



A Meta-modeling approach for extending the Instructional Design Semantics of Learning Management Systems & Model Weaving and Pedagogy *Mapping Abstraction Levels in Instructional Design Languages*

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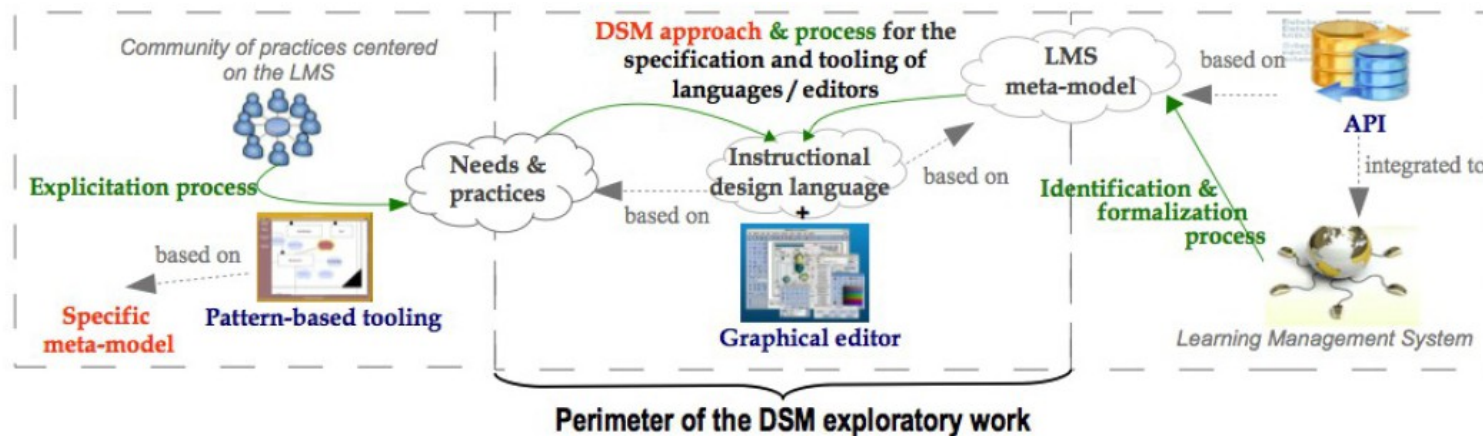
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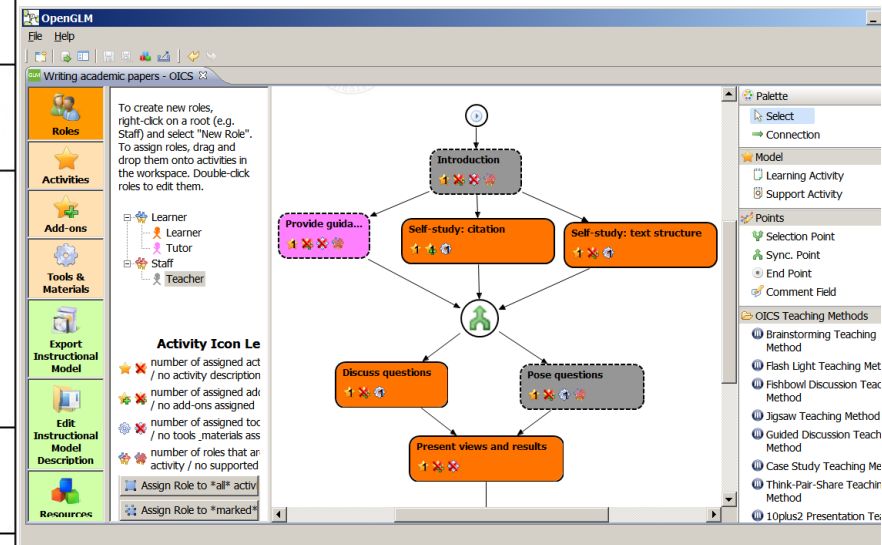
Research context

- x Laboratoire d'Informatique de l'Université du Maine (Le Mans, France)
- x TEL engineering team
- x PhD Thesis
- x GraphiT project: <http://www-lium.univ-lemans.fr/~laforcad/graphit/>
 - Funded by French research agency (ANR)
 - Study expressiveness limits of operationalizable learning design language
 - Learning scenarios automatically deployed on LMS



What is a learning scenario ?

Learning Goals	Assessment Activities	Learning Activities
<i>Recognize and understand common C# syntax and semantics (foundational knowledge)</i>	<i>Online study guides (quizzes that students can repeat until right)</i>	<i>Read textbook; classroom guided practice</i>
<i>Design, develop, test, and document custom C# Windows computer applications (application)</i>	<i>Forward-looking individual C# homework assignments; team project; final exam</i>	<i>Forward-looking application design discussions; demos; code-writing activities; student demos</i>
<i>Apply computer programming solutions to business and personal interests (integration)</i>	<i>Forward-looking individual C# homework assignments; team project</i>	<i>Forward-looking application design discussions; demos; code-writing activities</i>
<ul style="list-style-type: none"> • <i>Discover personal interest in a career as an application developer (human dimension/Self)</i> • <i>Develop ability to perform effectively as a member of a work-team (human dimension/Other)</i> 	<i>Reflective self-evaluation</i> <i>Peer feedback & evaluation</i>	<i>Discussions (classroom and/or forums); research</i> <i>Work on project teams</i>
<i>Find passion to use computer programming technology to help people and society (caring)</i>	<i>Team project; reflective self-evaluation</i>	<i>Classroom discussions; forums</i>
<i>Learn how to learn about new [program codes] when they are [issued]. (learning how to learn)</i>	<i>Treasure hunt homework assignments (students document their learning process)</i> <i>(Revise?)</i>	<i>Explanations; role-playing; practice treasure hunts; video demos</i> <i>(Revise?)</i>

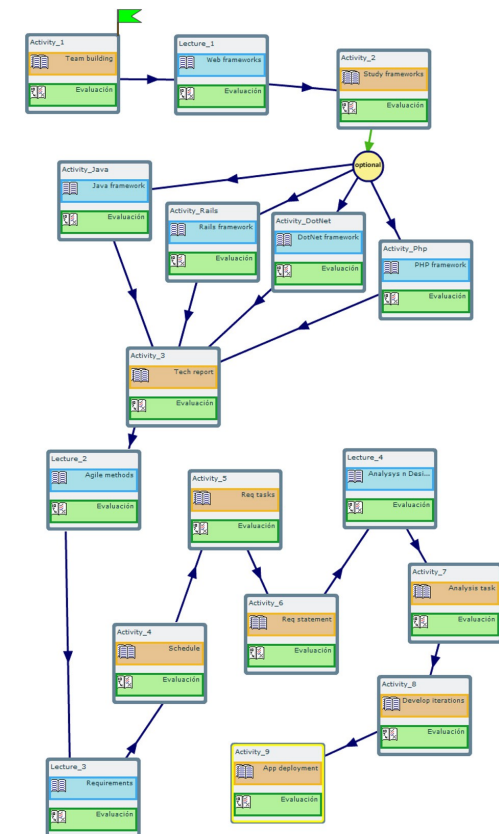


Credits to Jeff Straw retrieved from designlearning.org

OpenGLM screenshot retrieved from <http://edutechwiki.unige.ch/>

Visual Instructional Design Language

- ✗ To design learning scenarios
- ✗ Support creative thinking and human communication
- ✗ Do not systematically provide binding
 - ➔ Or through IMS-LD (LD standard)



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

What is a LMS?

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?](#) Maritime Navigation

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 problem?

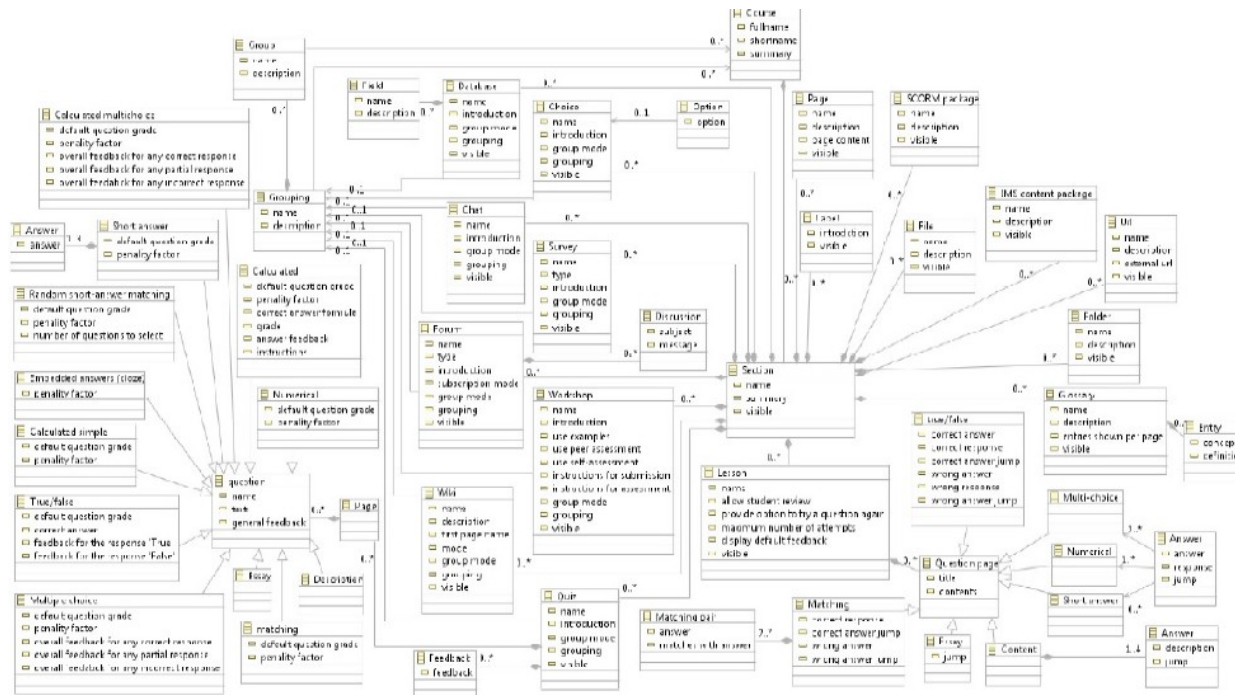
- x Institutions provide LMS to teachers and students
 - Rarely up-to-date software
- x Teachers are (sometimes) taught how to use it
 - Not how to design learning situations on the LMS
- x Binding between LD standard and LMS not successful
 - Loss of pedagogical information
 - Hard-coded / non flexible mechanisms

What we want to do

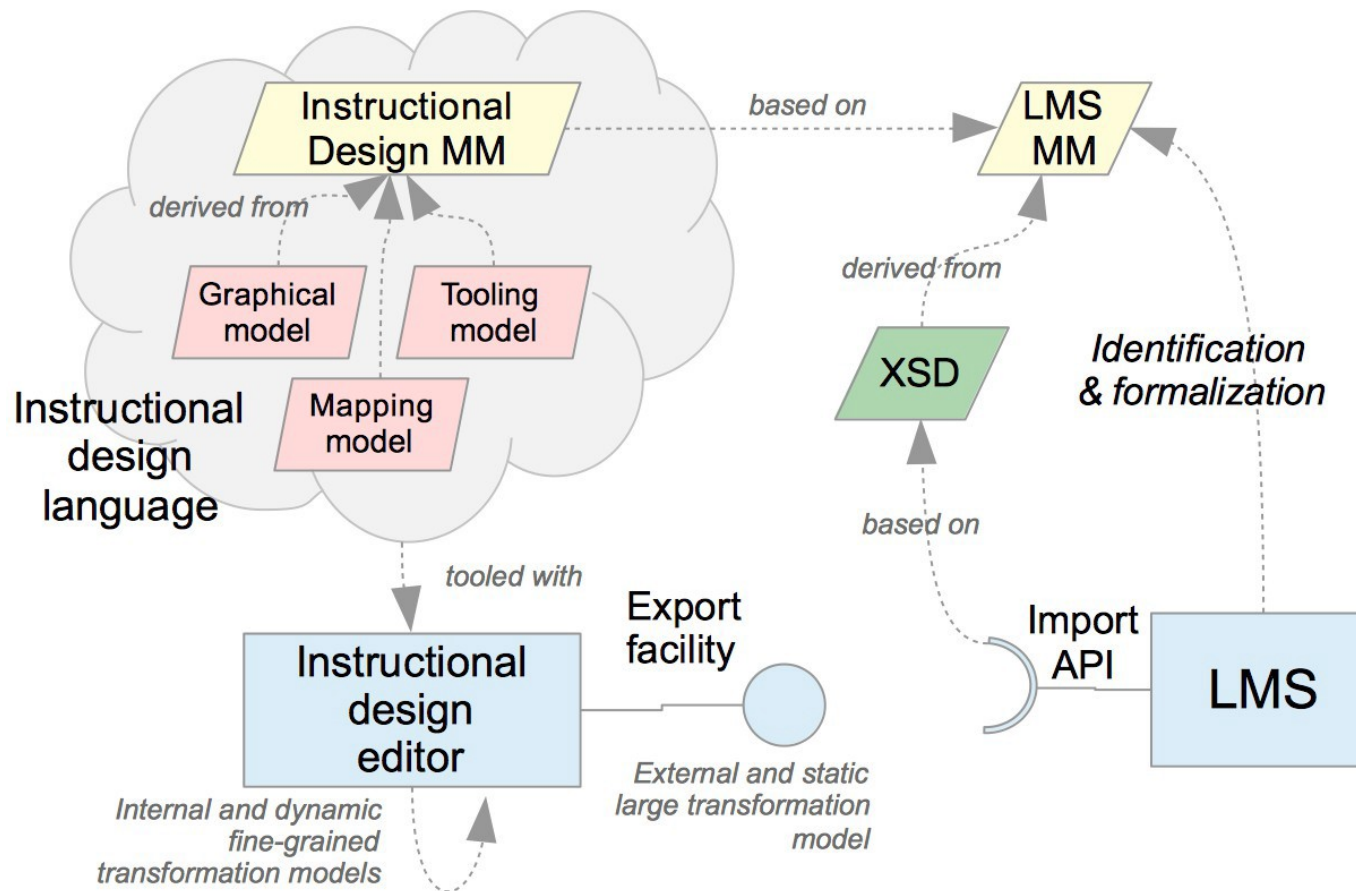
- x Provide teachers with graphical learning design language
 - “compatible” with LMS
- x Help to focus on the pedagogical aspect of the scenario
- x Foster individual reflection about learning design
- x Improve use of existing LMS

What is already done

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



Overview



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
- 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

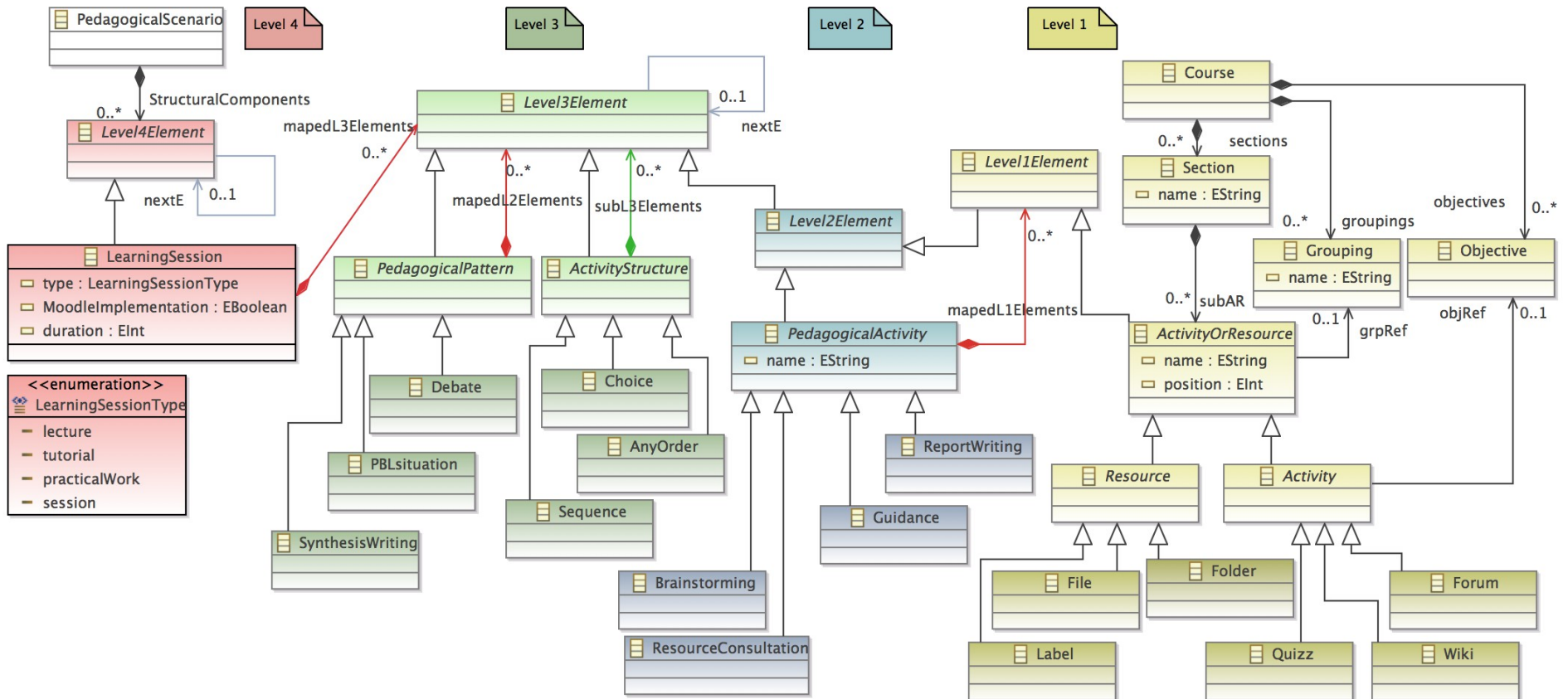
Teachers requirements

- x Collected through
 - Survey (200+ teachers)
 - Interviews
 - Study of existing courses
- x High level pedagogical building blocks
 - And LMS specific ones too!
- x Have **default** LMS implementations for high level concepts
 - And be able to modify it!
 - Or not having it
- x Have several types of structures
 - Sequences
 - Choices ...

Abstract concept examples

- x Pedagogical activity:
 - Exchange activity: students communicating with each other
 - Using the chat or forum feature in Moodle
 - How to decide? Synchronous property
- x Pedagogical pattern:
 - 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

Automatic mapping

- x “Default implementation” requirement
 - Automatically add instances to the models
 - Automatically set properties values
 - Automatically add implementation instances to the composition relationship
- 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?

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

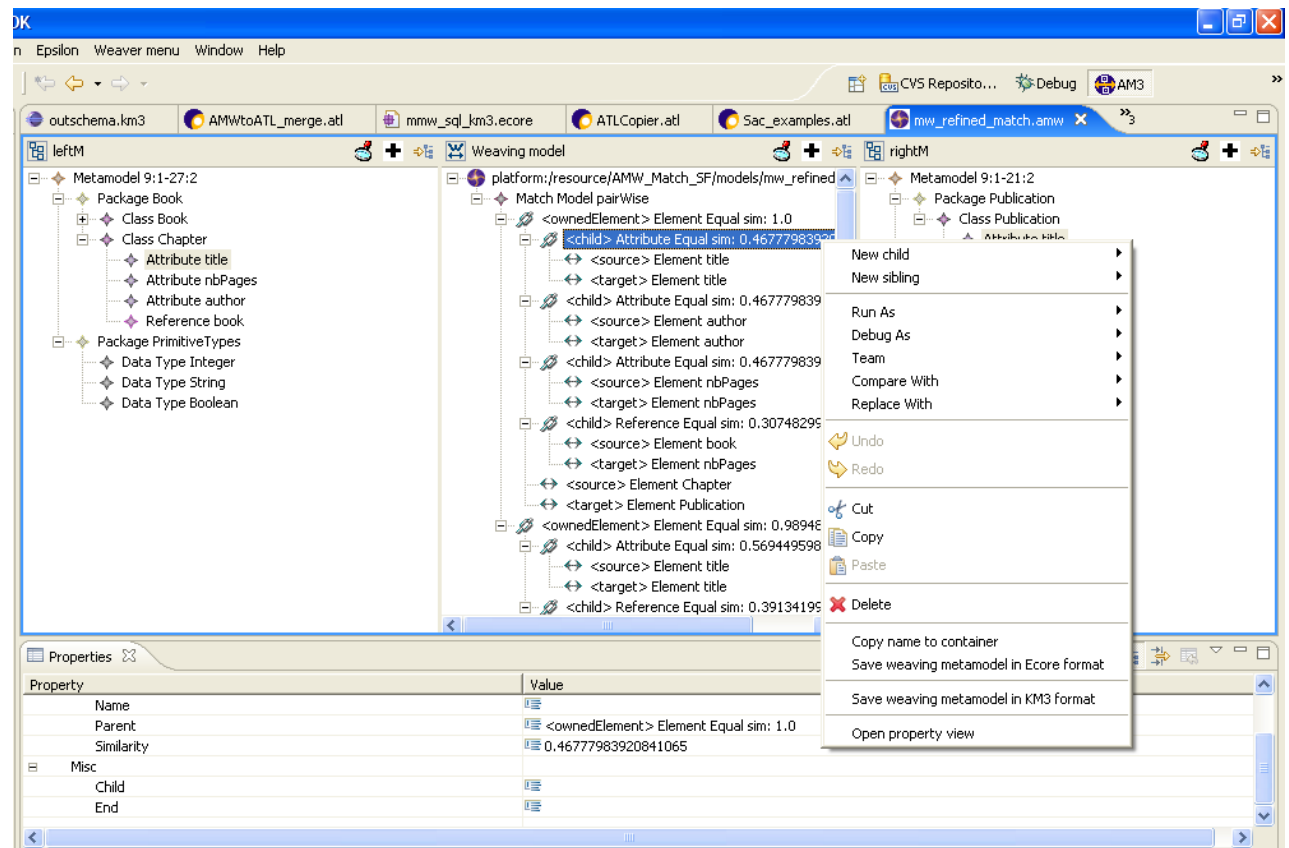
- x Some implementations only differ from the settings of the feature*
- x Also depending of the pedagogical element properties*

Model weaving

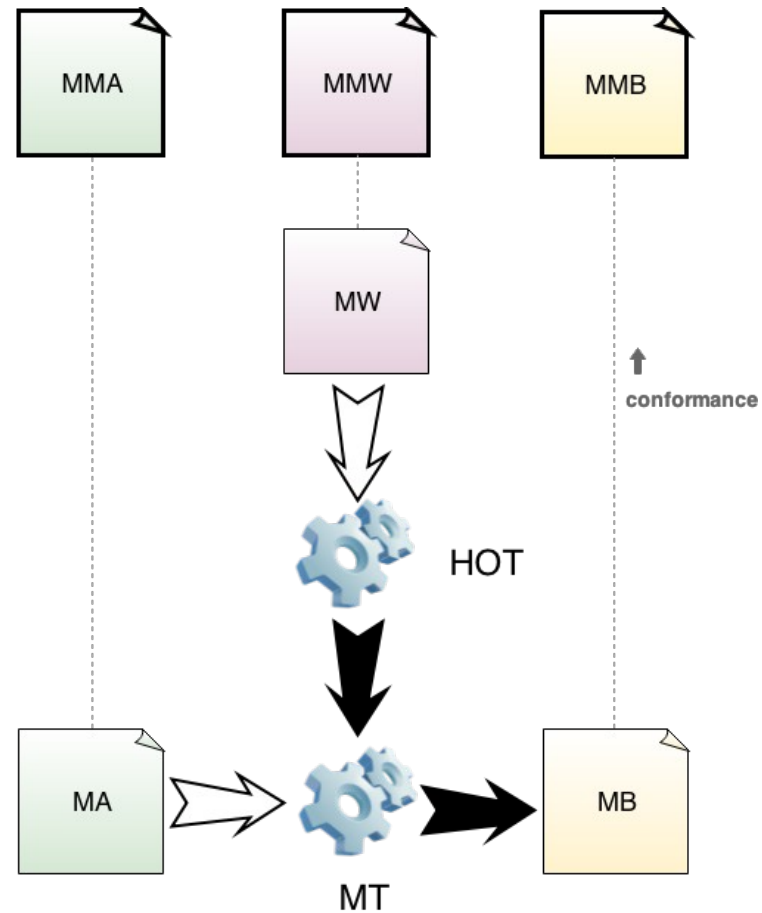
- x Weaving model = referencing other models (woven models) elements
- x Possible usage:
 - Model checking through pairing
 - Lazy loading of elements (in large models)
 - Non obtrusive refining of models
 - **Mapping formalization**
- x Challenge: how to make a weaving model executable?

AMW

- x AtlanMod Model Weaver
- x Basic weaving metamodel
- x Graphical tree editor
- x Matching transformations support
- x Several use cases and examples
- x EMF compatible
- x ATL based
- x Outdated

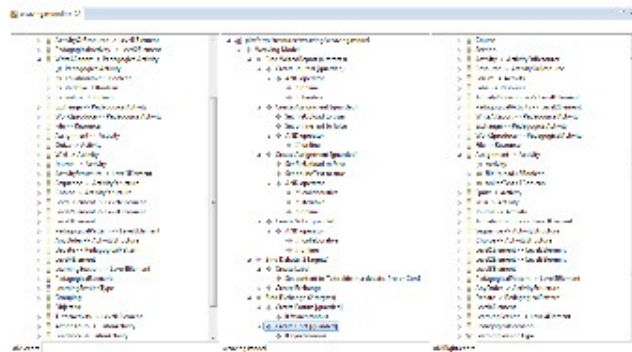


AMW architecture

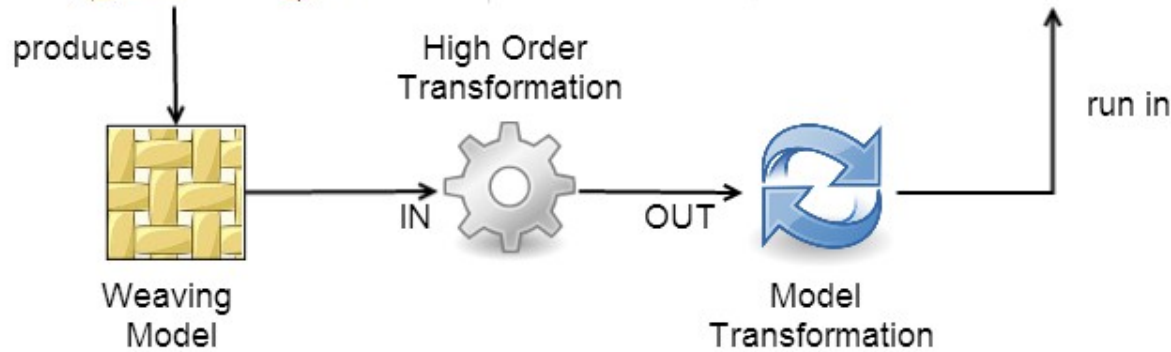


Our model weaving use case

Weaving editor



Learning scenario editor



Epsilon project

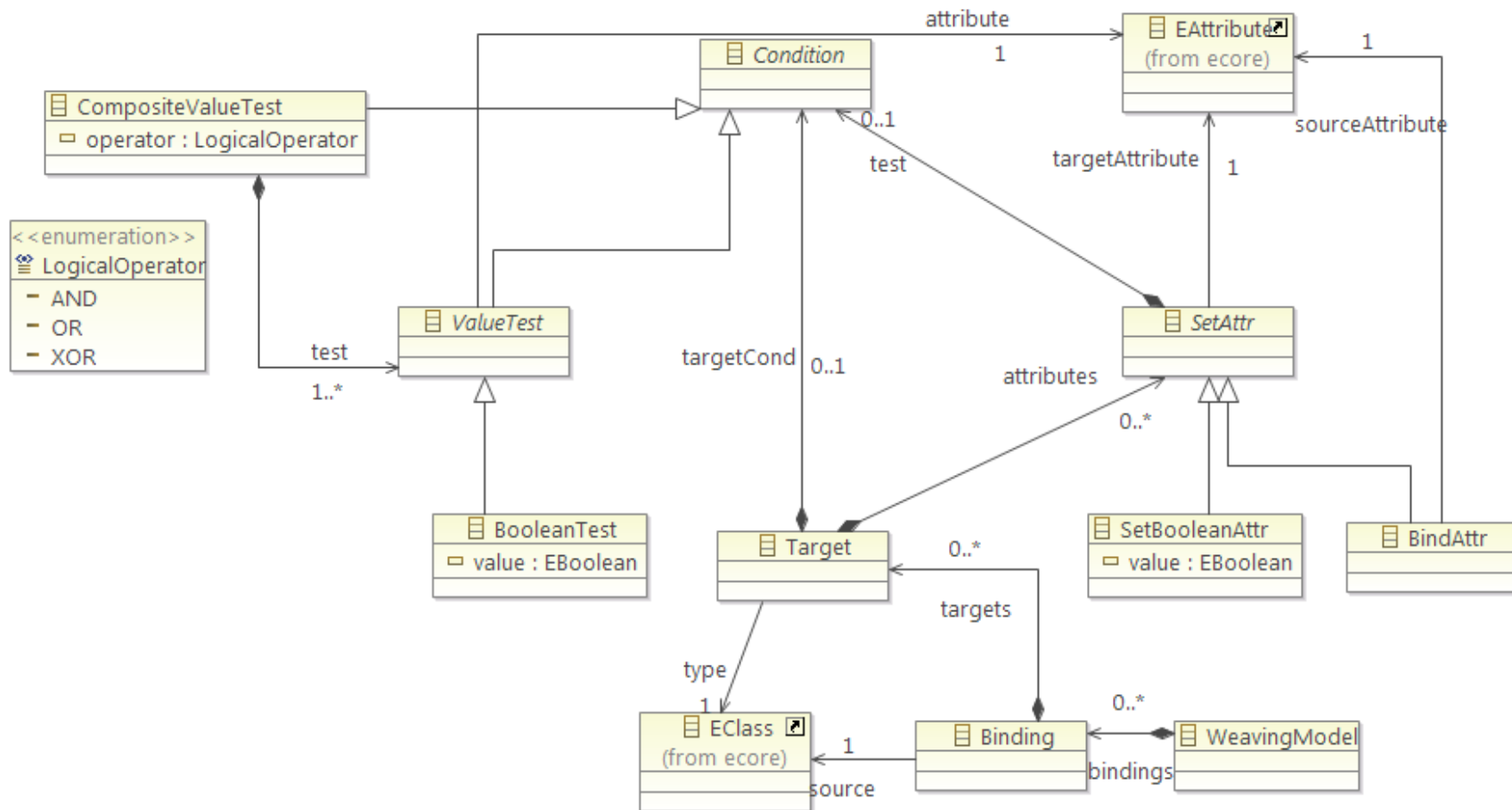
- x Eclipse foundation project
- x Collection of tools and language for MDD
 - Merging
 - Migrating
 - Transforming (M2T, M2M)
 - Validating
 - Comparing
 - ...
- x Active community
- x Up-to-date compatibility with EMF

<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 panel shows a tree view of the 'AM' (Activity Model) structure, with 'ReportWriting' selected under 'PedagogicalActivity'. The middle panel shows a detailed view of the 'weaving.model' structure, with 'Create ReportWriting' highlighted under 'Create Sequence'. The right panel shows the 'AM' tree view again, with 'ReportWriting' selected under 'PedagogicalActivity'.

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 

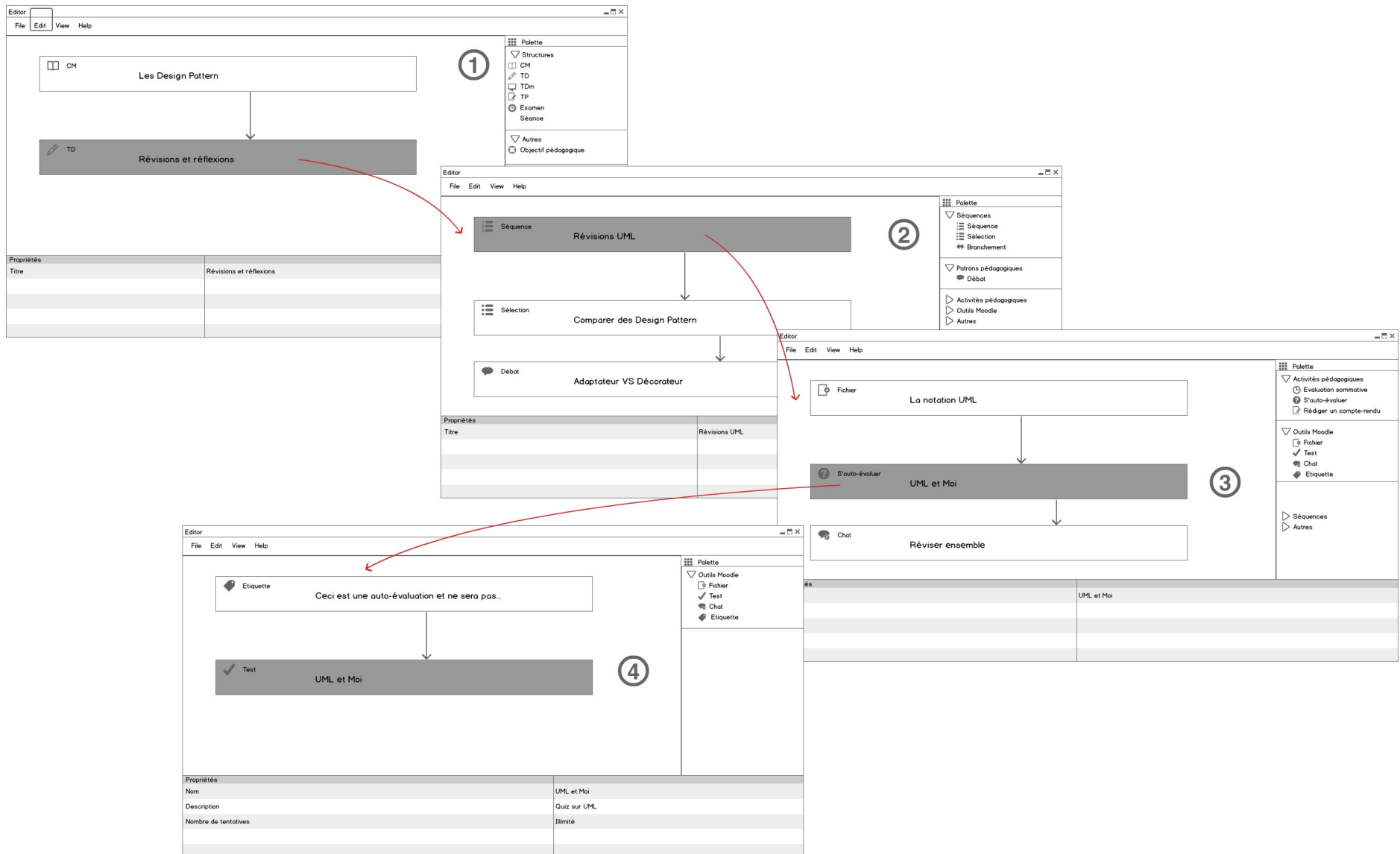
What we don't have (yet)

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

Thanks for your attention

Questions ?

Diagram editor mockup



Practises analysis

