Authoring Support Framework for Intelligent Educational Systems

Lora AROYO[1] and Riichiro MIZOGUCHI[2]

[1]*Computer Science Department, Eindhoven University of Technology*
P.O.Box 513, 5600 MB Eindhoven, The Netherlands
l.m.aroyo@tue.nl
[2]*ISIR, Osaka University, 8-1 Mihogaoka, Ibaraki, Osaka, 567-0047 Japan*
miz@ei.sanken.osaka-u.ac.jp

Abstract. In this paper we discuss how Semantic web concepts can be beneficial for the authoring support of Intelligent Educational Systems (IES). This work is based on modelling application-oriented aspects within SmartTrainer [3] and AIMS [1]. Authoring Task Ontology (ATO) is envisioned as main driving force in providing knowledge to the authoring tools and in enabling them to guide and check the consistency and completeness of the authoring activities. Further we present design principle of the ontology-based framework for authoring support of IES.

Introduction

The high and dynamic user demands in many aspects of software production are influencing research in the field of intelligent educational software. The ultimate problems are related to keeping up with the constant requirements for flexibility and adaptability of content and for reusability and sharing of learning objects and structures [7]. From the analysis of the current state of the art of AIED research [6] it appears that there is a deep conceptual gap between authoring systems and the authors. The authoring tools are neither intelligent nor user-friendly. Special-purpose systems provide extensive authoring guidance, but the disadvantage here is that changing such systems is not easy, and the knowledge and content can hardly be reused for other educational purposes [7]. All this leads to the requirement that the authoring tool has to offer tunable complexity and autonomous performance of authoring tasks. Structured guidance and feedback to the authors in the complex scale of the design process is also needed. Currently, a considerable amount of the research on intelligent systems moves towards concepts and ontologies [4][6] and focuses on knowledge sharing and reusability [3]. Semantic Web offers tools to educational systems to move towards semantics-aware environments. In this context, we consider systematization of the authoring process activities in authoring task ontology (ATO) as support for better process analysis and more efficient knowledge representation in authoring tools. It provides both methodology and vocabulary [5] for the authoring process description and reasoning.

1. Authoring Architecture for Intelligent Educational Systems

Providing user-oriented instruction depends on three factors (1) Domain Model (DM), describing the structure of the information content within the system; (2) User Model (UM) that represents the user aspects relevant from instructional point of view; and (3) Instructional Task Model (ITM) consisting of instructional rules and ontology (vocabulary, concepts and axioms) used for providing adequate instructional guidance, coaching and teaching, adapted to the user preferences, current status and knowledge level (from UM). The division into DM,

UM and ITM provides a clear separation of concerns when developing IES, reflected also in the reference architecture. In this context, our aim is to define an authoring architecture for IES. Figure 1 presents an outline of this intention exemplified with SmartTrainer CBT system and AIMS intelligent information management system. The author creates a domain model, constructs the desired learner's model and generates learning paths within the general instructional model. The student uses the prepared learning material and instantiates his UM.
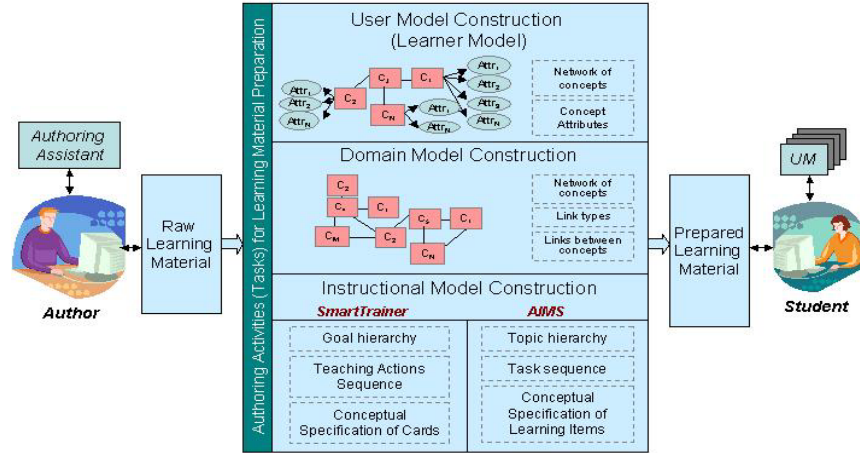

Fig. 1. Authoring Process based on the IES Reference Model

In this process an important part plays the Instructional Model, empowered by an Instructional Engine. The Instructional Engine executes instructional rules over the domain model ontology. It consists of an Operation and an Assistant layers The Operation layer handles the operations related to data in DM, UM and ITM and thus providing means for modelling data and creating alternative goal-oriented structures for teaching. The Assisting layer is directly responsible for interpreting the results from the Operation layer and helping the author with hints for creating course structure, or linking documents or teaching items to the DM ontology, etc.

3. Ontology-based Authoring Support Framework

According to [6], the authoring process knowledge can be split in two parts - static and dynamic knowledge organization. The static one corresponds to the curriculum organization with Instructional Design (ID) and the dynamic one reflects the tutoring strategy organization for adaptation to the learner. Such a separation is important and is in compliance with the main goal of modularizing the different parts of instructional systems and the process of their authoring. Figure 2 shows the architecture of the Authoring Support Framework for IES.
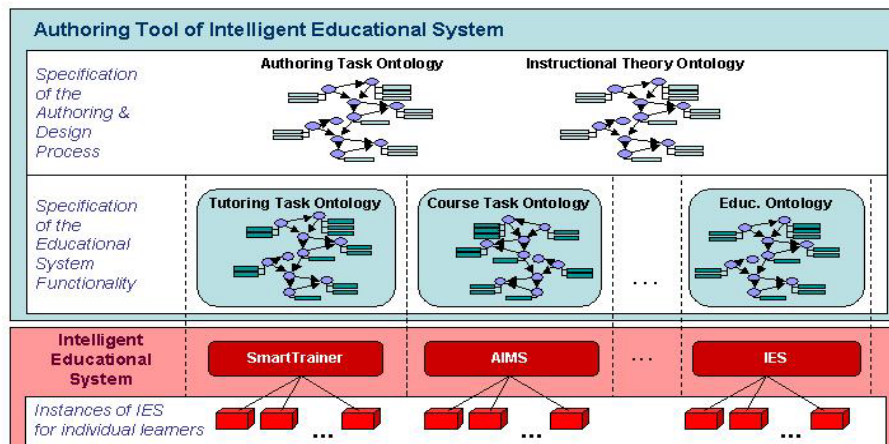

Fig. 2. Authoring Support Framework for IES

The bottom part of Figure 2 depicts the educational system with its type and various instances for each user (depending on the teaching strategy and goal and the UM). In the upper part of Figure 2, we build the authoring tool for the corresponding educational systems. The knowledge, which we supply to the authoring tool is split in two layers (in correspondence with [6], a dynamic part - specification of the educational system functionality and a static part - specification of the authoring and design process in compliance with instructional design theories. With these two layers the authoring support framework is in correspondence with the three ontology level introduced by [6]. This way, the ontology appears to be suitable solution for knowledge systematization within the authoring support tools.

4. Task Ontology for Web-Based Educational Systems Authoring

The IES authoring task ontology is based on the notion of 'task ontology' defined by [5]. With it we are able to formalize the IES authoring tasks and specify and modularize all the authoring activities in their specific context. The authoring process stands for a collection of various authoring activities over domain objects, where the process of their sequencing and combination is guided by instructional design axioms and constraints and each domain object carries a specific role within the corresponding authoring activity [2]. The authoring activities are independent of the system's domain and the educational strategy and goal. Each task in ATO is defined by: (1) sequence of activities; (2) goal; (3) requirements; (4) constraints and is presented by (1) generic nouns reflecting the roles of the objects in the authoring process, (2) generic verbs representing authoring activities over the objects, (3) generic adjectives representing the modifications of the objects and (4) other authoring task specific concepts.

5. Conclusions

We have illustrated the benefits of an ontology-based authoring framework for IES in order to achieve author-friendly primitives in terms of which the author can easily describe the goals and methods of their teaching. We discussed the basic issues related to authoring task ontology. Future work involves ATO implementation within the authoring framework.

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