Educational modeling languages

ICOOL 2007 Preconference Workshop
Penang, June 11, 2007
VERSION 1

Disclaimer: This is the first time I give this tutorial. There may be typos and things to be improved ...

Daniel K. Schneider
http://tecfa.unige.ch/tecfa-people/schneider.html

TECFA
Faculté de Psychologie et des Sciences de l’Education
Université de Genève
Code: ICOOL07-WS
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1. Objectives and Plan

1.1. Objectives
• Familiarization with the concept « educational modeling language »
• Modeling languages in the context of educational design

1.2. Plan
• Definition of educational modeling language »
• Identification of the « problem space »
• Instructional design models
• Instructional design methods
• Overview of modeling languages
  • Content aggregation (IMS / SCORM)
  • Learning Design
  • Other
• Discussion

Important: Some slides will not be used for presentation. They are included for (re) reading ....
1.3. What are educational modeling languages

Educational modeling languages (EML):
- define pedagogical scenarios
- are design languages.
- some incarnate norms and data standards

Objectives of EMLs (there is no general agreement):
- To formally model learner activities
- To exchange learning units (objects, scenarios)
- To execute learning units in a platform/player
- To sketch, design, plan, discuss learning scenarios

Several types of formal EMLs, for example:
- Menu-driven content aggregation: (Standalone) IMS Content Packaging
- Instructional design: Learning Design (LD) …
- Mastery learning: Simple Sequencing (SS) …

Informal EMLs
- Any kind of consistent drawing, lesson planning language, etc.
2. The problem space

1. Learning
   - Learning theory
   - Affect and motivation
   - Learning level
   - Learning type

2. Pedagogy
   - Educational theory
   - Instructional theory
   - Pedagogic strategies
   - Instructional design theory

3. Howto Models
   - Instructional design models
   - Objectives & constraints

4. Tools & Methods
   - Educational technologies
   - Instructional design methods
   - Technologies

Pedagogical design (scenarios)
3. Learning

Why bother?

- "Learning" is a complex multi-dimensional phenomenon
- There are different learning types, learning levels etc.
- It’s not obvious to identify learning goals
  
  ... learning theory can help a bit, in particular its taxonomies
- Learning theory strongly influences pedagogical theory & practice
3. Learning

3.1. Types of Learning

1. **Attitudes:**
   • Disposition or tendency to respond positively or negatively ....

2. **Factual Information (Memorization):**
   • Processing of factual information and remembering .....

3. **Concepts (Discrimination):**
   • ... how to discriminate and categorize things. It is not related to simple recall and must be constructed.

4. **Reasoning (Inference, Deduction):**
   • thinking activities that involve making or testing inferences

5. **Procedure Learning:**
   • .... being able to solve a certain task by applying a procedure.

6. **Problem solving:**
   • identification of subgoals, use of methods to satisfy subgoals.

7. **Learning Strategies:**
   • learning how to learn, very difficult to teach !
3. Learning ICOOL07-WS-11

3.2 Levels of Learning

(Bloom’s taxonomy of the cognitive dimension)

1. **Knowledge**: recall data or information
   - ... describe, identify, recall, arrange, define, duplicate, label, list, ...

2. **Comprehension**: be able to translate into own words.
   - ... give example, classify, describe, discuss, explain, express, identify, ...

3. **Application**: Use a concept in a new situation
   - ... apply, change, construct, compute, choose, demonstrate, write, ...

4. **Analysis**: split concepts into parts and understands the structure
   - ... analyze, break down, relate, appraise, calculate, categorize, compare, ...

5. **Synthesis**: Produce something from different elements
   - ... summarize, arrange, combine, categorize, assemble, collect, compose, ...

6. **Evaluation**: Make judgements, justify a solution, etc.
   - ... appraise, interpret, argue, assess, attach, compare, defend, predict, ...

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3.3. Learning theories

.....look at learning in different ways ... lead to different designs

- **Behaviorism**
  - (change behavior)

- **Constructivism**
  - (construct knowledge)

- **Social Cognition**
  - (interact with others)

- **Cognitivism**
  - (reach knowledge objectives)

- **Situated & Shared Cognition**
  - (interact with the situation)

Higher learning levels.
What does pedagogy tell us?

• There are very few generally applicable principles!

• Different pedagogies relate to different learning goals & types & levels

  ... Therefore try to have a "vocabulary" of strategies and tactics
4.1. Major pedagogical approaches (strategies)

(Baumgartner & Kalz), there are many other typologies ...

<table>
<thead>
<tr>
<th>Learning I</th>
<th>Learning II</th>
<th>Learning III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer</td>
<td>Tutor</td>
<td>Coach</td>
</tr>
<tr>
<td>Factual knowledge,</td>
<td>Procedural knowledge</td>
<td>Social practise,</td>
</tr>
<tr>
<td>“know-that”</td>
<td>“know-how”</td>
<td>“knowing in action”</td>
</tr>
<tr>
<td>Transfer of</td>
<td>Presentation of</td>
<td>Action in (complex</td>
</tr>
<tr>
<td>propositional</td>
<td>predetermined</td>
<td>and social) situations</td>
</tr>
<tr>
<td>knowledge</td>
<td>problems</td>
<td></td>
</tr>
<tr>
<td>to know, to remember</td>
<td>to do, to practise</td>
<td>to cope, to master</td>
</tr>
<tr>
<td>Production of correct</td>
<td>Selection of correct</td>
<td>Realization of adequate</td>
</tr>
<tr>
<td>answers</td>
<td>methods and its use</td>
<td>action strategies</td>
</tr>
<tr>
<td>Verbal knowledge,</td>
<td>Skill, Ability</td>
<td>Social Responsibility</td>
</tr>
<tr>
<td>Memorization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>to teach, to explain</td>
<td>to observe, to help,</td>
<td>to cooperate, to support</td>
</tr>
<tr>
<td></td>
<td>to demonstrate</td>
<td></td>
</tr>
</tbody>
</table>

(see “Overview of pedagogic strategy models” [p. 18])
4.2. Pedagogical strategies and methods?
There are many!
E.g. Khan’s (2000) list of Methods and Strategies

<table>
<thead>
<tr>
<th>Presentation</th>
<th>Exhibits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demonstration</td>
<td>Drill and Practice</td>
</tr>
<tr>
<td>Tutorials</td>
<td>Games</td>
</tr>
<tr>
<td>Story Telling</td>
<td>Simulations</td>
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<tr>
<td>Role-playing</td>
<td>Discussion</td>
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<tr>
<td>Interaction</td>
<td>Modeling</td>
</tr>
<tr>
<td>Facilitation</td>
<td>Collaboration</td>
</tr>
<tr>
<td>Debate</td>
<td>Field Trips</td>
</tr>
<tr>
<td>Apprenticeship</td>
<td>Case Studies</td>
</tr>
<tr>
<td>Generative Development</td>
<td>Motivation</td>
</tr>
</tbody>
</table>

... some (combinations of) strategies work better for some learning goals
5. Instructional design models

Types of instructional design models:

1. Functions of a learning environment
2. Quality of a design *(not in this talk)*
3. Complementary models that will enhance a design *(not in this talk)*
4. Change management models *(not in this talk)*
5. Pedagogic strategy models
6. Instructional design methods: how to implement a design (later)

EMLs may model 3 and 5 and relate to 1 and 6
5.1. Functions of a learning environment

- Focus can change
  - E.g. teacher role is central in activity-based designs
  - E.g. Learning material is important for mass-education

```
modified from Sandberg
```
### 5.2. Overview of pedagogic strategy models

- how to organize appropriate pedagogical scenarios to achieve instructional goals.
- a kind of abstract design rule for a given instructional design approach or a given pedagogic strategy.

There are dozens: a few models sorted by 2 dimensions:

<table>
<thead>
<tr>
<th>Learning I (information)</th>
<th>formal</th>
<th>open / informal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecturing, &quot;page turners&quot;, drill &amp; practise, ...</td>
<td></td>
<td>on-demand tutorials, handbooks, ...</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>small scale Learning II (know how)</th>
<th>formal</th>
<th>open / informal</th>
</tr>
</thead>
<tbody>
<tr>
<td>exercising, e-instruction, simulations, ...</td>
<td></td>
<td>on-demand e-instruction, self-learning with textbooks, ...</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>large scale Learning II (know how)</th>
<th>formal</th>
<th>open / informal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem-based learning, Inquiry-based learning, simulation &amp; gaming,...</td>
<td></td>
<td>help desk model, on-demand tutoring, knowledge management,...</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Learning III (knowing in action)</th>
<th>formal</th>
<th>open / informal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project-based learning formal e-portfolios</td>
<td></td>
<td>Communities of practice Mentoring, ...</td>
</tr>
</tbody>
</table>
5.3. E-instruction model

Part 1: A modular course architecture

- collections of reusable learning objects, i.e. focus on content aggregation
Part 2: Module design

- Should follow (some) sound behaviorist/cognitivist design principles, e.g. Gagne’s 9 steps of instruction

  a. **Gain attention** e.g. present a good problem or a new situation.
  
  b. **Describe the goal**: e.g. state what students will be able to accomplish.
  
  c. **Stimulate recall of prior knowledge** (facts, rules, procedures or skills) and show how knowledge is connected.
  
  d. **Present the material** to be learned e.g. text, graphics, simulations, figures, pictures, etc.
  
  e. **Provide guidance for learning** (instructions on how to learn on a different channel)
  
  f. **Elicit performance "practice"**, let the learner do something with the newly acquired behavior, practice skills or apply knowledge. At least use MCQ’s.
  
  g. **Provide informative feedback**, show correctness of the trainee’s response, analyze learner’s behavior, etc.
  
  h. **Assess** performance test and also more general progress information
  
  i. **Enhance retention and transfer**: inform the learner about similar problem situations, provide additional practice. Put the learner in a transfer situation.
5.4. Inquiry-based learning model

Purpose: concept learning and investigation methodology

Typical cycle of student activities (done several times)

Ask
- students ask questions

Investigate
- collect information
- observe
- experiment

Reflect
- examine results
- and look at questions again

Discuss
- share ideas
- confront ideas

Create
- synthesize
- make links
- write report
5. Instructional design models

5.5. Project-based learning model

- Main purpose: "deep learning" (applicable knowledge)

Outline of the model defined by "Moursund":

- A typical project has 4 phases:

(1) Getting started
   a. Define the topic of overall course
   b. Define timelines, milestones and assessment methods
   c. Identify resources
   d. Identify prerequisites
   e. Advance organization (project-methodology, skills that will have to be acquired etc.)
   f. Form teams

(2) Initial Team Activity - Project Planning
   a. Knowledge pooling by team members
   b. Initial project specification, e.g. formulate objectives and questions. At university level, this should lead to a research design.
   c. Planning, e.g. definition of work packages, milestones and timelines
   d. Formal teacher feedback
   e. Revision of the project specification and plan (if need return to steps 2 and 3)
(3) Project Implementation
   a. Have students complete one task and milestone at a time. Make sure that students engage in regular meetings
   b. Refining of project definition
   c. Sharing between team members (make sure that there is collaboration and cooperation, you decide)
   d. Provide feedback (this includes peer-to-peer tutoring, global feedback to the class for all projects, etc.)
   e. Move toward completion.
   f. Repeat all steps until all milestones have been met

(4) Completion
   a. Students have to polish the final product and prepare associated presentations.
   b. Assessment: The whole class should assist at the presentation of the results. Students may have the occasion to integrate a last feedback.
   c. Closing session with the whole class discussing the experience

Notes:
• There are many variants of this kind of model
• ICT-enhanced models put more emphasis on intermediary products and exchange activities (see next)
5.6. Structured project-based learning model (variant)

Level 1: Teacher roles and the overall design

- Strong story-boarding, projects are done individually or in small groups
- Teacher role is crucial & complex

Teacher as orchestrator
- designs the environment
- designs the global project
- designs flexible tasks
- designs exchange activities

Teacher as monitor
- makes audits
- reads blogs
- controls project plans
- evaluates

Teacher as facilitator
- gives feedback
- answers questions
- writes tutorials
- provides examples
- provides links

Projects

Scenario 1
- Goals and questions
  stage 1
  stage 2
  stage 3 ...
- output: objectives+
  research questions
- discussion at class level

Scenario 2
- R & D plans
  stage 1
  stage 2
  stage 3
- output: plan v.1

......
Level 2: Scenario orchestrations with workflow loops and ICT:

- Scenarios are **sequences of activity phases (stages)** within which group members **do tasks** and **play specific roles**
- Each activity leads to a product that can be discussed and reused

... this is just the “ur-loop” ... other variants!
5.7. A "help desk/knowledge management model" for life-long learning

- Purpose: support informal workplace learning
- Needs involvement of several organizational units
5.8. Community of practise model

Purpose: Engage actors in communities that learn

- often used in professional development, e.g. teacher training
- members of a community tend to make better progress
- knowledge through *enculturation* (collective memory)
- good communities are *knowledge management* aware

Use of portal software

- A place to find informations, news etc.,
- A place to exchange, to reflect, to be, ....

... difficult to set up (people don’t collaborate naturally)
5.9. Mentoring
Purpose: Formal or informal "elder" to "younger" training

1. Conditions: Mentoring works when:
   • individuals are committed to it,
   • there is a goal (see the mentoring contract),
   • there is a supportive environment.

2. Stages to set up a mentoring program
   • Identify development needs of protégé(s)
   • Identify and recruit mentor(s).
   • Prepare/train mentor.
   • Mentor and protégé negotiate a mentoring agreement (see below).
   • Carrying out (implementation can include meetings with a facilitator).
   • Evaluation.

3. Contract:
   • Mentors and protégés should agree on a formal contract.
   • Contents: development objectives, roles and expectations, duration, ground rules, other comments.
   • Both have to sign it (and believe in it).
6. Tools & Methods

Methodologies for design and implementation

• There are many instructional design methods (also called "instructional design models")
• Norms and standards
• Modeling languages (some based on norms and standards)
• Technologies for design, authoring, delivery, and repository
6.1. Plan at least for 3 areas

1. Roles, structures and relations between actors:
   - who does what and where (before, during and after)

2. Contents and knowledge
   - what to learn, materials, knowledge creation

3. Learning activities

Diagram:
- 1. Teacher
- Tutor
- Learner
- Designer
- Content Expert
- Knowledge & Information space
- Courseware
- 3. Learning Activities
6.2. Instructional Design Method (1): heavy duty industrial design?

MISA/MOT/ADISA: Course designer works on "4 models"

1. **Knowledge and Skill Representation**
   - DC: Design of Content (know-that and know-how)

2. Application of **Teaching Methods** and Approaches
   - DP: Design of Pedagogical specifications

3. **Specification of Learning Materials**
   - DM: Design of Materials

4. **Delivery Planning**
   - DD: Design of Delivery

- Worth the effort for large scale projects and if you have manpower

*url:* [http://www.cogigraph.com](http://www.cogigraph.com)
The complexity of the MISA model ....
6.3. Instructional Design Method (2): Instructional systems design

Analysis
- tasks and needs analysis
- constraints, ....

Design
- subject analysis
- learning objectives
- scenario specs.
- materials specs.

Development
- implementation of design,
- Delivery system, ...

Implementation
- distribution
- conduct training

E.g. ADDIE-like model

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6.4. Instructional Design Method (3): Rapid participatory prototyping

Principles:

a. Cooperating: all stake-holders (including learners) participate

b. Experimenting: ideas are or may be embedded within current conditions, e.g. they may emerge during teaching

c. Contextualizing: Setting and situations are particular, e.g. each class may evolve differently

d. Iterating: The not-yet-known, draws from the point of view of use

The implementation cycles:
6.5. Technology (not part of this talk)

- Technology is not innocent!
- Do not trust vendors who make universal claims ....
- Use different design languages for different problems (see later)

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<th>Teaching I know-that</th>
<th>Teaching II know-how</th>
<th>Teaching III knowing-in-action</th>
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<td>(exploring, reading)</td>
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<td>Groupware</td>
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<td>(producing, collaborating)</td>
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<td>C3MS (community portals)</td>
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<td>and web 2.0 services</td>
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<tr>
<td>Comp. Supp. Coll. Learning</td>
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7. Standards and EML Overview

7.1. The global picture

- Domain knowledge
- Pedagogical objectives
- Storyboarding Activities
- Contents: sequencing, navigation, Metadata, ....
- Administration: Students, Learning objects
- Services (tools), Activity tools, Content players, Repositories, ....

- Any of these "elements" can be modeled
- Relations between these "elements" can be modeled
7. Standards and EML Overview

7.2. Are there instructional norms and standards?

- Pedagogical standards?
- Instructional design methods like MISA or ADDIE implicitly define what a good pedagogical design might be...
- Curricular standards, e.g.
  - American Association for the Advancement of Science’s (AAAS, 1993) Benchmarks for Science Literacy
  - National Research Council’s (NRC, 1996) National Science Education Standards,
- Data Standards (e.g. IMS / SCORM introduced later), for example:
  - Learning objects: IMS Content Packaging
  - MetaData: IEEE Learning Object Metadata Standard (LOM)
  - Modeling of sequencing and activities: IMS Learning Design and IMS Simple Sequencing
  - IMS Question and Test Interoperability (QTI)

Educational modeling languages:

- Make pedagogical designs explicit
- Can model learning sequences, learning activities, domain knowledge, etc.
- Do not explicitly impose pedagogical designs, but do so implicitly by supporting given kinds of scenarios, learning materials, etc.
### 7.3. Major standards players

<table>
<thead>
<tr>
<th>Organization</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE (Learning Technology Standards Committee)</td>
<td>LOM Metadata standard for the reusability and interchangeability of LO's</td>
</tr>
<tr>
<td><strong>ADL</strong> Advanced Distributed Learning (US Gov)</td>
<td>Define various SCORM profiles</td>
</tr>
<tr>
<td></td>
<td>In the past: proper standards, today mostly adoption of IMS and IEEE norms.</td>
</tr>
<tr>
<td></td>
<td>Norms to implement systems.</td>
</tr>
<tr>
<td>ARIADNE Alliance for remote Instructional Authoring and Distribution Network for Europe (EU)</td>
<td>Metadata Standard for Interoperability (outdated, integrated and replaced by LOM)</td>
</tr>
<tr>
<td>DCMI Dublin Core Metadata Initiative (international organization)</td>
<td>DC Metadata specifications and content structure modeling</td>
</tr>
<tr>
<td></td>
<td>Light-weight alternative to LOM, popular for document repositories</td>
</tr>
<tr>
<td>AICC Aviation Industry CBT Committee (International organization)</td>
<td>Content structure modeling (part of older SCORM profiles)</td>
</tr>
<tr>
<td>IMS IMS Global Learning Consortium, Inc.</td>
<td>Metadata specifications</td>
</tr>
<tr>
<td></td>
<td>Simple Sequencing Information and Behavior Model</td>
</tr>
<tr>
<td></td>
<td>Content Packaging Specification</td>
</tr>
<tr>
<td></td>
<td>Learning Design</td>
</tr>
<tr>
<td></td>
<td>… more</td>
</tr>
</tbody>
</table>
7.4. What can be modelled in education?

Three main areas:
1. Domain knowledge + knowledge and skills to be learnt
2. Component aggregation / Sequencing of learning materials (SCORM)
3. Learning activities (Learning Design)

Additional areas:
- Architecture of computer systems
- Repository information (metadata)
- Learner information
- ......

To model, we are looking for
- **design languages** that can precisely describe a design
- machine readable languages to represent or even run a model
- a way to distribute modeled "stuff" (see: learning objects, units of learning)
- "players"/systems to execute some "stuff"
7.5. Kinds of design languages

- A design language is some kind of formalism to describe a class of artifacts, e.g. a computer software, pedagogical scenarios, knowledge.
- A design language is not necessarily formalized or standardized.

Criteria to look at various design languages

1. Complexity
2. Precision
3. Formality & standardization
4. Personal vs. shared
5. Implicit vs. explicit
6. standardized vs. non standardized
7. computability (can it be executed?)

Source: Gibbons et Brewer

c.f  http://edutechwiki.unige.ch/en/Design_language
7.6. Kinds of pedagogical design languages

Standardized executable languages
- Explicit standards, including formal languages
- Often: authoring tool, distribution tool and players
  - Most popular: IMS / SCORM
- Some lack good tools support (E.g. IMS Learning Design)
- Execution mechanism is not necessarily standardized
  - Means that you can’t use them yet (SCORM CAM is an exception)

Other executable languages
- 2 Versions: formalized vs. not formalized
- Often they are supported by an authoring tool and a player
- May offer export functionality, e.g. to IMS formats

Informal design languages
- Scenario building toolkits
- Many lesson planners ...

Research: .... lots !
7. Standards and EML Overview

7.7. Mainstream standards I

(According to Rob Koper, main inventor of IMS Learning Design)

UOL = Unit of learning

Grey boxes represent standards or equivalent

... focus on "IMS Galaxy"
7.8. According to Miguel R. Atacho (creator of PALO)

- Management: Interoperability parameters with LMS
- Pedagogical/Instructional: Pedagogical Information
- Activity/Task: Educational processes by activities. Collaborative tasks and activities
- Sequencing: Sequencing, prerequisites, deadlines, dependencies
- Structure: Navigational model
- Content: Small LO’s, assets and formatted content

... focus on "IMS Galaxy"
8. Modeling (1) - general purpose design languages

... any appropriate design language can be used to model pedagogical "things"

8.1. UML

• The Unified Modeling Language (UML) is a object modeling and specification language mostly used in software engineering.

• UML includes a standardized graphical notation for several diagram types:
  • *Use case* models and scenario's capture the user requirements and functionality of the system.
  • *Class and object diagrams* specify the structure of a system.
  • *Activity diagrams* to specify workflows.
  • *State diagrams* describe the dynamic behavior of an object in a system.
  • *Interaction diagrams* (sequence and collaboration diagrams) model how groups of objects collaborate in some behavior.
  • *Physical diagrams* (deployment and component diagrams) to model the implementation structure of a system.

• Some educational modeling languages are first of all described as UML diagram, e.g. the semantic information model of IMS Learning Design has been expressed in UML.
  • ... this is why I first present UML ....
8.2. UML Use Case

- Describe behaviors of actors
- Example: Rob Koper’s Learning Network diagram

- The figure specifies several use cases, i.e. the activities performed by the actors, represented with oval boxes.
8.3. UML class diagram


- **Classes (objects)**
  - Represented by: a rectangle with one, two or three "fields": classname, properties and operations

- **Association**
  - A relationship between instances of the two classes
  - Represented by: a solid line, or if directional with an arrow directed from the source class to the target class.

- **Aggregation**
  - A part-of relationship
  - Represented by: a solid line, with an empty lozenge at aggregation end and arrow at member end
  - Example: a learning object is part of an environment

- **Generalization**
  - is-a relationship
  - Represented by: A solid line with a triangular arrow from specialized class to class
  - Example: Learner is a role

- **Composition**
  - Like aggregation but you can add more constraints.
• An instance of a class can be potentially a component of several classes, but can only be owned by one.
• Represented by: a solid line, with an filled lozenge at aggregation end and arrow at member end

**Multiplicity**
• of an association: x or x...y (x = 0,1,n*) and y = 0,1,n,*

• Blue boxes (roughly) give an idea of the relationships involved.
9. Modeling (2) - Learning outcomes

1. Identify learning outcomes (SWBAT = Student Will Be Able To ...)
   • Depends on the kind of skills to be learnt

<table>
<thead>
<tr>
<th>Learning type</th>
<th>SWBAT ....</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem-solving</td>
<td>Generate ...</td>
</tr>
<tr>
<td>Rule-using</td>
<td>Demonstrate ....</td>
</tr>
<tr>
<td>Concepts</td>
<td>Classify, identify ....</td>
</tr>
<tr>
<td>Verbal information</td>
<td>State, list, recite, summarize ....</td>
</tr>
<tr>
<td>Affective</td>
<td>Choose ....</td>
</tr>
<tr>
<td>Psychomotor</td>
<td>Execute ...</td>
</tr>
</tbody>
</table>

2. Model domain knowledge

3. Identify skills a learner should master

Subordinate skills analysis according to Rieber
Ontology modeling languages can help, e.g. OWL the W3C language

Bicycle knowledge modeled with MOT+ Ontology editor
10. Modeling (3) - Metadata information

- Today’s most popular standard is LOM
- LOM is a complex definition
  - In real world, teachers usually refrain from entering MetaData
  - Document repositories often really on simpler Dublin Core
  - Web 2.0 relies on folksonomies (tagging)

10.1. The LOM standard

- LOM = Learning Object Metadata Standard
- LOM was proposed by Ariadne, IMS and then formalized by IEEE

LOM includes 9 sections:
- the General category, the Lifecycle category, the Metametadata category, the Technical category, the Educational category, the Rights category, the Relation category, the Annotation category, and the Classification category
## 10.2. The LOM Educational category section

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>interactivity Type</strong></td>
<td>• active: Active learning (e.g., learning by doing) is supported by content that directly induces productive action by the learner.</td>
</tr>
<tr>
<td>(IEEE 1484.12.1-2002)</td>
<td>• expositive: Expositive learning (e.g., passive learning) occurs when the learner's job mainly consists of absorbing the content exposed to them.</td>
</tr>
<tr>
<td></td>
<td>• mixed: A blend of active and expositive interactivity types.</td>
</tr>
<tr>
<td><strong>learning Resource Type</strong></td>
<td>exercise, simulation, questionnaire, diagram, figure, graph, index, slide, table, narrative text, exam, experiment, problem statement, self assessment, lecture</td>
</tr>
<tr>
<td>(IEEE best practice)</td>
<td></td>
</tr>
<tr>
<td><strong>interactivity Level</strong></td>
<td>very low, low, medium, high, very high</td>
</tr>
<tr>
<td>(IEEE 1484.12.1-2002 but meaningful only in community practice)</td>
<td></td>
</tr>
<tr>
<td><strong>semantic Density</strong></td>
<td>very low, low, medium, high, very high</td>
</tr>
<tr>
<td>(IEEE 1484.12.1-2002 but meaningful only in community practice)</td>
<td></td>
</tr>
<tr>
<td>Element</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>----------------------------------------------------</td>
</tr>
<tr>
<td>intended End User Role (IEEE 1484.12.1-2002)</td>
<td>• teacher</td>
</tr>
<tr>
<td></td>
<td>• author</td>
</tr>
<tr>
<td></td>
<td>• learner</td>
</tr>
<tr>
<td></td>
<td>• manager</td>
</tr>
<tr>
<td>context (IEEE 1484.12.1-2002)</td>
<td>• school</td>
</tr>
<tr>
<td></td>
<td>• higher education</td>
</tr>
<tr>
<td></td>
<td>• training</td>
</tr>
<tr>
<td></td>
<td>• other</td>
</tr>
<tr>
<td>typical Age Range</td>
<td>xx</td>
</tr>
<tr>
<td>difficulty (IEEE 1484.12.1-2002, meaningful only in a context of a community)</td>
<td>• very easy</td>
</tr>
<tr>
<td></td>
<td>• easy</td>
</tr>
<tr>
<td></td>
<td>• medium</td>
</tr>
<tr>
<td></td>
<td>• difficult</td>
</tr>
<tr>
<td></td>
<td>• very difficult</td>
</tr>
<tr>
<td>typical Learning Time</td>
<td>open text element</td>
</tr>
<tr>
<td>description</td>
<td>open text element</td>
</tr>
<tr>
<td>language</td>
<td>standardized def.</td>
</tr>
</tbody>
</table>
11. Modeling (4) - Learning Objects, Units and Content Packs

A provisional definition of Learning object and unit of learning

• **Learning objects** are small (relative to the size of an entire course) instructional components that can be reused a number of times in different learning contexts.

• **Units of learning** are course components (or entire courses) that include pedagogy (contents, sequenced contents and/or activities). Both isolated units of learning and entire courses can be distributed as content packs.

• Technically speaking, "learning objects + content packaging" mostly refers to reusable e-learning contents as defined by IMS and SCORM

Most important issues:

• Return on investment (is it worthwhile?)

• Size (how big is a learning object?)

• Standards (is IMS the only one?)
11.1. Motivation: Why learning objects?

SCORM 2004 3rd Edition Overview (p 1-6)

- **Accessibility**: The ability to locate and access instructional components from one remote location and deliver them to many other locations.
- **Adaptability**: The ability to tailor instruction to individual and organizational needs.
- **Affordability**: The ability to increase efficiency and productivity by reducing the time and costs involved in delivering instruction.
- **Durability**: The ability to withstand technology evolution and changes without costly redesign, reconfiguration or recoding.
- **Interoperability**: The ability to take instructional components developed in one location with one set of tools or platform and use them in another location with a different set of tools or platform.
- **Reusability**: The flexibility to incorporate instructional components in multiple applications and contexts.
11.2. Size of learning object

Two sorts of opinions: (1) Can be **of any** size - (2) something **in between**

A content-oriented view:

---

**Modular Content Hierarchy**

- **“Raw” Media Data Elements**
  - Audio
  - Text
  - Illustration

- **Information Objects**
  - Concept Process Summary

- **Application Objects**
  - Learning Object

- **Aggregate Assemblies**
  - Lessons Units

- **Collections**
  - Courses
  - Stories
  - Movies

---

Learnativity (2001)

Krull and Mallinson PPT slides

11.3. The IMS Content Packaging standard

• IMS Content packs are a kind of bigger learning object defined at learning unit or course level

Objectives:

• allow **transfer** of e-learning contents from one system to an other (inter-operability)

• allow to **import/export** contents into/from a learning management system. Therefore support authoring with a stand-alone tool.

• IMS Content Packaging is an evolving and **extensible** standard.
  • Therefore, make sure that you know what version you plan to build / import / export and more importantly what kinds of extensions various profiles adopt !!

• IMS Content packaging is a very popular e-learning standard
  • IMS Content Packaging 1.1.2 is adopted by SCORM 1.2
  • IMS Content Packaging 1.1.4 by SCORM 2004
  • IMS Content Packaging 1.1.4 (?) by IMS Learning Design
11.4. Architecture overview

- IMS Content packaging allows to deliver different sorts of e-learning contents, but all relay on the same PIF architecture.
- A Package Interchange File (PIF) is a zip file.
Details

1. File resources that include
   - All your **assets** (contents) needed, e.g. HTML pages, pictures, Flash Animations, PPT (whatever, the idea is that you take formats that your client can handle). You may use sub-directories

2. Schema files
   - that formally define all the vocabularies used in the manifest file (see next item).

3. A special file in the zip is **imsmanifest.xml containing:**
   - a **meta-data section** `<metadata />`: describes the package as a whole.
   - a **resource list** `<resources />`: containing references to all of the actual resources and media elements needed for a manifest (files), including meta-data describing these resources, and references to any external files (URLs).
   - an **organization section**: describing zero, one, or multiple learning sequences, i.e. information that is used to "play" the contents.
     The default tree-based default organization refers to simple resources (assets). However, this section can also contain IMS Simple Sequencing or IMS Learning Design organization or any other future standard.
   - (sub)manifests, that can do the same for subpackages.
Exemple 11-1: TestPack (made with RELOAD:

url: http://www.reload.ac.uk/ex/testpkg.zip - (http://www.reload.ac.uk/ex/)
## Files in a typical zip

<table>
<thead>
<tr>
<th>File Name</th>
<th>Size</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>imscp_v1p1.xsd</td>
<td>16.3 KB</td>
<td>eXtensible Markup Language definition (IMS CP)</td>
</tr>
<tr>
<td>imsmanifest.xml</td>
<td>8.5 KB</td>
<td>eXtensible Markup Language document</td>
</tr>
<tr>
<td>imsrmd_v1p2p2.xsd</td>
<td>23.7 KB</td>
<td>eXtensible Markup Language document</td>
</tr>
<tr>
<td>ims_xml.xsd</td>
<td>1.1 KB</td>
<td>eXtensible Markup Language document</td>
</tr>
<tr>
<td>eight.html</td>
<td>745 bytes</td>
<td>HTML document</td>
</tr>
<tr>
<td>five.html</td>
<td>751 bytes</td>
<td>HTML document</td>
</tr>
<tr>
<td>four.html</td>
<td>756 bytes</td>
<td>HTML document</td>
</tr>
<tr>
<td>one.html</td>
<td>738 bytes</td>
<td>HTML document</td>
</tr>
<tr>
<td>seven.html</td>
<td>762 bytes</td>
<td>HTML document</td>
</tr>
<tr>
<td>six.html</td>
<td>759 bytes</td>
<td>HTML document</td>
</tr>
<tr>
<td>three.html</td>
<td>755 bytes</td>
<td>HTML document</td>
</tr>
<tr>
<td>two.html</td>
<td>739 bytes</td>
<td>HTML document</td>
</tr>
</tbody>
</table>

- **extra contents (pictures)**
- **IMS CP Schema definition**
- **The manifest file**
- **IMS MD Schema definition**

**contents (assets) that will be used by the pedagogical organization**
Exemple 11-2: A simplified example with code

```
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifier</td>
<td>learning_sequence_1</td>
</tr>
<tr>
<td>Structure</td>
<td>hierarchical</td>
</tr>
</tbody>
</table>
```

Organization
Describes a particular hierarchical organization.
Header of the manifest

<manifest xmlns="http://www.imsglobal.org/xsd/imscp_v1p1"
    xmlns:imsmd="http://www.imsglobal.org/xsd/imsmd_v1p2"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    identifier="MANIFEST-1"
    xsi:schemaLocation="http://www.imsglobal.org/xsd/imscp_v1p1 imscp_v1p1.xsd
    http://www.imsglobal.org/xsd/imsmd_v1p2 imsmd_v1p2p2.xsd">

Metadata section

<metadata>
    <imsmd:lom>
        <imsmd:general>
            <imsmd:identifier>metadata-id</imsmd:identifier>
            <imsmd:title>
                <imsmd:langstring xml:lang="en">Simple IMS 1.1.4 Content Package</imsmd:langstring>
            </imsmd:title>
        </imsmd:general>
        <imsmd:metametadata> [....] </imsmd:metametadata>
        <imsmd:technical> <imsmd:format>text/html</imsmd:format> </imsmd:technical>
        <imsmd:educational>
            <imsmd:interactivitytype>
                <imsmd:source>
                    <imsmd:langstring xml:lang="en">LOMv1.0</imsmd:langstring>
                </imsmd:source>
            </imsmd:interactivitytype>
        </imsmd:educational>
        <imsmd:rights>
            <imsmd:description>
                <imsmd:langstring xml:lang="en">This is total freeware.</imsmd:langstring>
            </imsmd:description>
        </ imsmd:rights>
    </imsmd:lom>
</metadata>
Organization section

<organizations default="learning_sequence_1">
  <organization identifier="learning_sequence_1" structure="hierarchical">
    <title>Summer Pictures</title>
    <item identifier="ITEM-1" isvisible="true" identifierref="RES-1">
      <title>Loch Katrine</title>
    </item>
    <item identifier="ITEM-2" [ ....] <title>Ben Ledi</title>
    </item>
    <item identifier="ITEM-3" isvisible="true" identifierref="RES-3">
      <title>Jencks Earthwork</title>
    </item>
  </organization>
</organizations>

Resources section

<resources>
  <resource identifier="RES-1" type="webcontent" href="five.html">
    <file href="five.html" />
    <file href="supp/reloadhelp.css" />
    <file href="supp/reloadeditoricon.gif" />
    <file href="supp/trossachs.jpg" />
  </resource>
  [.....]
  <resource identifier="RES-3" type="webcontent" href="six.html">
    <file href="six.html" />
    <file href="supp/reloadhelp.css" />
    [.....]  </resource>
</resources>
11.5. What is SCORM?

- SCORM = Sharable Content Object Reference Model (since 2001)
- Since 2001, SCORM produces few specific standards but adopts "profiles" composed from other standards (IMS and IEEE) and norms for the systems architecture that run e-learning packages
- SCORM is the major player respected by industry

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2. Run-Time Environment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Metadata (Course Metadata, Content Metadata, Raw Media Metadata)</td>
</tr>
<tr>
<td>Version 1.1</td>
<td>Jan. 2001</td>
<td>Improved 1.0, clarification of &quot;Run Time&quot; specs</td>
</tr>
<tr>
<td>(most popular!)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Version 2004</td>
<td>Jan. 2004</td>
<td>Improvement of 1.2</td>
</tr>
<tr>
<td>(1.3x)</td>
<td></td>
<td>Inclusion of the &quot;simple sequencing&quot; modeling language</td>
</tr>
</tbody>
</table>
• IMS CP describes the structure of data (how to organize resources in sequences)
• SCORM Content Aggregation Model (CAM) standardizes how the activity tree will be constructed in a system (RTE) and how student data are to be collected.
SCORM adds so-called SCOs to the Content Pack:

- A SCO is a special kind of resource that can "talk" with an LMS
- Therefore we distinguish: simple "assets" (e.g. an HTML file, an animation) or an Shareable Content Object (SCO).
11.7. Summary IMS CP and SCORM

- IMS CP allows to assemble e-learning "data" for distribution
  - MetaData
  - Resources
  - Organizations (i.e. pedagogical sequencing of various kinds)

- SCORM, focuses on execution
  - defines how a resource and an LMS could interact (adds extensions to IMS CP !)
  - defines what execution means in terms of an student-activity tree

- Implementations of IMS CP + SCORM 1.2 players.
  - Most LMS provide support for simple IMS CP.
  - Lots, e.g. MOODLE support both IMS CP and SCORM 1.2
  - Few provide support for SCORM 2004 (including Simple Sequencing)
  - IMS Learning Design is badly supported

Playtime:
- Edit contents with eXe, export as IMS CP, dezip and then look at it
- Import this package into the Reload editor
- Get the IMS CP Test package with Reload editor and modify it

url: http://edutechwiki.unige.ch/en/Reload_Editor
url: http://edutechwiki.unige.ch/en/Reload_Editor_Tutorial
url: http://edutechwiki.unige.ch/en/eXe
12. Modeling (5) - Simple sequencing and QTI

- IMS Simple Sequencing is a norm to define complex learning sequences
- IMS Sequencing is also part of the ADL/Scorm 2004 profile
- IMS QTI Question and Test Interoperability (QTI) defines a sophisticated quizzing language

Simple Sequencing:
- describes navigation paths for a collection of learning activities
- controls navigation (taking into account performance etc.)

Computational architecture of "simple" sequencing:

1. Definition information
   - Definition of an organization in the imsmanifest.xml file

2. Tracking information
   - Collected informations from a learner using components
   - allows tracing and conditional navigation

3. Activity state information
   - A "snapshot" of the activity tree
   - Allows a learner to "pick up" again an activity.
12.1. Support for educational designs

- Simple sequencing is best for mastery learning
12. The sequence in IMS SS

- IMS simple sequencing isn’t simple!!

Simple linear activity:

Conditional activities:

(IMS Simple Sequencing Best Practice and Implementation Guide)
12.3. Example of a sequence and its XML code

(Picture from IMS Simple Sequencing Best Practice and Implementation Guide)

Basic sequencing behavior:
Some imsmanifest.xml code:

```xml
<?xml version = "1.0" encoding = "UTF-8"?>
<manifest xmlns = "http://www.imsglobal.org/xsd/imscp_v1p1"
         xmlns:imsss = "http://www.imsglobal.org/xsd/imsss"
         xmlns:xsi = "http://www.w3.org/2001/XMLSchema-instance"
         xsi:schemaLocation = "http://www.imsglobal.org/xsd/imsss Schemas/imsss_v1p0.xsd
                             http://www.imsglobal.org/xsd/imscp_v1p1 Schemas/imscp_v1p1p3.xsd"
         identifier = "BBT_TLCExamplePostTest">
<!-- This manifest contains a solution to the following ID Problem:
* Deliver content, then post-test
* If student doesn't pass the post-test, deliver remediation, then repeat the content and post-test
-->
<organizations>
  <organization identifier = "Organization">
    <item identifier = "Unit">
      <item identifier = "Content"/>
      <item identifier = "Posttest">
        <imsss:sequencing>
          <imsss:objectives>
            <imsss:primaryObjective objectiveID = "posttest1" satisfiedByMeasure = "true">
              <imsss:mapInfo targetObjectiveID = "content1" readSatisfiedStatus = "true"/>
            </imsss:primaryObjective>
          </imsss:objectives>
        </imsss:sequencing>
      </item>
    </item>
  </organization>
</organizations>
</manifest>
```
<imsss:objectives>
    <imsss:primaryObjective objectiveID = "remediation1">
        <imsss:mapInfo targetObjectiveID = "content1" readSatisfiedStatus = "true"/>
    </imsss:primaryObjective>
</imsss:objectives>

<imsss:sequencing>
    <imsss:controlMode choice = "false" flow = "true" forwardOnly = "true"/>
    <imsss:sequencingRules>
        <imsss:postConditionRule>
            <imsss:ruleConditions>
                <imsss:ruleCondition condition = "satisfied" operator = "not"/>
            </imsss:ruleConditions>
            <imsss:ruleAction action = "retry"/>
        </imsss:postConditionRule>
    </imsss:sequencingRules>
</imsss:sequencing>

<imsss:objectives>
    <imsss:primaryObjective objectiveID = "unit1">
        <imsss:mapInfo targetObjectiveID="content1" readSatisfiedStatus = "true"/>
    </imsss:primaryObjective>
</imsss:objectives>
</imsss:sequencing>
</item>
</organization>
</organizations>
<resources/>
</manifest>
12.4. IMS Question and Test Interoperability (QTI)

Objectives of this specification
- models questions and answers (assessment items)
- models data generated by learners (assessment data, user answers)

Integration with other norms
- QTI can be combined with IMS Simple Sequencing and IMS Learning Design (under the condition that you use an appropriate player)

Tools
- QTI players can be found in full SCORM 2004 compliant LMSs (some 1.2)
- APIs
  - http://sourceforge.net/projects/apis/
- QPlayer
  - http://www.e-teach.ch/q-player
- TOIA
  - http://www.toia.ac.uk/
12.5. QTI use case analysis

- **authoringTool**: allows to create an item (questions / answers)
- **itemBank**: Item repository
- **testConstructionTool**: assembly tool (should be part of the authoring tool)
- **assessmentDeliverySystem**: QTI player
- **learningSystem**: LMS containing the player and that directs the learner to a test
12.6. Example code

```xml
<assessmentItem xmlns="http://www.imsglobal.org/xsd/imsqti_v2p0"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://www.imsglobal.org/xsd/imsqti_v2p0 imsqti_v2p0.xsd"
    identifier="choice" title="Unattended Luggage" adaptive="false" timeDependent="false">

    <responseDeclaration identifier="RESPONSE" cardinality="single" baseType="identifier">
        <correctResponse>
            <value>A</value>
        </correctResponse>
    </responseDeclaration>

    <outcomeDeclaration identifier="SCORE" cardinality="single" baseType="integer">
        <defaultValue>
            <value>0</value>
        </defaultValue>
    </outcomeDeclaration>

    <itemBody>
        <p>Look at the text in the picture.</p>
        <p><img src="sign.png" alt="NEVER LEAVE LUGGAGE UNATTENDED"/></p>
        <choiceInteraction responseIdentifier="RESPONSE" shuffle="false" maxChoices="1">
            <prompt>What does it say?</prompt>
            <simpleChoice identifier="A">You must stay with your luggage at all times.</simpleChoice>
            <simpleChoice identifier="B">Do not let someone else look after your luggage.</simpleChoice>
            <simpleChoice identifier="C">Remember your luggage when you leave.</simpleChoice>
        </choiceInteraction>
    </itemBody>

    <responseProcessing
template="http://www.imsglobal.org/question/qti_v2p0/rptemplates/match_correct"/>
</assessmentItem>
```
13. Modeling (6) - Learning Design

13.1. Introduction

- SCORM is about content aggregation and mostly "Learning I" pedagogy
- LD is more concerned by "Learning II" and some "Learning III"

Objectives of Educational Modeling Language (Koper et al, 2001):  
- focus on the organization of learning activities
- wants to formalize the "source code" of pedagogy ...

Central elements:

- **Roles** that are performed by learners, teachers, tutors etc.
- **Activities** instantiated by performers.
- **Environments** including services (e.g. a forum) and learning resources
- The **scenario** is called method and contains play, act and role-parts.
- People playing the roles undertake a series of activities within an act.
- An act is completed after all the activities of a specified role, or roles, are finished.
13.2. The LD core activity
The UML class diagram:

source: [http://www.imsglobal.org/learningdesign/ldv1p0/imsld_infov1p0.html#1495548](http://www.imsglobal.org/learningdesign/ldv1p0/imsld_infov1p0.html#1495548)
13.3. Structure of a LD "unit of learning" (UOL)

In LD, a UOL is a complete learning scenario, organized according to pedagogical principles.

Technically: An IMS Content Package, i.e. a *.zip file with the following components:

1. resources (including materials, tools and links)

2. A XML « manifest »:

   describing the « method »:

   • play (scenario),
   • its acts,
   • role-parts of acts

   and its components

   • roles,
   • activities,
   • environment,
   • properties,
   • conditions and notifications (more sophisticated designs allow "jumping")
Difference with simple IMS Content Packaging (CP) and IMS Simple Sequencing (SS):

- LD defines a method (an organization) with acts
- IMS CP (default organization) defines menu-based access to resources
- IMS SS defines conditional learning sequences
- SCORM 1.2 extensions (SCO) are somewhat in between simple CP and SS

A simple LD (formalized in the MOT editor):

Act is central

Engaging in an act means doing something: reading, conferencing, sending mail, search ....
13.4. Major Elements of Learning Design

In IMS CP terminology a LD is an organization. It has the following sections:

```
learning-design
  components
  roles
    learner
    staff
  activities
    learning-activity (*)
    support-activity (*)
    activity-structure (*)
  environments
    learning-object (*)
    service (*)
  method
  play
    act (*)
      role-part (*)
```

(*) means multiple instances are possible

- LD makes a distinction between components of a play and its organization, i.e. the method (the play).
- Role-parts refer to components with links
  Looks a bit like a cooking recipe that lists ingredients first, then directions how to cook ...
### Overview Table of LD elements (there are some extra elements, e.g. title)

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>learning-design</td>
<td>The base level container</td>
</tr>
<tr>
<td>title</td>
<td>A title for the learning design</td>
</tr>
<tr>
<td>learning-objectives</td>
<td>What this unit of learning achieves</td>
</tr>
<tr>
<td>prerequisites</td>
<td>Whether there are dependencies?</td>
</tr>
<tr>
<td>components</td>
<td>The reusable elements of the learning design - this is the key level of granularity</td>
</tr>
<tr>
<td>roles</td>
<td>The Role List</td>
</tr>
<tr>
<td>learner*</td>
<td>Learner-role</td>
</tr>
<tr>
<td>staff*</td>
<td>Tutor-role</td>
</tr>
<tr>
<td>activities</td>
<td>The Activity Container: Activities (can) have objectives, prerequisites and metadata. They have an activity description (typically a web page containing instructions for how to perform the activity). If the activity is offline, then no further content is needed. If online, there would also normally be reference to an environment.</td>
</tr>
<tr>
<td>learning-activity*</td>
<td>e.g. view this learning object</td>
</tr>
<tr>
<td>environment-ref*</td>
<td>A reference to the environment for this activity</td>
</tr>
<tr>
<td>activity-description</td>
<td>A narrative description of the activity</td>
</tr>
<tr>
<td>support-activity*</td>
<td>e.g. pose question to class</td>
</tr>
<tr>
<td>environment-ref*</td>
<td>A reference to the environment for this activity</td>
</tr>
<tr>
<td>activity-description</td>
<td>A narrative description of the activity - usually a web page, This is kept separate from the resources in the environment, and so the runtime system can treat it differently - perhaps keeping it always available as a tab.</td>
</tr>
<tr>
<td>activity-structures*</td>
<td>A grouping of activities (with attributes to determine whether individual activities are presented as selection or in sequence). At this point there is no facility for coordination of different users doing different things - that has to be done one level up.</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>environment-ref*</td>
<td>A reference to the environment for this activity-structure</td>
</tr>
<tr>
<td>environments</td>
<td>The Environment Container: which contains learning objects and/or services to be used in that activity</td>
</tr>
<tr>
<td>environment*</td>
<td>Container for an individual environment (an environment is the collection of resources, services etc necessary for an activity)</td>
</tr>
<tr>
<td>title</td>
<td>A short-name for the environment</td>
</tr>
<tr>
<td>learning objects*</td>
<td>Learning content utilised within this environment</td>
</tr>
<tr>
<td>services*</td>
<td>A service needed for this environment to be utilised</td>
</tr>
<tr>
<td>environment-ref*</td>
<td>ref to another environment in the package</td>
</tr>
<tr>
<td>metadata</td>
<td>metadata about the environment</td>
</tr>
<tr>
<td>method</td>
<td>The key container - cf simple sequencing.</td>
</tr>
<tr>
<td>play*</td>
<td>Usually only one, but more than one would run in parallel.</td>
</tr>
<tr>
<td>act*</td>
<td>Acts run in sequence, with start triggered by the end of the preceding act. Transitions between acts form synchronisation points for roles. any coordination of events has to be done at this level - it can't be done at the activity level.</td>
</tr>
<tr>
<td>role-parts*</td>
<td>Run in parallel - so different roles do different things at the same time. Usually used for learners and teachers, but can be sophisticated - e.g. to support group-setting and role-play</td>
</tr>
<tr>
<td>role-ref</td>
<td>ref. to a specific role for this role-part.</td>
</tr>
<tr>
<td>activity-ref</td>
<td>ref to activity(-structure) for this role-part.</td>
</tr>
<tr>
<td>metadata</td>
<td>Descriptive Metadata for the LD</td>
</tr>
</tbody>
</table>
13.5. LD implementation levels

- There are 3 levels: A, B, C (makes gradual tools development easier)

**Level A: Contains the core idea of learning design:**
- Ingredients:
  - a series of activities (assessment, discussion, simulation),
  - performed by one or more players (learners, teachers etc.) - roles,
  - in an environment consisting of learning objects or services.
- Coordination of ingredients with method, play, act
- This provides a model for a series of time ordered learning activities to be performed by learners and teachers (one act after each other)

**Level B: adds conditions and properties**
- conditions (like in SS) allow to program evolution of a scenario in terms of evaluation functions.
- properties are informations about a group of learners (external or generated by activities)

**Level C: adds notifications**
- Allows to start another activity (jump out/goto)
13.6. Tools and implementations overview

- Most authoring tools and players are not end-user ready so far (5/2007)
  
  url: http://www.unfold-project.net/general_resources_folder/tools/currenttools (list)

13.7. LD with MotPlus

url: http://www.cogigraph.com/

- MotPlus is a hybrid between a specialized Mind Map and a "Case Tool".
- Besides LD, this tool also can model knowledge ontologies and other things.
- MOT can export to LD level A. The manifest can then be imported into Reload in order to add level B,C instructions.
- The MOT LD design language has 6 knowledge types and 7 link types:

![Six knowledge element types](image)

(Michel Léonard, Walkenburg workshop, 2005)
Elements of the LD editor component:

- **RESSOURCES (Concepts):**
  - Environment
  - Learning object or outcome
  - Conference
  - Send-Mail
  - Search by index

- **ACTIONS (Procedures):**
  - Method
  - Play
  - Act
  - Activity Structure
  - Learning Activity
  - Support Activity
  - External unit of learning

- **ACTORS (Principles):**
  - Learner role #1
  - Staff role #1

- **RULES (Principles):**
  - Number to select #1
  - Time limit #1
  - On completion #1

- **BASIC SPECIFIC OBJECTS (Facts):**
  - Learning objectives
  - Prerequisites

- **EXTENDED SPECIFIC OBJECTS (Facts):**
  - Metadata
  - Item
  - Class
  - Index by Class
  - Index by Element
  - Index by Type of Element
Example of an activity structure

- MOT activity structure = LD Act
- Each learning activity uses environments that can contain contents or services
MOT links

The seven link types:
- **composition** (C): "x is decomposed in", "y is part of x"
- **specialization** (S): "is a sort of"
- **regulation** (R): x regulates y (Concept, procedure, etc.)
- **precedence** (P), x before y
- **input/product** (IP): links a concept and a procedure
- **application** (A): links a fact to knowledge
- **instantiation** (I): fact is an instance of, object X is a y"

Links grammar
- Direction of arrows: "A -->c-->D" means "D is a component of A"
- There are restrictions on how to use links
  (see next slide)
Links summary

- **composition**
- **instance**
- **regulation**
- **preceding**
- **input/product**
13.8. LD with the Reload Editor

- The last version of the Reload Content Packaging Editor can edit LD level A for each section of the LD organization there is a different tab.
13.9. Reload Learning Design Editor

url: http://www.reload.ac.uk/tools.html

Can edit levels A,B,C. It has several tools:

- Overview: define titles, objectives and prerequisites
- Roles: to define roles
- Properties
- Activities: single activities and activity structures
- Environments: Tools and services
- Methods: The play, i.e. the learning design
- Files: Resource management à la IMS CP
- Export: Creation of IMS CP for distribution

Discussion

- Difficult to use because
  - on has to start defining components
  - do a lot of links
  - then define the method (and again do many links)
14. Modeling (7) - Other learning design environments

• These tools are not IMS LD, although you can store data in LD format (but e.g. for LAMS there is no way to play LAMS contents elsewhere ...).

14.1. LAMS

LAMS is a on-line authoring and activity management system

• Authoring / scenarization with a graphical editor
• User and role management
• Scenario execution with the same on-line tool (now that’s nice !)

Inspired by IMS LD

Authoring

• The scenario is defined with activities
• Each activity can be parametrized
  • ex. add contents to a reading activity
  • ex. decide which group has to discuss what
  • ex. people can vote on question
• Activities are sequenced
Screendump of LAMS
15. Modeling (8) - Scenario planners

15.1. DialogPlus

On-line scenario building toolkit (including sharable url: http://www.nettle.soton.ac.uk/toolkit/)

Key concept: the nugget = learning activity

3 elements:

- The *context* of the activity: e.g. subject, level of difficulty, intended learning outcomes and the environment within which the activity takes place.
- The *learning and teaching approaches*: including theories and models.
- The learning *tasks*: This includes type of task, techniques used, associated tools and resources, interaction and roles of those involved and learner assessment.
15.2. Tasks in DialogPlus

The diagram on the right illustrates various types of tasks in DialogPlus, categorized into Assimilative, Information handling, Communicative, and Productive. Each category further breaks down into specific tasks such as Reading, View, Listening, Gathering, Ordering, Classifying, Selecting, Analysing, Manipulating, Discussing, Presenting, and Debating. The left side of the image focuses on the resources and tools available for these tasks, including simulation, email, forums, conferencing, text creation, image creation, text viewers, image viewers, audio players, video players, search, and applications.
Tasks (2): Evaluation and assessment
Learning and teaching approaches / learning outcomes
15.3. OASIF

- French scenario planner made for ODL.
- Activity oriented


- Organization of a teaching unit in with four levels:
Organization and tool looks a bit like a project planner
16. Modeling (9) - Back to Contents

• IMS CP/Scorm are not content models, they are aggregators of smaller assets.
• If you plan to produce on-line textbooks, maybe IMS is not a good idea ...
• See also: DocBook, Latex, Semantic XHTML, DITA (e.g. document formats)

16.1. ELML

• The eLesson Markup Language (eLML) is an open source XML framework for creating structured eLessons using XML.
• eLML is an authoring toolkit that doesn't need a specific environment to run the contents

url: http://edutechwiki.unige.ch/en/ELML
17. Conclusion

17.1. You don’t need to be formal and you can simplify
17.2. There are many tools to build an activity-based environment

- Just do it ... but think in terms of storyboarding

Learning platform
either a flexible LMS or a portal or a web 2.0

- E.g.:
  Moodle
  Drupal (C3MS)
  BSCW (Groupware)

- Web 2.0 tools
  Social software
  Wikis, Blogs, ...

- Document and bibliography server (CSPACE)
- Theory encyclopedia (Mediawiki)
- Scenario engine (Blog, Mediawiki, task manager, etc.)
- Links manager
- Reference manager
- Online writing tools

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