



Abstraction of Learning Management Systems Instructional Design Semantics: a Meta-Modeling approach applied to the Moodle case-study

Esteban Loiseau, Pierre Laforcade, Sébastien Iksal

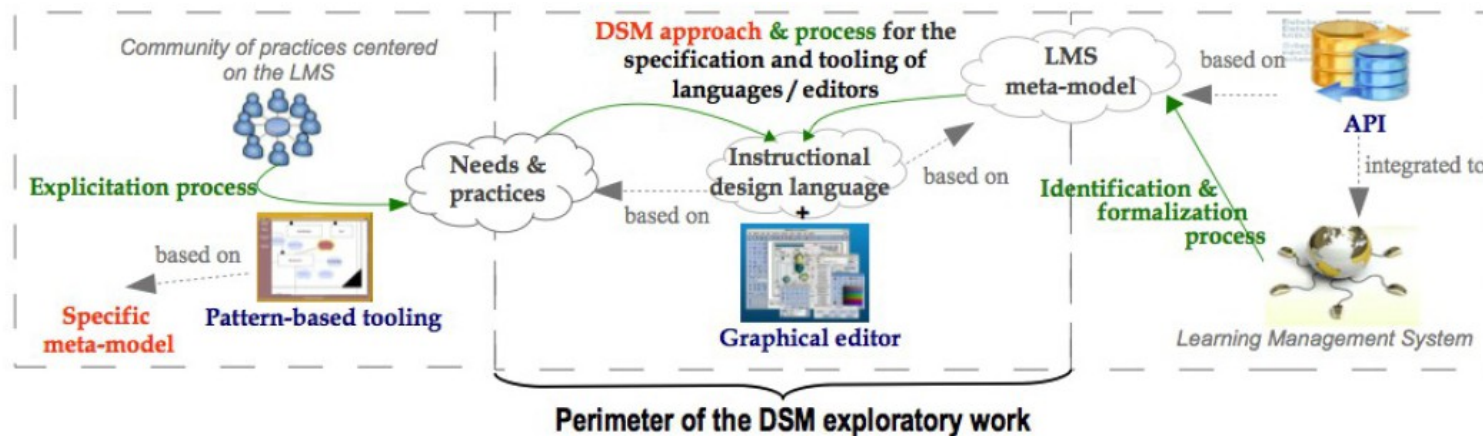
LIUM Université du Maine

esteban.loiseau@univ-lemans.fr, pierre.laforcade@univ-lemans.fr



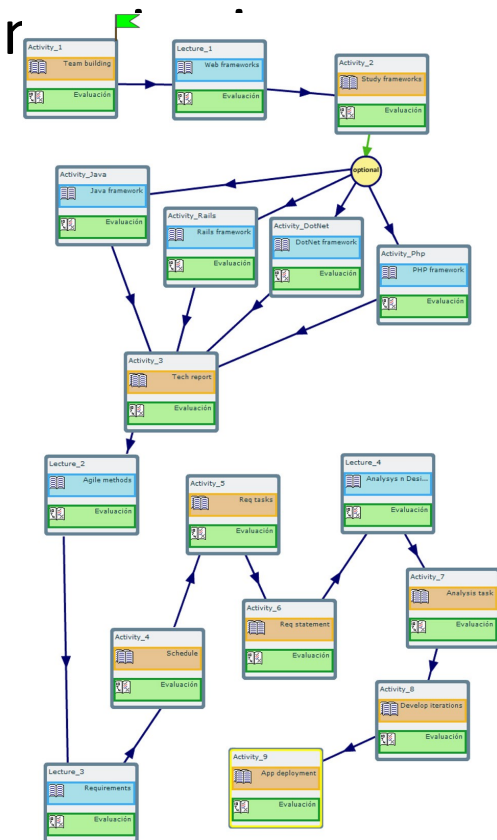
Research context

- x LIUM: Computer Science Lab (Le Mans, France)
- x TEL systems engineering team
- x PhD Thesis
- x GraphiT project: <http://www-lium.univ-lemans.fr/~laforcad/graphit/>
 - Funded by the French research agency (ANR)
 - Study expressiveness limits of operationalizable learning design language
 - Learning scenarios automatically deployed on the targeted LMS



Visual Instructional Design Language

- ✗ To design learning scenarios
- ✗ Define a visual representation of pedagogical concepts
- ✗ Support creative thinking and human communication
- ✗ Do not systematically provide binding



Dodero, J., Martinez del Val, A., Torres, J. 2010. An extensible approach to visually editing adaptative learning activities and designs based on services. In Journal of visual languages & computing 21 : 332-346.

Learning Management System

UMTICE

Instaurer des activités collaboratives

Accueil ► Mes cours ► Formations pour les personnels ► Espaces de formation ► Activités collaboratives

NAVIGATION

- Accueil
- Mon profil
- Cours actuel
- Activités collaboratives
 - Participants
- Mes cours

RÉGLAGES

- Administration du cours
- Notes
- Réglages de mon profil

Instaurer des activités collaboratives

Cet espace-cours a été conçu par le PRN. Ces ressources et ces activités sont mises à disposition de au préalable.

Objectif général : Développer des activités collaboratives
Objectifs spécifiques :

- Organiser des activités de travail collaboratif
- Mettre en place des outils de communication
- Mettre en place des outils de travail collaboratif
- Créer des groupes dans un espace-cours

Pré-requis :

- savoir passer en mode édition
- savoir utiliser le mode édition

(Cliquez [ici](#) si vous ne maîtrisez pas ces pré-requis)

Durée : 3h
Démarche : apport théorique - mise en pratique - manipulation sur ordinateur

Contenu :

- "Je m'informe" : procédures à suivre / didacticiels
- "Je mets en pratique" : activités permettant de développer les compétences attendues
- "Je découvre" : activités de découverte de la plateforme
- "Je valide mes compétences" : auto-évaluation des compétences acquises à travers le module de fo
- "à retenir" : dossier comprenant toutes les procédures abordées dans le module

Section 1

Le travail collaboratif

- Instaurer des activités de travail collaboratif
- La notion de collaboratif
- Comment organiser des travaux de groupe ?
- Pyramide de l'apprentissage

Je mets en pratique

- Activité - Proposer un projet de travail collaboratif

Moodle

Ganesh
BY ANEMA

TABLEAU DE BORD MESSAGERIE FORUM CHAT

Apprenant [Séguine? STAGIAIRE?](#)

100%

Accueil

Inland Rules of the Road (HTML Format)

References and Lesson Objective

Steering & Sailing Rules

- Conduct of Vessels in any Condition of Visibility
- Conduct of Vessels in Sight of One Another
- Conduct of Vessels in Restricted Visibility
- Lights & Shapes
- Sound & Light Signals
- Exam

Détails des résultats Historique de vos scores Informations sur la séquence

Activité déjà traitée (7/7)

100% 100.0% 0.0%

Maritime Navigation

Activité	Score	Temps passé	Nombre d'accès
Inland Rules of the Road (HTML Format)			
References and Lesson Objective	0%	00:14:29	118
Steering & Sailing Rules			
Conduct of Vessels in any Condition of Visibility	0%	01:48:13	164
Conduct of Vessels in Sight of One Another	0%	00:25:04	55
Conduct of Vessels in Restricted Visibility	0%	00:02:48	23
Lights & Shapes	0%	00:21:05	59
Sound & Light Signals	0%	00:24:11	37
Exam	100%	00:25:34	95

Ganesh LMS

What is the issue?

- x Institutions impose a specific LMS to teachers
- x Teachers are (sometimes) taught how to use it
 - Not how to design learning situations on the LMS
- x No “out-of-the-box” Binding between LD standard and LMS
- x Direct “on-the-fly” design on the LMS
 - Depending on the teacher skills about the LMS

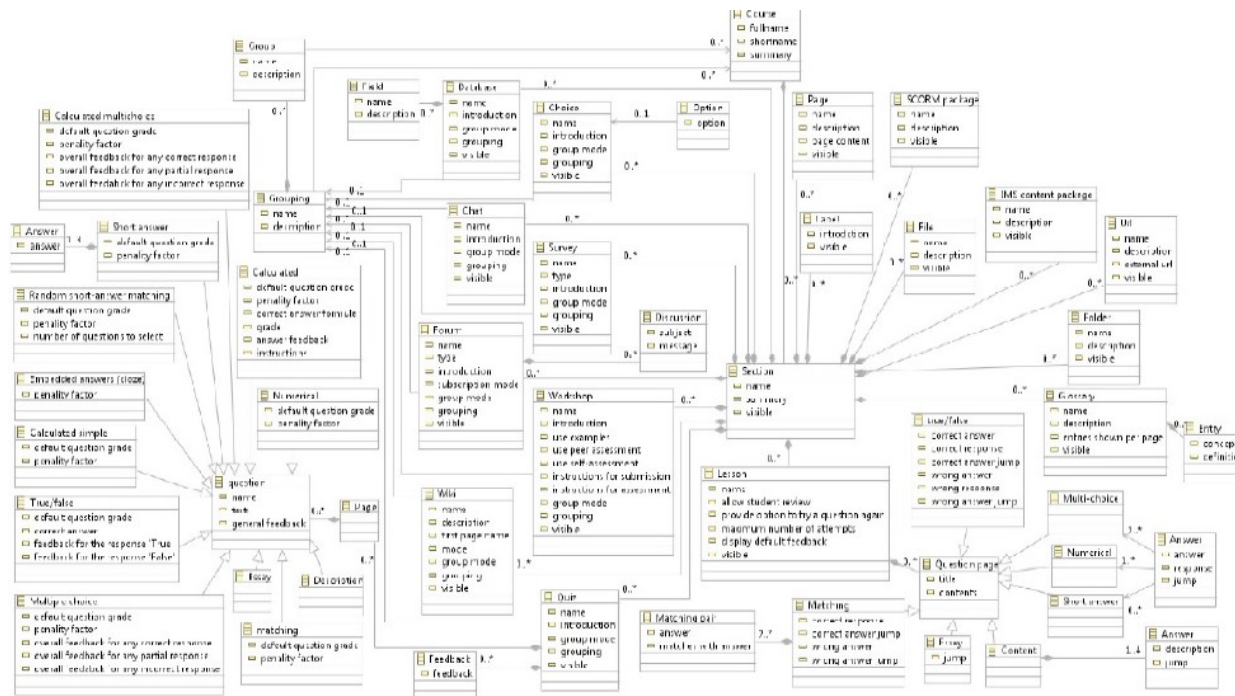
What we want to do

- x Provide teachers with graphical learning design language
 - “compatible” with LMS
- x Help to focus on the pedagogical aspect of the scenario
 - Instead of setting-up complex tools
- x Foster individual reflection about learning design
- x Improve uses of the existent LMS

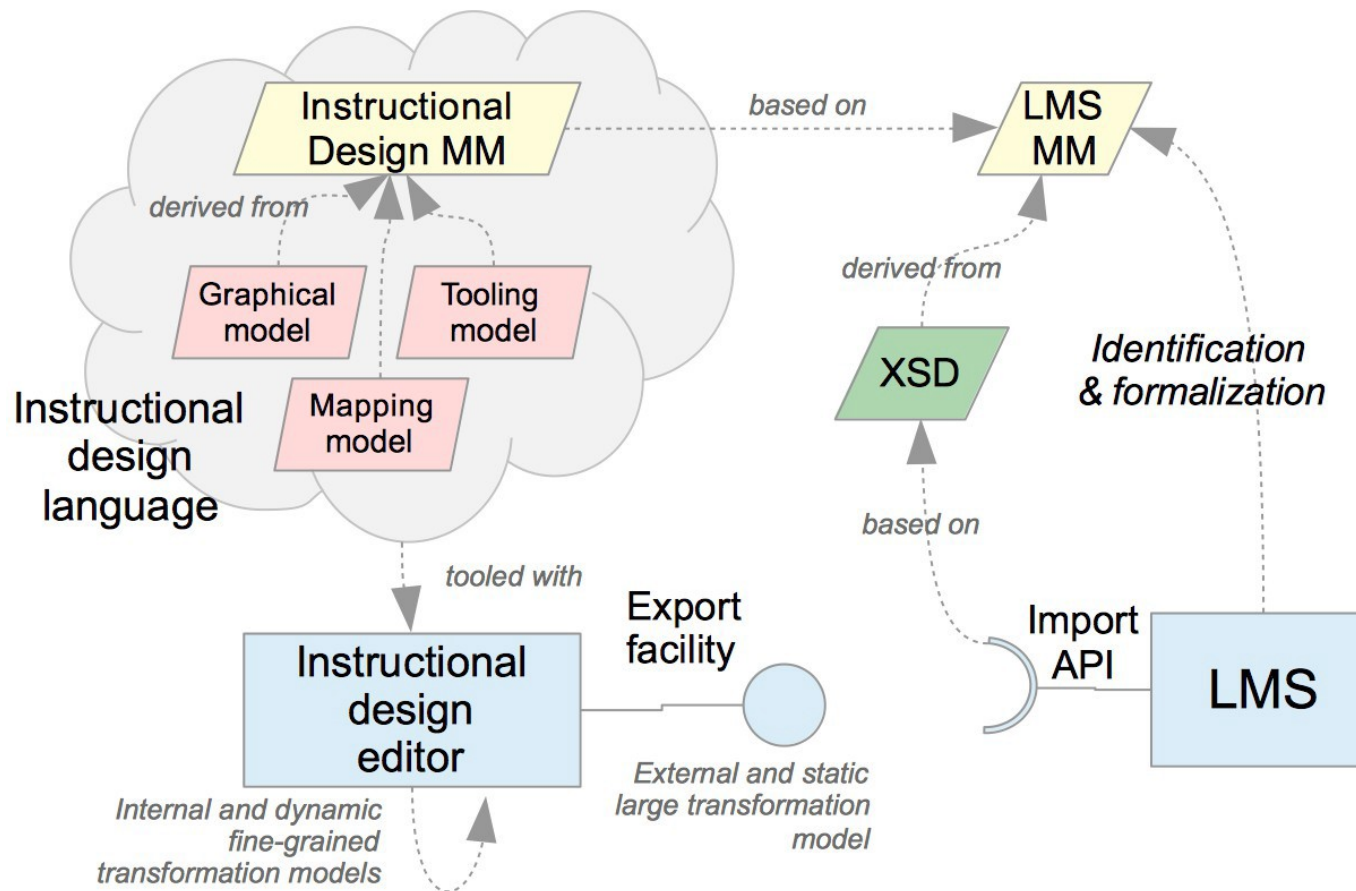
What is already done in GraphiT

x LMS-compatibility layer:

- LMS Metamodel: Moodle and Ganesha (WIP) (conceptual model)
- LMS learning scenario file format: XML Schema
- Learning scenario deployment plugin



Overview of the LMS-centered approach



What I do

- x Only one design language: at a higher abstraction level
- x Keep the LMS compatibility
- x Focus on one platform : Moodle
 - Open-source , modular: easy to extend, customize if needed
 - Large community of users
 - “Used at home”
- x Domain Specific Modeling approach
 - Code generation tools
 - Model = Abstraction

How ?

- x Designing a new language with pedagogical concepts
 - With a “bottom-up” approach
 - Abstraction from the LMS features
 - Instead of “top-bottom”
 - Bridging the gap between pedagogical needs and LMS features
- x Extending the Moodle Metamodel
 - To be able to use the file format / deployment plugin
- x Making sure every pedagogical concept can be implemented in Moodle
- x Asking teachers what they want

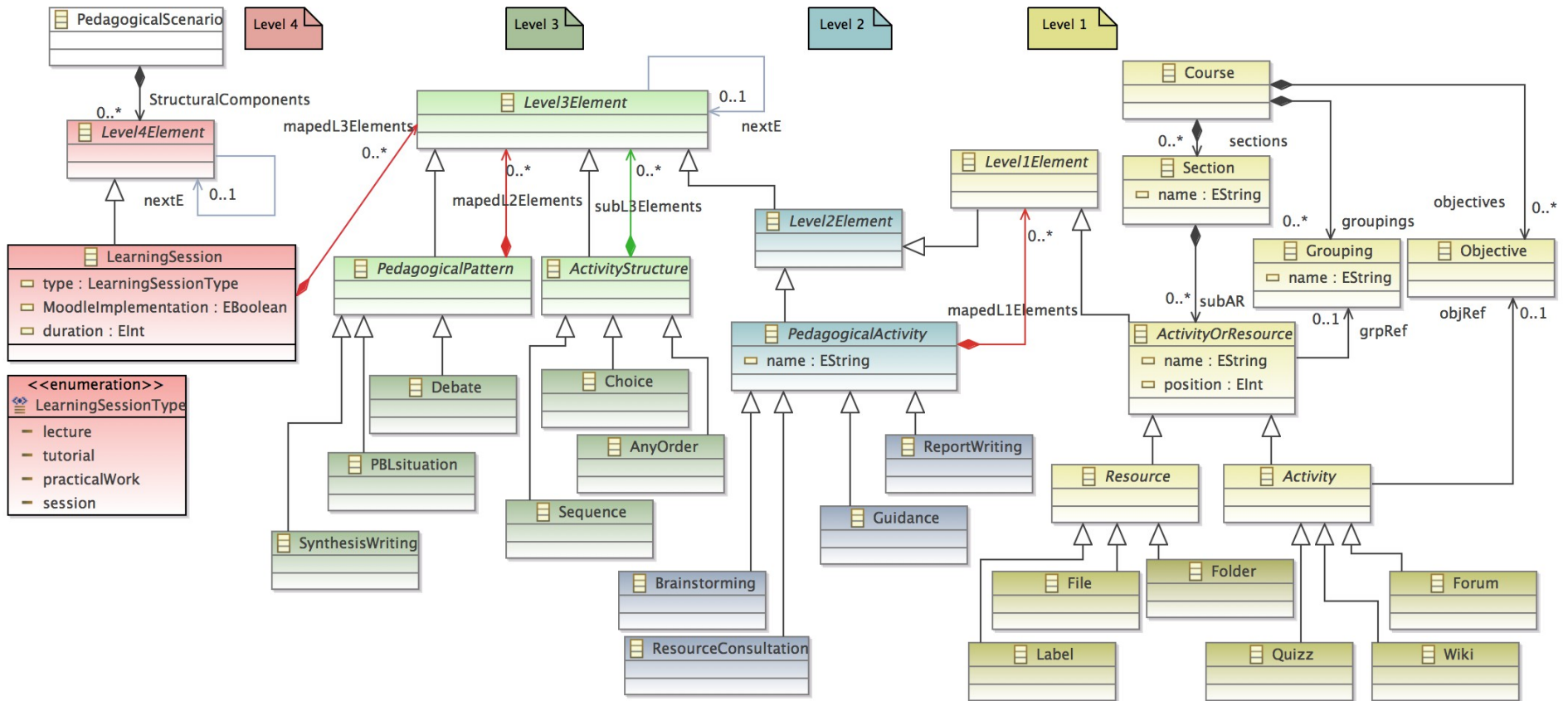
Teachers requirements

- x Collected through
 - Survey (200+ teachers)
 - Interviews (~30)
 - Study of existing courses
- x Learning design with Moodle
 - Time consuming for elaborated courses
 - Moodle *activities* settings difficult to understand
- x Using an external LD tool
 - Need for specific use cases of Moodle features
 - Flexible tool (but not **generic**)
 - Visual and offline benefits

Abstract concept examples

- x Pedagogical activity (fine grained):
 - Exchange activity: students communicating with each other
 - Using the chat or forum feature in Moodle
 - How to decide? Synchronous property
- x Pedagogical pattern (coarse grained):
 - Higher level
 - Synthesis writing: sequence of pre-defined pedagogical activities
 - Resource consultation
 - Brainstorming
 - Report Writing
- x Activities structures:
 - Sequence: students have to complete all the tasks

Metamodel



Learning scenario example

- ▼ ◆ Pedagogical Scenario
 - ▼ ◆ Learning Session lecture
 - ▼ ◆ Resource Consultation
 - ◆ File
 - ▼ ◆ Learning Session practicalWork
 - ◆ Label
 - ▼ ◆ Synthesis Writing
 - ▼ ◆ Sequence
 - ▼ ◆ Resource Consultation
 - ◆ Folder
 - ▼ ◆ Brainstorming
 - ◆ Forum
 - ▼ ◆ Report Writing
 - ◆ Wiki
 - ▼ ◆ Guidance
 - ◆ Label

Mapping examples

- x Exchange activity: if synchronous then use chat else use forum*
- x Report writing activity: 3 boolean criteria and 4 possible implementations*

	Journal	Wiki	Assignment (file upload)	Assignment (online text)
Online	Y	Y	N	Y
Collaborative	N	Y	/	N
Iterative	Y	/	/	N

- x Some implementations only differ from the settings of the feature*
- x Also depending of the pedagogical element properties*

Automatic mapping

- x “Default implementation” requirement
 - Automatically add instances to the models
 - Automatically set properties values
- x For levels 2 & 3 only
- x Using hand written model transformations
 - It works but...
 - A lot of rules
 - Complex business logic
 - Hard to maintain
 - Hard to understand



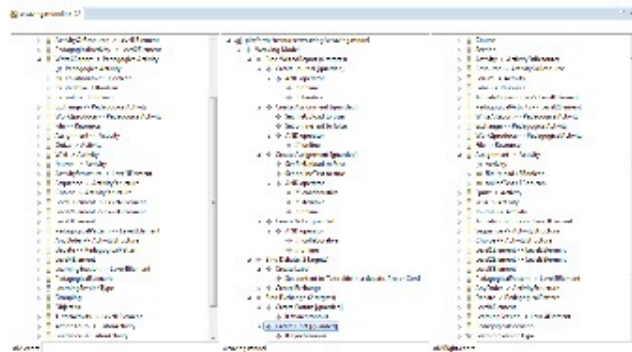
Why not modeling?

Model weaving

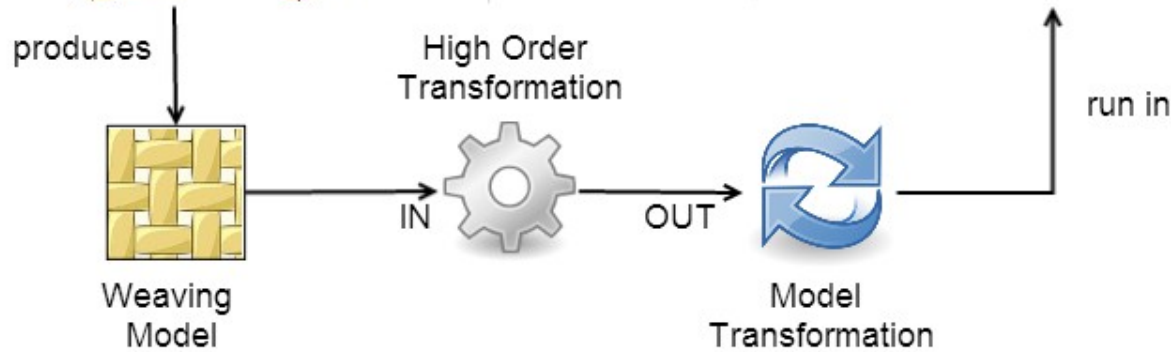
- x Weaving model = referencing other models (woven models) elements
- x Possible usages:
 - Model checking through pairing
 - Lazy loading of elements (in large models)
 - Non obtrusive refining of models
 - **Mapping formalization**
- x Challenge: how to make a weaving model executable?

Our model weaving use case

Weaving editor



Learning scenario editor



Epsilon project

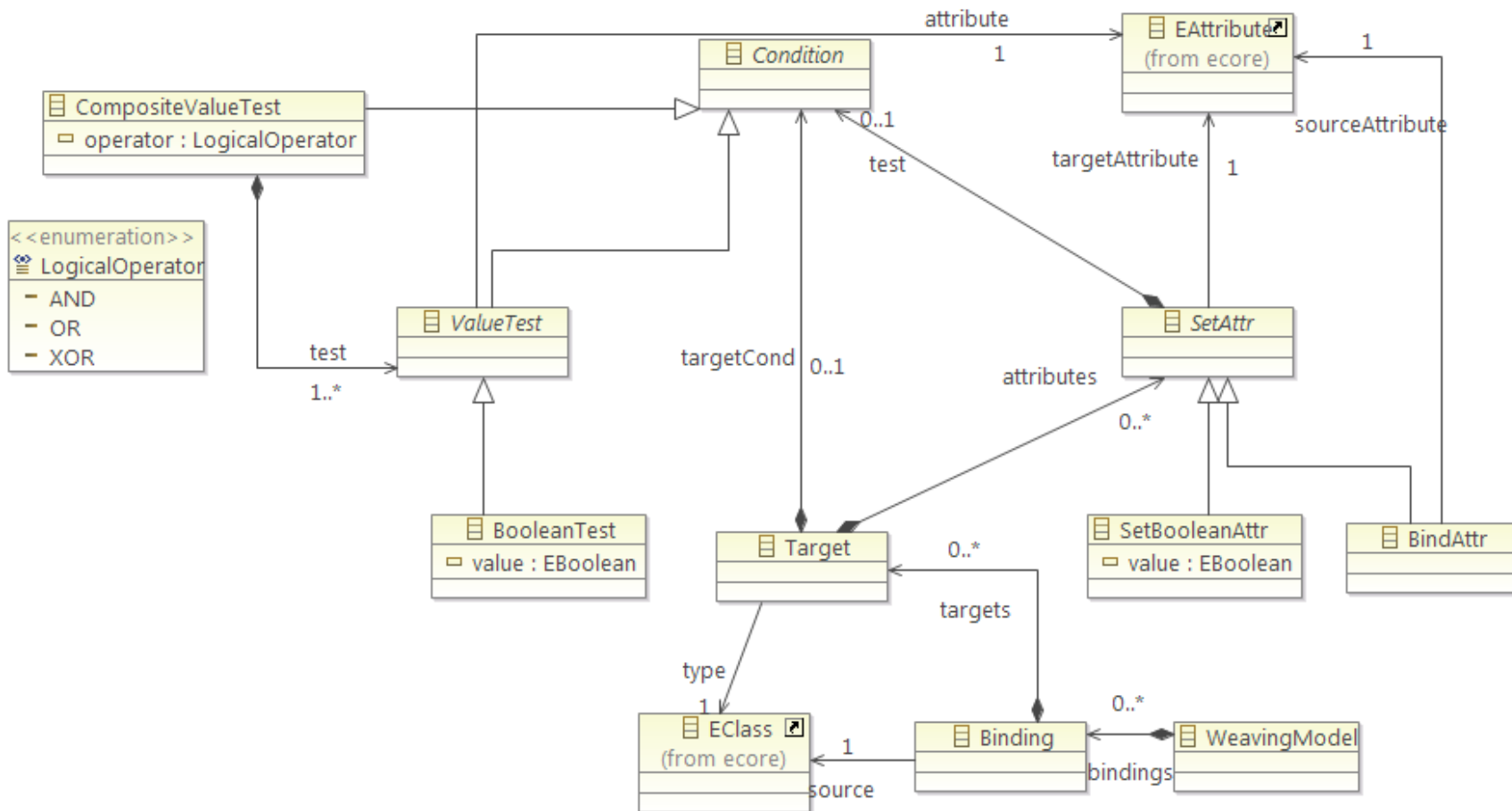
- x Eclipse foundation project
- x Collection of tools and language for MDD
 - Merging
 - Migrating
 - Transforming (M2T, M2M)
 - Validating
 - Comparing
 - ...
- x Active community
- x Up-to-date compatibility with EMF

<http://www.eclipse.org/epsilon/>

How we use it

- x Custom weaving Metamodel (Ecore)
- x Model weaving editor: ModeLink
- x HOT through M2T template: EGL
- x Model transformations with EOL

Weaving metamodel



Example weaving model (UI)

The image displays three panels illustrating a weaving model in a software interface. The left and right panels show a tree view of an 'AM' (Activity Model) structure, with 'ReportWriting' selected. The middle panel shows a detailed view of the 'weaving.model' structure, with 'Create ReportWriting' highlighted.

Left Panel (AM):

- AM
 - Course
 - Section
 - Activity -> ActivityOrResource
 - Resource -> ActivityOrResource
 - Forum -> Activity
 - Label -> Resource
 - ActivityOrResource -> Level1Element
 - PedagogicalActivity -> Level2Element
 - Guidance -> PedagogicalActivity
 - ReportWriting -> PedagogicalActivity**
 - PedagogicalActivity
 - collaborative : EBoolean
 - File -> Resource
 - Wiki -> Activity
 - Quizz -> Activity
 - ActivityStructure -> Level3Element
 - Level3Element
 - subL3Elements : Level3Element
 - Sequence -> ActivityStructure
 - Choice -> ActivityStructure
 - Level1Element -> Level2Element
 - Level2Element -> Level3Element
 - Level3Element
 - PedagogicalPattern -> Level3Element
 - AnyOrder -> ActivityStructure
 - Debate -> PedagogicalPattern

Middle Panel (weaving.model):

- platform:/resource/weaving/weaving.model
 - Weaving Model
 - Bind SynthesisWriting (1 targets)
 - Create Sequence
 - Create ResourceConsultation
 - Create Brainstorming
 - Create ReportWriting**
 - Create Guidance
 - Bind ResourceConsultation (2 targets)
 - Create File [guarded]
 - AND operator
 - If quantity = one
 - If location = local
 - Create Folder [guarded]
 - AND operator
 - If quantity = many
 - If location = local
 - Bind Brainstorming (1 targets)
 - Create Forum [guarded]
 - If orientation = discussion
 - Bind ReportWriting (1 targets)
 - Create Wiki [guarded]
 - If collaborative
 - Bind Guidance (1 targets)
 - Create Label

Right Panel (AM):

- AM
 - Course
 - Section
 - Activity -> ActivityOrResource
 - Resource -> ActivityOrResource
 - Forum -> Activity
 - Label -> Resource
 - ActivityOrResource -> Level1Element
 - PedagogicalActivity -> Level2Element
 - Guidance -> PedagogicalActivity
 - ReportWriting -> PedagogicalActivity**
 - PedagogicalActivity
 - collaborative : EBoolean
 - File -> Resource
 - Wiki -> Activity
 - Quizz -> Activity
 - ActivityStructure -> Level3Element
 - Level3Element
 - subL3Elements : Level3Element
 - Sequence -> ActivityStructure
 - Choice -> ActivityStructure
 - Level1Element -> Level2Element
 - Level2Element -> Level3Element
 - Level3Element
 - PedagogicalPattern -> Level3Element
 - AnyOrder -> ActivityStructure
 - Debate -> PedagogicalPattern

Example weaving model

- platform:/resource/weaving/weaving.model
 - Weaving Model
 - Bind WriteAReport (4 targets)
 - Create Journal [guarded]
 - AND operator
 - If online
 - If iterative
 - Create Assignment [guarded]
 - Set fileUpload to true
 - Set onlineText to false
 - AND operator
 - If !online
 - Create Assignment [guarded]
 - Set fileUpload to false
 - Set onlineText to true
 - AND operator
 - If !collaborative
 - If !iterative
 - If online
 - Create Wiki [guarded]
 - AND operator
 - If !collaborative
 - If online
 - Bind Debate (2 targets)
 - Create Label
 - Set content to Take side in a debate, Pro or Con?
 - Create Exchange
 - Bind Exchange (2 targets)
 - Create Forum [guarded]
 - If !synchronous
 - Create Chat [guarded]
 - If synchronous

EGL HOT

```
[%
import "./hotOperations.eol";
var sourceClassName:String = binding.source.getName();
var sourceVarName:String = sourceClassName.firstToLowerCase();
%]

operation source![%=sourceClassName%] addMapping(element:source!Level3Element) {
    if(element.isKindOf(source!Level1Element)) {
        self.mapedL1Elements.add(element);
    }
    else if(element.isKindOf(source!Level2Element)) {
        self.mapedL2Elements.add(element);
    }
    else {
        self.mapedL3Elements.add(element);
    }
}

operation source![%=sourceClassName%] bind[%=sourceClassName%]() {

    [% for(targetElement:Target in binding.targets) {
        var cond:Boolean = targetElement.targetCond.isDefined();
        var targetClassName:String = targetElement.type.getName();
        var targetVarName:String = targetClassName.firstToLowerCase();
        if(cond) [%]
            if([%=targetElement.targetCond.formatCondition()%]){
                [%}%]
                    var [%=targetVarName%]:[%=targetClassName%] = new source![%=targetClassName%];
                    self.addMapping([%=targetVarName%]);
                [%if(cond){%]
            }
        [%}
    }%]
}
```


Model transformations

```
operation source!SynthesisWriting addMapping(element:source!Level3Element) {
  if(self.isKindOf(source!Level2Element)) {
    self.mapedL1Elements.add(element);
  }
  else if(self.isKindOf(source!Level3Element)) {
    self.mapedL2Elements.add(element);
  }
  else if(self.isKindOf(source!Level4Element)){
    self.mapedL3Elements.add(element);
  }
}
```

```
operation source!SynthesisWriting bindSynthesisWriting() {

  var sequence = new source!`Sequence`;
  var resourceConsultation = new source!`ResourceConsultation`;

  sequence.subL3Elements.add(resourceConsultation);
  var brainstorming = new source!`Brainstorming`;

  sequence.subL3Elements.add(brainstorming);
  var reportWriting = new source!`ReportWriting`;

  sequence.subL3Elements.add(reportWriting);
  var guidance = new source!`Guidance`;
  guidance.public = Public#tutor;



  sequence.subL3Elements.add(guidance);
  self.addMapping(sequence);
}
```

What we do have

- x Requirements
- x LD language metamodel
- x Mapping solution through Model weaving
 - Weaving Metamodel
 - High Order transformation
 - Simple editor
- x Ideas



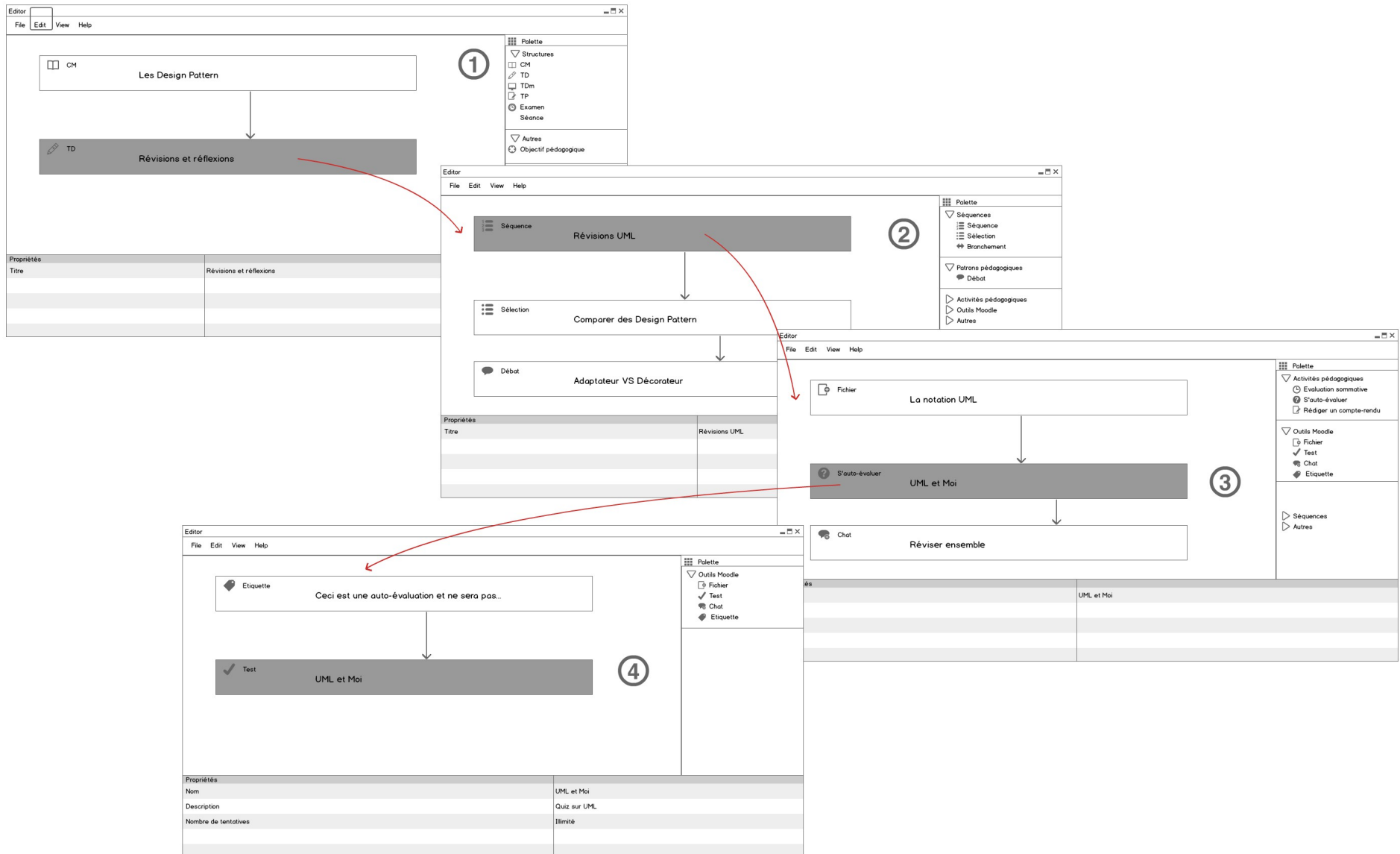
What we don't have (yet)

- x A graphical learning scenario editor (GMF diagram editor) (WIP)
- x Integrated model transformations
- x More mapping use-cases
- x A more user-friendly mapping editor (weaving model editor)
- x A cleaning transformation 
- x More ideas 

Thank you for your attention

Questions ?

Diagram editor mockup



Practises analysis

