Computers & Education 73 (2014) 9–25

Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

Supporting orchestration of CSCL scenarios in web-based Distributed Learning Environments

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ARTICLE INFO

Article history:
Received 7 September 2013
Received in revised form
16 December 2013
Accepted 17 December 2013

Keywords:
Architectures for educational technology system
Cooperative/collaborative learning
Distributed Learning Environments
Improving classroom teaching
Evaluation of CAL systems

ABSTRACT

The orchestration of technology-enhanced learning situations (especially collaborative ones), that involve both Virtual Learning Environments and Web 2.0 tools (what some authors call Distributed Learning Environments, or DLEs) is often complex and burdensome, given the heterogeneous array of resources involved. In this paper we explore how GLUE!-PS (a system for the deployment and run-time management of learning designs across DLEs) supports orchestration, through its teacher usage in three authentic university courses and one teacher workshop. Our mixed methods evaluation reveals that GLUE!-PS supports multiple aspects of orchestration, especially the efficient implementation of teacher learning designs, the ability for useful and intuitive adaptations in run-time, and its adequacy to pragmatic restrictions that teachers face in authentic settings. Aside from the implications for the evaluated system itself, this article discusses the need for evaluations that address orchestration's multiple facets, and provides a practical example of such multi-faceted evaluation of educational systems, in order to assess their potential for adoption and sustainability in authentic settings.

1. Introduction

As information and communication technologies permeate our lives and our classrooms, the preparation and management of many technology-enhanced learning (TEL) and computer-supported collaborative learning (CSCL) activities has become a non-trivial endeavour. The classroom (either physical, virtual or blended) has become a complex technological ecosystem (Luckin, 2008) where wireless networks, computers, virtual learning environments or mobile devices coexist with pen and paper or the traditional blackboard - thus making this complexity commonplace (Roschelle, Dimitriadis, & Hoppe, 2013). Many researchers in the field of TEL have been discussing the issue of this increased complexity, and the sustainability problem it may create, under the label 'orchestrating learning' (Dillenbourg, 2013; Prieto, Holenko-Dlab, Abdulwahed, Gutiérrez, & Balid, 2011).

Despite the growing interest in this notion of 'orchestration', there is a general lack of consensus about what exactly is meant by it, or what it entails. For instance, some researchers say it focuses on run-time classroom issues (Dillenbourg, 2013; Dimitriadis, Prieto, & Asensio-Pérez, 2013), while others advocate that preparation and design of the learning experience is also an integral part of it (Kollar & Fischer, 2013; Prieto, Holenko-Dlab, et al., 2011; Tchounikine, 2013). Nevertheless, current attempts at synthesizing these divergent opinions highlight the challenge of applying many of the innovations proposed by TEL research under the multiple constraints of an authentic educational setting (curriculum, discipline, time, limited resources, etc.) (Roschelle et al., 2013).

If we now look at the context of higher education, we can observe how different trends exemplify the increasing technological complexity of the classrooms: the widespread usage of Virtual Learning Environments (VLEs, e.g., Moodle[1] or Blackboard[2]), or the use of Web 2.0 tools (Conole & Alevizou, 2010). The combination of these trends hints at an evolution towards what some authors have called

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[1] http://moodle.org (Last visit: 29 Aug 2013).
[2] http://www.blackboard.com (Last visit: 29 Aug 2013).

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http://dx.doi.org/10.1016/j.compedu.2013.12.008

Distributed Learning Environments (DLEs): heterogeneous technological settings that integrate diverse learning platforms and external web tools (MacNeill & Kraan, 2010). The orchestration of learning activities (and especially CSCL ones) using such a DLE in an authentic educational setting is currently far from trivial, often involving manual operations across many different distributed web-based services (some of them outside the domain of the educational institution) (Prieto, Asensio-Pérez, et al., 2013). This complexity leads to several *orchestration challenges*, such as the difficulty to translate teachers' pedagogical ideas into a DLE that supports them, or the effort needed to modify such support in run-time. Given the distributed nature of the system, the time-efficiency of most orchestration actions can also be a factor that makes it difficult for teachers to adopt these environments in authentic practice.

This article explores whether (and to which extent) an educational software system (GLUE!-PS, see Prieto, Asensio-Pérez, et al., 2013; Prieto, Asensio-Pérez, Dimitriadis, Gómez-Sánchez, & Muñoz Cristóbal, 2011) overcomes DLEs' most prominent orchestration challenges, thus supporting the orchestration of CSCL activities that use DLEs. To that aim, we have conducted a mixed methods evaluation in university settings, composed of four studies: three authentic usage interventions in which GLUE!-PS was used within real university courses, and one teacher workshop in which 24 university teachers from different disciplines used the system to orchestrate CSCL activities across DLEs.

The structure of the article is as follows: Section 2 describes the notion of 'orchestrating learning' in CSCL, and what orchestration challenges DLEs pose to authentic teaching practice; Section 3 presents GLUE!-PS briefly, as a technological system to support teacher orchestration of blended CSCL across web-based DLEs; Section 4 describes the context, methodology and results of the studies performed to evaluate GLUE!-PS's orchestration support; finally, Section 5 discusses some of the implications and lessons learnt from this evaluation of orchestration support, with a few concluding remarks closing the article in Section 6.

2. Orchestration of CSCL in web-based Distributed Learning Environments (DLEs)

In order to better understand the complex research problem that orchestration of learning (and the design of technologies to support such orchestration) poses, the following subsection reviews the most relevant literature sources on the subject. Afterwards, we look at how this problem of orchestration applies to Distributed Learning Environments (DLEs), as one significant example of the kind of complex, heterogeneous technological settings that teachers are prone to encounter now and in the near future.

2.1. Orchestration in computer-supported collaborative learning

Although the metaphor of 'orchestration' has a long tradition in the field of education (e.g., Jurow & Creighton, 2005; Kovalainen, Kumpulainen, & Satu, 2001), the use of this word referring to the coordination of a technology-enhanced classroom has experimented a dramatic rise in the last decade. In the fields of TEL and CSCL, Dillenbourg, Järvelä, and Fischer (2009) have proposed orchestration as an important challenge in collaborative learning, defining it as "the process of productively coordinating supportive interventions across multiple learning activities occurring at multiple social levels" (p. 12). Researchers in the STELLAR European Network of Excellence confirmed this importance by recognizing orchestration as one of the major outstanding challenges in the field of TEL (Sutherland & Joubert, 2009). Indeed, "orchestrating learning" has been the central topic of a recent special section in this journal (Various authors, 2013), also appearing prominently in several keynotes, symposia and workshops held at recent international conferences in the fields of TEL and CSCL (Dillenbourg, 2009; Dillenbourg, 2012; Dimitriadis, Dillenbourg, Nussbaum, Looi, & Roschelle, 2012; Fischer et al., 2013; Nussbaum, Dillenbourg, Fischer, Looi, & Roschelle, 2011).

There is, however, a lack of clarity and consensus about how this orchestration should be defined, and which aspects it entails (or should be left out of it): Alavi, Dillenbourg, and Kaplan (2009) look at the awareness in a classroom in order to optimize its time management, while Pérez-Sanagustín, Hernández-Leo, and Blat (2009) or Niramitranon, Sharples, Greenhalgh, and Lin (2010) try to automate classroom management; Dillenbourg (2013) asserts that orchestration refers only to run-time classroom management, while Kollar and Fischer (2013) or Tchounikine (2013) consider preparation and design an essential part of it. The interested reader may refer to Roschelle et al. (2013) and other articles in the same journal issue for a recent gathering of contrasting points of view around the subject.

Recently, several attempts have been made at unifying (or, at least, summarizing) these differing views. Hämäläinen and Vähäsantanen (2011), from an educational perspective, propose three dimensions for teacher orchestration to foster collaborative learning (pedagogical bases, teachers' pre- and real-time activities, and opportunities and challenges). Roschelle et al. (2013) highlight that all these views share a concern about the "challenges of classroom use of technology, with a particular focus on supporting teachers' roles" (p. 523).

Similarly, Prieto, Holenko-Dlab, et al. (2011) gather relevant orchestration literature in TEL research, and cluster these differing views around eight aspects. They also propose that any analysis of orchestration in authentic educational settings should look at all these aspects:

- *Design*, covering all the preparation needed for the learning process, often performed by the teacher.
- *Management*, including classroom management, time management, etc.
- *Awareness*, in the sense of the perceptual processes in order to assess how the learning situation evolves.
- *Adaptation*, understood as the run-time changes to the actors' original plans, due to the situation unfolding or unexpected events.
- *Teacher and other actors*, meaning the identification of the actors directly involved in orchestration, and their respective roles in it.
- *Theory*, including beliefs, attitudes and concepts about how orchestration should be done.
- *Synergy*, that is, how the different elements in the learning situation can be aligned and used together.
- *Pragmatism*, covering the compliance to the authentic settings' multiple constraints.

Aside from these efforts trying to define what is orchestration, we can also find in the literature recommendations about how to conduct research dealing with the phenomenon of orchestration, such as those by Dillenbourg (2009): teacher-centrism (considering the role and potential impact of taking teachers into account, especially in formal educational settings), curricular relevance, multi-planism (i.e. including not only collaborative but also individual and class-wide work), attention to legacy resources, time management issues, flexibility and sustainability (in the sense of addressing all kinds of teachers, not only enthusiasts).