Combining Individualization and Intuitive Guided Learning through Compound Learning Resources


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Problem Statement

Sometimes is difficult for teachers to find a correct, fluid and comprehensive sequence of learning activities covering a given topic and able to fit any learners’ need

• This may be due to several reasons:
  – complex nature of the topic
  – different needs of involved learners
  – lack of knowledge about prerequisite concepts
  – different learning styles

• This may result in unappealing and inefficient learning experiences
**Individualized Teaching**

- Learning is a *journey* that is different for each learner
- The best sequence of learning activities is selected for each learner according to *learning needs* and *preferences*

  ![Diagram of Individualized Teaching]

- **Drawback**: it tends to force the learner to follow a *fixed*, optimized, sequence of activities allowing few crossing possibilities

**Intuitive Guided Learning**

- Learners are *not forced down* a particular sequence of activities
- The experience is *non-linear*: the learner can deviate from the intended path through the learning experience

  ![Diagram of Intuitive Guided Learning]
• Learners are **not forced down** a particular sequence of activities
• The experience is **non-linear**: the learner can deviate from the intended path through the learning experience
Intuitive Guided Learning

- Learning happens in an **incidental manner**, through:
  - the **exploration**
  - the finding of a **personal key** of understanding
- It is particularly suitable for **digital natives**:
  - they are **curious** and driven by the pleasure of discovering something new
  - they consider this kind of interaction as more **natural** and **stimulating**
- **Drawbacks**:
  - the learner may **feel lost** within the course
  - sometimes it can be **difficult to reach** the required information

Our Approach

**Combining Individualized Teaching and Intuitive Guided Learning**

- **Compound Learning Resources** (CLRs)
  - are composed by a set of learning activities linked with **semantic connections**
  - can be **browsed in different ways** by different learners
- **Semantic connections**
  - **guide** the learner during the resource navigation
  - are used to **adapt** CLRs with respect to learning needs and preferences
Our Approach
Components

• Semantic Connection Model
  – To formally describe the meaning of semantic connections

• Compound Learning Resource Model
  – To formally describe a CLR as a graph where:
    • nodes are learning activities
    • arcs are semantic connection between activities

• Adaptation Algorithm
  – To automatically adapt CLR connections with respect to:
    • teaching preferences, learning preferences, context information

Semantic Connection Model

• Describes a connection with a set of attributes:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Specifies the nature of the connection. It is composed by three sub-parameters: group, name, colour.</td>
</tr>
<tr>
<td>Scope</td>
<td>Specifies the part of resource text on which the connection is applied. If blank it applies to the whole resource.</td>
</tr>
<tr>
<td>Optionality</td>
<td>Specifies if a connection is optional or mandatory. Optional connections can be removed by the system while mandatory ones can't be.</td>
</tr>
<tr>
<td>Tooltip</td>
<td>Provides a brief description of the connected content and is shown to the learner when he places the cursor over the connection activator.</td>
</tr>
<tr>
<td>Target</td>
<td>It is the target content to be shown when the connection is clicked by the learner. It can be internal (i.e. a resource page) or external (i.e. another resource or a URL)</td>
</tr>
</tbody>
</table>
### Connections between learning resources

*from rhetorical structure theory and learning objects networks*

<table>
<thead>
<tr>
<th>Connection Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elaboration</td>
<td>The referenced resource elaborates the content of the described resource or of a part of it.</td>
</tr>
<tr>
<td>Evidence</td>
<td>The referenced resource provides information to increase the belief in the claim mentioned in the described resource or in a part of it.</td>
</tr>
<tr>
<td>Interpretation</td>
<td>The referenced resource interprets or explains the described resource or a part of it.</td>
</tr>
<tr>
<td>Justification</td>
<td>The referenced resource justifies the described resource or a part of it.</td>
</tr>
<tr>
<td>Summary</td>
<td>The referenced resource summarises the described resource or a part of it.</td>
</tr>
<tr>
<td>Contrast/Opposite</td>
<td>The content of the described resource (or a part of it) and of the referenced resource are opposites.</td>
</tr>
<tr>
<td>Condition/Restriction</td>
<td>The referenced resource limits the content of the described resource or a part of it.</td>
</tr>
<tr>
<td>Restatement/Alternative</td>
<td>The referenced resource provides an alternative of presenting the described resource or a part of it.</td>
</tr>
<tr>
<td>Sequence</td>
<td>The referenced resource is the sequence or chronology of the described resource</td>
</tr>
</tbody>
</table>


### Connections within a learning resource

*from the theory of conditions of learning and the educational rationale metadata initiative*

<table>
<thead>
<tr>
<th>Connection Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation</td>
<td>The referenced content is an activator i.e. it strongly motivates and justifies the importance of the topic explained in the described resource or in a part of it.</td>
</tr>
<tr>
<td>Critique</td>
<td>The referenced content presents a critical review of the issues included in the described resource or in a part of it.</td>
</tr>
<tr>
<td>Collaboration</td>
<td>The referenced content includes spaces for discussion or cooperation about the topic described within the described resource or a part of it.</td>
</tr>
<tr>
<td>Engaging</td>
<td>The referenced content leads students to discover the validity of what they are studying by displaying bad behaviours held by those who do not know the topic explained within a resource or a part of it.</td>
</tr>
<tr>
<td>Integration</td>
<td>The referenced content is purposed to deepen (from several viewpoints) the theme explained in the described resource or in a part of it.</td>
</tr>
<tr>
<td>Anchor</td>
<td>The referenced content is purposed to anchor the knowledge explained in the described resource (or in a part of it) within an authentic context.</td>
</tr>
<tr>
<td>Perspective</td>
<td>The referenced content explains the knowledge provided by the described resource (or by a part of it) from a different perspective.</td>
</tr>
</tbody>
</table>


Connections Customisation

- **Optional connections** of a given type $c$ are **removed** if:
  - the CLR is use by a **learner** whose preference degree for that type is less then a given threshold i.e. $p(c) < \theta$
  - the CLR is used in a **course** that do not allow connections of that type i.e. $c \notin C_{Crs}$
  - the CLR is used in a **context** that do not allow connections of that type i.e. $c \notin C_{Cntx}$

- **Page connections** are **reordered** according to the preference degrees of the learner that is using the CLR

Connections Customisation

- Learner **preference degrees** of connections are inferred by the system
- A **machine learning** algorithm is used to analyse learner behaviour during the compound learning resource navigation

**History-Based Component**

Which connections have been preferred in the past by the same user?

**Collaborative Component**

Which connections similar users prefer?
The Prototype Editor

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**Experimentation**

- **68 students** were enrolled in an on-line course on **Software Engineering**
- The topic **Requirements** was modelled with a standard lesson and with a CLR
  - Students had to choose between the standard lesson or the CLR
  - Students selecting the CLR (41) had to fill a questionnaire basing on the SUS

<table>
<thead>
<tr>
<th>Participants</th>
<th>Experimental Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Satisfaction Questionnaire (range: 0-10)</td>
<td>M = 6.59, SD = 2.17, Md = 7</td>
<td></td>
</tr>
<tr>
<td>Perceived Usefulness of CLR as Learning Resource Questionnaire (range: 0-10)</td>
<td>M = 7.08, SD = 2.87, Md = 8.5</td>
<td></td>
</tr>
<tr>
<td>Usability SUS Score (range: 0-100)</td>
<td>60.78</td>
<td></td>
</tr>
<tr>
<td>Student Performances Assessment (range: 0-10)</td>
<td>M = 7.83, SD = 0.78, Md = 8</td>
<td>M = 6.33, SD = 1.28, Md = 6</td>
</tr>
</tbody>
</table>

**Conclusions**

- **Experimentation results** are promising considering the prototypical nature of software components
- An **additional experimentation** involving both learner’s and teacher’s points of view is currently running
- We are working on the **improvement of the user interface** both for students (during the delivery phase) and for teachers (in the authoring phase)
- This research is partially supported by the European Commission under the Collaborative Project “Adaptive Learning via an Intuitive, interactive, Collaborative, Emotional system”, **ALICE**, VII Framework Program, Theme ICT-2009.4.2, Grant Agreement n. 257639
Thanks for Your Attention

www.aliceproject.eu

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