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Scaffolding Topic Decomposition in Investigative Learning with Web Resources

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Abstract: Investigative learning with Web resources requires learners to find out related topics to be further investigated and decompose the topic into the related topics as sub-topics while navigating Web resources/pages to construct knowledge for learning the topic. However, finding out the related topics from Web resources/pages is not so easy for them. The purpose of this work is how to enhance an awareness of related topics during investigative learning process. This paper proposes a scaffolding method, which could promote finding out related topics from Web resources and activate the topic decomposition.

Keywords: attributes, investigative learning, iPad, learning scenario, scaffolding, Web

1. Introduction

In recent years, Web resources available for learning have increased, which also bring a lot of opportunities for learners to investigate any topic to learn. Such investigative learning allows learners to construct a wider, deeper, and timely knowledge from a great variety of Web resources.

On the other hand, Web resources do not always provide a learning scenario, which indicates the topics and their sequence to be learned. Therefore, the learners need to build the learning scenario by themselves. However, it is not so easy for them to build their learning scenario. Since they tend to pay more attention to Web resources/pages navigation and knowledge construction for learning the topic (Hill, and Hannafin, 1997), they often miss finding out related topics to be further investigated, which results in an insufficient investigation.

In order to resolve it, we have proposed the model of Web-based investigative learning (Kashihara, and Akiyama, 2013). This model requires learners to build the learning scenario by decomposing the topic into the related topics as sub-topics to be further investigated while learning Web resources. The learning scenario is represented as a tree of topics investigated (called topic tree), which is composed of partitive (part-whole) relations between the topic and sub-topics. We have been also developing a system in which learners could construct knowledge about a topic and build a learning scenario seamlessly based on the model of Web-based investigative learning. The results of the case study we have conducted suggest that this system allows the learners to build their learning scenario more structured, which also allows them to promote their reflection on constructed knowledge after investigative learning process (Kashihara, and Akiyama, 2013).

On the other hand, the learners are not always able to find out related topics from Web resources/pages. This indicates the necessity of scaffolds for finding out related topics during investigative learning process.

The main issue addressed in this paper is how to enhance an awareness of related-topics during investigative learning process to promote the topic decomposition. In order to address this issue, this paper proposes a scaffolding method for allowing learners to find out related topics by means of attributes representing the semantic relations between the topic and related topics. This paper also demonstrates an interactive learning scenario builder (iLSB for short) including the scaffolding method, which is implemented on iPad.

2. Scaffolding in iLSB

2.1 A Model of Web-Based Investigative Learning

In order to represent the process of building a learning scenario while learning Web resources, we have proposed a model of Web-based investigative learning (Kashihara, and Akiyama, 2013). This model includes three phases, which are phase of search for Web resources, navigational learning phase, and learning scenario building phase.

In the phase of search for Web resources, learners who undertake a task of investigating learning about a topic are expected to use a search engine such as Google with a keyword (called topic keyword) representing the topic to gather the Web resources suitable for learning the topic. They are then expected to navigate across these resources.

In the navigational learning phase, they are also expected to navigate the Web pages in the resources gathered to learn the contents and construct knowledge about the topic. Such knowledge construction with navigation is called navigational learning. In the navigational learning process, they could find out related topics to be further investigated, which can be viewed as sub-topics of the topic.

In the learning scenario building phase, the learners are expected to build a learning scenario by decomposing the topic into sub-topics, each of which could be further investigated and learned in the phases of search for Web resources and navigational learning.

These three phases are repeated until the topic decomposition does not occur anymore. The results of the case study suggest that model of Web-based investigative learning makes investigative learning more structured, and that it allows learners to promote reflection on knowledge constructed (Kashihara, and Akiyama, 2013).

2.2 Attributes as Scaffold

The attributes presented as scaffold represent the semantic relations between a topic and its sub-topics. When a learner investigates a topic *global warming* and learns the related topic *greenhouse gas*, for example, *greenhouse gas* is a main cause for global warming. In this case, *cause* indicates an attribute representing the semantic relation between *global warming* and *greenhouse gas*. We have enumerated such attributes from Japanese thesaurus, which are related to investigative learning.

The attributes to be presented in investigative learning process are expected to enhance an awareness of related topics to be extracted from Web resources and to promote topic decomposition. Let us here consider an example where a learner investigates a topic about *global warming*. *Global warming* can be classified into the topic type *phenomenon*. There are several attributes to be presented for this type such as *cause*, *background*, *principle*, *effect*, *countermeasure*, and so on. Such attributes could bring about the following effects. If he/she has not learned about the cause of *global warming* such as *greenhouse gas* during investigative learning process, the presented attribute *cause* could first allows him/her to be aware of the related topics (*greenhouse gas*, *CO2* for example) from Web resources/pages and to promote the navigational learning process. When he/she finds out related topics in navigational learning process, the presented attribute could second allow him/her to grasp the semantic relations between the topic and the related topics to make sure the correctness of the contents to be learned. When he/she has learned the cause of *global warming* such as *greenhouse gas* and builds the learning scenario, the presented attribute *cause* could finally allow him/her to be aware of sub-topic *greenhouse gas* to be decomposed from the topic *global warming* and to promote the topic decomposition.

2.3 iLSB: interactive Learning Scenario Builder

In order to scaffold the investigative learning process as modeled with the attributes, we have implemented iLSB including the scaffolding method on iPad. Figure 1 shows the user interface of iLSB. This system first requires the learners to input an initial topic as topic keyword and select the appropriate topic type. This system next allows the learners to use the search engine with the topic keyword to find out and navigate across Web resources fruitful for learning the topic. In navigational learning with these resources, they are allowed to browse the Web pages and extract keywords, which represent the contents

to be learned about the topic. If they could not become aware of related topics from the contents to be learned, they are allowed to use the attribute list to see the attributes, which induces them to become aware of the sub-topics. The keyword repository allows them to put the extracted keyword and to make inclusive relations among them, which represent knowledge constructed. In the keyword repository, the learners could become aware of sub-topics to be further investigated. In the learning scenario building, they are allowed to drag the keywords representing the sub-topics to drop them on the topic tree map. The next task for the learners is to investigate these sub-topics. Tapping a topic keyword in the topic tree and select appropriate topic type, they could set it up as the current topic investigated. The keyword repository to be provided is changed into the current topic keyword synchronously, which displays the keywords extracted in learning the current topic. The attributes to be presented in the attribute list are also changed into the current keyword's topic type synchronously.

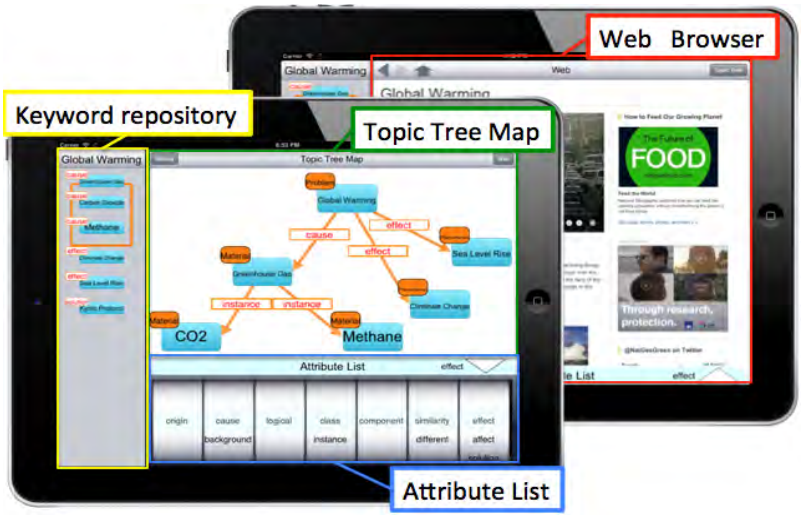

Figure 1. iLSB: interactive Learning Scenario Builder

3. Conclusion

This paper has proposed a scaffolding method, which presents attributes representing the semantic relations between the topic and sub-topics, for finding out related topics during investigative learning process and topic decomposition, and has demonstrated iLSB with the scaffolding method. In future, we will conduct more detailed evaluation with iLSB to refine the scaffolding method.

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