Semantics-Based Knowledge Representation and Personalized Learning Content Development

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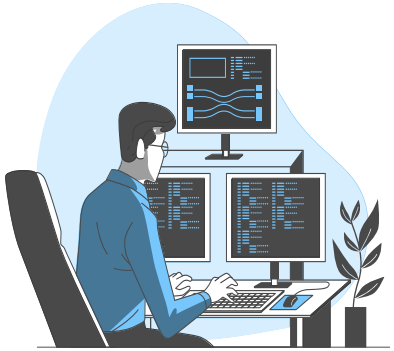


Agenda

INTRODUCTION

E- LEARNING CONTENT DEVELOPMENT FOR SEMANTICS-BASED PERSONALIZED E-LEARNING SYSTEMS

USAGE OF SEMANTIC MODELS TO SUPPORT DEVELOPMENT OF VARIOUS TYPES OF E-LEARNING CONTENT

LEARNING CONTENT DEVELOPMENT STEPS AND SEMANTICALLY REPRESENTED KNOWLEDGE

DISCUSSION

CONCLUSION

INTRODUCTION

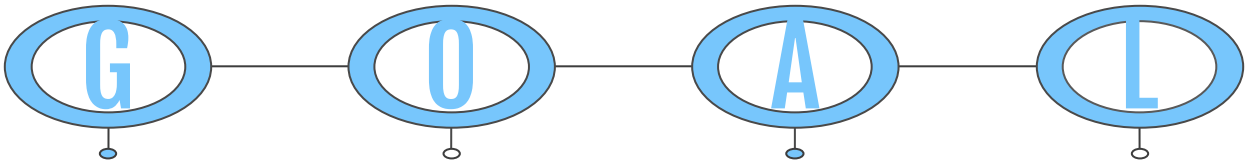
Importance and complexity of development of adaptive content;

Complex dynamic mappings between learning objects and various cognitive, psychological, or pedagogical characteristics should be made.

Semantic representation of the knowledge about learning content and tutoring context can support this complex process.

Our research questions are:

- For what type learning content semantics-based models and what type models (ontologies or concept maps) are the most useful for adapting to the specific educational needs of learners or groups of learners?
- In what phases of learning content development semantics-based models and what type models (ontologies or concept maps) are most useful?



E- LEARNING CONTENT DEVELOPMENT FOR SEMANTICS-BASED PERSONALIZED E-LEARNING SYSTEMS

The main categories of adaptive and intelligent e-learning systems are:

- **Adaptive learning content recommendation systems;**
- **Intelligent Tutoring Systems;**
- **Intelligent Educational Environments;**
- **Personal Learning Environments;**
- **Pedagogical Agents;**
- **Adaptive hypermedia systems;**
- **Intelligent Computer Assisted Instruction systems;**
- **Personalized educational game-based systems.**

USAGE OF ONTOLOGICAL MODELS TO SUPPORT DEVELOPMENT OF VARIOUS TYPES OF E-LEARNING CONTENT

Ontologies are very useful in the following e-learning resource development tacks:

- **E-learning content searching and reuse;**
- **Automated personalized tests generation;**
- **Personalized E-learning content sequencing;**
- **Personalized assessment .**
- **E-learning content annotation;**

SEMANTIC MODELS AND ANNOTATION OF E- LEARNING OBJECTS

Each learning object should be described by metadata, that will be used by software agents or humans during searching adequate content, recommend resources or dynamic organization and personalization of the learning process.
The metadata should be machine-readable and semantics-based to allow computer systems to interpret the metadata from other sources and support reuse of learning objects.

Annotation of learning objects makes them usable for some category of intelligent instructional software as: Adaptive learning content recommendation systems; Intelligent Tutoring Systems; Intelligent Educational Environments; Pedagogical Agents; Adaptive hypermedia or Intelligent Computer Assisted Instruction.

LEARNING CONTENT DEVELOPMENT STEPS AND SEMANTICALLY REPRESENTED KNOWLEDGE

Semantic models are very useful in the following steps of development of Learning Objects (LOs):

- Building and linking LOs;
- Content – based Search, comparison and classification of learning resources for reuse;
- Resource annotation;
- Comparing structure or presentation of Annotated learning resources;
- Resource sequencing. Building learning paths.

LEARNING CONTENT DEVELOPMENT STEPS AND SEMANTICALLY REPRESENTED KNOWLEDGE

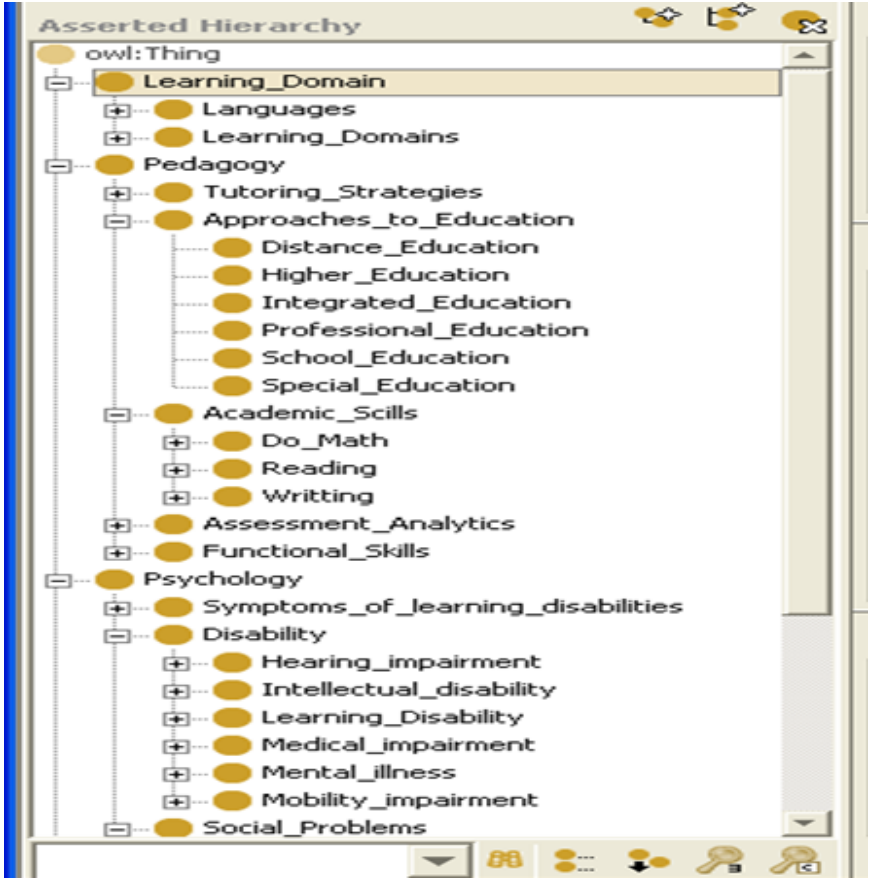
A grand amount of well-structured metadata is needed for supporting adaptive content development. We organize the information, needed for the annotation in four main categories:

- **Learning content description metadata;**
- **Psychological metadata (including learning styles, disabilities, etc.);**
- **Pedagogical metadata (including approaches of educations, skills, goals, assessment, etc.);**
- **Learning resource types, structure and presentation metadata.**

WE PROPOSE A GENERAL ONTOLOGY FOR ANNOTATION OF LEARNING CONTENT

It contains all the terminology, needed for imprecise annotation of the learning objects

Specific scientific domain ontologies, as well as pedagogical or psychological sub-ontologies can be mapped to general ontology for supporting more precise annotations.



OUR GENERAL ONTOLOGY FOR ANNOTATION OF LEARNING CONTENT

The proposed general ontology for annotation of learning content contains terminology, needed for integration of above discussed ontologies in ontological network for learning objects annotation.

This ontology for example can not contain all the information, needed for description of learners with disabilities, or for description of every specific scientific domain, but it includes all the needed terminology for mapping them in one ontological network

Semantics–based models – Discussion

Concept maps are the most useful for manual graphical representation of the structure of the learning content. Having the general scheme or big picture of the course content is very useful during development the learning objects. Concept maps are the most useful for teachers, not familiar with ontological models.

Ontologies are useful during development, annotation and evolution of tutoring content.

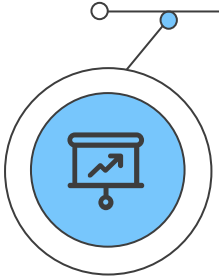
Learning resource annotation is the most important requirement for development of adaptive learning content. Adequate annotation can support both resource development and evolution, and dynamic selection and recommendation of the learning content in personalized learning.

Important ontologies, needed for resource annotation include:

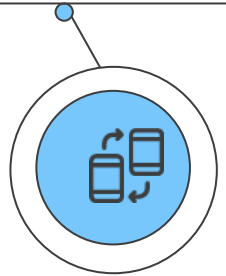
- Learner profile ontology, used typically for linking resources to learners, described with specific mental, emotional or cognitive properties.
- Learning resources structure and presentation ontology, describing properties of resources, important for mapping them to the learners.
- Learning content ontologies, making scientific content of the course machine-readable and machine-processable.

Conclusions

Adequate semantics-based annotation is crucial for evolution, searching and recommendation of suitable learning content for learners, having specific educational needs (including dyslexia, autism, etc.).



We propose a general ontology, modeling general knowledge in all the sub-domains of e-learning domain. This ontology can be used for standardized annotation of all the learning objects in various adaptive e-learning systems.



Unified semantics-based annotation will be in the base of dynamic search, recommendation and reuse of personalized e-learning content both in the adaptive tutoring process and for future adaptive resource development.

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