Intelligent Learning Content Management System based on SCORM Standard

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Researching Topics

• e/m/u Learning
• Expert System
• Data Ming
• Internet-based Applications
• Intrusion Detection System (IDS)
Introduction

• Goal:
  – Provide learners with appropriate learning contents according to learners’ capabilities and learning performance.

• Current Research Results:
  • Learning Content Standard Definition:
    – Teaching Material Markup Language (TMML).
  • Transformation and Authoring of SCORM Content.
  • Management Scheme of SCORM Learning Object Repository.
  • Content Adaptation on Mobile Device.
  • Authoring System of Instruction Design.
  • Learning Portfolio Analysis Scheme.
Teaching Material Markup Language (TMML)

TMML V1.5

Content Level

SCORM
- LOM
- Sequencing

Extension
- Subjects
- Pedagogy

Quiz Level

IMS QTI
(試題標準+延伸)
Procedure of Transforming PPT into TMML content

1. Fill the TMML Metadata
2. Define the Section Unit
3. Show the Result
Applications Demo

Table Of Content

• 影像的壓縮

• 沉積岩就是指經過「沉澱、堆積」作用而形成的岩石。
Authoring Tool of SCORM 2004

• **SCORM 2004** (*Sharable Content Object Reference Model*):
  
  – **Define Sequencing & Navigation (SN) Specification:**
    • Can set the automatic learning guidance rules.
  
  – **Issue:**
    • It is hard to define and edit for users.
  
  – **Approach:**
    • Analyze and modularize the SN into several SN components.
    • Visual based Authoring Interface.
An Example of Sequencing Rules

```
<imsmanifest.xml>

<metadata>
  <organizations default="TOC1">  
    <organization identifier="TOC1">  
      <title>ConditionalLinear</title>
      <item identifier="INTRO" identifierref="RESOURCE_INTRO">  
        <title>Introduction</title>
        <imss:sequencing>
          <imss:sequencingRules>
            <imss:postConditionRule>
              <imss:ruleConditions>
                <imss:ruleCondition operator="not" condition="satisfied" />
              </imss:ruleConditions>
            </imss:postConditionRule>
          </imss:sequencingRules>
        </imss:sequencing>
      </item>
    </organization>
  </organizations>

<item identifier="FIRST_QUESTION1" isvisible="false" identifierref="RESOURCE_QUESTION1" parameters="?main=First Exam&sub=Question 1">
  <item identifier="FIRST_QUESTION2" isvisible="false" identifierref="RESOURCE_QUESTION2" parameters="?main=First Exam&sub=Question 2">
    <item identifier="FIRST_QUESTION3" isvisible="false" identifierref="RESOURCE_QUESTION3" parameters="?main=First Exam&sub=Question 3">
      <imss:sequencing>
        <imss:controlMode choice="false" flow="true" forwardOnly="true" />
      </imss:sequencing>
    </item>
  </item>
</item>
```

Sequencing Rules
Existing Authoring Tool

- Open Source Tools: (Reload Editor)
  - www.lsal.cmu.edu/adl or http://www.reload.ac.uk

Hard to image the sequence of final course and it is time-consuming, too.

Edit the Sequencing Rules by clicking in the comboBox of sequencing rules
The Idea in SCORM 2004 Authoring Tool

Constructing the course structure

Sequencing Component Set
(Middleware)

Sequencing Component #1

Sequencing Component #i

Sequencing Component #k

Sequencing Control Modes:
1. Sequencing Control Choice = True/False
2. Sequencing Control Flow = True/False
3. Sequencing Control Forward Only = True/False

Sequencing Control Rules:
1. if <Condition 1> then <Action 1>
2. if <Condition 1> then <Action 1>

Rollup Rules:
1. if <Condition 1> True for <child activity set 1>
   then <Action 1>
2. if <Condition 2> True for <child activity set 2>
   then <Action 2>

Objectives:
1. if (Measure 1) then (Status 1)
2. if (Measure 2) then (Status 2)

Corresponding Rules Set

Easy to use

Hard to use
A Course Created by Our Approach

(a) The HLPN Model of Photoshop Course

(b) The Corresponding AT of HLPN Model
SCORM 2004 Authoring Tool-1

Edited Structure

Modularized content structure

Edit structure of content
SCORM 2004 Authoring Tool-2

Set rule parameters
SCORM 2004 Authoring Tool-3

Set Learning Resources

Photoshop Tutorial

Level 2
Mode---Choice

RESOURCE1
RESOURCE2
RESOURCE3
RESOURCE4
RESOURCE5

4_Lesson 2 -- Toolbox
5_Lesson 3 -- Palettes
6_Lesson 4 -- Layers
7_Lesson 5 -- File Types
6_Lesson 6 -- Resolution...
Management Scheme of SCORM Learning Object Repository (LOR)

- **Goal:**

- **Functions:**
  - **Maintaining:**
    • Automatic create the relationship among Los for fast searching.
  - **Searching:**
    • Provide users with general and Specific Los after searching.
  - **Retrieving:**
    • Provide users with target LO with associated Los.
The Issues on Searching LOR

**Whole Content** will be retrieved by **its Metadata** or **Keyword Vector**

1. **Desired Specific Data** within content has to be found **by Self**.
2. **Delivering a whole content** leads to **higher latency** than its **included objects**, especially in **Wireless Network**.
3. **Related Learning Objects** within **different contents** can’t be indicated.
SCORM Content Packaging Scope as a structured document
The Idea for Managing SCORM LOR

Keep similar LOs
1. Group Similar LOs by their Keyword Vectors (KVs) (TF-IDF)

Keep the KVs about included LOs
2. KV of LO in Upper Level is refined by the Center (CC) of its associated groups
3. Repeatedly Group similar LOs and Refine KV of their upper LOs level by level.

Keep inter-relation about included LOs
4. Create Relation Link from group in upper level to related groups on lower level.

Keyword Vector (KV_0)

KV_1 += avg(Σ CC_2)

Keep similar LOs
Keep the KVs about included LOs
Keep inter-relation about included LOs
Level-wise Content Clustering Graph

1. Get Desired LOs with General & Specific Information

2. Related LOs in other contents

3. Fast Delivery Speed

Level wise Content Clustering Graph (LCCG)

Query Keywords

1. Representative KV

2. Related Clusters Link

3. Related LO Link
Level-wise Content Management Scheme (LCMS)
Management Scheme of SCORM Learning Object Repository-2

Keyword Search

SCORM Metadata

Search Result

Similarity Grade

Content Structure

Learning Content
Adaptive Content Delivery Mechanism

• **Goal:**
  – Deliver content to users according to 1. **User Requirement**, 2. **Hardware Capability**, and 3. **Bandwidth Status**.

• **Approach:**
  – Apply clustering approach and decision tree to manage a large number of users’ requests.
  – Proposed decision scheme to decide which content is suitable enough to be delivered.
Results of Content Adaptation

**Bandwidth (B) = 150 KB**

- **Text**
- **Icon**
- **Image**
- **Bar**

**HP** = <1, 400, 128, 480, 640, 16, 16, 44, S, WL>

**Bandwidth (B) = 60 KB**

- **Audio & Background Picture Links**
- **Icon Picture Links**

**UP** = <3, 1/7, DQC, JGBP, CSB, 1, 0, 0, 1, 1>

**Bandwidth (B) = 60 KB**

- **4 bits of Color Depth**

**HP** = <1, 400, 128, 160, 640, 4, 16, 44, S, WL>
Object Oriented Learning Activity System (OOLA)

• Issue:
  – It is difficult to build a adaptive learning system for Teachers.

• Goal:
  – How to provide teachers with a system to efficiently design their desired learning activity.

• Approach:
  – A object Oriented Based Instruction Design Model.
  – A Visualized Authoring Tool.
Object Oriented Learning Activity (OOLA) Model

• Object Oriented Learning Activity (OOLA) Model:
  – efficiently represents an Adaptive Learning Activity:
    • can provide learners with Content, Interaction, and Assessment.
OOLA Demo
Support Complex Learning Activity
Concept Map Construction

• Concept Map:
  – denote the **pre/post-requisite relationships** among learning concepts of a course.

• Adaptive Learning/Testing Systems:
  – offer learners customized courses according to their aptitudes and learning results.
  – use a **predefined Concept Map** to find proper learning paths for learners.

• Issues:
  – It is **difficult** and **time consuming** to create the concept map of a course for experienced teachers.
  – How to **automatically create a correct concept map** of a course.
The Idea of Constructing the Concept Map

- Apply **data mining technique** to analyze the relationship between test results and concepts of course for creating **concept map** which offers teachers to evaluate their teaching strategies.

<table>
<thead>
<tr>
<th>Test Item</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q₁</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Q₂</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Q₃</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Q₄</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Q₅</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

The table records the learning concepts contained in each test item.

**find the fuzzy association rules** of test items according to discrimination

**Phase 1:**
Grade Association Rule Mining Process

**Phase 2:**
Concept Map Constructing Process

**Concept Map**

**Mined Association Rules**
- **L-L Rule Type**
- **L-H Rule Type**
- **H-L Rule Type**
- **H-H Rule Type**

**Discussion**

**Educational Experts**

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System Demo-1
System Demo-2
(a), (b), and (c) with Discrimination 0.0, 0.3, and 0.5.
(Support=50, Confidence=0.85)
END
THANKS