Sharing Knowledge in Adaptive Learning Systems

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Overview

Issue: specification of concrete learning design instances is usually context dependent and does not support reusability very well

Minsky: the mind as a **collection of structures** that can both cooperate with and oppose one another to find ways to deal with conflicting goals;
redundancy in knowledge representation is an important feature of our brains that enables viewing objects in various contexts and from different perspectives

Aim: we need to represent the knowledge that could help us in generating the instances dynamically – **procedural knowledge**

Structure:

- Model of Adaptive Learning
- Representation of Learning Activities and Adaptation – reusability
- Summary and Conclusion

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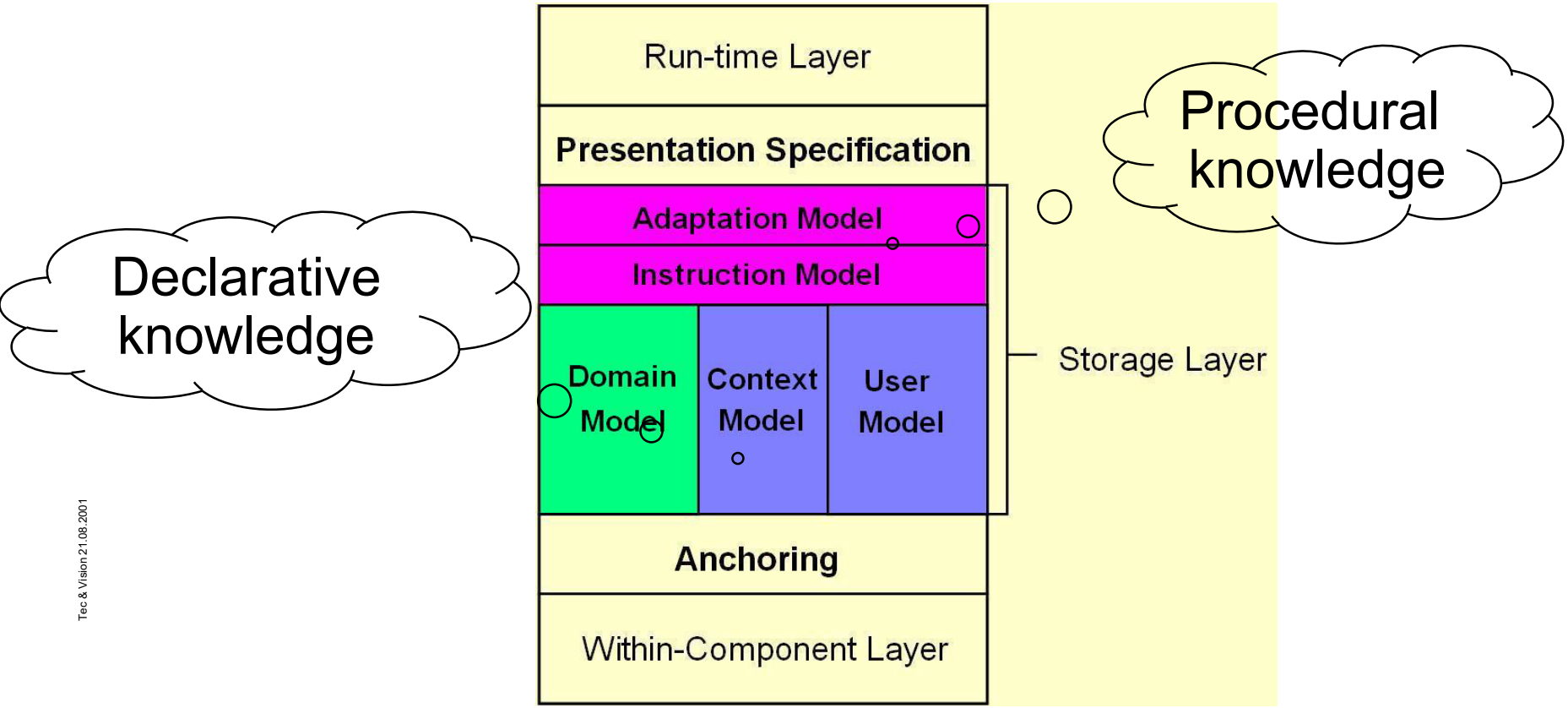
Model of Adaptive Learning



Tec & Vision 21.08.2001

Representations of Learning Activities and Adaptation

Koper, 2005: *the notation must make it possible*
*to **identify, isolate, de-contextualize, and exchange***
*useful parts of a learning design so as to stimulate their **reuse** in other contexts*

- **Informal scripts**
- **System encoding**
- **Specification Encoded in System**
- **Standards**
- **Ontologies**
- **Suggestions for improvements**

Informal Scripts

Adaptive learning units – designed by a **team** of people with different competencies, including domain experts and teachers

Overall design – a list of modules to develop
Detailed design – sensitive to individual students by generating diagnostic questions and providing suitable feedback

Designers sketch informal scripts – design logic and messages for the learner
Programmers – programming logic, screen design, suitable media

Knowledge is represented **implicitly** in the design scripts – **not reusable**

The more freedom of authors, the more complicated authoring process :-(

Specification Encoded in System

Teachers specified pedagogical requirements

programmers implemented them in ALE

procedural knowledge encoded in the system

Example: **WINDS**

Simplified authoring – authors without programming skills can create adaptive courses

Fixed representation of procedural knowledge

Separated specifications

Separation of learning design and adaptation strategies from concrete materials & contexts

Reusability of procedural knowledge

Examples:

•LAOS

•FOSP

To achieve a critical mass of its instances
a specification language has to be **standardized**

Standards

IMS Simple Sequencing: provides learning material tailored to the learner's current context, but makes no distinction between users

IMS Learning Design: explicit notation to enable

interoperability on the level of systems;

personalization – conditions, DIV layers, hide-visible properties

Towle & Halm: IMS LD provides a way to implement **simple adaptive learning strategies**, but not complex forms of adaptive learning, like multiple rules interactions or enforced ordering

Ontologies: Solutions

Challenge: creation and use of ontologies to represent
various types of **knowledge** relevant for personalized adaptive learning

Ontologies for e-learning (Stojanovic et al., 2001)

structure, content, and context

Learning design ontologies (Zarraonandia et al., 2006) (Knight et al., 2006)

increase consistency and potential for exchange

enable the use of Semantic Web technologies, e.g. reasoning and recommendation

facilitate the use of intelligent agents technology

runtime adaptation to actual context

LO context ontology bridges LD & LO content structure ontologies

Ontologies

Personalization – not just one ontology in a ALS

domain, goal and constraint, user, adaptation, and presentation (Cristea, 2004)

domain, user, observation (interaction), and presentation (Henze et al., 2004)

domain, learning paths, user, content structure, and content type (Jovanović et al., 2006)

Ontologies: Open issues

Sharing adaptation rules

RuleML, SWRL for sharing rules on Semantic Web

RWERSE Rule Markup Language – a general rule language

Ontology evolution

A marriage of “Web 2.0” and the “Semantic Web”

ontologies of folksonomies, and ontologies based on folksonomies

version management

Learning and business process

OWL-S Web Service ontology

Summary & Conclusion

Various ways of knowledge representation for learning design and adaptation

Issue: reusability and adaptivity

Challenge: representation of various types of knowledge and
their interaction when generating concrete instances dynamically

Interoperability demands – between systems & between models/layers

Standards are not harmonized

Semantic Web is used as mediator, but still need a lot of research