A Model for Knowledge of a Subject Matter in E-learning Using Ontology

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Abstract: When enveloping educational courseware, the structure and sequence of learning experience is concerned. So, IMS and SCORM have proposed their sequence and navigation of E-learning content package in E-learning, but these models are insufficient for adaptive and efficient learning because these models can not consider the structure of a subject matter's knowledge but only express the educational activities of student. If E-learning would be designed based on the structure of learning content's knowledge, this content will be more adaptable for learners. So, we present a knowledge model for subject matter in E-learning using ontology. We proposed the formal knowledge model by ontology and E-learning Management System architecture, which consisted of educational materials, learner's profiles, ontology model of subject matter's knowledge and learning sequence model. This ontology model includes, the structure of subject matter with some related valuable information between educational materials.

Key words: Structure of subject matter's knowledge, ontology, E-learning, LMS

INTRODUCTION

Reusing educational materials and adaptive learning in E-learning are the main concerns in recent years. Reusing educational materials is possible as object-oriented paradigm makes educational materials into reusable objects like LEGO block (Wiley, 2000). Because educational material metadata suggests learning object attributes for the purpose of classifying and reusing it, many researchers and committees announced their metadata specifications such as Dublin Core, Learning Object Metadata (LOM), CanCore in Canada and Korea Educational Metadata (KEM) in Korea. After enveloping educational materials with metadata, E-learning designer has to design and develop the structure and sequence of learning activity with these. IMS and SCORM have proposed their sequence and navigation models in E-learning, but these models are insufficient for adaptive and efficient learning because these models can not consider the structure of subject matter's knowledge but only express the educational activities of student. If E-learning would be designed based on the structure of learning content's knowledge, E-learning material will be more adaptable for learners. The aim of this study, is to present a knowledge model for a subject matter in E-learning using ontology.

METADATA AND ONTOLOGY

Metadata is defined as data about data, or someone say that metadata is machine understandable information.

Because, metadata gives more important information about resources to both machines and human, many learning technology committees and researchers have enveloped their learning materials with metadata such as Dublin Core, LOM, CanCore in Canada and especially, KEM in Korea. Many metadata specifications almost have general elements such as identifier, title, keywords, data format, date and description. These elements of metadata help educational designer or application system choosing, organizing and sequencing educational materials according to their plan (Choe and Kim, 2005).

Ontology specifies a conceptualization of a domain in terms of concepts, attributes and relations. It can play a crucial role in enabling knowledge processing, sharing and reusing between applications. Also, it provides a common understanding of topics that can be communicated between people and application systems (Decker *et al.*, 2000). Ontology typically contains a hierarchy of concepts within a domain and describes each concept's crucial properties through an attribute-value mechanism. Further, defining relations between concepts might be described through additional logical sentences. Many formal languages to specify ontology have been proposed such as RDF, XOL, OML, SHOE, OIL, DAML+OIL and OWL. Especially, Tim Berners-Lee proposed a Semantic Web, which gives semantic relations among web resources with ontology languages (Tim Berners-Lee, 2000). Web resources described with its metadata can easily integrate with ontology for Semantic Web.

KNOWLEDGE OF A SUBJECT MATTER AND E-LEARNING MATERIALS

E-learning metadata such as DC, LOM, CanCore and KEM describe the properties of educational materials. These help human designers and E-learning Content Management System getting proper information from educational material and reusing it. But these metadata data have only explanation about material itself and do not have sufficient relational information among knowledge of a subject matter in an educational activity. For example, LOM has <kind> element and its attribute values such as ispartof, references, isbasedon, requires, etc. These some metadata elements only show the relationship between other E-learning materials. These are useful to organize two, or three E-learning materials, are insufficient to organize all educational materials based on the knowledge of a subject matter. Thus, finding appropriate method for organizing these all educational materials according to the sequence or structure of a subject matter in learning is necessary.

Quemada and Simon (2004) have presented a model for educational activities and educational materials. A model for educational activities denote educational events, which identify educator(s) involved and take place at a virtual meeting according to a specific schedule. It consists of ANAME-Activity name, OBJECTIVE-Educational objective, EDUCATORS, EM-Educational material and DSEQ-Delivery sequence. SCORM also has announced the SCORM Sequencing and Navigation

Model. The key technologies of it are activity tree, learning activities, sequencing rules, navigation and navigation model. SCORM sequencing defines a method for representing the intended behavior of an authored learning experience and navigation describes how learner and system initiated navigation events can be triggered and processed. These two models describe well in the educational activity or implemented system aspect, but are insufficient for describing structure of a subject matter's knowledge in E-learning. If we will provide educational content structure of one unit based on the knowledge of a subject matter to E-learning system with ontology, which based properties such as hierarchical content structure and some semantic associations, LCMS has capabilities for designing adaptable learning content for learners. Hierarchical content structure shows the entire knowledge of a subject matter, sequence of learning and related super-or sub-contents. Some semantic relations among educational materials such as equivalent, inverse, similar, aggregate and classified can give related useful information to a designer or E-learning system. Thus, we provide the structure of a subject matter's knowledge using ontology. Figure 1 is ontology of geometry in mathematics using Protégé.

Content structure model consists of many educational materials in one educational subject unit. Educational materials are a presentation, a text book, a video, a CD-ROM, a web page, etc. Organizing these educational materials in the form of hierarchy and defining semantic relations among these materials are the main concern of our research.
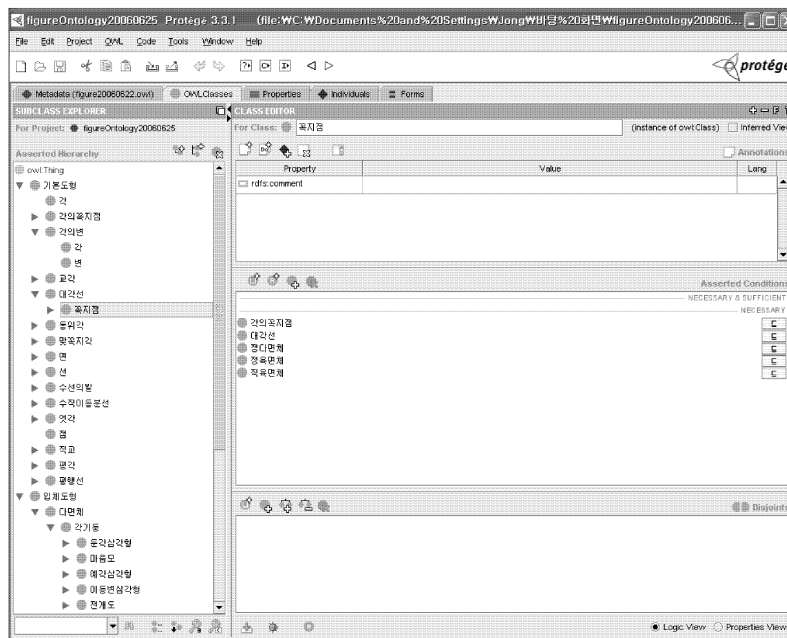

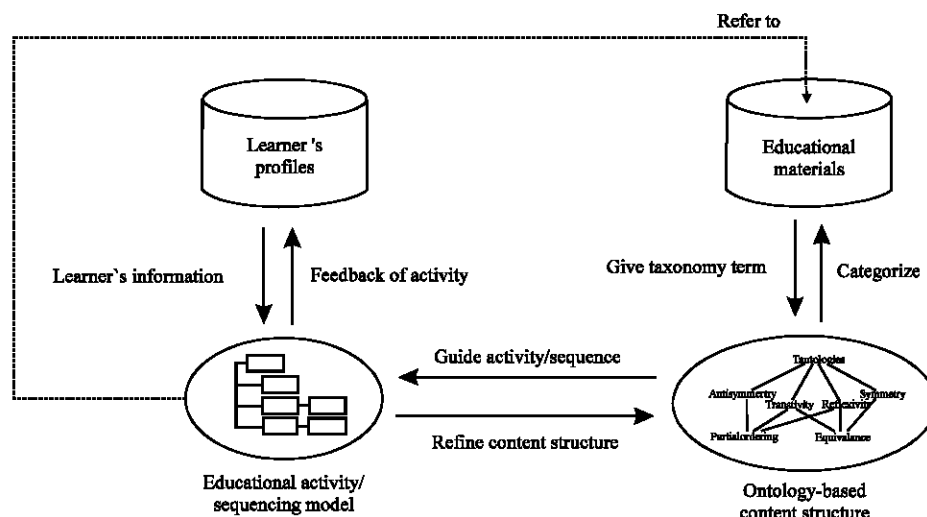Fig. 1: Ontology of geometry in mathematics using Protégé

Fig. 2: E-learning system architecture with ontology-based content structure

Figure 2 is our proposed E-learning system architecture with ontology-based content structure. Ontology has information about hierarchical structure of a subject matter's knowledge and some relational properties to guide a learning activity sequence. This can help to categorize the educational materials with the term of ontology like taxonomy. Educational activity/ sequencing model seems to be a learning mediator, which refers to sequencing educational materials in an educational application system. It gets learner's profile and content structure in order to arrange the event or activity of learning by teachers or educational content designers. After finishing an educational activity, it gives feedback information to learner's profile as well as refines ontology-based content structure.

CONCLUSION

This study proposes, a new taxonomy for learning resources that differentiate educational content model from educational materials and provides a concise definition of educational content model. This model serves as a coordinator for educational activity/ sequencing model and metadata taxonomy of educational materials in E-learning. The educational content model includes the structure of educational content with some related valuable information on semantic relationship between educational materials.

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