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SceDer and COML : Toolsets for Learning Design and Facilitation in One-to-One Technology Classroom

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Abstract: In a one-to-one collaborative learning classroom supported by ubiquitous computing and a distributed system runtime environment, teachers require tools that allow them to design learning scenarios, and to manage and monitor the activities happening in the classroom. We propose an architecture for a classroom management system and a scenarios designer tool (SceDer), both based on a Classroom Orchestration Modelling Language (COML), to support these requirements. We have developed and tested this with the GroupScribbles software based on a set of learning scenarios for classrooms equipped with pen tablet computers.

Keywords: Collaborative and group learning; learning systems platforms and architectures; learning design; wireless and mobile technologies

1. INTRODUCTION

The emergence of one-to-one technology (one computer device or more per student) has the potential to enhance learning in the classroom [1]. A literature survey reveals two main areas of interest. The first is a pedagogical approach, with a focus on the study of possible patterns of face-to-face classroom activity. The aim is to capture and describe common learning situations, particularly for collaborative learning [2] [3] [4]. The second is focused on the technology and is concerned with creating innovative software and hardware tools that can enhance specific learning scenarios [5] [6] [7]. A key problem with this research is how to balance the pedagogical and computational approaches, so that technologies for classroom interaction can support effective collaboration in real classrooms [8]. On the one hand, teachers should be easily able to design and manage collaborative learning supported by ubiquitous computing (such as a combination of tablet PCs, desktop PCs and electronic whiteboards). On the other hand, the computational system, including hardware and software technologies should be able to support a range of effective learning scenarios. This

paper describes a scenarios designer tool (SceDer) and a Classroom Orchestration Modelling Language (COML), both developed and implemented by the lead author, to provide a single platform that brings together the pedagogical and technological aims we have highlighted.

2. PROPOSED DESIGN AND ARCHITECTURE

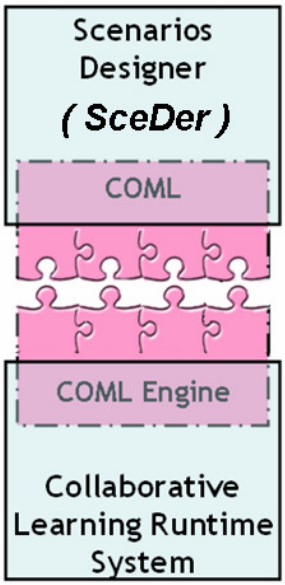

Figure 1: Systems architecture

As seen in **Figure 1**, the architecture of the system has been divided into two major parts, the Scenarios Designer (SceDer) and collaborative runtime system. These are integrated by the use of a common COML definition of the learning scenario, as supported by the COML constructor on the scenarios designer side and a COML execution engine on the runtime system side.

The Scenarios Designer has been developed through the study of pre-existing scenarios for effective interactive learning in the classroom [3]. These scenarios were analysed to capture collaborative patterns and common components such as actors, learning activities, pre-prepared and in-class learning electronic artefacts, which were then defined as elements of the formal notation. A sequence of prototyping has produced a software system that supports notations for interactive learning design, including actors and learning artefacts.

These components can then be combined into activity diagrams that cover the original scenarios. The real value of these learning diagrams is that they can be exported as a COML package, which comprises the COML document and learning artefacts, in the form of electronic files. COML will be then executed by COML Engine embedded in the computer supported collaborative learning run-time system. COML is based on a generic XML description and has similar design aims to CML [9], that is to formalize collaboration and workflow patterns in a one-to-one technology classroom (although CML is currently only a conceptual design rather than an actual technology). The COML engine manages the interaction of a teacher and learners with ubiquitous computing in a classroom guided by the COML scenario definition.

3. LEARNING SCENARIO AND SCENARIOS DESIGNER TOOL

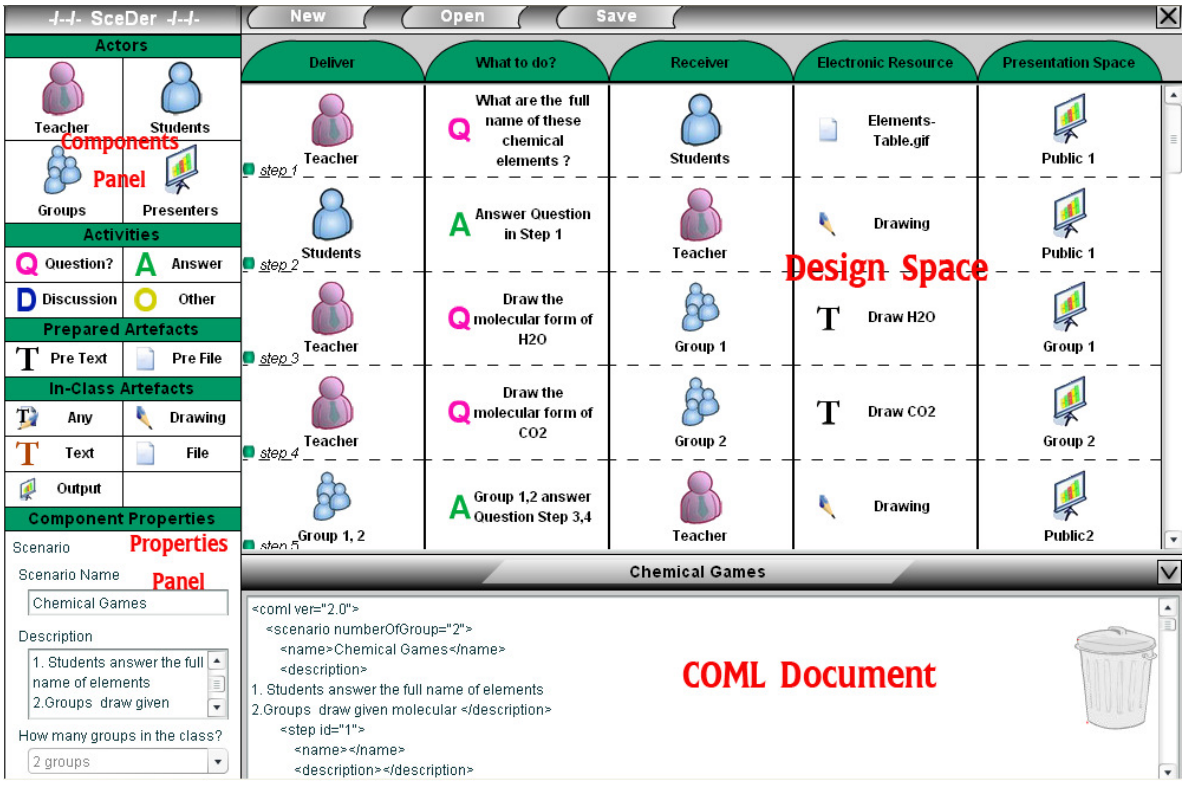

Figure 2 : Screen shot of SceDer

SceDer has four main parts: a components panel, a components properties, a working space and a COML document preview window which is resizable. In the components panel, common components captured from the scenario analysis process are listed, which are

divided into three sets: actors, activities and learning artefacts. Actors have four different roles: teacher, students, groups and presenters (the computational actors that present the learning artefacts on spaces such as a display screen). The activities have four components: question, answer, discussion, other (user defined). The learning artefacts comprise four types of electronic resource: text, file, drawing and any, where all of these are data to be displayed on particular presentation spaces such as a computer screen.

To create a learning scenario, a teacher drags items from the components bar and drops them onto the appropriate blocks in five 'swim lanes': deliverer, what to do?, receiver, electronic resource, and presentation space. Once any component is placed in the working area, the COML interpreter engine, which is running in the background of the SceDer, will convert the diagram into the COML document corresponding to the designed diagram.

As an example in **Figure 2**, we show two main learning scenarios running in order: brainstorming, followed by groups work. The brainstorming scenario begins with a teacher showing the picture of an abbreviated name of some chemical elements to all students and then asking students as a whole class for the full name of each element. In the next scenario, the students are formed into two groups and the teacher gives each group a chemical formula shown on their tablet computers. The teacher then asks them to draw the correct molecular relation corresponding to the given question. The results drawn by the groups are then shown on the classroom display.

Therefore, the meaning of the scenario design pictured in **Figure 2** from the first to the fifth rows can be interpreted as the following

- 1st row: a *teacher asks students verbally* "What are the full names of these chemical elements?" and the system shows an *electronic resource* (Elements-Table.gif) which is a chemical element table to *all students in the class* on the public *presentation space* named 'Public 1';

- 2nd row: *all students answer* the *teacher* by *drawing* on their personal computing devices and the all answers are then shown on the *public presentation space* 'Public 1';

- 3rd row: the *teacher* splits the students into two groups and *verbally asks* the 'Group 1' to draw the molecular form of H_2O. The *electronic resource* 'Draw H_2O' which

was created using the text tool is also displayed on the *presentation space* of 'Group 1' (an environment for the group to work collaboratively);

- 4th the *teacher verbally asks* the 'Group 2' to draw a molecular form of CO_2. The *electronic resource* 'Draw CO_2' is also displayed on the *presentation space* of 'Group 2';

- 5th *Groups 1 & 2* respond to the *teacher* using the electronic resource *drawing tool* and all answers are displayed on the public *presentation space* named 'Public 2'.

The design tool for SceDer is intended to support classroom teachers (not expert designers) with a design toolset of predefined learning activities in graphical format shown in a comprehensible way. Expert designers are also able to create more complex learning scenarios out of individual learning activities. In relation to similar software, Collage [10] is a collaborative learning design editor but it is based on pre-set learning patterns (Jigsaw, Brainstoming, etc.) and does not support re-use at the granularity level of activities. The LAMS activity-based designer [11] steps through tasks on web-based tools provided by LAMS itself (for example, an activity may start in a chatroom then move to a vote and from vote to questions and answers). SceDer can also identify the actor(s) who will be in charge of creating or completing of each particular task and can specify the complete sequence and direction of flow of the tasks from one actor to another, at every granularity level (e.g. the task A flows from a teacher to all students, or from group A to group B).

4. COML, COML ENGINE AND RUNTIME SYSTEM

COML has a similar basic learning design model to EML [2], that is '*Role* performs *Activities* within an *Environment*', but the main idea underlying COML is derived from trends in the field of collaborative learning supported by one-to-one technology and distributed system runtime environments. Therefore COML has its own language structure and specification to be able to define a smaller unit of interaction than EML,

As our test bed for this research we are using an existing distributed system for collaborative learning called GroupScribbles (GS) [12] as the runtime system. In order to make GS understand and work in coordination with COML, a COML engine has been implemented into GroupScribbles which works as an interpreter and interface between COML and GS. The COML engine is able to call all GS functions to prepare and deliver the designed lesson for the class.

```
<coml ver="2.0">
  <scenario numberOfGroup="2">
    <name>Chemical Games</name>
    <description>
          1. Students answer the full name of elements
          2.Groups  draw given molecular </description>
    <step id="1">
      <name></name>
      <description></description>
      <deliver type="teacher">
      </deliver>
      <activity type="question">
        <name>What are the  full name of these chemical elements ?</name>
        <description></description>
      </activity>
      <receiver type="student">
      </receiver>
      <resource type="preparedFile">
        <data isFile="true" resourceName="Elements-Table.gif" />
      </resource>
      <space type="presenter">
        <name>Public 1</name>
        <target isPublic="true" />
        <data groupNumber="" />
      </space>
    </step>
```

Figure 3: Sample of COML document for the 1st step of Brainstorming scenario

Figure 4: The screens of a teacher and 2 student screens in GroupScribbles embedded with COML Engine and Toolbar

In the example scenario, the teacher displays a table of chemical elements and verbally asks students "What are the full names of these chemical elements?" This step uses a COML document which is generated by SceDer as shown in **Figure 3**. The COML document is parsed and interpreted by the COML engine, to loads the prepared picture onto the GS public space.

In **Figure 4**, a learning scenario is approaching the 2nd step in which all students have to answer the question to the teacher. The COML Engine, guided by COML document, performs the following tasks:

- loads a prepared file (Elements-Table.gif) to the board 'Public 1';
- shows the status and relevant information for the 2nd step to inform the teacher which step is running;
- prepares the environment to be ready to answer by switching all students' boards to 'Public 1';
- monitors the answers of each student and display this information on the monitoring bar (green dot refers to a particular student or group has already answered).

We can regard the COML engine as an actor that prepares and delivers the technical learning environment, and monitors, controls and gives relevant information to the teacher and students so that they know when to transition to subsequent stages of the learning scenario.

5. CONCLUSIONS

The goals of proposed design and system are to:

- allow teachers (both expert and non-expert designer) design or prepare the lessons beforehand;
- enable monitoring, tracking of learning activities/sequences and transition changing;
- potentially make the designed scenarios exchangeable in a collaborative learning object format, so that teachers can share lesson elements.

The system has been implemented, as shown in the Figures, and run on desktop, tablet, and handheld computers and it has also been test in simulated environment corresponding to a set of selected scenarios. SceDer is able to design various kind of class and groups interaction to construct the learning scenarios. The final output of SceDer is exported into a COML package which consists of a COML document and learning resource files. The control and monitor toolbar embedded in GS work synchronously with COML to perform the interaction of actors on each certain step through out the complete scenarios.

We are currently setting up another two stages of evaluation based on the actual 1:1 classroom in a university and in a school to explore more in heuristic and usability problems

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