

Exploring teachers' perceptions on different CSCL script editing tools

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Abstract

Despite the apparent maturity of the learning design field, and the variety of tooling available to support it, adoption among the teacher community (one of its alleged main targets) is still low. There is a lack of research on teachers' perception and use of different technological learning design tools, as existing evaluations are often restricted to a single tool. In order to explore whether there are common factors hampering teacher adoption, and which tool features might appeal to different teachers, more studies involving multiple authoring tools are needed. This paper provides a first step in this direction, describing a mixed methods study performed around a professional development workshop with 18 university teachers from multiple disciplines. This workshop exposed teachers to two different authoring tools (WebCollage and EDIT2), as they learned to create computer-supported collaborative learning (CSCL) designs and implement them. The findings of our interpretive study (which included questionnaires, observations, or group discussion recordings) support the idea that there is no single tool or set of features that are globally perceived as better, although our evidence also highlights certain factors as important for participant teachers – amongst others, the integration of learning designs with the ICT platforms for enactment, as well as with other tools that they already use in their everyday practice.

Keywords: learning design, computer-supported collaborative learning, teacher perceptions, teacher adoption

1. Introduction

The planning and preparation of learning activities is a very common activity in any formal education setting, and it has been studied in depth in the fields of instructional design (Gagné & Briggs, 1974) and learning design (Koper & Tattersall, 2005; Conole, 2013). The roles and actors involved in such preparation vary from setting to setting: a large online university may have specialized roles and technical support staff while, in a smaller institution, the teacher may have to face most of the work involved. Even in research-driven scenarios (e.g., De Jong et al., 2010), teachers often play a role in adapting the provided plan to the context of their concrete classroom. Thus, it is commonly considered that teachers play a crucial role in the process of learning design (Casey et al., 2008).

Throughout the years, researchers have proposed computer-aided support to learning design (to make pedagogical decisions explicit) and computer-interpretable representations of the designs (to ease the creation of the technological environment to support learning). These proposals have varied in emphasis and audience: from specialist learning designer tools to others aimed specifically at teachers (who might not be expert in ICTs or modelling languages) as designers (Dalziel, 2003; Griffiths & Blat, 2005; Hernández-Leo et al., 2006; Laurillard et al., 2013). These researcher-driven tools are often developed in co-design efforts with a limited number of target users (e.g., teachers, see for example Laurillard et al., 2013). However, despite the variety of approaches and technical support proposed in this area (see Persico et al., 2013; Prieto et al., 2013c, for a recent sample), the adoption of learning design tools in the teacher community is still low (Berggren et al., 2005; Neumann et al., 2010; Griffiths et al., 2011; Mor & Mogilevsky, 2013).

This problem is especially apparent in pedagogical approaches such as computer-supported collaborative learning (CSCL), which studies "how people can learn together with the help of computers" (Stahl et al., 2006). The added

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social complexity of this kind of approach has prompted the proposal of specific learning design approaches such as *scripting* (the structuring of the collaboration process to make such social learning more productive, see, e.g., Fischer et al., 2007; Kobbe et al., 2007), and their own range of supporting tools (e.g., Hernández-Leo et al., 2006; Harrer et al., 2009). Not surprisingly, in the complex case of CSCL we also find the same lack of adoption of research proposals in teacher practice (Looi et al., 2011; Chan, 2011).

There is *not*, however, a clear understanding of the reasons behind this lack of adoption or about the tool features that could appeal most to the teacher community. We could interpret the lack of adoption as the natural resistance (or negotiation) to the introduction of any new technology in the local teaching culture (Demetriadis et al., 2003). However, this lack of widely-accepted understanding might also be related with the fact that most learning design studies normally consider and evaluate only one approach or tool, thus making it difficult to accumulate knowledge in this regard (Doboz, 2013).

There exist compilations of different technological approaches and tools for educational design (Botturi & Stubbs, 2008), as well as several comparative analyses of different learning design technologies (Vignollet et al., 2008; Prieto et al., 2013c). However, all these studies take on a specialist/researcher (as opposed to a teacher) perspective. Masterman and others (Masterman, 2006; Masterman et al., 2009; Masterman & Manton, 2011; Masterman et al., 2013) have initiated studies of teachers' perceptions of learning design from the conceptual and technological points of view. However, studies in which teachers have the opportunity to experience and compare different tools within their local, authentic setting are still scarce. This kind of studies can help us understand which features teachers perceive as more useful when they design for learning (in contrast with evaluating whether teachers like the one approach/tool proposed by the evaluation team, which is the usual approach). Providing empirical evidence not centered on a single approach can thus be invaluable in helping design new technological learning design tools that could overcome the current adoption hurdles.

In this paper we explore this issue of practitioner perceptions of learning design technological tools, from an interpretive, naturalistic perspective (Orlikowski & Baroudi, 1991). Our mixed methods study involved 18 university teachers from a wide variety of disciplines, who used two different tools for authoring designs (concretely, for authoring CSCL scripts). The structure of the paper is as follows: first, we describe in more detail existing related work on the issue of teacher adoption and perception of learning design and CSCL script authoring tools; next, we describe the context, methodology and results of our exploratory mixed methods study; then, we discuss these results, including implications for authoring tool designers and also providing advice for similar future studies.

2. Related work

2.1. Learning design, authoring tools and teacher adoption

Literature in the field of learning design commonly cites a variety of benefits of using authoring tools for teachers and teacher practice. These benefits can be coarsely clustered into two large groups: a) their role as tools for pedagogical reflection (exemplified in more "conceptual" approaches to learning design, see Laurillard, 2012; Persico et al., 2013), and b) as helpers in the preparation and implementation of the infrastructure needed in a (technology-enhanced) learning situation (represented by more technology-oriented proposals such as Koper & Tattersall, 2005, or the ones mentioned by Prieto et al., 2013c). However, despite these benefits, teacher adoption is still considered one of the main unsolved challenges in the learning design community (Mor et al., 2013).

A number of studies have tried to explore how teachers perceive and adopt *conceptual* tools for learning design. For example, Masterman et al. (2009) explore these perceptions, finding that "providing students with a structured sequence of learning activities was the major value to teacher". Bennett et al. (2011) study the contexts of multiple Australian university teachers, concluding there is space for adopting learning design approaches. In this regard, there is a widely-held understanding that there exist multiple paths to conceptualize and represent learning designs (Conole, 2013).

Teachers perceptions and adoption of *technological* support to learning design, however, are a much less researched issue. Many different technologies have been proposed so far to support learning design, often around the IMS-LD specification (e.g., Recourse¹, Reload², etc.), but also based on other modeling languages (Martel et al., 2006;

¹<http://tencompetence-project.bolton.ac.uk/ldauthor/index.html> (Last visit: January 2014).

²<http://www.reload.ac.uk/ldeditor.html> (Last visit: January 2014).

Caeiro, 2008) and approaches to design (Dalziel, 2003; Villasclaras-Fernández et al., 2013; Laurillard et al., 2013). The most widely-studied case, which polarized the learning design community, has been that of teacher adoption of the IMS-LD specification (IMS Global Learning Consortium, 2003) and its technological tooling. Despite the initial claims of it being suitable for non-expert teachers, several problems for adoption have been cited over the years, either technical or related to how teachers perceive it (Berggren et al., 2005; Neumann et al., 2010). Interestingly, recent studies support the idea that the conceptual structure of IMS-LD itself might not be a problem for teachers (Derntl et al., 2010, 2011). In any case, its adoption among teachers continues to be marginal (Griffiths et al., 2011).

Several of these technological tools have been analyzed comparatively in the past, mostly by specialists or researchers trying to assess their expressiveness, i.e., their capacity to model a wide variety of different situations (Vignollet et al., 2008; Katsamani & Retalis, 2013; Prieto et al., 2013c). However, despite the fact that teachers are one of the main intended audiences for these learning design tools, and that many of the aforementioned proposals have been evaluated with a number of teachers, these studies were mostly confirmatory of the usefulness of each particular new tool/approach (creating the “greenfield” effect mentioned by Goodyear & Dimitriadis, 2013). Few studies investigate teachers’ perceptions of the technological support for learning design outside the restrictions of a single approach or tool.

An interesting exception to this lack of studies on teacher perceptions of learning design tools is the work by Liz Masterman and colleagues. Masterman (2006) analyzes the use of generic tools (e.g. office suites) to design for learning, concluding that future learning design tools should: i) meet the varying needs of a heterogeneous population of practitioners; ii) allow users to iterate easily between editing and enactment tools; and iii) accommodate the unplanned digressions that can occur during a learning session. Masterman & Manton (2011) study the use of a single learning design tool (Phoebe), but draw some factors necessary for uptake of this kind of technological tools: intrinsic motivation, sense of ownership, institutional support, or supporting both guided and flexible paths for design. Masterman et al. (2013) compare the findings of studies regarding three different design tools (Phoebe, LAMS and the Learning Designer), concluding that the most important criterion of acceptability for teachers is its mapping to an individual teacher’s design thinking, which is “largely a matter of personal style”. These disjoint set of factors and conclusions, however, were extracted from studies of teachers being exposed to *only one design tool/approach* at a time. More research, particularly studies in which teachers are able to experience and compare multiple learning design tools, is needed to unravel and organize these factors (e.g., are they underlying all learning design practice? are they tool-specific?), and discover new ones.

2.2. CSCL script authoring tools and teachers as CSCL script editors

Within this general learning design panorama, several pedagogy-specific proposals exist: tools to support the creation of inquiry-based learning scenarios (Mulholland et al., 2012), science learning situations (Jong et al., 2012), or CSCL scenarios. CSCL research focuses on “how people can learn together with the help of computers” (Stahl et al., 2006), considering that “interactions among peers constitute the most important factor in learning” (Dillenbourg et al., 2009). Indeed, the CSCL community has proposed its own flavor of learning design under the notion of *scripting*: the design of scaffolds that “specify, sequence and distribute learning activities and roles among the learners of a group” (Fischer et al., 2013). CSCL research has been especially prolific in providing authoring tools for such “collaboration scripts”, from ad-hoc tools and environments incarnating a concrete script (e.g., ArgueGraph or ConceptGrid in Dillenbourg & Jermann, 2007), to more general CSCL script authoring tools: Mocolade (Harrer et al., 2009), Collage (Hernández-Leo et al., 2006) and WebCollage (Villasclaras-Fernández et al., 2013), S-COL (Wecker et al., 2010), SceDer (Niramitranon et al., 2010), or EDIT2 (Sobreira & Tchounikine, 2012). There have also been attempts to integrate such scripts with more general learning design specifications such as IMS-LD (Hernandez-Leo et al., 2004).

Different issues have been discussed in the literature about how to support the construction of CSCL scripts: which entities to consider (Kobbe et al., 2007), which elements may be reused and how (Hernández-Leo et al., 2007), or whether the designer should be guided through the process of designing (e.g., by patterns or templates, see Hernández-Leo et al., 2010), or rather be allowed more freedom and flexibility over the different aspects of script edition (Dillenbourg & Tchounikine, 2007; Sobreira & Tchounikine, 2012).

As in the overall learning design panorama, many of the authoring tools proposed within CSCL are specifically aimed at teachers (e.g., the aforementioned Collage, EDIT2, or Mocolade). However, we find the same lack of adoption by the teacher community. This should not be surprising, given that it is a particular case of the learning design adoption problem, with the added complexity of the social dimension that CSCL approaches inherently have

to take into account (Stahl et al., 2006; Dillenbourg et al., 2009). At the same time, this lack of adoption of CSCL script tooling is part of the larger problem of teacher adoption of CSCL approaches, which we ourselves have studied recently (Prieto et al., 2013b). This prior study focused on how carefully-designed professional development actions that take into account both the design of scripts and also their implementation in authentic contexts, can help improve such adoption.

The lack of teacher adoption of the multiple learning design authoring tools (and CSCL scripting tools) may have a common origin in the difficulties of the CSCL paradigm, or it may stem from flaws in the tools themselves. However, we have insufficient empiric evidence to unravel this origin. Furthermore, another general weakness of existing learning design and CSCL authoring tool studies is that, even if the tools are aimed at teachers (and in many cases are co-designed with teachers of a particular educational context, e.g., Laurillard et al., 2013), generally they have been evaluated by “militant” teachers in the same or very similar contexts to the one in which they were designed. Moreover, such evaluations are typically done exposing teachers solely to one specific approach/tool. However, this kind of approach does not scale well: if we aim at widespread adoption, tools will be used out of such controlled, comfortable settings, by “average teachers” (Dillenbourg, 2009). In the next section we describe a study which represents a first step in overcoming these limitations, aiming to provide useful information to future learning design and CSCL script authoring tool designers.

3. The study

Following the discussion above, our *research question* can be defined as ‘How do teachers perceive different CSCL script authoring tools and their features?’. This emphasis on teacher perception of a technological system prompted us to take an interpretive perspective on the problem (Orlikowski & Baroudi, 1991), trying to understand the concerned phenomena by accessing teachers’ subjective meanings around it. Given the lack of a widely accepted conceptualization or theory that exhaustively describes these perceptions, or the factors and tool features with respect to teacher adoption, we chose to perform an exploratory study in one concrete educational setting, trying to unearth factors affecting tool adoption, in conditions as authentic as possible (i.e., naturalistic, as opposed to controlled/experimental) and focusing more on the qualitative evidence (Guba, 1981) rather than in producing statistically-significant, generalizable results.

This initial exploration of the aforementioned research question took place in a professional development workshop where university teachers from different disciplines (who did not have prior experience with learning design approaches or CSCL scripts) used two authoring tools. In order to achieve more naturalistic, ecologically-valid results, we used two tools already available in the learning design community, which had been tested with teachers, separately and in more controlled conditions (Sobreira & Tchounikine, 2012; Villasclaras-Fernández et al., 2013). Despite their common general goal of helping teachers develop CSCL scripts, from a tool designer’s perspective both tools are diametrically different: one guides teachers in using pedagogically-sound techniques, by forcing them to choose among a limited set of so-called “patterns”, while the other purposefully leaves the teacher freedom to choose the structure and elements of the script (epitomizing the flexibility/guidance debate mentioned in the previous section). This choice of two radically different tools was aimed at exploring a larger portion of the authoring tool design space, and to overcome the limitation of most existing learning design evaluations, which expose only a single tool/approach. Using a larger number of different tools would have been desirable, but proved unfeasible within the context of such introductory teacher workshop.

Thus, in this study we gather and analyze data about how teachers perceive these two apparently opposing sets of tool features, and their eventual adoption. Using qualitative research terminology (Stake, 2010), we transpose the general research question outlined above onto the concrete context of this study, to have our study’s main *issue* (i.e., a central question to help researchers focus their interpretations of the data). Such issue could be formulated as: ‘how did participants perceive the two presented tools and their features?’ (see also Figure 3).

3.1. Context

Our study was conducted during a professional development action aimed at academic staff in the University of Valladolid (Spain). The action was a 12-hour blended learning teacher workshop for teachers of any discipline to learn about strategies and technologies for computer-supported collaborative learning. The workshop, facilitated by

four members of the researcher team, was composed of two 4-hour face-to-face sessions and four more hours of autonomous online work in-between. The workshop included both group work on designing a fictitious but realistic collaborative scenario, and individual work on designing an authentic CSCL situation aimed at each teacher's own courses.

The general structure of the workshop activities is shown in Table 1. This workshop structure was aimed at providing an interesting learning experience for teachers, following similar principles to those of previous professional development actions in the same institution, which exposed teachers to the design of CSCL scripts and to their implementation using technologies already available to them (see Prieto et al., 2013a,b), in a context as authentic as possible. At the same time, the structure provided *all* teachers with opportunities for practical usage of the two concerned CSCL script authoring tools/approaches (EDIT2 and WebCollage).

Table 1: Workshop structure, including the sequence of learning activities as well as the data gathering activities performed *during* the workshop (marked between brackets, see Figure 2)

Session/phase	Learning activities
Pre-workshop activities	<ul style="list-style-type: none"> - Read an example CSCL scenario - Answer an initial profiling questionnaire [Q1]
Session 1 (4h) [O1][R1]	<ul style="list-style-type: none"> - Introduction to the workshop, and to general collaborative learning strategies - Introduction to authoring tools for CSCL (EDIT2, WebCollage) - In dyads, model the example CSCL scenario with one authoring tool (randomly-selected 50% using EDIT2, 50% using WebCollage) [L1] - In dyads, model the example CSCL scenario using the other tool (randomly-selected 50% using WebCollage, 50% using EDIT2) [L1] - Individually, answer a short questionnaire about the usage of the tools [Q2a] - Demonstration of the implementation of CSCL scripts to Moodle - Next steps and wrap-up
Online work (at home) (4h)	<ul style="list-style-type: none"> - Individually, create a CSCL scenario with an authoring tool freely chosen by each participant (EDIT2 or WebCollage) [L2][D]
Session 2 (4h) [O2][R2]	<ul style="list-style-type: none"> - Facilitator feedback regarding the individual exercise - Individually, revise/extend the questionnaire answers regarding tool usage [Q2b] - In dyads, discuss about the presented tools and their adoption [DD] - In 4-6 person groups, agree on issues about tools and their adoption (focus groups) [FG] - Introduction to technologies for implementing CSCL: Moodle, Web 2.0 tools, GLUE!-PS - Individually, deploy designs done at home to Moodle (using GLUE!-PS) - Wrap-up - Answer a professional development action evaluation questionnaire [Q3]
Post-workshop activities	<ul style="list-style-type: none"> - Answer a post-workshop questionnaire about tool features and adoption [Q4] (3 weeks later)

WebCollage (Villasclaras-Fernández et al., 2013; see Figure 1, left) is a graphical, web-based authoring tool based on the principles of Collage (Hernández-Leo et al., 2006). The tool proposes the designer to construct a learning design visually by using collaborative learning flow patterns (e.g. the well-known jigsaw collaborative strategy) as the main building blocks, guiding the user in choosing the pattern most adequate for the teacher's pedagogical intentions (Hernández-Leo et al., 2010). By using and combining these strategies that have been shown to work in practice, more pedagogically-sound collaborative scenarios will hopefully be created.

EDIT2 (Sobreira & Tchounikine, 2012) is a CSCL script editor aimed at providing teachers with a simple interface and high degree of flexibility in defining the script. EDIT2's interface is similar to that of a spreadsheet in an office suite (see Figure 1, right). A script is represented as a table, with columns representing the different script notions (activities, groups, participants, resources, and roles, see Kobbe et al., 2007). EDIT2 does not impose a unique representation pattern about how the conceptual notions it provides may be used (i.e., lack of a unique syntax). Thus, EDIT2 allows the user to reorder and use (or not use) these notions (e.g., rows and columns) at will. This flexibility is intended to provide a minimal degree of support (by introducing pertinent conceptual notions) while not over-constraining users with complex representation structures.

In order to allow teachers to perform meaningful comparisons between these two editing tools', all participant teachers had the opportunity to use both editing tools in the first workshop session (see Table 1): half of the participants were assigned randomly to first use WebCollage to model an example scenario, and then re-model it using EDIT2; the other half performed the same activities reversing the order of tools used. In the individual, autonomous work on the design of an authentic CSCL script, teachers were told to choose the tool that they liked most. Furthermore, both tools were introduced as two different ways to edit a CSCL design with a similar outcome: the designs could then be deployed in the same way to the platforms used by students. This deployment was done in both cases using the same middleware (GLUE!-PS, see Prieto et al., 2013a), resulting on courses available on the same learning platform

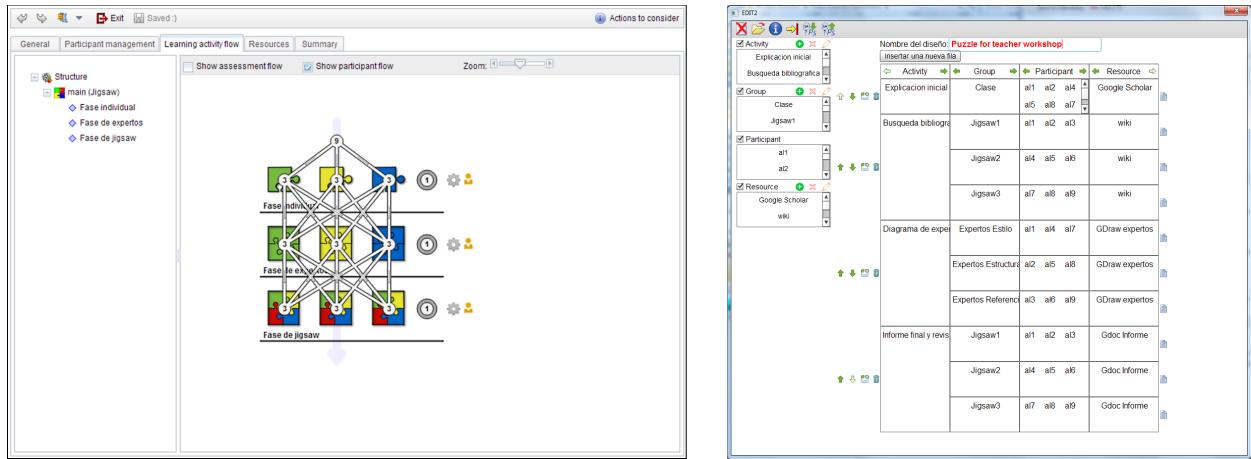


Figure 1: Screenshots of the graphical user interfaces of WebCollage (left) and EDIT2 (right)

(Moodle). This required a certain degree of engineering work to be done before the study (which, eventually, led to teachers experiencing certain technical difficulties during the enactment of the workshop - see the ‘Results’ section below).

3.2. Methodology

To explore the main *issue* of our study ('how did participants perceive the two presented tools and their features?'), from an interpretive, naturalistic standpoint, we chose to perform a mixed methods study (Creswell, 2009), with more emphasis on the qualitative evidence. Mixed methods are regarded as the most adequate to explore complex phenomena in the field of CSCL, and the multiple perspectives often involved (Suthers, 2006; Strijbos & Fischer, 2007). More concretely, we used a concurrent-nested research design (similar to the one described in Martínez et al., 2006), where quantitative and qualitative evidence is analyzed at the same time, using quantitative evidence to show general trends and qualitative data to confirm/disconfirm such trends and also to explore emergent issues.

In order to study teachers perceptions of learning design tools in conditions as authentic as possible, without artificially motivating participation, the study was set within a free, voluntary workshop for professional development of university faculty. Participants had no obligation or reward to provide information for the study, and they would receive credit for completing it independently of such participation. A total of 24 teachers from different disciplines (including Law, Medicine, Engineering or Education) were initially enrolled in the workshop, of which 19 attended the first face-to face session. A total of 18 teachers completed the workshop, and 15 of them answered to all questionnaires involved in the study. Given the voluntary nature of the workshop and participation in the study, and the tight schedules of the university faculty, such attrition rates are normal (see, e.g., Prieto et al., 2013b). An initial online questionnaire to gather profiling information ([Q1], see ‘Data gathering’ below) showed that teachers had varying levels of teaching, ICT and collaborative learning expertise, although none were CSCL or learning design experts.

3.2.1. Data gathering

As it can be seen in Figure 2, our study used a variety of data gathering techniques, as is often the case in a mixed methods approach, in order to gain a deeper understanding of the participants’ perceptions and to triangulate the collected evidence (Stake, 2010):

- Both face-to-face workshop sessions were audio-recorded [R1][R2], and unstructured observation notes (including photos) were taken by two non-participant observers [O1][O2].
- Data from the dyad and group discussions among participants regarding teacher adoption of the presented tools (in the second face-to-face session, see Table 1) was also recorded, in the form of written notes generated during the dyad discussion [DD] and audio recordings of the four group discussions [FG].

- Participant-generated design artifacts (i.e., CSCL scripts) from the individual autonomous work between sessions [D], as well as tool log files recording the usage of the tools throughout the workshop [L1][L2][L3] were gathered. Unfortunately, a technical failure prevented the gathering of a part of these log files and design artifacts.
- Participants responded to four questionnaires including open-ended and closed (Likert-scale) questions aimed at giving us general trends about teacher perceptions to be triangulated with the qualitative evidence (rather than exact quantitative measurements of an abstract construct). A first questionnaire before the workshop inquired about teachers' background, teaching experience and knowledge about CSCL and learning design [Q1]. A second questionnaire at the end of the first session assessed the first impressions about the presented tools and their features [Q2a], and was later reviewed by teachers themselves during the second session [Q2b]. Another questionnaire inquired about the value of the workshop as a professional development action [Q3] – part of the common practice in the workshops of this concrete university. A last questionnaire, three weeks after the workshop, was used to triangulate preliminary findings from the analysis of the data sources above, and to see how stable were teachers' perceptions once they had gone back to their usual practice. Given the exploratory nature of the study and the lack of existing research instruments to systematically conceptualize and measure constructs related to teacher adoption of learning design tools, such questionnaires were prepared ad-hoc for this study.

This profusion of data gathering sources, distributed along more than one month, tried to capture rich evidence about the different moments and contexts of usage of the tools (in the face-to-face workshop, but also involving free usage of the tools by teachers at home/in their office, and questionnaires several weeks after the main event). Thus, we intended to counter the dangers to ecological validity that this kind of one-shot punctual studies often pose (while keeping the research effort feasible).

3.2.2. Data analysis

Our concurrent-nested mixed methods study (Creswell, 2009) emphasized the qualitative perspective and data analysis, providing the main structure for the study results. To organize the output from the analysis we used an “anticipatory data reduction” method common in qualitative research (Miles & Huberman, 1994), in which the investigation of the main *issue* of our study ('how did participants perceive the two presented tools and their features?', see Figure 3) was to be illuminated through various more concrete *topics* (Stake, 2010). In our case, the two first axes of exploration came from existing learning design literature: the design tension between guidance vs. flexibility in designing a CSCL script (mentioned in section 2.2) (topic 1); and the usefulness of the authoring tools for reflection vs. for practical purposes (as mentioned in section 2.1) (topic 2). Furthermore, since this kind of exploration has hardly been attempted before, we also aimed at explicitly gathering information about emergent factors that we might not have anticipated as important in the previous two topics (topic 3). The general trends from the quantitative evidence were mainly used to triangulate (i.e., confirm or disprove) the qualitative findings along these three topics. More concretely, the data coming from all the aforementioned sources was analyzed concurrently, in the following manners (see also Figure 2):

- Open coding was performed on most of the available qualitative sources ([O1][O2][Q1][Q2a][Q2b][Q3][Q4][DD][FG]), by a single coder, given the exploratory nature of the study, and the lack of well-established coding schemes about the subject. The rest of the qualitative data ([R1][R2][D]) were used as auxiliary sources in case of ambiguity. Later on, the code counts of the qualitative data have also been treated quantitatively (e.g., absolute counts, relative frequency of appearance in a certain data source) to give a general idea of their respective importance.
- Descriptive statistic analyses were performed on the quantitative data from questionnaires [Q1][Q2a][Q2b][Q3][Q4] (e.g., Likert-scale closed questions), to give general trends of teachers' opinions regarding the tools, which could support or counter the qualitative analysis above.
- In order to explore whether (or how) teachers with different profiles might perceive the tools in different ways, a post-hoc heuristic clustering analysis (Diday & Simon, 1980) was performed to study differential trends present

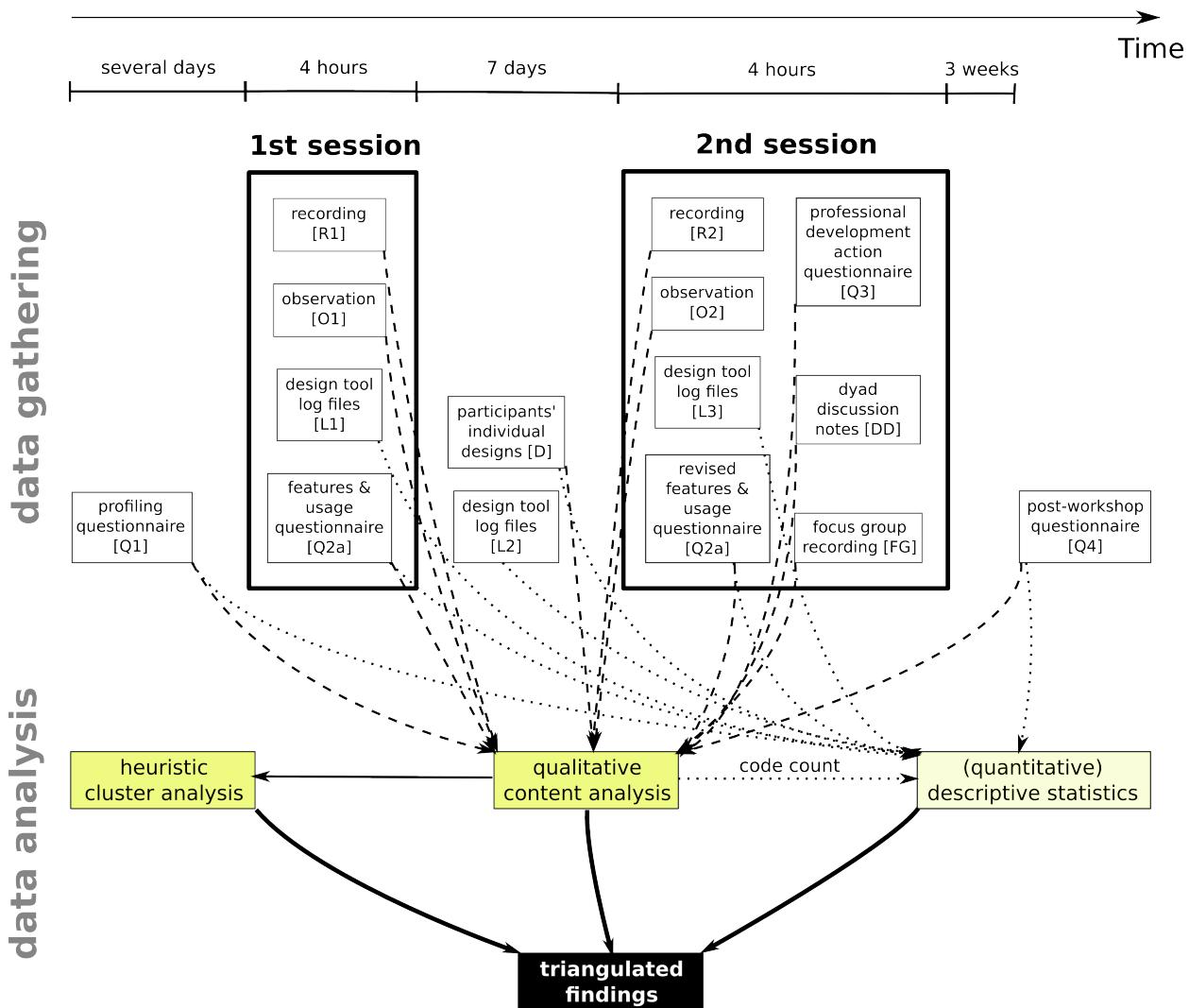


Figure 2: Data gathering and analysis techniques used during the mixed methods study. Data source labels (between brackets) as used in the 'Results' section

in the (qualitative as well as quantitative) responses of various groups of teachers (e.g., teachers that preferred one tool over the other, teachers with more or less experience in using ICTs, etc.).

3.3. Results

Overall, participant teachers found both authoring tools usable, with EDIT2 being perceived as easier to apprehend. Teachers, however, valued WebCollage slightly higher in their intentions of future use. In the qualitative data, teachers valued most EDIT2's simplicity of use and flexible structure, as well as WebCollage's visual appeal and the notion of collaborative patterns it uses [O1][O2][Q2a][Q2b][DD][FG][Q4]. These results are aligned with previous individual tool evaluations (Sobreira & Tchounikine, 2012; Villasclaras-Fernández et al., 2013). However, in our study we were more interested in finer details of the differential perception of the tools and their features, and their potential impact on adoption.

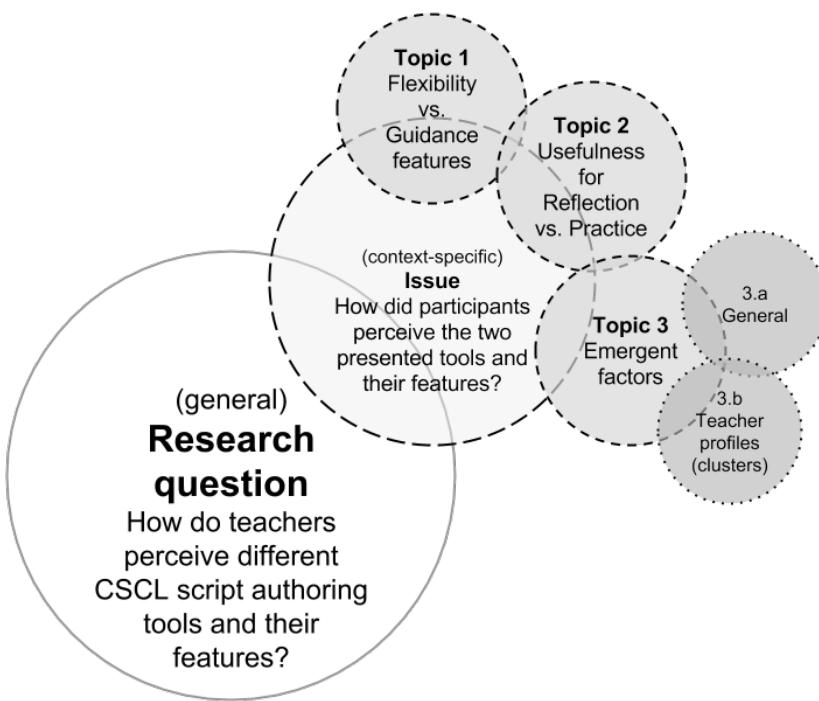


Figure 3: General research question, main study issue and topics of exploration used to focus the analyses of data (anticipated data reduction process)

3.3.1. Topic 1: Flexibility vs. guidance

Regarding the design tension between “flexible design” (generally epitomized by the EDIT2 tool) and “guided design” (exemplified more strongly in WebCollage), teachers’ opinions did not conclusively incline towards either side. Quantitative data from the questionnaires shows that guidance features (fixed script notions, usage of patterns, etc.) were slightly more valued, generally, than flexibility features (the free reordering of notions or activities, breaking pattern restrictions, etc.): on average, 14.4 out of 19 participants (75.8%) “Agreed” or “Strongly agreed” that the different guidance tool features were useful, by an average of 13.6 (71.6%) for the flexibility features [Q2b]. Among the most appreciated flexibility tool features we can find the ability to break a pattern’s restrictions, and being able to reorder the activity sequence. Conversely, the most appreciated guidance features were the online help describing collaborative patterns and their usage, as well as having a set of predefined script notions to design [Q2b]. However, feature scores were generally high, making it difficult to assess to which extent these differences in score are important.

The qualitative data seemed to support this lack of a clear inclination towards one side or the other: the availability of collaborative patterns for design appeared quite frequently in teachers’ responses (e.g. “[when asked about why they found the authoring tools useful] having the predetermined learning patterns gives you more ideas for a first approach [to the scenario design]” [Q2b]), as it also did the appreciative mentions to EDIT2’s flexible structure (e.g., “the reordering of rows and columns helps [...] sometimes an activity has several phases, and you do not consider it initially [...] this phase, I have to move it further up” [FG]). There were, however, no overwhelming differences in the appreciation of features from either side.

Looking at the responses per individual, and to their evolution throughout the different data gathering events spanning one month, we found that teachers’ preference regarding flexibility and guidance were not consistent over time. In the questionnaire during the workshop, 5 teachers veered more towards appreciation of flexibility features, while 6

teachers were more inclined towards guidance ones³[Q2b]. On the other hand, when asked explicitly three weeks later in the post-workshop questionnaire, 6 teachers valued more flexibility than guidance, while other 6 teachers did the opposite (4 remained neutral) [Q4]. However, the sets of teachers that showed these preferences at different moments only overlapped partially, hinting that many teachers do not have clear preferences in that regard, and/or that those preferences were being shaped as the workshop went on. If we look into teachers' preferences for one tool or the other, as a proxy to preferences for a "guided approach" (WebCollage) vs. a "flexible approach" (EDIT2), we find similar results: although a small number of teachers clearly preferred WebCollage, or EDIT2, a greater number of teachers remained neutral with respect to the tools (13 out of 19 teachers did not vote substantially higher EDIT2 features with respect to WebCollage's, or vice-versa [Q2b]; 7 teachers asserted that they would use in the future one tool or the other, depending on the occasion [Q4]).

Correlation analyses of the quantitative data from the tool feature questions, their aggregated indexes (see footnote 3) [Q2b], and background/profile characteristics of teachers [Q1] did not show any clear correlation either. Only mild correlations were found between the years of prior teaching experience and the scores to the aggregated flexibility features preference (correlation index, corr=+0.42), indicating that more experienced teachers may prefer having more flexibility to design their scenarios. Similarly, mild correlation was also found between the years of teaching experience and the preference for EDIT2 over WebCollage features (corr=+0.36), which might indicate that more experienced teachers prefer a simple table interface rather than a complex, visual one. But, as indicated, these correlation results are not at all conclusive.

3.3.2. Topic 2: Reflection vs. practice

Regarding the other dichotomy to be explored (the usefulness of the presented tools for pedagogical reflection, vs. their usefulness for putting ICT-enabled scenarios in practice, see 'Related work' section), results are also balanced. The quantitative data gathered during the workshop sessions shows a considerable difference in the number of teachers that "Agreed" or "Strongly Agreed" that the tool features were useful for reflection, versus those that showed the same kind of appreciation of tool features for practice (averaging all feature questions, 16.2 and 11.8 participants agreed, respectively) [Q2b]. However, this apparent preference for the reflection value of tools was offset by the fact that, three weeks after the workshop, when asked explicitly, 11 out of 15 teachers expressed that they would use the tools for both purposes, with the remaining 4 teachers actually expressing that they would use them to put the scenarios into practice [Q4].

How to explain this shift in teachers' opinions from favoring more reflection (during the workshop) to favoring more practice (after the workshop)? One possible cause could be the fact that, due to the workshop structure (see section 3.1 above), teachers used the GLUE!-PS system (Prieto et al., 2013a) to transform their learning designs into ready-to-run Moodle courses after questionnaire [Q2b], and thus questionnaire [Q4] might reflect an increased perception that doing learning designs can actually be applicable to their everyday practice. The qualitative data gathered during the study seems to support this balance: mentions to the adoption of the tools for reflection (e.g., "Both tools are useful to rethink our models of teaching with ICTs" [Q2b]) and for supporting actual teaching practice (e.g., "Yes, [we would use the presented tools] to prepare our classes" [DD]) were comparable [O1][O2][Q2a][Q2b][DD][FG][Q4]. In both cases, teachers mentioned more often positive intentions of using the tools, rather than negative ones.

Regarding individual teachers' opinions about the usefulness of tools for reflection vs. practice, and their evolution over time, we found a similarly balanced panorama. In both questionnaires (during and three weeks after the workshop) a majority of teachers (12 out of 19 and 11 out of 15, respectively) remained neutral, appreciating both sides equally and expressing intentions of using the tools for both purposes [Q2b][Q4]. Most of the teachers more inclined towards reflection in [Q2b] (during the workshop) shifted their opinions towards neutrality in [Q4] (three weeks after the workshop), while two of them expressed in this last questionnaire that they were considering adopting the tools for practical purposes, not for reflection.

³This inclination was calculated by subtracting a "quantitative flexibility index" (calculated by taking the sum of scores a teacher gave to flexibility-related tool features, in a 1-6 Likert scale, and projecting that sum linearly over a 0-1 scale; thus, an index of 1 would correspond to a teacher that valued all flexibility features with the maximum score, and an index of 0 to a teacher that valued them all with the minimum score), from a similarly-calculated "quantitative guidance index" (regarding the score in the guidance-related feature questions).

3.3.3. Topic 3a: Emergent factors - Global issues

Aside from the two aforementioned topics derived from existing literature on learning design and CSCL scripting support, it was also crucial for our study to uncover other emergent factors that participant teachers could consider important for adoption. The additional issues arising more frequently from the open coding of the qualitative data were:

Technical difficulties. Several unexpected technical difficulties arose during the workshop (e.g., sometimes, one of the tools was not able to save teachers' designs, thus losing the teacher's work in that session), due to the tool adaptations needed to portray them in equivalent terms of usefulness. The mentions to these unexpected "bugs", even if not directly related to the aim of our study, were quite numerous in the different qualitative data sources available [O1][O2][Q2b][DD][FG][Q4]. It is worth noting that, despite the potential threat to the validity of results that these errors might have caused, teachers apparently were not discouraged by them (e.g., only two out of 18 respondent teachers mentioned these difficulties at all when evaluating the workshop [Q3]; only one out of 15 respondents asserted that she would not adopt the tools in the future, mentioning these technical issues as the cause [Q4]).

Integration with learning platforms. An issue that appeared very frequently in our qualitative data (up to 34 times in [O1][O2][Q2b][DD][FG][Q4]) was the need for ways to connect the learning design tools with the learning platforms used for enactment of the scenarios (in this case, mostly mentioning Moodle, as the official learning platform of the university where the workshop took place). For example, "They [the participants] ask whether they can work with these tools from within [the university's] Moodle" [O2]; "[when asked about aspects they found most useful in WebCollage] Connection with standard tools like Moodle" [Q2b]; "[when talking about desirable tool features] accessing the list of students of a [Moodle] course [...] how could we load it" [FG]; "[when asked whether the benefits of adopting these tools outweigh the costs] Yes, provided that I can integrate them with platforms like Moodle [...]" [Q4]. Although these mentions are not entirely surprising (given that the workshop also touched upon the topic of implementing the activities in Moodle and other ICTs), this idea was mentioned without it being asked about by the workshop facilitators or the questionnaires. The importance of this factor was explicitly confirmed in the post-workshop questionnaire several weeks later (9 out of 15 respondent teachers considered this feature the single most important one, while only 3 considered patterns the most important, or 2 considering flexible structure as most important [Q4]).

Cost-benefit analysis. In the qualitative data there are also a considerable number of mentions to the (often implicit) cost-benefit analysis that teachers made when considering usage and adoption of the design tools. When asked explicitly, 12 out of 15 respondents considered that the benefits *did* outweigh the costs [Q4], although it was clear from the different qualitative data sources that some teachers did not perceive the benefits as so clearly superior to the costs: "I think some of the participants did not understand well the role of [the tools], and consider them an overload, given that they already have Moodle" [O2]; "[when writing about negative aspects of the tools] Too much technical complexity for the benefits it provides" [DD]; "[when asked about why they think WebCollage was useful] I think the tool has to help enhance the design, and also save time. If it requires more time than the traditional materials, I don't think I'll opt-in" [Q2b]. In some of these cases, this can be due to the limited usage that they normally do of ICTs in their teaching practice [Q1] (which renders ineffective the benefit for technological implementation that these tools provide, leaving only the conceptual/pedagogical reflection benefits).

Conceptual support. Another transversal aspect that emerges as important from the qualitative evidence is the need for tutorials and other in-line conceptual support, in order to use the design tools effectively (e.g. to understand which resources and tools are adequate for each kind of learning activity): "[when asked about the ideal combination of tool features] Having some kind of pre-defined notions for each of the available [learning] tools (usefulness, how would the student use it, how would the teacher see it)" [Q2b]. In the case of WebCollage, quite a few teachers struggled with the notion of the different available patterns and how to choose among them and combine them with the available tools, e.g., "I have also seen how some groups had problems identifying the pattern described in the example scenario" [O1]. This is consistent with the experience of the researcher team in previous workshops using WebCollage, in which a considerable amount of time had to be spent in explaining and ensuring understanding of the collaborative strategies/patterns. This extra time highlights the importance of pedagogical understanding in complex educational settings such as CSCL ones.

Non-design-specific tool features. There are also a number of features, often not directly related to the design approach of the tools, that are mentioned multiple times as interesting: automated group formation, provision of an

“undo” button, the ability to work offline (as opposed to web-based tools that require being online to design), the ability to share designs in a wider community and connecting with social networks, the ability to copy-paste elements from different parts of the tools, having an overview/summary of the design, or the compatibility with existing tools like MS Word and Excel (e.g., a few teachers seemed to prefer Excel to manage a table-like learning design).

Adoption obstacles. As it has been mentioned, teachers were generally positive about adopting the presented learning design tools and approaches. However, a number of obstacles to this adoption are also mentioned in the qualitative data: the scale of the scenarios (i.e., having a high number of students in a course/classroom), student attitudes being opposed to collaborative work, high curriculum load or subject restrictions. These kinds of obstacles are coherent with previous studies about teacher adoption of collaborative learning in general in the same context (see Prieto et al., 2013).

3.3.4. Topic 3b: Emergent factors - Cluster/Profile analysis

Given the lack of clear global trends regarding the usefulness of different tool features, and the hints of correlation between certain tool preferences and background factors such as teaching experience (see topic 1 above), we explored the possibility that the opinions of different groups of teachers (e.g., teachers with different profiles/backgrounds) could be substantially different, but evened out when observing the global average opinions. We performed a post-hoc heuristic cluster analysis on the available quantitative and qualitative data, by choosing different clustering criteria so as to provide clusters small enough to be appreciably different from the global average, but large enough to provide at least some statistical power. We analyzed the quantitative (averages from the Likert-scales) and qualitative data (e.g., code counts) available from such clusters of participants, comparing it with the global averages. Under this exploratory analysis, several criteria seemed to provide differentiation on a number of aspects⁴. Although Appendix A provides more detailed evidence regarding the resulting clusters and their differential factors with respect to the global group, it is worth mentioning certain factors that seemed to produce differentiated results:

- *Prior use of ICTs in teaching.* Participant teachers that did not normally use ICTs in teaching (which coincided with the more experienced side of the spectrum) were less likely to adopt the authoring tools, and tended to appreciate EDIT2’s more simple user interfaces over WebCollage’s, which they saw as too complex. Conversely, participant teachers who frequently used ICTs in their teaching seemed to perceive more positively the authoring tools and their adoption. However, they also questioned more often the added value of such special-purpose tools over the tools they already use in their usual workflow (e.g. spreadsheet software), and in the conditions they usually experience (e.g. ability to work offline).
- *Prior experience with collaborative learning.* In similar ways, people that already had used collaborative learning before in their teaching (often, younger but still experienced teachers), were more likely to consider adoption of the authoring tools after the workshop. They seemed to have a certain leaning towards appreciating more flexibility features and consider WebCollage visually appealing but too rigid. Conversely, teachers who were novices to collaborative learning (often, most experienced ones) were less likely to consider adoption of the tools after the workshop. Despite their appreciation of guidance features, they had problems with the concepts and vocabulary used in WebCollage, and ended up preferring EDIT2’s simple interface.
- *Initial exposure to one authoring tool.* The clusters of teachers that were exposed first to one tool or the other (randomly assigned at the beginning of the workshop) also showed certain differentiation in their responses. First exposure to EDIT2 seemed to co-occur with higher appreciation of tool features for practice (and vice-versa) and, paradoxically, with a higher appreciation of WebCollage’s features (even if the tool was considered too rigid). First exposure to WebCollage coincided with lower intentions of adoption after the workshop (and to a higher appreciation for EDIT2’s simple interface). This could indicate that EDIT2 might provide an easier point of entry to the design of CSCL scripts (although also to a perception of insufficient support to understand the collaborative learning strategies being taught in the workshop). However, these preliminary trends collide with certain notes by workshop observers (“[when designing a scenario with the authoring tool teachers were

⁴Other criteria were also analyzed, such as the preference of flexibility over guidance (or viceversa) in [Q4], as well as the preference for using one tool or the other in the individual design exercise at home [D]. However, these clusters did not provide clear or easy-to-interpret differentiations, and are not included for brevity’s sake.

exposed secondly] Apparently, [the ones using] EDIT2 go faster after having done the design in WebCollage, maybe because they already understand the design and the concepts in use..." [O1]), and should be examined more thoroughly in future studies.

4. Discussion

The findings from our study cast a new light over the panorama of teachers' perceptions and adoption of learning design tools. The absence of distinctive results regarding the two main topics of the study, derived from the learning design and CSCL scripting literature (flexibility vs. guidance, and usefulness of reflection vs. practice, see section 2), is in itself interesting. Rather than having a global (or even a personal) preference for a certain tool or certain set of features (as authoring tool designers expect when they propose a new tool), participant teachers' opinions evolved over time as they discovered both the tools and the activity of learning design, and as they carefully consider whether the benefits of using each tool outweigh the cost of making changes in their everyday practice. However, even this evolution does not necessarily end up in a clear preference, but rather in the usage of one tool or another, depending on the occasion. This absence of a global trend in teachers' perception of the tools supports the idea that, despite our intentions as tool designers to cater to a public as wide as possible, there is no "silver bullet" approach to learning design that can please every teacher (as held by more ecosystemic views of learning design, see Agostinho et al., 2011). This finding also supports Masterman & Manton (2011)'s conclusions, indicating that teachers might need both guidance and flexible design paths (see section 2.1).

However, our study also identified several emergent factors about teacher adoption of authoring tools that are not usually at the center of the discussions in the learning design community. The importance of connecting these tools to (already in use and/or institutional) enactment platforms and tools emerges as the most relevant of them, and confirms previous findings by Masterman (2006), regarding the need of tools allowing to iterate between design editing and enactment (see section 2.1). This feature also links somehow to the original IMS-LD dream of "design once, deploy anywhere" (and to the current difficulties of doing so in many authentic computer-supported environments, see Prieto et al., 2011, 2013a). Other unexpected, seemingly minor functionalities are also mentioned frequently enough, and should not be disregarded: the ability to work offline, the provision of initial templates to speed up design work, tools with an accessible vocabulary, group and resource instantiation automations, simplicity of use, etc.

Our heuristic clustering analysis seems to support the idea that teachers with different profiles (especially regarding prior usage of ICTs or collaborative learning for teaching) do perceive tools differently, and are not equally likely to end up adopting the authoring tools. This importance of prior attitudes, beliefs and background is consistent with existing literature on efforts that try to change everyday educational practice (Looi et al., 2011), as well as with our own prior studies in using professional development actions to foster CSCL adoption (Prieto et al., 2013b). The different disciplines and backgrounds that participant teachers had may partially explain these differences; however, the low number of participants from each discipline/background prevented from a deeper analysis of this influence. These different teacher clusters/profiles can also be seen as representing the different kinds of audience that make up the "teacher community", often cited as a monolithic entity. Rather, this community contains wide variations – from militant enthusiasts to outright skeptics about the value of learning design and ICTs in general.

The frequent mentioning of the cost-benefit analysis performed by teachers that consider adopting a learning design tool/approach was also unexpected, as this issue is seldom mentioned specifically in the learning design literature. This cost-benefit consideration can be related to the multiplicity of the teacher audience mentioned above. When we test our authoring tools with "militant teachers", they will be more likely to provide positive opinions about them. However, a more "reluctant teacher" will carefully consider pros and cons, evaluating the effectiveness, side effects and level of control of each new technology, as described by Demetriadis et al. (2003). As tool designers, we should consider and provide for these reluctant teachers as well.

Regarding the implications for the concrete field of CSCL scripting and its technological support, it is interesting to see how teachers that had already tried collaborative learning before in their teaching were likely to perceive the authoring tools and their adoption more positively. This, along with explicit mentions to the "conceptual leap" that some teachers found difficult when choosing a collaborative strategy and translating it into the authoring tools, highlights the special complexity of CSCL approaches, which combine the use of ICTs with non-trivial social structuring. To overcome this challenge, several authors have proposed specific professional development approaches that address such conceptual complexity before trying to introduce the tools (e.g., Prieto et al., 2013b), or even multi-dimensional

efforts that consider not only individual teachers and their classrooms, but also wider institutional and policy changes (Chan, 2011; Looi et al., 2011). Our findings are limited, in this sense, to gathering information on a per-teacher basis.

Other limitations of our exploration of teachers' perception of multiple design tools include: a) the fact that the evaluation team was composed by proponents of both concerned tools (which may have introduced biases); b) that, despite our efforts to minimize such effects, our study still was concerned with a single intervention of limited duration, which lacks the ecological validity of a more longitudinal study of usage; c) the relatively low number of teachers and the fact that they all were part of the same university prevents our conclusions to be statistically generalizable (which is why we chose a qualitative-heavy mixed methods methodology, to understand more deeply the factors involved and explore emergent issues which can be studied quantitatively later on, if so desired). However, these limitations are offset by the severe triangulation of techniques, data sources and informants performed in the analysis. Indeed, far from pretending to be the last word said in this direction of research, we have tried to discover emergent themes to be explored in future studies.

Furthermore, to aid future research efforts in this direction of providing comparative tool studies, we may highlight certain issues that we found especially challenging when performing this study:

- *Authenticity and ecological validity*: many learning design tool evaluations center on one-shot, short interventions with teachers (for obvious feasibility and resource expense reasons). However, our study has shown how teachers' perceptions are not static, evolving as teachers explore and try to integrate tools into their practice. We recommend striving for longer studies with as much ecological validity as possible (as we did in our study by extending the workshop duration to two sessions, including free work in-between sessions, and also gathering feedback well after the intervention itself).
- *Addressing a wide teacher audience*: Again, a common limitation of learning design studies is that only "enthusiast" teachers from a narrow context (e.g. a single kind of background) are part of them. Our workshop, as a voluntary activity, was more likely to gather intrinsically-motivated practitioners. However, the workshop was purposefully kept open to all kinds of faculty (to gather as many different disciplines and backgrounds as possible), and it was soon apparent that not all teachers were enthusiasts (some might have been just curious, or might have other motivations to join the workshop, aside from its learning benefits). Designing the intervention, its materials, its examples, etc. to make it attractive for wildly different teachers is not an easy task, but it is something we should still strive to achieve.
- *Avoiding tool bias in the intervention*: In the same way, designing this kind of multi-tool study often requires the intervention of the proponents of the tool, who obviously want their tool to be portrayed in the best of lights. Balancing the intervention so that the advantages of all implied tools are equally obvious (or subdued) is not an easy task, that will require close collaboration among the different research teams concerned, and/or the intervention of an external, "neutral" evaluator.
- *Creating technological conditions for meaningful comparison*: Related to the previous one, it is also important to choose tools that work at the same level of abstraction and have comparable goals, so that any comparison makes sense. Comparing a highly-automated, detailed modelling tool like WebCollage with a conceptual aid like the "course map view"⁵ might leave teachers puzzled when facing certain questions, as the tools address clearly different aims. In the same way, comparing tools that have different means of enacting the designed activities (e.g., EDIT2 activities going into a Moodle course, vs. an integrated design-enactment environment like LAMS) might also make unbiased comparisons difficult. In this regard, utilizing systems that deploy learning designs regardless of the design representation (such as GLUE!-PS, see Prieto et al., 2013a), might be of help.

5. Conclusions

In this article we have seen how learning design, despite being a common part of educational practice, and the fact that there exist multiple tools and proposals that address this need, is still not widely adopted by teachers. There is a

⁵See <http://www.open.ac.uk/blogs/OULDI/> (Last visit: January 2014).

lack of studies approaching teacher perceptions of such tools from outside the bias of one tool and its original context of development, which might help us understand this lack of adoption. Our mixed methods study tried to explore this largely uncharted space of what teachers perceive from the knowledge and use of multiple authoring tools, in the context of designing CSCL scripts.

Our data suggests that there is no single “silver bullet” tool for editing learning designs or CSCL scripts (a similar message to what Persico et al., 2013, conclude for conceptual approaches to learning design), and that teachers appreciate different kinds of support, depending on the moment and the concrete task at hand. Indeed, recent learning design approaches (such as the design studio by Mor & Mogilevsky, 2013) consider the value and benefits (if not the inevitability) of using multiple tools and design representations (Conole, 2008) for the complex activity that is learning design. Our data also suggests that learning design and CSCL script tool designers should not neglect other features that are not necessarily related with the act of designing itself (but rather to the wider ecosystem within which the tool is used). Such features include the connection of the tool with the teachers’ learning platform of choice, the cost of integrating the tool into the existing workflow/practice, with its different restrictions (and which may even be variable with time). This kind of support can be achieved by providing tools that are interoperable, that can work both offline and online, etc. In this context, current multi-tool platforms and approaches, such as GLUE!-PS (Prieto et al., 2013a) or the recently-started METIS⁶ project, seem to make sense.

However, this study is not meant as a definitive response to this line of studies on teachers’ perceptions and adoption of learning design technological tools. Rather, we expect further studies by our research teams and by others, addressing a wider range of tools, a more thorough analysis of the influence of the teachers’ disciplines/background, as well as more longitudinal data gathering. To support this aim, in this paper we have provided a first set of recommendations for future research.

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⁶<http://metis-project.org> (Last visit: January 2014).

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Appendix A. Detailed evidence of the heuristic cluster analysis

Table A.2: Selected evidence from the heuristic clustering analysis of data, including the most noticeable deviations of each cluster from the total teacher participant averages

Cluster criteria	# of teachers	(main) Quantitative data differentiation	(main) Qualitative data differentiation
1. Considered using CSCL but not LD authoring tools in [Q4]	6	<ul style="list-style-type: none"> - Lower initial usage of ICTs in teaching practice (avg=2.17 vs. global avg=3.11, in a 1-6 scale [Q1]) - Longer teaching experience (avg=20.5 yrs vs. global avg=17.3 yrs [Q1]) 	<ul style="list-style-type: none"> - More mentions to the importance of connecting the authoring tools with the VLE [Q2b][Q4] - More mentions to WebCollage as being a powerful tool, especially with relationship to the patterns as predefined design templates [Q2b][Q4] - More mentions to WebCollage as being too complex [Q2b][Q4] - No mentions to the issue of classroom scale as an obstacle for adopting the authoring tools
2. High initial usage of ICTs in teaching [Q1]	6	<ul style="list-style-type: none"> - More positive initial attitudes towards collaborative learning (avg=4.67 vs. global avg=4, in a 1-6 scale [Q1]) - Higher degree of initial usage of collaborative learning in teaching (avg=4.17 vs. global avg=3.11, in a 1-6 scale [Q1]) - More likely to consider flexibility as more important than guidance ($p=0.75$, vs. global $p=0.4$ [Q4]) - More likely to consider the adoption of authoring tools to implement CSCL ($p=1$, vs. global $p=0.53$ [Q4]) - More likely to value usefulness of the tools for reflection purposes ($p=1$, vs. global $p=0.73$ [Q4]) 	<ul style="list-style-type: none"> - More mentions to WebCollage's visual appeal [Q2b][Q4] - More mentions to appreciating EDIT2's flexible structure [Q2b] - More mentions to the importance of being able to work offline [Q2b][Q4] - Less mentions to the conceptual problems of translating scenarios into designs/patterns in the authoring tools [Q2b] - More positive remarks about the adoption of the authoring tools, both for reflection and for practice [Q2b] - More mentions to the need of integrating existing ICT tools already in use (e.g. Excel) [Q2b]
3. Low initial usage of ICTs in teaching [Q1]	8	<ul style="list-style-type: none"> - Less positive initial attitude towards usefulness of learning design for practice (avg=3.88 vs. global avg=4.5, in a 1-6 scale [Q1]) - Less likely to consider the adoption of authoring tools after the workshop ($p=0.29$, vs. global $p=0.53$ [Q4]) 	<ul style="list-style-type: none"> - More mentions to applying collaborative learning with non-ICT tools (e.g. pen and paper) [Q2b][Q4] - More mentions to the appreciation of EDIT2's simplicity of use [Q4] - More mentions to WebCollage as being too complex [Q4] - More mentions to WebCollage as being a very powerful tool [Q2b][Q4] - More mentions to the conceptual problems of translating scenarios into designs/patterns in the authoring tools [Q2b][Q4] - Less mentions to WebCollage's visual appeal [Q2b]

Table A.3: Selected evidence from the heuristic clustering analysis of data, including the most noticeable deviations of each cluster from the total teacher participant averages (continued)

Cluster criteria	# of teachers	(main) Quantitative data differentiation	(main) Qualitative data differentiation
4. High initial usage of collaborative learning in teaching [Q1]	6	<ul style="list-style-type: none"> - Higher initial use of ICT in teaching (avg=4 vs. global avg=3.11, in a 1-6 scale [Q1]) - More positive initial attitudes towards usefulness of learning design for practice (avg=5 vs. global avg=4.5, in a 1-6 scale [Q1]) and reflection (avg=5.5 vs. global avg=4.72, in a 1-6 scale [Q1]) - Shorter teaching experience (avg=11.9 yrs vs. global avg=17.3 yrs [Q1]) - Less likely to consider guidance as more important than flexibility ($p=0$, vs. global $p=0.33$ [Q4]) 	<ul style="list-style-type: none"> - More mentions to WebCollage's visual appeal [Q2b][Q4] - Less mentions to WebCollage as being a powerful tool [Q2b][Q4] - More mentions to WebCollage as being too rigid [Q2b][Q4] - More mentions to appreciation of EDIT2's flexible structure [Q2b] - More positive mentions to adopting the authoring tools, especially for practice [Q2b][Q4]
5. Low initial usage of collaborative learning in teaching [Q1]	5	<ul style="list-style-type: none"> - Less positive initial attitudes towards usefulness of learning design for practice (avg=3.6 vs. global avg=4.5, in a 1-6 scale [Q1]) and reflection (avg=3.4 vs. global avg=4.72, in a 1-6 scale [Q1]) - Longer teaching experience (avg=21.4 yrs vs. global avg=17.3 yrs [Q1]) - Higher average scores of EDIT2 tool features' usefulness (aggregated practice index=0.79, vs global index=0.75 [Q2b]) - Higher average scores of guidance tool feature usefulness (aggregated practice index=0.85, vs global index=0.80 [Q2b]) - Less likely to consider adopting collaborative learning practices after the workshop, or the presented authoring tools (in both cases, $p=0.33$, vs. global $p=0.53$ [Q4]) - Less likely to consider flexibility as more important than guidance ($p=0$, vs. global $p=0.4$ [Q4]) 	<ul style="list-style-type: none"> - Less mentions to WebCollage's visual appeal, and to the usefulness of patterns [Q2b][Q4] - More mentions to problems with the vocabulary used in the tool's user interfaces [Q2b] - More mentions of appreciation of EDIT2's simplicity of use [Q4] - Less positive mentions to adoption of the authoring tools, either for practice or for reflection [Q2b]

Table A.4: Selected evidence from the heuristic clustering analysis of data, including the most noticeable deviations of each cluster from the total teacher participant averages (continued)

Cluster criteria	# of teachers	(main) Quantitative data differentiation	(main) Qualitative data differentiation
6. Initially exposed to EDIT2 tool [O1]	8	<ul style="list-style-type: none"> - Higher average scores of tool feature usefulness for practice purposes (aggregated practice index=0.79, vs global index=0.68 [Q2b]) - Higher average scores of WebCollage's tool features' usefulness (aggregated practice index=0.82, vs global index=0.75 [Q2b]) 	<ul style="list-style-type: none"> - More mentions to WebCollage as a powerful tool [Q2b][Q4] - More mentions to WebCollage as being too rigid [Q2b] - More mentions to the conceptual problems of translating scenarios into designs/patterns in the authoring tools [Q2b][Q4] - More mentions to the need for tutorials and other support for tool usage [Q2b]
7. Initially exposed to WebCollage tool [O1]	10	<ul style="list-style-type: none"> - Lower average scores of tool feature usefulness for practice purposes (aggregated practice index=0.59, vs global index=0.68 [Q2b]) - Lower average scores of WebCollage's tool features' usefulness (aggregated practice index=0.70, vs global index=0.75 [Q2b]) - Less likely to consider adoption of authoring tools after the workshop ($p=0.29$ vs. global $p=0.53$ [Q4]) 	<ul style="list-style-type: none"> - More mentions of appreciation of EDIT2's simplicity of use [Q2b] - Less mentions of appreciation of WebCollage's group automation features [Q2b][Q4], and of the usefulness of patterns [Q2b] <ul style="list-style-type: none"> - Less positive mentions of adopting the authoring tools for practice, and more negative mentions about adopting the authoring tools for reflection [Q2b][Q4]