A Domain–Specific Modeling approach for supporting the development of Visual Instructional Design Languages and tools

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REDiM Project
(Model Driven Reengineering of Technology Enhanced Learning)
LIUM lab
(Computer Science Laboratory of Le Maine University)
Research Context: background about VIDL

- **Main objective**
  Providing practitioners with community-centered VIDL and dedicated user-friendly editors

- **Our approach**
  - Experiencing Software Engineering theories and practices

- **Our past research works and results**
  - **The CPM language**
    - UML profile dedicated to Problem-Based Learning Situations
    - Tooled by extending an existent CASE-tool
  - **The UML4LD language**
    - UML profile dedicated to IMS-LD
  - **Learning scenarios Transformations**
    - From IMS-LD to UML4LD (graphical activity-diagram representation)
    - From CPM to IMS-LD
Research Context: background about DSM

• Software Engineering red-line
  ▪ From **UML**, UML profile, meta-modelling...
  ▪ ...*Model Driven Architecture* (MDA)...
  ▪ ...*Model-Driven Engineering* (MDE)...
  ▪ ... to *Domain Specific Modeling* (DSM)

• **Domain Specific Modeling** (DSM)
  ▪ Software engineering methodology for designing and developing systems
  ▪ DSM involves systematic use of a graphical *domain-specific language* (DSL) to represent the various facets of a system
  ▪ DSM languages tend to support higher-level abstractions than General-purpose modeling languages (like UML)
DSM approach of VIDLs

• 3 categories according to the business learning domain and objectives targeted
  – Practitioners-centered Scenarios
    • Terminology = the one shared by a community of practitioners
      (in relation to some pedagogical theories, didactical fields as well as specific references to the LMS they use)
    • Objectives = act as a design guide, support of thinking/communicating
  – Abstract Scenarios
    • Terminology = high-level abstraction for supporting pedagogical diversity + independence from any LMS
    • Objectives = exchange/interoperability
  – LMS-centered Scenarios
    • Terminology = specific to a LMS
    • Objectives = act as guide for manual or semi-automatic configuration of the LMS platform
DSM approach of VIDLs (2)

- Two-complementary formalizations for each category
  - Visual/graphical notation
    - For a human-readable scenario interpretable by practitioners
  - Textual notation (XML)
    - For a machine-readable scenario interpretable with no ambiguity

- Two kind of transformations for scenarios
  - *Extra*-domain (when terminologies and/or notations change)
    - *For what*: exchanging with other communities of practitioners or for obtaining the objectives of the targeted categorization
  - *Intra*-domain (only notations change)
    - *For what*: adaptation to another public (machine/human)
DSM approach of VIDLs (3)

- Schematization

Practitioners-centered Scenario  Abstract Scenario  LMS-centered Scenarios

```xml
<xml-s
<essay
```

```xml
<xml-s
<essay
```

```xml
<xml-s
<essay
```
DSM approach of VIDLs (4)

• Tools and techniques needed to support emergence of communities of practice from our 3-categorizations

1. To define domain-oriented VIDL
   • Metamodelling techniques for specifying the terminology
   • Techniques for specifying human&machine-readable notations

2. To graphically define learning scenarios (user-friendly editors)

3. To realize the *intra* & *extra* learning scenarios transformations
Experiencing Eclipse DSM tools

- **Eclipse Modeling Project**
  - a unified set of modeling frameworks, tooling, and standard implementations
  - EMF: main metamodel-oriented framework,
  - GMF: graphical framework
  - ATL: model-to-model transformation framework

- **Experimentations within several projects of different scopes**
  - a VIDL and an editor specific to a TEL system (the LEA system)
  - some practitioners-centered VIDLs and editors
Process example

- Practitioners' intention
  - Having a UseCase-like visual editor for specifying Learning activities and roles performing them into learning phases

- Specification of
  - the metamodel (or domain model)
  - the graphical notation for future models with GMF
  - the 'palette/tooling' model
  - the mapping model
  - the serialization format

- Full-code generation step
  - Graphical editor generated!
Process example (2)

- Visual editor, 100% EMF/GMF-generated (no hand-coding)

- XMI/XML serialization of produced learning scenarios

```xml
<?xml version="1.0" encoding="UTF-8"?>
<lduc:Scenario xmlns:xmi=http://www.omg.org/XMI xmlns:lduc="lduc">
  <phase name="Act2">
    <activities name="Exploit available information to draw conclusions"/>
    <activities name="Reciprocal teaching" nextActivities="//@phase/@activities.2"/>
    <activities name="Forum posts analysis"/>
  </phase>
  <actors activityRealized="//@phase/@activities.0" name="Investigator" super="//@actors.1"/>
  <actors name="Learner"/>
  <relations label="includes" source="//@phase/@activities.0" target="//@phase/@activities.1"/>
  <relations label="includes" source="//@phase/@activities.0" target="//@phase/@activities.2"/>
</lduc:Scenario>
```
Summary and ongoing works

- Proposition of a conceptual framework for the application of Model Driven Engineering principles to scenario-based instructional design
  - 3 categorizations for scenarios and languages reflecting different communities of practices sharing a same business learning domain towards specific objectives
  - 2 notations per category to provide human and machine readability
- *Domain Specific Modeling* orientation to support our proposition
- DSM tooling can be helpful for
  - Easing the emergence of community of learning design practices
  - Supporting the building of user-friendly & visual learning editors

- Present and future works
  - Deeper experimentation of the Eclipse GMF
  - Experimentation of learning scenarios transformations with the Eclipse ATL tool
Thank you!

...Any questions?

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