Standard-compliant Scenario Building with Theoretical Justification in a Theory-aware Authoring Tool

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Abstract. Nowadays standard technologies play important roles in enhancing sharability, reusability and interoperability of learning contents. However, there is a lack of pedagogical justification of the contents implemented with the standards. This paper discusses the standard-compliance of our ontology-based modeling framework and how the framework gives theoretical justification to standard-compliant learning/instructional scenarios in a theory-aware authoring tool.

Introduction

Nowadays standard technologies play important roles in enhancing sharability, reusability and interoperability of learning contents. However, it is pointed out that there is a lack of pedagogical justification of the contents implemented with the standards [5].

In this study we take an ontological engineering approach to organize educational theories in a formal and computer-understandable way [4]. Through this approach we have proposed a comprehensive ontology[1] that covers different theories and paradigms, and have developed a modeling framework of learning/instructional scenarios based on the ontology [1][2]. This paper discusses the standard-compliance of our modeling framework and how the framework gives theoretical justification to standard-compliant learning/instructional scenarios in a theory-aware authoring tool.

1. Standard-compliant scenario building on an ontological modeling framework

In our framework, a scenario can be modeled as a hierarchical structure of "Instructional_Leaning (I_L) event", which are composed of instructional and learning actions for achieving a certain change of a learner state [1]. We call the model an "I_L event decomposition tree". The basic idea of the model is to relate a macro-I_L event to the lower (micro) ones that collectively achieve the upper (macro) I_L event in terms of a learner state (The relation is referred to as "WAY" in this study). Currently, we have organized about 100 pieces of WAY based on some theories [2]. Such WAYs are called WAY-knowledge.

[1] The ontology is opened to the public on our OMUNIBUS project web page (http://edont.qee.jp/omnibus/).

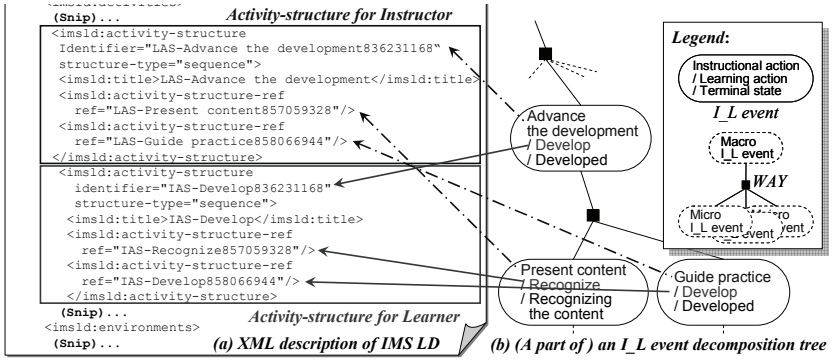

Fig. 1 Mapping an I_L event decomposition tree into IMS LD

In order to enhance sharability and reusability of the scenario descriptions, we have mapped I_L event decomposition tree onto IMS LD specifications [3]. Briefly speaking, each unit of decomposition in an I_L event decomposition tree can be converted to two `activity-structures` for `learner` and `instructor` in an IMS LD description as shown in Fig. 1.

In IMS LD, only top and leaf activities have the description of the objective while the others do not have. Therefore only a part of the design intention can be converted to the IMS LD description although it keeps sharability and executability of learning/instructional scenarios. On the other hand, an I_L event decomposition tree keeps the whole design intention together with theoretical justification of it. For these reasons, IMS LD and our modeling approach are complementary to each other.

2. Generation mechanism of theoretical scenario explanation

This study aims at building a theory-aware authoring tool based on our comprehensive ontology and modeling framework. One of the characteristics of such an authoring tool is its ability to interpret and explain learning/instructional scenarios in terms of theories. A descriptive concept (I_L event) and a prescriptive concept (WAY-knowledge) in our comprehensive ontology enable information systems to give explanations and suggestions about scenarios described as an I_L event decomposition tree.

In order to generate scenario explanation we made message templates whose vocabulary comes from the ontology and whose structure is partly based on an I_L event decomposition tree. Table 1 summarizes the classification of the templates. If a scenario is described based on a piece of WAY-knowledge, an interpretative explanation gives a theoretical justification. On the other hand a scenario is described only in the terms defined our ontology, a suggestive explanation offers suggestions for improvements in the scenario in terms of theories.

Table 1 A classification of explanation types and cases (not exhaustive)

		Cases
Explanation types	Interpretative	Theoretical justification (Notes: *Explaining interpretation of relation among events in a scenario in terms of a theory*)
		Theory description
		Scenario comprehension
	Suggestive	Insufficiency of necessary goals (Notes: *It seems learners can not achieve the goal because necessary (sub) goal is insufficient in the scenario.*)
		Insufficiency of supplementary goals
		Excess of goals
		Disproportion in process
		Inconsistency of principle
		Unsustained state

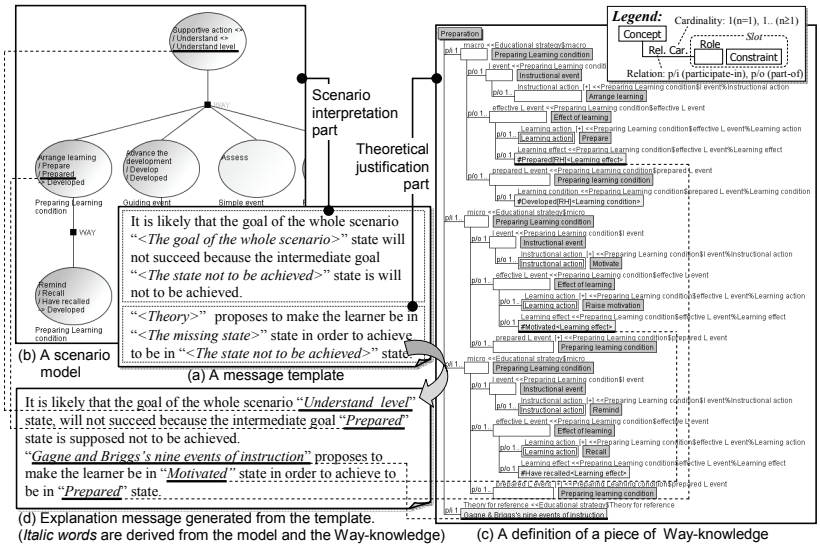

Fig. 2 An example of suggestive explanation

We are currently developing the explanation function in our prototype system named "Smarties". Fig 2 illustrates an example of suggestive explanation. Fig 2 (d) shows an example of generated messages about *Insufficiency of necessary goals*. This message is generated by the message template (Fig. 2 (a)) and the scenario interpretation based on WAY-knowledge. Italic words in the message are specified with the scenario model (Fig. 2 (b)) and a definition of a piece of WAY-knowledge (Fig. 2 (c)) in the ontology. Such a message can be generated if the scenario is described in the terms defined in the ontology.

3. Conclusion

We have discussed a functionality of theory-awareness of an ontology-based authoring tool and its compliance with standard technologies, especially focused on IMS LD specifications. Conceptual understanding of scenarios based on the theory-awareness enables an authoring tool to explain scenarios theoretically and to record them in a sharable format with theoretical justification.

References

[1] Hayashi, Y., Bourdeau, J. and Mizoguchi, R. : "Ontological Modeling Approach to Blending Theories for Instructional and Learning Design", *Proc. of ICCE2006*, pp. 37-44, 2006.

[2] Hayashi, Y., Bourdeau, J. and Mizoguchi, R. : "Ontological Support for a Theory-Eclectic Approach to Instructional and Learning Design", *Proc. of EC-TEL2006*, pp. 155-169, 2006.

[3] IMS Global Learning Consortium, Inc.: IMS Learning Design. Version 1.0 Final Specification, 2003. Retrieved Dec. 15, 2006 from `http://www.imsglobal.org/learningdesign/`

[4] Mizoguchi, R. and Bourdeau, J.: "Using Ontological Engineering to Overcome Common AI-ED Problems", *International Journal of Artificial Intelligence in Education*, Vol.11, No.2, pp. 107-121, 2000.

[5] Psyche, V., Bourdeau, J., Nkambou, R., and Mizoguchi, R.: "Making Learning Design Standards Work with an Ontology of Educational Theories", *Proc. of AIED2005*, pp. 539-546, 2005.