Dynamic Groups for Digital Content for Collaborative Learning

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Abstract

This paper presents a module for dynamic grouping designed to be used as part of digital educational lessons. Dynamic groups can be generated ad hoc, depending on the educational settings and the designed lessons. The students are dynamically grouped via several algorithms and a number of parameters preconfigured by teachers. This kind of an approach is used to make digital contents of any kind collaborative, as long as it confirms to the basic specification of the system interfaces. It is a means of achieving collaboration-based classroom experiences, which tend to be more dynamic and engaging for the students. The paper presents the existing SCOLLAm platform and the dynamic grouping mechanisms used within.

1. Introduction

SCOLLAm project (“Opening up education through Seamless and COLLAborative Mobile learning on tablet computers”) is one of the first scientific research projects closely related to mobile learning that is implemented in Croatian schools. SCOLLAm is building up on the experience of team members and in similar projects from Sweden, USA, and especially the Seamless learning project conducted by the National Institute of Education in Singapore [1]. The main goals of the project are: proposal and design of a technologically innovative, scalable and durable mobile learning platform, cooperation with teachers in order to ensure an adequate teacher development and their competences in the ICT and mobile technologies fields, and creation of digital content tailored for usage in the first years of primary school.

There are two main parts of the system designed as part of the SCOLLAm project: a mobile learning platform named SCOLLAm [in]Form, and a designer and player of digital lessons – SCOLLAm Author. The core central system components include collaborative learning, augmented reality, analytics and adaptivity modules.

In this paper the special attention will be given to the collaboration components of the system which include static grouping and dynamic grouping of students to be engaged in a diverse set of collaborative educational activities. The paper will attempt to answer these two research questions:

1. What are the mechanisms to be used in synchronous in-class collaboration around digital content and
2. How can ad hoc group formation for in-class collaboration be supported by the system

The rest of this paper is organized as follows: in section 2 the theory behind dynamic grouping in collaborative learning is presented. The mechanisms for authoring digital collaboration content in the SCOLLAm platform is presented in section 3. Usage of collaboration and dynamic grouping in digital lessons is laid out in sections 4 and 5. Finally, Section 6 concludes the paper.

2. Dynamic group formation in collaborative learning

There are several reasons for adapting content to learners such as different level of prior knowledge and skills among individuals, sociocultural and demographic differences, different abilities or disabilities and student's affective state such as frustration, motivation, confidence etc. [2]. Adaptive instruction [3], [4] can be designed using one or more approaches based on macro and micro level [4]. The papers reporting on the use of adaptive mechanisms in collaborative and cooperative activities are:

1. An educational reality-based virtual environment called EVE [5] which supports cooperation among members through avatars. Based on communication techniques of knowledge and skills, typically used in intelligent tutoring systems, the EVE system is able to adapt the level of the knowledge representation to the children.
2) An intelligent argumentation assessment system based on machine learning techniques for computer supported cooperative learning [6] uses feedback rule construction mechanism to issue feedback messages to the learners in case it detects unwanted learning behaviour of a single user. As a result the student is provided a hint or suggestion. This system is also able to determine the argumentation skill level based on a student’s argument.

3) A constructivist computational platform [7] constructed out of a student model, a domain model and an interactive model. They are all used for content adaptation based on user knowledge.

3. Authoring digital collaboration content in the SCOLLAm platform

3.1. The SCOLLAm Author system

The SCOLLAm Author system is a web application for designing and reproducing interactive lessons. Each lesson is a package that may contain multimedia elements such as text, image, shapes, widgets and others. There is also an option of defining interactive rules that trigger an action based on some interaction. Some examples of user defined triggers can be object move, object touch, object drag and drop that can make some other object change position, style or size. Using these simple concepts, a variety of interactive lessons can be created which would allow for easier usability (Figure 1).

![Figure 1: Author learning system - editor component](image)

Every widget can be turned into a collaborative widget by feeding it with the adequate parameters. Whenever a widget is used as part of lesson, the parameters will be utilized and the widget will be specialized for the current use. There is a variety of possible parameters to be set (please refer to the right side of Figure 1), but only some of them are tied to the collaborative functions (Figure 3).

![Figure 2: A third-party interactive learning module after it is imported into the Author system – the preview mode](image)

![Figure 3. Widget parameters (generic ones in to upper part; collaboration-specific in the bottom in red box)](image)

The parameters in the bottom part of the parameters panel (Figure 3) specify how groups can be created and/or associated with a specific widget. If selected, the Group field fixes collaboration group for the specific widget.
operation. Areas specify content areas to which widget should relate when adapting to users’ prior knowledge, while the Main area is used to solely classify the widget topic content. Grouping algorithm is used if ad hoc grouping is to be used (in that case Group will not be used for fixed grouping), where the Gr. size parameter determines how big the subgroup created by the algorithm will be. Determined by the lesson designer, groups are used only if the collaboration parameters of a specific widget are set on a widget instance within a lesson. This is not mandatory and lesson designers (i.e. teachers) can set them only if they are designing a collaborative lesson. Once a widget instance is launched by students/users ad hoc groups will be momentarily generated and the system will continue its operation in the collaboration mode.

4. Designing digital collaborative lessons with dynamic grouping

In the SCOLLAm Author system, the design of a digital lesson includes deciding on the main building parts of the lesson, so called slides. Slides are visual components shown to as one scene on a computer/tablet/smartphone screen. Students choose to advance to the next or previous slide depending on the learning trajectory chosen or on the lesson design employed by the teacher (Figure 4).

Widgets, on the other hand, are reusable components that exist in a variety of instances across the slides of one or more lessons. The context is of great importance when it comes to widgets as they get adapted or adjusted according to different use scenarios. For example, in once context, a widget can leverage one set of ad hoc groups (i.e. pairs), while in the other context it can operate in completely different ad hoc group context (i.e. triads) (Figure 5).

5. Using dynamic groups in a mathematics lesson

In order to trial out the system a simple trial run in one class was designed in June 2016. It was P1 class of 19 students and the task was to work in groups to solve a sequence of simple mathematical tasks in the content area of addition (e.g. 10 + 5 = ?). The digital lesson parameters were:

- Math widget was used
- Ad hoc grouping was used
- Random grouping algorithm was employed
- Ad hoc groups were of size 2 (pairs)
- The widget was designed to support the roles of recorder and checker

The system was trialed in an existing classroom as part of the Mathematics lesson (Figure 6).

6. Conclusion and references

This paper presented the SCOLLAm projects and the tools developed as part of the project: SCOLLAm [in]Form and SCOLLAm Author. The tools can be used to support a variety of learning scenarios relying on digital lessons. Lesson designers can distribute the learning contents to students who then consume it on their tablets or smartphones, independent of the operating system (platforms) of their devices. This paper tackled the use of collaborative learning in such a complex system where users can be grouped in fixed groups or take part in more emergent ad hoc collaborative activities. Since the digital content is organized around slides composed of widgets, lesson designers can leverage the context of use to parametrize collaborative learning experiences.

A trial run had been completed to demonstrate the use of the system whereby the following issues and challenges were identified:

- Synchronous collaborative learning scenarios require more advance synchronization mechanisms since users tend to drop out and return back to the lesson in a group work more...
• Teachers need more overview and tools to maintain the structure of the lesson
• Adaptivity is of great importance to maintain the attention of both underachievers and overachievers.

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8. References