained in designing solutions, debating science subjects, and critiquing the resources they learn. However, it requires specialists to prepare all the inquiries. In our system, the use of the semantic open learning space allows us to automatically generate all support.

3. Design rationale: Reinforcing inquiry-based learning

We have two objectives with our system:

- Reinforce the domain understanding of the subject learned. The system supports learners to help them learn the most important concepts and explore the relation between them.
- Reinforce learner skills for self-directed learning of history. The provided support is aimed to help the learner become aware of the important points during the study of an historical period.

Regarding objective A, the system provides support to help learners not only learn history but also understand it. In history learning, an understanding of chronology is necessary. Chronology is defined by Smart (1996) as “the sequencing of events/people in relation to other and existing knowledge of other, already known, events/people”. Learners need, of course, to know events but they also need to understand their context.

Regarding objective B, the system supports the acquisition of two level of awareness:

- Macro level: Inquiry driven self-directed learning process. Learners need to be made aware of the importance of setting objectives in self-directed learning. Learners using the system set an objective every time by choosing a question. Then, they learn from the document to be able to answer the question. Learners will be directly influenced by their choice of objective.
- Micro level: Context-dependent question generation. Learners need to become aware of the importance of asking relevant questions depending on their learning state. All the questions are generated depending on the machine understandable concept map built by the learners. Thus, they can make the connection between their knowledge and the generated questions.

The system, as illustrated in Fig. 1, is composed of four windows:

- Question window (a): the question window displays a list of questions generated by the system.

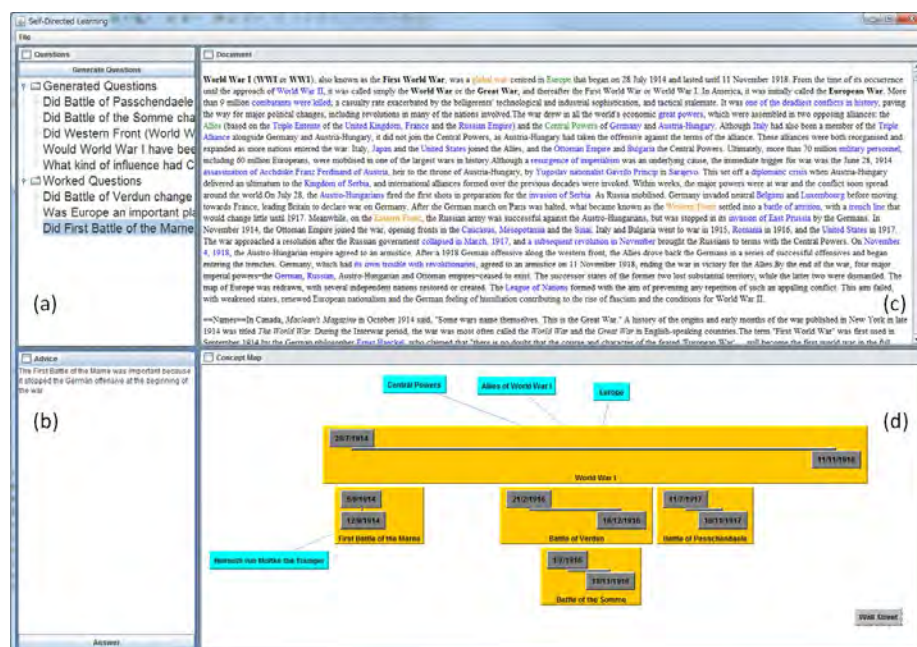


Figure 1. System interface

- Answer window (b): Learners can use this window to answer their active question. They can write their answer in natural language.
- Document window (c): This window displays the document the learner selected. The learner can click on the concepts in the documents to add them to the concept map.
- Concept map window (d): The concept map window is used both to display and manage the concept map. The display of the concept map is built for history learning. The events are organized on a timeline. The learners can also add relations between concepts.

The starting point of learning is the same for all learners: they are provided with the same list of questions. Learners will then build a concept map following what they think the answers to the questions are. Once learners give their answers to the questions, new questions will be generated depending on their concept map. All learners will be directed by the questions to help them correct the weaknesses in their concept map.

To support the acquisition of the macro level of awareness i.e. meta-cognitive training, before learning, learners need to set a learning objective by choosing a question. Then, learners need to gather information to be able to answer the questions. Repeating the process should make learners develop awareness of the importance of inquiry during self-directed learning of history.

The problem in providing good quality training is that the quality of the learning depends on the questions given during this process. According to Riley (2000), a good enquiry question in history should: “capture the interest and imagination of your pupils, place an aspect of historical thinking, concept or process at the forefront of the pupils' minds, result in a tangible, lively, substantial, enjoyable "outcome activity" through which pupils can genuinely answer the enquiry question.” To answer a questions learners should think about what they learned (Husbands, 1996). Generating such questions is possible by using the semantic open learning space.

To support the acquisition of the micro level of awareness, the system generates questions depending on the learner's concept map. Using the semantic information available, the questions will be relevant to the studied subject in most cases. The generated questions use types defined in Graesser's taxonomy (Graesser, Ozuru and Sullins, 2010) which are content-independent. The system uses its own ontology to create links among the questions, concept, and relation types. These natural language patterns are hand written for every concept type.

4. Concluding Remarks

In this paper, we described the additions made to our system to enable meta-cognitive training in self-directed learning of history. Using our semantic open learning space, we are able to automatically generate relevant inquiry questions which are used to train the learners' skills.

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