Adaptive Learning Applications based on Semantic Web Services

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Content

• Background

• A SWS based Framework for E-Learning – Idea and Approach

• A SWS oriented Architecture – Prototype Application

• Conclusion and Outlook
**Background:** Semantic Web Services

- **Dynamic Web Services**
  - UDDI, WSDL, SOAP

- **Static**
  - **WWW**
    - URI, HTML, HTTP
  - **Semantic Web**
    - RDF, RDF(S), OWL
Dynamic usage of WS: Automatic discovery, composition, and invocation based on semantic service descriptions

Background: Semantic Web Services

**Dynamic Web Services**
- UDDI, WSDL, SOAP

**Static Web Services**
- URI, HTML, HTTP

**Semantic Web Services**
- RDF, RDF(S), OWL
Currently, supporting learning objectives means:

- Providing learners with composite learning content
- Using learning metadata standards
  (e.g. ADL SCORM, IMS Learning Design) …
E-Learning Technologies: Issues

Issues:

- Limited dynamic adaptability at runtime of a package
- Limited reusability across learning contexts
- High development costs
Idea: Dynamic reuse of Learning (Meta-)Data?

(e.g. IMS LD, ADL SCORM, …)

(e.g. Open Learn, …)
Idea: Dynamic Services instead of static Data

1st Step - Abstract from learning data (content) …

- Providing learning functionalities instead of static data
- Dynamic adaptation to specific learning context based on dynamic delivery of appropriate data
Idea: Dynamic SWS instead of static Data

... 2nd Step - Abstract from learning functionalities (services) ...

- Using Semantic Web Service technology (WSMO framework)
- Dynamic selection and invocation of services appropriate to achieve a specific learning objective in a specific learning context
- Enables dynamic adaptation to different learning contexts
Idea: Dynamic SWS instead of static Data

... 3rd Step - Abstract from specific learning process metadata standards ...

- Semantic models of learning processes independent from specific standard (LPMO)
- Describing learning processes in terms of learning goals
- Mapping to and between several metadata standards as well as SWS goals
Idea: Dynamic SWS instead of static Data

... 4th Step - Abstract from process domain.
  • Enables mapping between different kind of processes
    (e. g. business processes, learning process ...)
  • Semantic models of processes independent from specific kind of
    process (e. g. learning process, business process)
Idea: Dynamic SWS instead of static Data
Prototype Application: Using IMS LD and WSMO

Scenario:

- One unique IMS Content Package (IMS LD) reused across different learning contexts
- Different learners supported with achieving different objectives
  (e.g. “Learn German”, “Learn Italian” …)
- Individual learner preferences (e.g. native language) are considered at runtime
  (e.g. French learners get French learning content…)

Application:

- Web services provided to support learning objectives
  (retrieval of learning content and learner profiles, mappings)
- IMS LD activities not referred to static learning resources but mapped to SWS goals
- Package adapts dynamically based on a dynamic invocation of SWS at runtime
- Implements semantic layer framework, mappings and SWS based architecture based on standard-compliant RTEs for WSMO and IMS LD
Prototype Application: Architecture

SWSOA for E-Learning

- IMSLD Runtime Environment – Reload IMSLD Player
- IMSLD Application Authoring – Reload IMSLD Editor
- Ontology / SWS Development – WSMO Studio, IRS III Browser

SWS Environment IRS III

- Invocation Engine
  - Choreography Interpreter
  - Orchestration Interpreter
  - Mediation Handler
- WSMO Library
  - WSMO Goals
  - WSMO Services
  - WSMO Ontologies
  - WSMO Mediators

- SOAP Handler

Learning WS Library
- (External)
- (Internal)

Semantic Learning Metadata
- (External)
- (External)

Learning Content
- (External)

Semantic Learner Profiles
- (Internal)

WSMO Goals
WSMO Services
WSMO Ontologies
WSMO Mediators
Prototype Application: Architecture

User interfaces

- Standard user interface for editing of SWS (WSMO Studio, IRS III)
- Standard user interfaces for editing and presenting IMS LD (Reload)
Prototype Application: Architecture

Semantic Web Service Environment IRS III

- Selects and invokes appropriate web services dynamically to support specific learning objective (e.g. “Learn Italian”, “Learn German”)
- Hosts and interprets ontologies implementing semantic layers (Semantic Web Service Layer, Semantic Learning Process Model Layer)
Web services and data

- (External) web services providing functionalities to support the learning objectives
  (e.g. for selecting and providing appropriate learning content or to perform semantic mappings between different terminologies)
- (External) learning data and content
  (e.g. tutorials to teach the language Italian to native English speakers)
Prototype Application: Architecture

**SWSOA for E-Learning**

- **Learners**
  - IMSLD Runtime Environment – Reload IMSLD Player
  - Invocation Engine
  - Mediation Handler
  - SOAP Handler

- **WSMO Application Developers**
  - IMSLD Application Authoring – Reload IMSLD Editor
  - Orchestration Interpreter
  - WSMO Library
  - Learning WS Library (External)
  - Learning WS Library (Internal)

- **WSMO Web Service Developers**
  - Ontology / SWS Development – WSMO Studio, IRS III Browser
  - WSMO Ontologies
  - WSMO Mediators

**SWS Environment IRS III**

- **WSMO Goals**
- **WSMO Services**
- **Semantic Learning Metadata** (External)
- **Learning Content** (External)
- **Semantic Learner Profiles** (Internal)
Conclusion

• Proposed SWS based framework to provide adaptive learning environments
• Initial prototype application based on standards
• Highly adaptive and reusable content ➔ decrease of development demands (different learning contexts, platforms, metadata standards)
• Reuse of all available SWS goals and services in different learning packages!

Issues and future work

• Provide variety of learning objectives (goals), and appropriate services
• More comprehensive standard-compliant learning processes
• Extension and improvement of ontologies to implement semantic layers
• Implementation of generic Semantic Process Model Layer (http://www.ip-super.org/) and mapping between different process domains