Συνέδρια της Ελληνικής Επιστημονικής Ένωσης Τεχνολογιών Πληροφορίας & Επικοινωνιών στην Εκπαίδευση

7ο Πανελλήνιο Συνέδριο ΕΤΠΕ «Οι ΤΠΕ στην Εκπαίδευση»

ΕΤΠΕ

ΕΛΛΗΝΙΚΗ ΕΠΙΣΤΗΜΟΝΙΚΗ ΕΝΩΣΗ
ΤΕΧΝΟΛΟΓΙΩΝ ΠΛΗΡΟΦΟΡΙΑΣ
& ΕΠΙΚΟΙΝΩΝΙΩΝ ΣΤΗΝ ΕΚΠΑΙΔΕΥΣΗ

7ο Πανελλήνιο Συνέδριο ΕΤΠΕ
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Κόρινθος

23 - 26 Σεπτεμβίου 2010

ISSN : 2529-0916
ISBN : 978-960-88359-5-5

Supporting teachers in orchestrating CSCL classrooms

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Βιβλιογραφική αναφορά:

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Abstract

Teachers face numerous problems in orchestrating technology-enhanced classrooms, especially when dealing with complex pedagogies such as collaborative learning. Designing and putting in practice computer-supported collaborative learning (CSCL) lesson plans requires an extensive knowledge both in pedagogy and technology, which needs to match teachers' beliefs and goals. This paper and keynote talk addresses teacher practices as well as the support that may be provided in order to achieve the goals of effective and sustainable creation and use of CSCL lesson plans or scripts. Some illustrating examples are drawn from the GSIC/EMIC research work in the past decade, as well as other initiatives in the quest for appropriate mediating artefacts that may support the complex life cycle of CSCL scripts.

Keywords: learning design, scripts, lesson plans, CSCL, support, mediating artefact, teachers

Introduction

A pedagogically effective and sustainable use of Information and Communications Technologies (ICT) in education is far from being a reality, in spite of the huge advances in ICT, the investments and political plans, and especially all promising research results in the field. One of the reasons for such a delay can be found in the lack of understanding on how teachers orchestrate their classrooms, taking into account their complex ecosystem. Teachers have to deal with context factors, such as time pressure and insufficient infrastructure or deficiencies in knowledge about technology affordances and in skills for ICT management. The introduction of ICT in classrooms, with face-to-face, blended or remote interactions, has added several degrees of complexity, since the new technology affordances allow for new teaching/learning opportunities. These problems are getting even worse when innovative pedagogies are sought, such as those of collaborative, inquiry or project-based learning. Knowledge, Goals and Beliefs (KGB) of the teachers have to match the new technological affordances (Chen et al., 2009), together with an efficient classroom management at several social levels in order to increase the chances of pedagogical effectiveness. Thus, teachers need to accomplish a very difficult task, i.e. to orchestrate their technology-enhanced classrooms dealing with ICT and non-ICT artefacts and tools, and social interactions at various levels (Dillenbourg et al., 2009).

The case of computer-supported collaborative learning (CSCL) has attracted a lot of attention in the last two decades with promising results at a research level. However, the production of effective learning interactions is not guaranteed in a "free" and unconstrained environment. Scaffolding of learners in such an environment, either by the teachers themselves and/or the technological system has been found to be especially helpful, while scripting has been used as an alternative term to express structuring of groups, timing, tasks or resources. Independently of the term employed, scripting or scaffolding, there is a wide

consensus that there is a need for additional planning for CSCL based on good practices and existing knowledge in order to increase the chances of effective teaching/learning processes. However, there is a need to solve several important tensions and achieve in practice a balance between a flexible and creative constructivist class and one guided by effective knowledge stemming from instructional design-oriented practices (Dillenbourg, 2002).

Orchestration of CSCL classrooms requires a careful production of lesson plans, scripts or scaffolds that need to be enacted and managed in concrete context conditions. However, as mentioned above, there exist several challenges for an effective and sustainable support of the complete life cycle of such an orchestration. There is a need to understand better existing practices probably through ethnographical studies, analyze the alternative mediating artefacts that may support a more effective and efficient life cycle, and eventually construct and evaluate the most appropriate artefacts.

This paper, as a support to the associated keynote talk, addresses some of the aforementioned challenges related to the effective and sustainable support of orchestration in CSCL classrooms. It aims to provide a better understanding of such a problem, in both theoretical and practical terms, together with some proposals that have been analyzed in the last decade in the frame of the GSIC/EMIC group and the broader research and practice community.

The following section deals with the concepts of orchestration, learning design and the life cycle of CSCL scripts. Later, some specific proposals are studied in light of experiences and cases studies. Special focus is put on the use of learning and assessment patterns in higher education at the University of Valladolid, Spain, as well as design and enactment routines in a primary school at Cigales, Spain. A broader literature review and similar research efforts are presented and discussed in the following section. The life cycle of CSCL scripts in blended environments is discussed with a special focus on the sustainability issues, which may be dealt through the Glue! architecture proposed by the GSIC-EMIC group. Conclusions and open research issues are also presented and discussed in the final section.

Mediating artefacts in CSCL scripting

A CSCL classroom may involve various elements that have to be taken into account in its management: ICT (e.g. a generic concept map tool, an interactive digital blackboards or a learning management system) or non-ICT (e.g. post-its or traditional blackboards) tools; face-to-face, distance or blended interactions at home, classes or museums through different media; work in small groups, at a whole-class classroom and community level, or individually. Orchestration of all these elements has been acknowledged as one of the major research challenges in the technology-enhanced learning (TEL) field by the *Stellar* network of excellence (Stellar, 2010). The effective "coordination of supportive interventions across multiple learning activities occurring at multiple social levels" (Dillenbourg et al., 2009) by teachers is especially complex, given the great number of elements to be controlled and the associated trade-offs.

Scaffolding of learners may be based on micro or macro-scripts that regulate the processes, through the sequencing and distribution of roles and activities (Weinberger et al., 2009). However, such regulation should be sufficiently flexible and adaptable, fading in time as learners internalize the external scripts. Additionally, such guidance should not be excessively prescriptive and reflect existing research knowledge that could be understood by the educational practitioners. From a technical point of view, these scripts might be partially or completely formalized using an appropriate educational modelling language,

such as IMS-LD (IMS, 2003), so that they can be interpreted by computational systems. In this case, teachers should be able to find the balance between socially and technologically mediated coordination, so that emergent situations could be adequately handled.

In any case, independently of the use of terms and metaphors, such as scaffolds, scripts, or orchestration, expert instructional designers or educational practitioners need to produce learning designs or lesson plans for their CSCL classes. At the same time, they have to choose adequate tools, think of the specific conditions of their classes and instantiate their designs while being able to reuse their generic designs. Finally, practitioners have to enact their instantiated designs, being able to monitor and regulate the evolution of the interactions. There is no consensus in the literature on the model and stakeholders of the life cycle of orchestration or scripting, but it is generally accepted that it is complex, non-linear and iterative.

Although there are several educational, technological and research trends, one framework for the analysis of the aforementioned issues is the Cultural Historical Activity Theory (CHAT). The associated concept of "mediating artefact", i.e. instruments, signs, language, and machines has been analyzed especially in the task of learning design (Conole, 2008). Thus, our research objective is to understand the processes and the mediating artefacts that are currently employed, using ethnographical methods, formalize them, and eventually construct mediating tools that might better support the life cycle of orchestrating CSCL classes. Conole (2008) identifies several mediating artefacts that correspond to models, vocabularies, patterns, iconic representations or case studies. Such artefacts support the decisions made by the practitioners, either isolated or aggregated to other artefacts, thus forming meta-mediating artefacts. Examples of meta-mediating artefacts include repositories of patterns, toolkits, pedagogical planners, or scaffolds in the form of hints, advisors, etc. Isolated or aggregated artefacts are typically implemented in software tools that are especially adequate for a technology-enhanced class.

In the following section, we focus on one type of artefacts, i.e. pedagogical patterns (Goodyear, 2005) as a means to support the design and enactment phases of the life cycle.

A pattern-oriented approach to CSCL scripting

Pedagogical patterns form a special category of design patterns, and as such they capture and communicate good practices in learning and teaching processes (Dimitriadis et al, 2009a). Design patterns have been used broadly in several fields, starting with the pioneer work of Alexander in architecture and going through Human Computer Interaction to the Gamma design patterns in software engineering. They capture reusable knowledge about a contextualized problem and its associated, broadly accepted, solution. Although patterns may be used individually, typically they are grouped in networks of interconnected patterns, thus forming pattern languages that provide solutions to broader problems.

Pedagogical patterns are especially relevant to our research objective, since the ultimate actors in CSCL class orchestration are educational practitioners, who might be more familiar with the practice-oriented knowledge represented in pedagogical patterns. According to (Retalis et al., 2006) pedagogical design patterns could be elicited in a life cycle that merges bottom-up and top-down approaches. On the one hand, case studies in authentic contexts or other more controlled experiences capture practices, while literature and theory-driven work looks for evidence and wider support of these patterns and the associated pattern languages.

In our case, a CSCL scripting pattern language was proposed in (Hernández-Leo et al., 2010) that focuses on Collaborative Learning Flow Patterns (CLFP), i.e. flows of activities,

such as jigsaw, pyramid, or think-pair-share. This type of patterns, whose visual representation is shown in Figure 1, has been shown to be effective in several contexts, as e.g. in repurposing existing Open Educational Resources for collaborative learning (Dimitriadis et al., 2009b). Later, such a pattern language evolved in an assessment-aware scripting language that includes assessment patterns (Villasclaras-Fernández, 2010). The following subsection discusses the use of the learning and assessment pedagogical patterns and the associated software tools in the context of higher education.
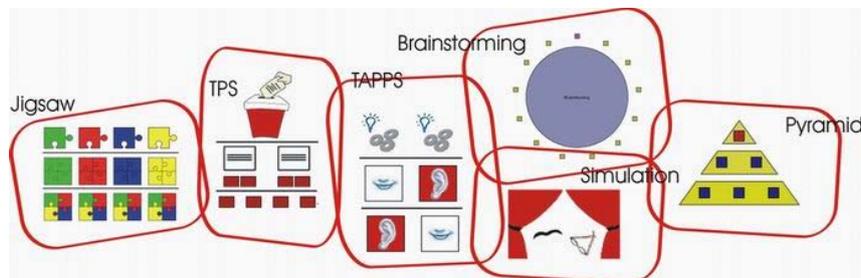

Figure 1. Visual representations of Collaborative Learning Flow Patterns

On the other hand, similar research has been conducted in a primary school environment with respect to design and enactment patterns. A brief report of the associated research is presented in the second subsection.

Learning and assessment patterns in higher education

Use of ICT in higher education is typically associated with blended (or distance) learning settings in which courses are delivered using Learning Management Systems (LMS). While collaborative activities are especially appropriate for problem or project-based learning, university professors are reluctant and several times unaware of collaborative techniques, such as the ones described in CLFP. On the other hand, technology mediated coordination in CSCL scripting could be especially appropriate for the production and delivery of such courses. However, existing Educational Modelling Languages (EML), and especially IMS-LD, are rather far away from a practitioner's mindset, and therefore they should be "hidden" to final users. Thus, is seems reasonable to think of employing CLFP and other elements of the CSCL scripting language as mediating artefacts for design and enactment of collaborative learning activities in higher education.

The first generation of tools created in the context of the GSIC/EMIC group included *Collage* (Hernández-Leo et al., 2006) for the support of the authoring phase and *InstanceCollage* (Villasclaras-Fernández et al., 2009) for the instantiation phase, while scripts could be deployed either in LMS with an IMS-LD player or in a service-oriented environment, such as *Gridcole* (Bote-Lorenzo et al., 2008). Thus, the complete life cycle of CSCL scripting and orchestration can be supported by this set of tools, or meta-mediating artefacts.

Figure 2 illustrates part of the pattern-based design process supported by *Collage* for a CSCL script used in the context of a real course in University of Valladolid (Hernández-Leo et al., 2010). In this case, the teacher is using the jigsaw CLFP so that students may work on different parts of a complex technical document. Such pattern is adequate since the aforementioned document is divisible and the teacher wants to promote positive

interdependence together with individual accountability. Thus, students need to work individually and then join the expert groups for each part of the document, while in the last phase super groups are formed in order to deal with the complete document. However, the teacher does not want to have expert groups with many students that are not effective in tasks of joint production. Thus, she selects the pyramid CLFP in order to implement the expert phase of the jigsaw CLFP, hoping that it will promote the quest for consensus among students. The *Collage* tool supports this process of selecting patterns, combining and configuring them, assigning adequate services (tools) for the activities, and finally producing a reusable IMS-LD compliant file. Such support is implemented through advices and empty building blocks, with a strong emphasis in visual representations. Finally, the *InstanceCollage* tool is employed in order to instantiate this script for a specific context, taking into account all intrinsic features of the patterns, while *Gridcole* or an LMS such as .LRN and the associated IMS-LD player are employed for the enactment of the CSCL script.
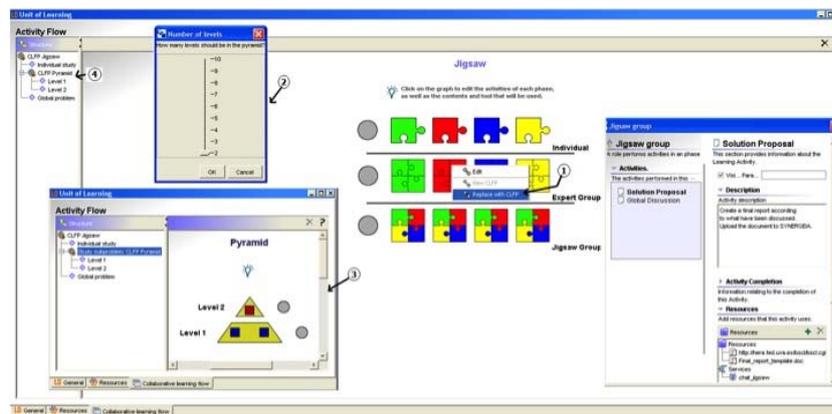

Figure 2. Authoring a CSCL script based on the Jigsaw and Pyramid CLFP in *Collage*

From the above short presentation of the illustrating example, it can be seen that this set of ICT tools may be effective and efficient as mediating artefacts for orchestration of CSCL classes. Indeed, the process has been evaluated through a multi-case study that covers seven experiences that took place in the period 2005 to 2007 (Hernández-Leo et al., 2010). The first set of workshops with professors at several Spanish universities showed that practitioners were able to create CSCL scripts for their own context. On the other hand, a workshop held in an international conference allowed to show that the tools were able to implement a scenario proposed by a third-party, while several case studies in courses showed that the whole process could be carried out in real settings.

However, several elements were missing from the above process and the associated toolset, and especially in relation to adaptation and flexibility, or the effective use of monitoring and regulation. The second generation of tools focused on the inclusion of assessment plans in the scripts. It is widely accepted that assessment is an integral part of any teaching/learning process and there is a significant body of knowledge related to production and use of assessment. We were especially interested in understanding and supporting the alignment between learning and assessment flows in scripts. In collaborative learning settings it is expected that formative assessment may be used employing assessment evidence produced in various activities. The use of appropriate assessment

techniques could provide input for the adoption of further actions in other learning and support activities.

As mentioned above, the pattern-based approach was used again in order to formulate a set of assessment patterns and produce an expanded assessment-aware CSCL scripting language. On the other hand, a new information model has been proposed together with a design process that aligns learning and assessment patterns. This proposal has been implemented in the new *WebCollage* tool and has been evaluated through four workshops with university professors, two complete case studies in real settings, as well as a controlled evaluation experience with practitioners and experts in the period 2007 to 2010 (Villasclaras-Fernández, 2010).

Figure 3 illustrates the interweaved learning and assessment flows for a concrete script implemented through *WebCollage*. The results (reports) of the first phase of the jigsaw CLFP are used as a source for the assessment pattern REPORT REVIEW (top-right icon) while the expert phase is employed as a source for the pattern OBSERVATIONS OF COLLABORATIVE WORK (bottom-right icon). *WebCollage* supports visualization of the complete set of patterns and the associated documentation, configuration of the templates for each pattern, and especially provides advices on the set of actions for an effective use of the patterns, the information model and the design process (see e.g. the advice provided through an exclamation mark for a missing element in the first phase of jigsaw).
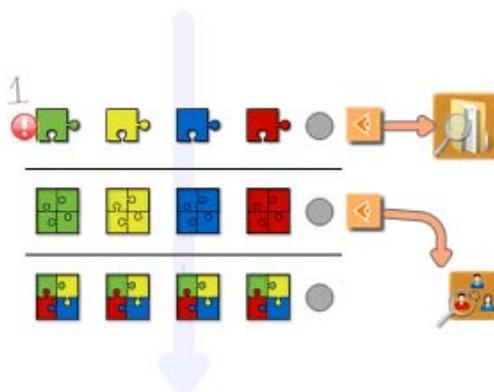

Figure 3. Defining learning and assessment flows in Web *Collage*

The evaluation process confirmed that the process is especially complex, when learning and assessment are considered together in collaborative settings. Practitioners and experts acknowledged the usefulness and effectiveness of the support provided by *WebCollage*, although several actions were recommended with respect to user interface or even the process itself.

Design and enactment patterns in a primary education school

Another parallel thread of our research refers to primary education classrooms that are significantly different from those described in the previous subsection. We have been conducting since 2008 a long case study in the "Ana de Austria" rural school at Cigales, Spain. In this case, we have focused on the problems of orchestrating face-to-face

interactions in K6-8 classes, using typical non-ICT tools and communication media, together with wireless tablet PC connected in a local network and interactive digital boards. We were especially interested in understanding improvisation and social coordination mechanisms, through the introduction of the *GroupScribbles* collaborative learning software tool (SRI, 2006). Additionally, the qualitative case study that took place aimed at detecting routines (or patterns) that are recurrently used during the design and enactment of collaborative activities. Finally, we have been looking for an effective use of these patterns by teachers in new activities.

A significant result of this study shows that several patterns have been detected in both design and enactment phases (Prieto et al., 2010) in line with independent research results published by SRI research staff (deBarger et al., 2010). Also, results from a recent workshop with teachers have shown a clearly positive perception of the usefulness of these patterns as means to enrich new collaborative learning activities. A more extensive presentation of these results will be included in the keynote talk.

Conclusions

This paper and the associated expanded keynote deal with some issues related to orchestration of CSCL classes, and especially in supporting educational practitioners through appropriate mediating artefacts. Orchestration of technology-enhanced classes is relevant in the case of collaborative learning activities, due to the complexity of this pedagogical approach and the excessive number of aspects and trade-offs that have to be controlled by the teachers.

Patterns have been analyzed as a particularly promising set of mediating artefacts, for the support of the design, instantiation and enactment phases of the orchestration life cycle. In spite of the positive results of the evaluation studies, many issues are still open. Flexibility, adaptation and improvisation need to accompany adequately these structuring, scaffolding or scripting approaches. On the other hand, other mediating artefacts, such as visual representation or social software may be analyzed and integrated (see the *CompendiumLD* and *Cloudworks* tools developed in the Open University). Also, a seamless integration of scripts, LMS and external tools has to be accomplished in order to provide a sustainable use of these solutions (see the *Glue!* Architecture proposed by the GSIC/EMIC research group, or similar initiatives at the *IMS Global Consortium*). Finally, the complexity of the orchestration process has to be handled adequately in the framework of pragmatic theoretical approaches.

Acknowledgments

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