

# Collage, a Collaborative Learning Design Editor Based on Patterns Special Issue on Learning Design

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# COLLAGE: A collaborative Learning Design editor based on patterns

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**ABSTRACT**

This paper introduces *Collage*, a high-level IMS-LD compliant authoring tool that is specialized for CSCL (Computer-Supported Collaborative Learning). Nowadays CSCL is a key trend in e-learning since it highlights the importance of social interactions as an essential element of learning. CSCL is an interdisciplinary domain, which demands participatory design techniques that allow teachers to get directly involved in design activities. Developing CSCL designs using LD is a difficult task for teachers since LD is a complex technical specification and modelling collaborative characteristics can be tricky. *Collage* helps teachers in the process of creating their own potentially effective collaborative Learning Designs by reusing and customizing patterns, according to the requirements of a particular learning situation. These patterns, called Collaborative Learning Flow Patterns (CLFPs), represent best practices that are repetitively used by practitioners when structuring the flow of (collaborative) learning activities. An example of an LD that can be created using *Collage* is illustrated in the paper. Preliminary evaluation results show that teachers with experience in CL but without LD knowledge, can successfully design real collaborative learning experiences using *Collage*.

**Keywords**

IMS-LD, CSCL, Learning flow, Patterns, Authoring tool

## Introduction

CSCL (Computer-Supported Collaborative Learning) constitutes a significant field that has drawn the attention of many researchers and practitioners (Dillenbourg, 2002). This domain is characterized by the coexistence of very different expectations, requirements, knowledge and interests posed by both collaborative learning practitioners and experts in information and communication technologies. In other words, CSCL is an intrinsically interdisciplinary field that implies a need for mutual understanding among the implied stakeholders. This need demands the active participation of all these stakeholders during the whole development cycle of CSCL solutions. Participatory Design (PD) approaches (Muller & Kuhn, 1993) propose a diversity of theories, practices, etc. with the goal of working directly with users and other stakeholders in the design of social systems. That is, PD methodologies define processes where users and developers work together during a certain period of time, while they identify the requirements of an application. In the CSCL case, it has been shown that it is not efficient enough to simply perform the identification and analysis of requirements for the development of CSCL solutions that support effective ways of learning. Collaborative learning practitioners also become active players in the process of customizing technological solutions to their particular needs in every learning situation. PD poses a new requirement that CSCL developers should tackle: how to obtain technological solutions for collaborative learning capable of being particularized/customized by practitioners that usually do not have technological skills.



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This paper explores a solution to this problem: facilitating practitioners to play the role of designers of those technological solutions. Specifically, how PD can be enabled by providing authoring tools for collaboration scripts that can be automatically interpreted and executed by LMSs (Learning Management Systems). A collaboration script is a set of instructions prescribing how students should form groups and how they should interact and collaborate in order to solve a problem (Dillenbourg, 2002). In order for these scripts to be interpreted by computer applications, (Hernández-Leo et al., 2005) propose to formalize them using IMS Learning Design (LD). LD is an educational modelling language that enables the description of any learning process in a formal way (IMS, 2003).

Since there are several LD compliant systems such as those based on CopperCore (Martens & Vogten, 2005), e.g. Gridcole (Bote-Lorenzo et al., 2004), a practitioner can influence in the behaviour and the functionality of a CSCL system by providing a collaboration script formalized with LD. The problem is that LD uses formalisms (XML) that are not familiar to educators. This fact means that authoring tools are needed to facilitate the elaboration of collaboration scripts. Furthermore, those tools should guide practitioners through that elaboration process by using representations and abstractions that are easy to understand and use by them.

At the moment, there are several LD editors available or under development. Some of them are listed in Griffiths et al. (2005), and in Griffiths & Blat (2005). Depending on the type of user (technical expert, instructional designer, teacher) and their degree of pedagogical specialization, these authors classify the tools according to two dimensions:

- Higher vs. lower level tools (or distant from specification vs. close to specification). This dimension is related to the level of expertise in LD required by the user of the tool. That is, how much the tool interface is influenced by LD or how many LD details it hides.
- General purpose vs. specific purpose tools. This dimension deals with the pedagogical scope of the tools. Teachers using a clearly defined pedagogical approach (e.g. collaborative learning) would not need all the capabilities of the LD specification. This implies that authoring tools more tightly focused on that particular pedagogical approach might present to their users only the needed functionality, reducing significantly the complexity of authoring.

The audience on which we focus the problem of authoring collaboration scripts or collaborative LDs is composed of teachers that are collaborative learning practitioners (novice or not). They do not need to know LD and they are not supposed to be technologists. In this sense, a *high-level specific collaborative learning editor* will be appropriate. However, we are not aware of any authoring tool specialized in collaborative learning that is distant from the specification.

RELOAD (RELOAD, 2005), CopperAuthor (OUNL, 2005) and COSMOS (Miao et al., 2005) are examples of general purpose editors that are close to the specification. Their target audiences are LD experts that are not focused on a particular pedagogy. MOT+ editor (Paquette et al., 2005) and ASK-LDT (Karampiperis & Sampson, 2005) are intended also for expert learning designers rather than teachers, although they provide graphical representations that facilitate the authoring task to a certain extent. However, the type of editor practitioners (usually classroom teachers and not expert learning designers) need should be similar to the authoring environment provided by LAMS (Macquarie University, 2005). LAMS is a specialized editor because it offers a set of predefined learning activities, shown in a comprehensible way for teachers, that can be graphically dragged and dropped in order to establish a sequence of activities. Nevertheless, although LAMS is inspired by the LD philosophy, it is not LD compliant at the present time.

The rationale for specific purpose and high level tools is particularly evident in the case of the CSCL domain, considering the difficulty implied in modelling collaborative learning processes (Hernández-Leo et al., 2005; Miao et al., 2005). These difficulties are, among other things, related to defining groups or structuring the flow of collaborative learning activities. Moreover, if the collaborative learning process is structured in order to favour productive interactions, the potential effectiveness of the collaborative LD is enhanced (Jermann et al., 2004). Structuring the collaborative learning process in an appropriate way is also relevant since free collaboration does not necessarily produce learning (Dillenbourg, 2002) and because of the risk involved in incorporating collaborative learning structures into a class or a course (NISE, 1997).

To overcome these drawbacks, we advocate the use of patterns (Alexander et al., 1977) that reflect best practices in collaborative learning structuring as LD templates that can be applied to many collaborative learning situations (Koper, 2005). We call these patterns Collaborative Learning Flow Patterns (CLFPs) (Hernández-Leo et al., 2005), since they represent broadly accepted techniques that are repetitively used by practitioners when structuring the flow of learning activities involved in collaborative learning situations. CLFPs can be

implemented in an editor as specific high-level collaborative learning structures built on top of LD. The main contribution presented in the paper is based on this idea: the provision of a specialised high-level collaborative learning editor that is capable of guiding teachers in the process of creating their own collaborative LD by starting from existing CLFPs. The tool is called *Collage*: *COLaborative LeArning desiGn Editor*.

Therefore, this paper is structured as follows: in the following section, our proposal of using CLFPs and LD to link collaborative learning practice with technology is introduced. It follows an analysis of *Collage*, which includes the description of the design process supported by the editor and its functionalities concerning the selection of CLFPs and the editing of the associated learning flow. Then, we illustrate the design process with an example and discuss the results of a preliminary evaluation study with real users. The paper ends with some concluding remarks and some pointers to future work.

## Linking Collaborative Learning Practice with ICT

Summarizing what has been exposed in the introduction; our general aim is to link collaborative practice with Information and Communication Technologies (ICT). In order to achieve this, we exploit:

- The use of LD specification and high-level LD editors for practitioners (i.e. teachers), so the created LDs can be automatically interpreted and executed by an LMS. One of the aims of LD is the possibility to share and modify LDs in order to build better practice for e-learning (Griffiths et al., 2005).
- The utilization of a particular type of educational pattern (Goodyear et al., 2004) regarding collaborative learning flows to introduce design techniques in an LD authoring tool, enabling teachers to easily create potentially effective collaborative LD by particularizing and customizing the patterns.

### Collaborative Learning Flow Patterns

CLFPs represent broadly accepted techniques that are repetitively used by practitioners when structuring the flow of types of learning activities involved in collaborative learning situations (Hernández-Leo et al., 2005). Thus, CLFPs can be understood as a way of collecting "best practices" in collaborative learning. These best practices refer to suitable ways of arranging participants in collaborative learning situations, sequencing types of collaborative learning activities, etc. in order to promote the achievement of a set of desired educational objectives. Among other advantages, they provide a way of communicating collaborative learning expertise to other (novice) practitioners: instead of trying to create their own collaborative designs from scratch, practitioners can reuse CLFPs as templates or guides for structuring their own collaborative situations.

Some examples of CLFPs are: TPS (Think-Pair-Share), Simulation, TAPPS (Thinking Aloud Pair Problem Solving) and Brainstorming (Aronson & Thibodeau, 1992; Johnson & Johnson, 1999; NISE, 1997). Table 1 summarizes two CLFPs. CLFPs can also be combined forming CLFP hierarchies. A collaborative learning situation may be designed according to several CLFPs in different levels. For instance, the "expert" phase of Jigsaw CLFP can be organized according to Pyramid CLFP.

*Table 1*. Summary of Jigsaw and Pyramid CLFPs

| CLFP Name | Jigsaw CLFP | Pyramid (or Snowball) CLFP |
|---|---|---|
| Problem | How should the collaborative learning flow of activities be for a context in which several small groups should solve a complex problem/task that can be easily divided into sections or independent sub-problems? | How should the collaborative learning flow of activities be for a context in which several participants face the resolution of the same complex problem, usually without a concrete solution, whose resolution implies the achievement of gradual consensus among all the participants? |
| Solution | Each participant (individual or initial group) in a group ("Jigsaw Group") studies or works around a particular sub-problem. The participants of different groups that study the same sub-problem meet in an "Expert Group" to exchange ideas. These temporary focus groups become experts in the subproblem given to them. Lastly, participants of each "Jigsaw group" meet to contribute with their "expertise" in order to solve the whole problem. | Each individual participant studies the problem and proposes a solution. Groups (usually pairs) of participants compare and discuss their proposals and, finally, propose a new shared solution. Those groups join larger groups in order to generate new agreed proposal. At the end, all the participants must propose a final and agreed solution. |

A necessary step before using CLFPs in an authoring tool is to represent them in a formal way. Our proposal for such a formalization, which has been reported in Hernández-Leo et al. (2005), is the basis for *Collage*.

## Collage tool

Collage is a graphic-based high-level specialized Learning Design authoring tool for collaborative learning. It is based on RELOAD (RELOAD, 2005), which provides a plug-in framework. Collage is IMS-LD level A (IMS, 2003) compliant.

### Design Process in Collage

The Best Practice and Implementation Guide included in the LD specification (IMS, 2003) details the different conceptual components of a system implementing LD. Figure 1 summarizes these modules, emphasizing the authoring problem and illustrating which functions are covered by *Collage*. Namely, *Collage* is not devoted to the enactment problem: instantiating LDs, binding participants to roles, interpreting an LD, etc. However, *Collage* allows the authoring of LDs. A Unit of Learning (UoL) is a content package (IMS, 2004) including an LD and a set of physical resources (content and tools) or their location. The resources that contain learning objectives, prerequisites, descriptions of activities and information about roles can be edited as text files in *Collage*. Other resources should be created with external editors.

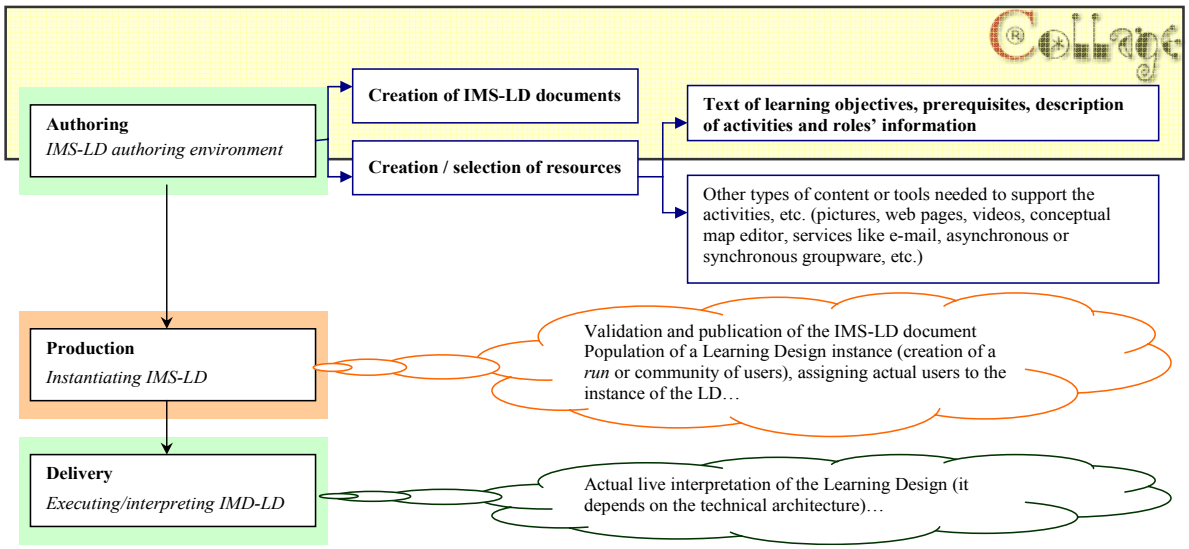



*Figure 1.* General modules of a system implementing LD

Designer's Guide, which is also included in LD specification (IMS, 2003), proposes the stages for creating a UoL. (Sloep et al., 2005) details these stages according mainly to three phases:

- Analysis of a specific educational problem. The result of this phase is a narrative description of what should be learnt, how it should be learnt as well as other characteristics of the educational situation.
- The narrative is translated into a UML activity diagram in the design phase. This diagram is the basis of an (XML) LD document.
- In the development phase the resources are created (if it is necessary) and added to the design, constituting a UoL.

These basic design phases are useful depending on the type of user that edits the UoL (designer, teacher, etc.) and, consequently, the type of authoring tool available. That is, different editors may support diverse design processes (Paquette et al., 2005). The more distant from the specification and specific purpose authoring tools are, the more valuable (for teachers) the supported design processes may be. This processes will be specially valuable if they provide a methodology for the analysis phase and enable teachers to understand and edit the UoLs (Griffiths et al., 2005).

The need for these kinds of processes is clearly evident in the complex CSCL domain. As it has been exposed in the introduction, planning collaborative learning designs to favour productive interactions is necessary. Strijbos et al. (2004) proposes a process-oriented methodology for the design of CSCL settings. The methodology implies that a conceptualization of the expected interaction is made explicit in advance and consists of six steps:

1. Determine which type of learning objectives should be specified.
2. Determine the expected interactions according to the specified objectives. It is related to the co-ordination of activities and the types of interaction promoted by the different types of activities (e.g. discussion).
3. Select task-types with respect to the learning objective and expected interaction. For example, if students have to solve a complex and ambiguous problem with no clear solution.
4. Determine how much structure is necessary to accomplish the learning objectives, expected interactions and task-types (e.g. privileged roles within an activity).
5. Determine which group size is best suited with respect to learning objective, expected interaction, task type and level of pre-structuring.
6. Determine how computer support is best used to sustain learning and expected interaction: face-to-face or computer mediated (synchronous or asynchronous).

Figure 2 shows the design process facilitated by *Collage*. The process is not strictly sequential. *Collage* provides guidance but it does not direct the user through a rigid wizard-style set of steps. The different tasks included in the *Collage* design process can be accomplished in the order preferred by the user.

The tasks included in the design process supported by *Collage* can be easily mapped to the steps indicated in the methodology proposed by Strijbos. Step 1 regarding learning objectives is partially performed in task *a* and completed in task *c*. Steps 2, 3 and 4 correspond to a large extent to the selection of a CLFP (mainly task *a*). Note that tasks *a* and *b* are repeated if the collaborative learning flow is structured according to a hierarchy of CLFPs (task *d*). Tasks *e* and *h* embody also step 4 as far as the structure of the interaction processes within activities is concerned. The description of an activity and the tool that supports it can represent a certain level of activity pre-structuring (e. g. a discussion activity supported by a simple chat vs. a chat with a structure dialogue interface that allows different roles). Task *e* clearly refers to step 5 (group-size). While determining the computer support (step 6) is accomplished in tasks *f*, *g* and *h*.

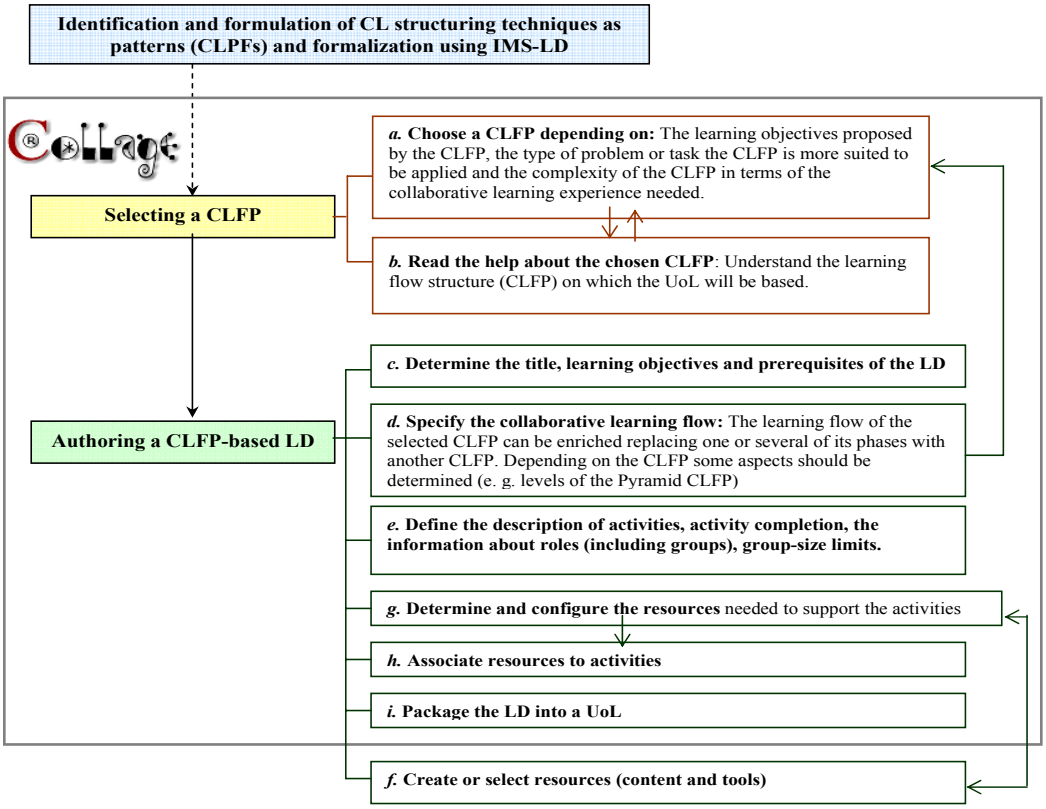



*Figure 2.* Design process in Collage

*Collage* and its implied design process represent an innovation to the phases recommended by LD specification in creating a UoL. Selection of CLFPs supports the analysis phase in which a collaborative learning situation is planned. It is necessary for teachers to know the structures (CLFPs) that are available in *Collage* in order to plan a feasible design to be created by *Collage*. On the other hand, the need for understanding those learning flows promotes the application of collaborative-learning best practices, i.e. reuse of CLFPs in their own educational settings. The design phase is highly simplified mainly thanks to the use of specific high-level collaborative learning structures (CLFPs) instead of raw LD elements. Moreover, the graphical interface provided by *Collage* facilitates the editing. That is, the UML diagram is not necessary (each CLFP has an intuitive diagram that represents the learning flow) and the XML code is automatically generated. Furthermore, available information about each CLFP and adequacy of CLFPs for educators enable teachers to understand and easily edit collaborative UoLs.

In order to offer a deeper understanding of these ideas, the selection of CLFPs and the authoring of LDs using *Collage* are analyzed in the following two subsections.

**Selecting a CLFP**

*Collage* provides a repository with a pool of CLFPs. The available CLFPs available at the moment are Jigsaw, Pyramid, Simulation, Brainstorming, TPS and TAPPS, but more CLFPs can be added. With the aim of facilitating the choice of CLFPs in *Collage*, a selection utility has been designed considering the following premises:

1. Potential *Collage* users may not explicitly know the collaborative techniques formulated in the CLFPs.
2. Users may not be familiar with pedagogical jargon. In this context it is more appropriate to indicate the meaning of the psychological term. E.g.: positive interdependence means that team members need each other to achieve a common goal.
3. Teachers should be able to select a CLFP, so that the LD they create is adequate for their educational purposes. Moreover, they should find CLFPs addressing their needs even if they do not know exactly the learning outcomes they want to promote.

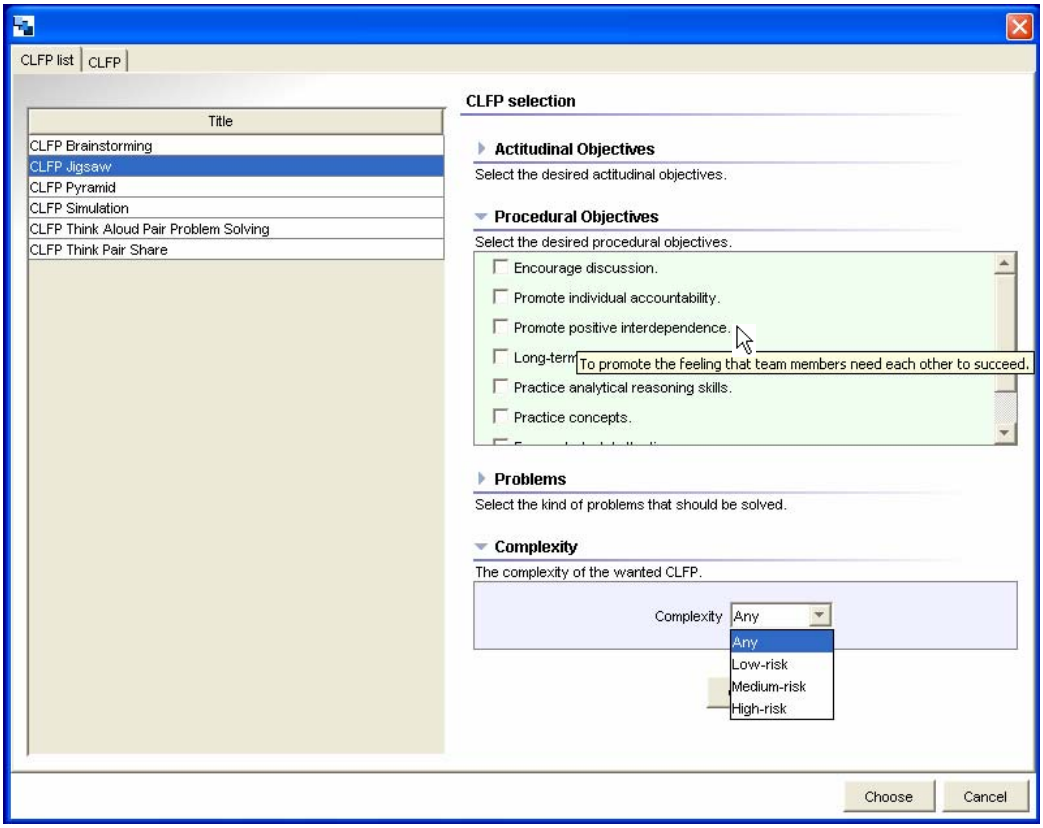
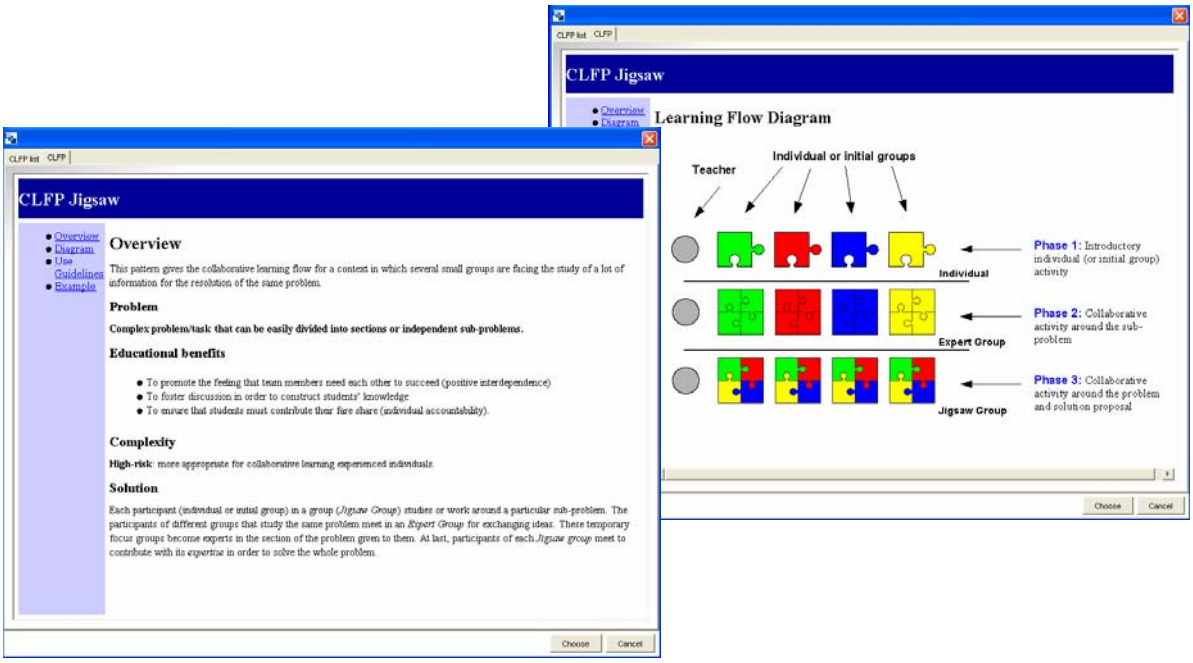



*Figure 3.* Collage CLFP selection interface

Figure 3 shows the interface of the CLFP selection utility, which allows the user to choose a CLFP directly or select one or several characteristics of CLFPs. The list of CLFPs displayed in the interface shows only the CLFPs that comply with the selected characteristics. These characteristics may or may not univocally identify a CLFP and they are retrieved from CLFPs' metadata, which include:

- **Learning objectives that the CLFP elicits**. They are related to the gain of conceptual knowledge, on one hand, and to the gain of meta-cognitive strategies, on the other hand (Miao et al., 2005). However, these objectives have been formulated in a simplified way (so teachers may understand them better) and classified in two types: attitudinal and procedural objectives. Attitudinal objectives are related to motivational and emotional competencies, while procedural objectives refer to the acquisition of skills. An example of an attitudinal objective is "to promote tolerance and respect" (Brainstorming CLFP). "To promote analytical reasoning skills" (TAPPS CLFP) is an example of a procedural objective. The fact that a CLFP can be selected according to objectives fulfils the two first steps of the methodology proposed in (Strijbos et al., 2004).
- **Types of problems that are best served with the CLFP**. It is equivalent to the selection of task type proposed in step 3 of Strijbos' methodology. For instance, the task type of Jigsaw CLFP is "complex problem that can be easily divided into sections or independent sub-problems".
- **Complexity or risk in terms of collaborative learning experienced needed**. Depending on the conditions in which the CLFP is to be applied or the experience in collaborative learning of teachers and learners, some CLFPs are recommended above others; e.g. Jigsaw CLFP is complex and is probably more appropriate for experienced participants (NISE, 1997).

Further information about each CLFP can be read by clicking on the title of a CLFP in the list of the selection interface. This information is displayed in a window that provides a navigation tree including four hyperlinks:




*(a* *(b)*

*Figure 4*. Help information about the Jigsaw CLFP: (a) overview, (b) diagram

Overview: apart from the learning objectives, the type of problem and the complexity of the CLFP, it contains the context in which the CLFP can be applied. It also explains the collaborative learning flow proposed by the pattern (see Figure 4 (a)).

Diagram: a graph illustrating the CLFP. The same graph is used in the authoring process (see Figure 4 (b)).
Use guidelines: indications and recommendations for particularization/customization, instantiation and execution (or authoring, production and delivery according to Figure 1).

Example: a sketch of a particular Learning Design based on the CLFP.

With this help information about CLFPs, teachers can be quite sure about the usefulness of a CLFP for their particular needs. In other words, they can understand the CLFP before reusing it and, consequently, they can be quite confident of the validity of the created UoL before running it in a real setting. The more significant functionalities of Collage that facilitate authoring of a CLFP-based LD are explained next.

***Authoring a CLFP-based LD***

Authoring LDs in Collage is actually a process of particularizing and adapting a CLFP according to the requirements of a particular learning situation. This includes tasks from c to i, as it is exposed in the recommended design process of Figure 2. The most significant functionality of Collage concerns task d: specifying the collaborative learning flow.

Once a CLFP is selected, the learning flow of the LD to be created is determined. However, it is necessary to state that it can be modified to a certain extent:

- Depending on the CLFP, configurable attributes are presented. That is, the user has to decide several aspects of the activity flow. A good example is Pyramid CLFP: it specifies the organization of activities (in a series of levels), and how participants will form groups and interact in each level, but the number of levels is not fixed. To create an LD based on this CLFP, users must first determine how many levels they want.
- Moreover, the flow of activities can be enriched by replacing phases of a CLFP with another CLFP. Whenever a new CLFP is to be inserted in the LD, the selection of CLFP functionality in *Collage* is presented. The result is a hierarchical structure of CLFPs. Although the actual number of CLFPs implemented in *Collage* is not large, there is no theoretical limit on the combinations of CLFPs that can be described.
- Apart from the configurable elements of each CLFP and the opportunity of combining several CLFPs, it is not explicitly possible to add or delete phases and activities. Nevertheless, *Collage* allows specifying an activity as not *visible*, which ensures that it will be ignored during the execution of the UoL.

Accordingly, Collage represents a trade off between generality and unrestricted design options vs. good reuse and particularization of CLFPs (and hierarchies of CLFPs) as well as an easy editing of collaborative LDs. Firstly, a simple intuitive graphical representation of each CLFP is provided. Secondly, users do not need to be aware of the existence and function of particular LD elements which are difficult to understand without knowing the specification. These elements are for instance activity-structure, method, play, act or role-part.

The tasks of describing activities and roles and associating resources to activities (tasks e and h of Figure 2) are facilitated by the use of forms, which are accessible by clicking on the graphical representation of each CLFP phase.

## Discussion

One aspect that should be remarked on regarding our collaborative LD editor is interoperability. Tests have determined that CopperCore validates the UoLs created by *Collage*. Since *Collage* has been implemented as a new editor in RELOAD, the tool identifies whether a UoL has been created by *Collage* or by another editor implemented in RELOAD, and opens the UoL using the appropriate editor. However, the LDs created using *Collage* can be eventually opened by, a priori, any LD compliant editor. (Note that high-level or specialized editors, such as *Collage*, may need additional information about their representation in the authoring tool, etc.). This point leads the discussion to one of the limitations of our editor: it cannot be used as a viewer for any UoL. Other types of authoring tools should be employed to accomplish this goal and to change low-level elements of the LDs created by *Collage.*

Although *Collage* can be used by instructional designers, it has been specifically designed to be used by teachers. We support the idea that teachers should be able to intervene actively in the design process, especially if they do not have the support of specific instructional designers. A massive support of ICT in Education or specifically of LD requires the participation of teachers as real practitioners who know the reality of their context and could possibly assume the adoption of good practices (such as those reflected in CLFPs).

The initial adopted approach for the selection of CLFPs is simple. A more valuable approach could be, for example, the use of ontologies. Another limitation regards the addition of new CLFPs. If a new CLFP is to be included in *Collage*, the plug-ins related to the graphical interface for editing the collaborative learning flow must be implemented. Although there is no limit to the possible combinations of CLFPs that can be created, concatenations of CLFPs (adopting separate sequenced CLFPs) are not allowed yet. At this point, it is necessary

to state that our LD editor approach is similar to LAMS in that it reuses predefined "modules" created with lower-level tools. However, *Collage* does not reuse at the granularity level of activities yet. It reuses the whole learning flow implied in collaborative learning best practices. There is definitely value in both approaches as they are complementary.

On the other hand, *Collage* supports only level A of the specification. In order to enrich and make more flexible the LDs that can be created using *Collage*, we are exploring the use of level B and C (IMS, 2003) in the formalization of CLFPs. That would enable the use of *properties* and *global elements* in order to define some flexible elements to be determined at run-time.

## Creating an LD using Collage

CLFPs have been previously used in real contexts (Aronson & Thibodeau, 1992) without authoring tools. Now we can see how *Collage* can further expand such useful design processes, making them more efficient and effective. This section shows how a real collaborative learning situation can be designed with our editor. Besides, a preliminary evaluation of the tool has been accomplished.

### Example: "Use of ICT in Education"

*Description of the example*

The example is connected to an experience that takes place within a course on "the use of ICT in education" at the Faculty of Education, University of Valladolid, Spain. This experience is one of the case studies included in the TELL project (TELL, 2005). This case study is a blended situation, where normal face-to-face activities are interleaved with technology-supported (distant or not) activities. It uses Synergeia system (ITCOLE, 2005). Synergeia combines an asynchronous component named BSCL (Basic Support for Cooperative Learning) and a synchronous component called MapTool. It mainly provides a shared web-based workspace in which documents and ideas can be shared.

The real scenario consists of 40 students (maximum). The example is an extract of the case study, in which students revise three topics in order to produce a deeper understanding of them. The analysis of the example is illustrated in Figure 5. The applied method is a combination of Jigsaw and Pyramid CLFPs.

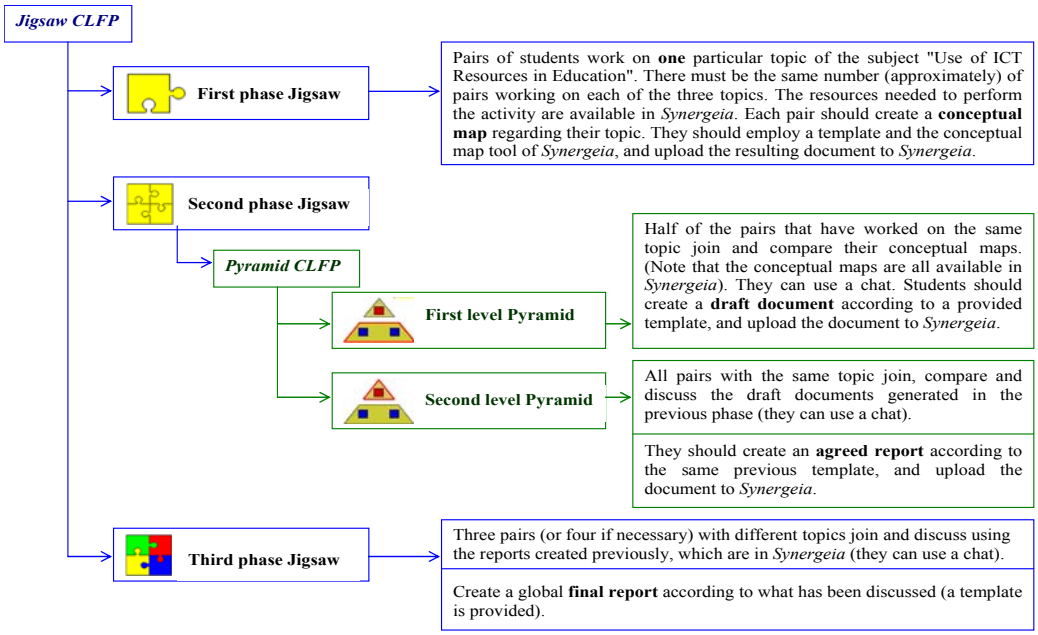



*Figure 5.* Analysis of the example based on Jigsaw and Pyramid CLFPs

*Authoring the example with Collage*

Figure 6 illustrates how the learning flow of the example can be edited using Collage. After selecting the CLFP base of the flow of activities, i.e. Jigsaw CLFP, the "Expert Group" phase is replaced with a two-level Pyramid CLFP. This is indicated with the circled "1", "2" and "3" of Figure 6. "4" points to the whole structure of the activity flow. This tree also provides access to any CLFP included in the hierarchical structure, thus the activities of each CLFP can be further particularized. The tasks of describing activities, roles, associating resources to activities, etc. are accomplished using a form analogous to the example shown in Figure 6. These steps are detailed in the worksheet included in the Collage user manual, which is available in (GSIC, 2005).

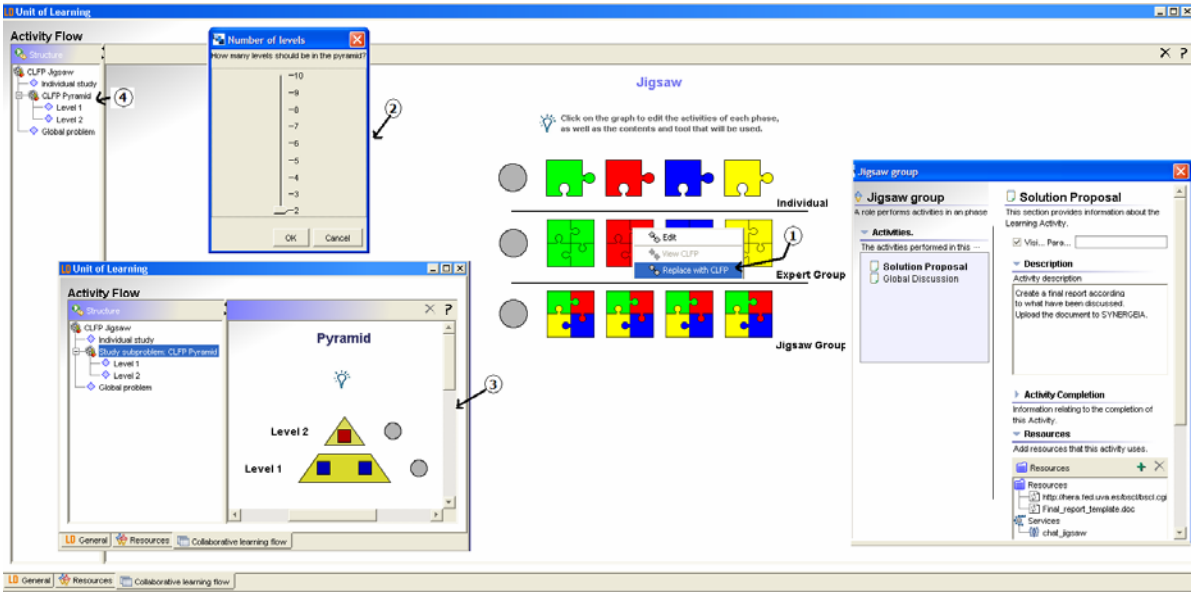



*Figure 6.* Editing the collaborative learning flow

**Preliminary Evaluation Results**

With the aim of obtaining some impressions about *Collage* from active teachers before using it in real situations, and in order to get some feedback for improving the tool, a preliminary evaluation has been accomplished at the present stage. We are not trying to provide definitive conclusions but a general idea of its usability in real practice. The conditions of the evaluation are the following. The three teachers of the course that correspond to the example shown in the previous subsection used *Collage* for the first time in order to create an LD describing this example (summarized in Figure 5) during 90 minutes. Two support persons were available for any question they may have.

The evaluation method that has been applied is a simplification of the mixed method proposed in (Martínez et al., 2003). Although it is devoted to the study of classroom social interactions, it includes quantitative approaches that allow us to detect general tendencies related to practitioners´ opinions and attitudes, and qualitative methods that help us to better understand these tendencies through the introduction of context issues and considering the participants' perspective (Stake, 1995).

In this sense, a small evaluation process has been designed in which the data has been built in the following way. During the first 15 minutes, practitioners were informed about the task and are provided with a user manual which includes a worksheet which illustrates the steps to create an example. During the experience, a qualitative evaluation expert made direct observations of the experiment so that difficulties were recorded. Then, each practitioner filled in an on-line questionnaire about the experience. Finally, an assessment of the LDs created was performed. The data has been examined (triangulated) considering the data (information of three teachers) and the techniques used to capture information (direct observation, questionnaire, analysis of the generated LDs).

To analyze the contributions generated during the process, a schema of categories has been established. The main categories are: user profile, general use of the editor, example creation and suggestions.

Regarding “user profiles” we can mention that they are teachers of the Faculty of Education that often practice collaborative learning but do not have LD knowledge. They are not technologist experts, however they usually integrate technological resources in their curriculum. They have not used any other LD tool. They are familiar with the techniques formulated in the CLFPs that *Collage* provides, which they find significant.

With regard to the “use of the editor” we can affirm that the way in which CLFPs are represented in *Collage* is considered quite adequate. The teachers’ original ideas about these techniques were rather similar to the way they are presented in *Collage*. We find arguments supporting the user-friendliness of *Collage*. For instance, they mention in the questionnaire that they do not have problems when selecting a CLFP or editing the title, objectives and prerequisites, a fact that is also commented on by the observer. Another conclusion is that the editor is considered to be intuitive: its graphical representations are quite useful for editing the flow of activities.

The main issues we can extract concerning “example creation” are as follows. First, they rate their experience in authoring the example as successful with minor problems that were easily coped with. In fact, CopperCore correctly validates the three UoLs, and the integrated LDs largely describe the learning situation of the example. However, all participants failed to particularize a specific activity, i.e., they do not enter a description or associate resources to the activity. This indicates the need to clearly specify the status of CLFPs and to highlight activities which have not been completed.

After the completion of the task, the opinions are quite positive: Teacher1 said, “It helps to think in terms of collaborative learning and its previous arrangement”. Teacher2 affirmed, “It helps to structure a complex learning design and promotes times and resources planning”. Teacher3 declared, “It enables the generation of contextualized learning processes according to the needs of each situation”. They also insisted on the usefulness of the provided CLFP help information. On the other hand, a drawback of *Collage* is the need for understanding CLFPs before the editing.

**Further evaluation and discussion**

Further evaluation has been performed. Two other teachers used *Collage* to try to design existing experiences they had performed in their classrooms. Both teachers belong to the research team that promotes *Collage*, although their knowledge of LD is minor and their first contact with the *Collage* tool takes place during this evaluation experience.
The first teacher teaches a course on "Operation, Administration and Maintenance of Communication Networks". He used *Collage* to design a two-hour experience consisting of a collaborative reading and discussion of a difficult long technical paper. Students are divided in groups of three and each group is organized according to the Jigsaw CLFP in order to read the paper. For the final step of the Jigsaw ("experts" share their expertise and agree on a final proposal) the teacher selects the Brainstorming CLFP. Final proposals simply consist of a list of the ten most important ideas found in the paper. Then, the different groups start working according to the Pyramid CLFP so as to agree on a final and unique list of 10 ideas.

The second teacher utilized *Collage* to design an existing approach in the graduate course of “Advanced Telematic Systems”, in which students try to propose a research question on a complex interdisciplinary field that involves several keywords. In order to achieve this goal, a Jigsaw CLFP is employed, where students in the expert group study and propose research questions related to some of the keywords. Then, students in the “jigsaw groups” try to merge the research questions.

The conclusions of the evaluation in these cases, which followed an analogous evaluation method to the one used in the preceding subsection, are quite similar to the results of the previous preliminary evaluation. However, some minor usability problems become apparent due to the fact that the teachers did not use any worksheet indicating the steps they should follow. They finally managed to create both UoLs, which were validated in CopperCore, and they were able to adequately shape their learning situations (one of the teachers affirms that *Collage* provided him with new design ideas). Nevertheless, they recognized a *Collage* limitation regarding the addition of complementary activities to the defined CLFPs and the possible need for making the description of CLFPs more flexible.

The designs employed in the evaluation study may be applied to different types of situations: synchronous and asynchronous, face-to-face and distant situations, with or without computer-supported activities or blended situations that mix different facets. Thus, *Collage* allows the creation of LDs for any combination of these

environments. Furthermore, the durations of the diverse examples are quite different (from a two-hour to a month session).

Nevertheless, these evaluations are limited. Further evaluation with users that do not know the techniques formulated in CLFPs is especially needed. Additionally, running UoLs created by *Collage* in real settings with students is also desirable. These new evaluation studies might contribute towards a more consistent and thorough evaluation, which would address a limitation of current research in the field of LD.

## Conclusions

This paper has presented *Collage*, a collaborative LD editor that is intended to be used by teachers. It allows an easy editing of UoLs by reusing and customizing best practices, which are formulated as patterns (CLFPs), in structuring the flow of collaborative and non-collaborative learning activities. The ultimate goal of an LD editor such as *Collage*, is to create significant, pedagogically sound scenarios that can be interpreted by players. *Collage* covers an essential part of the participatory design process and therefore it may form part of the whole life-cycle of an LD. *Collage* can be integrated into a system that enables creation, modification, adaptation, running and testing. In our case, we are in the process of integrating *Collage* into Gridcole (Bote-Lorenzo et al., 2004), a system capable of interpreting LDs and setting up the technological environment needed to support all the (collaborative) learning activities included in the LD.

In addition to accomplishing further evaluation studies with users of our University, evaluating *Collage* by an independent testing agency would be particularly useful. Although there are no easily available solutions, we will try to propose this issue within our participation among different projects.

Additional future work includes: adding more CLFPs and researching whether other types of patterns (e.g. activity patterns) can also be included in the editor. We may come to some conclusions in this sense using the work that is under way within TELL project, in which we are identifying patterns following a bottom-up approach, i.e., using real case studies as a starting point. In addition, we are currently exploring solutions to the lack of support for LD levels B and C in *Collage*. This problem has not been highlighted in the evaluation, perhaps because users designed scenarios that did not require a complete implementation through an LD player. However, it is necessary to study and evaluate this aspect in a larger variety of scenarios.

We have also planned the development of new functionality for *Collage*: the creation of a printed lesson plan of the UoL. It could be used to check if the created LD actually conforms to the collaborative learning situation analyzed for their particular situation, or to simply directly use the schema in a face-to-face situation without computer support. Moreover, we are exploring the possibilities and limitations of several alternatives for creating LDs that include both CLFPs and other structures that are not based on them. Furthermore, we expect to develop a management tool that will easily enable the creation of groups and the further binding of individuals to groups according to the CLFP hierarchy structure of an LD created by our authoring tool. *Collage* will be released under the General Public License.

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