GENERATING CSCL SCRIPTS

From a conceptual model of pattern languages to the design of real scripts

INTRODUCTION

E-learning environments designed for computer-supported collaborative learning (CSCL) mediate social interactions as key activators of learning. However, free collaboration does not necessarily by itself produce the interactions we want. Scaffolding collaboration can increase the probability of successful learning outcomes (Fischer, Kollar, Mandl, & Haake, 2007). CSCL scripts embedded in (Dillenbourg & Jermann, 2007), or interpreted by (Hernández-Leo et al., 2006c), e-learning environments aim to shape the way learners interact with each other to elicit fruitful interactions.

The design of effective scripts is a non-trivial task that requires significant expertise in, and knowledge of, the possibilities and risks of structuring collaboration (Fischer et al., 2007). This chapter focuses on patterns as a way of formulating and sharing experience regarding the design of potentially effective scripted collaborative learning situations.

Design patterns capture reusable knowledge about a contextualized problem and its associated, broadly accepted, solution. Patterns are decoupled when they are applied, but they work together with other interconnected patterns to generate emergent contextualized wholes. A pattern language (PL) embraces a set of patterns relevant to a specific design space, together with the rules that link the patterns together in meaningful ways, so that they provide guidance when creating a space-related whole (Alexander et al., 1977).

In this chapter we aim to identify the types of patterns, and connections between patterns, that can be used for generating CSCL scripts. These types of patterns and relationships are formulated as a conceptual model (or meta-language) for describing CSCL scripting PLs. That is to say, CSCL scripting is the design space of the patterns and rules that can be situated in the proposed conceptual model. We believe this model can provide the scientific community with a starting point for an agreed high-level structure for the production of patterns and PLs that enable the generation of CSCL scripts. Each institution or community of practice may have its own patterns of effective scripted CL situations that typify that particular community. We can foster the sharing and communication of good practice within and between communities if such practice can be framed within the same conceptual model (Goodyear, de Laat & Lally, 2006).

To illustrate the feasibility of this proposal, an Appendix to this chapter includes a CSCL scripting PL (with our own and some adopted patterns) that can be
described with the conceptual model. The PL comprises 18 patterns; each pattern documents its relationships to other patterns. The map of relationships sketches many ways in which the patterns may be put together when creating different CSCL scripts. Different patterns and connections of patterns may or may not apply, depending on the context of a particular educational situation. Nevertheless, it is important to point out that the PL is not complete as a set, in the sense that these patterns cannot be used to generate any CSCL script. Each community can augment the PL with its own patterns, or propose different ones (which might borrow from some of the other patterns). This chapter also sets out a real scripted CL situation generated using the proposed PL. The situation expresses and illustrates the relationships between the patterns and shows how the diverse types of CSCL scripting patterns can be applied.

We start by describing the methodology used to propose the conceptual model and the PL.

METHODOLOGY

We developed our conceptual model and PL as an iterative process, accomplished as we identified the constituent patterns of the PL. We formulated some of these patterns ourselves, and adopted others from other authors. We identified some patterns using knowledge culled from the literature by applying a deductive or top-down approach; we discovered others in case studies, using a more inductive or bottom-up approach (Baggetun, Rusman, & Poggi, 2004).

Capturing experience reported in the literature

Some of the patterns collected in the Appendix were identified and constructed according to experience broadly reported in the literature. In other words, the resulting patterns represent best or good practice (when scripting CL situations) that has been extensively tested and applied in a broad range of situations (including a variety of content and disciplines).

One well known example of this is the ‘jigsaw’ strategy, introduced by Aronson & Thibodeau (1992) and applied by many others, including DiGiano et al. (2003). A generalization of the strategy is formulated as the JIGSAW pattern in the Appendix (Pattern 1.1). Briefly, the jigsaw strategy relates to a situation where several small groups of students (‘jigsaw’ groups) each try to solve a complex problem that can be divided into independent sub-problems. Each group participant studies or works around just one sub-problem. Participants from the various different jigsaw groups meet up in temporary ‘expert’ groups to exchange ideas about their common sub-problems. Finally, participants return to their jigsaw group to contribute their newly acquired expertise to solve the whole problem. Two of the educational objectives this strategy favours are: promoting the sense that team members need each other to succeed (positive interdependence), and ensuring that students contribute their fair share (individual accountability).

Other patterns included in the Appendix that are formulated following this approach are: PYRAMID or SNOWBALL (Pattern 1.2), THINK-PAIR-SHARE (Pattern
1.3), BRAINSTORMING (Pattern 1.4), SIMULATION (Pattern 1.5) or THINKING ALOUD PAIR PROBLEM SOLVING (Pattern 1.6).

A similar approach is applied by Retalis, Georgiakakis & Dimitriadis (2006), where they follow a reverse-engineering process for identifying good design practices embedded in e-learning systems and, at the same time, analysing the way users employ those systems in authentic scenarios. The resulting patterns for CSCL systems can be found in Georgiakakis & Retalis (2006). One of them, MANAGEMENT OF ON-LINE QUESTIONNAIRES (cf. Pattern 3.2), has been adopted for our CSCL scripting pattern language.

Using case studies as a starting point

Other patterns included in the Appendix were distilled using case studies related to scripted CL situations. Some of them arose from the TELL project (TELL, 2005) and the process we followed is based on the procedures employed in that project.

A case study served as the starting point for the initial selection of titles and topics for potential patterns. It involved an experience that took place within a course on ‘The use of ICT resources in education’ (NNTT, its acronym in Spanish) at the Faculty of Education, University of Valladolid, Spain (Ruiz-Requies, Anguita-Martínez & Jorrín-Abellán, 2006). However, the design of this experience also benefited from a previous case study that concerned a course on ‘Computer architecture’ (CA) at the School of Telecommunications Engineering, also at the University of Valladolid (Martínez-Monés et al., 2005). It is noteworthy that, although the content and discipline of the case studies differed, NNTT reused several design issues deeply evaluated in CA.

During the enactment of NNTT we iteratively wrote and evaluated the patterns. We held several meetings with the various stakeholders (teachers and researchers) related to the case study to discuss the patterns. We also consulted literature related to the problems tackled by the patterns, with the aim of complementing the analysis of their forces and the associated solutions. In this phase, we also identified links between the patterns so that together they form meaningful designs. Furthermore, a workshop for reviewing the patterns was held as part of a meeting of the TELL project. We received feedback on the patterns at this meeting and in subsequent asynchronous interactions. Each pattern received two reviews from two different participants in the project.

Using NNTT as a starting point, we proposed the following patterns, which are included in the Appendix: ENRICHING THE LEARNING PROCESS (Pattern 1.7), INTRODUCTORY ACTIVITY: LEARNING DESIGN AWARENESS (Pattern 2.1), PREPARING FRUITFUL DISCUSSIONS USING SURVEYS (Pattern 2.3), ENRICHING DISCUSSIONS BY GENERATING COGNITIVE CONFLICTS (Pattern 2.4), GUIDING QUESTIONS (Pattern 3.3) and FACILITATOR (Pattern 4.1). JIGSAW and PYRAMID were formulated using information from the literature, but they were also applied in this case study. Since NNTT benefited from the practice of the CA course, CA also exhibited some of these patterns.
Other patterns considered in the CSCL scripting pattern language were proposed by other authors within the TELL project and, thus, were also formulated using this procedure. They are THE ASSESSMENT TASK AS A VEHICLE FOR LEARNING (Pattern 2.5) and STRUCTURED SPACE FOR GROUP TASKS (Pattern 3.1).

As mentioned earlier, all these patterns can be linked, forming a PL that outlines many different possibilities for designing a script. The methodology presented in this section led us to identify the different types of patterns and relationships between them that can appear in potential CSCL scripting PLs. In the next section we introduce a conceptual model for PLs covering the CSCL scripting design space. We present this in the form of an aggregation model (according to the granularity and scope of the types of CSCL scripting patterns) and the description of types of pattern-connecting rules.

CSCL SCRIPTING PATTERN LANGUAGES CONCEPTUAL MODEL

CSCL scripting is not an isolated design space. On the contrary, it is highly interrelated with other spaces involved in educational design. Figure 1 shows how CSCL scripting patterns relate to other types of patterns. Higher level patterns of CSCL scripting patterns are those related to high level pedagogy (e.g. collaborative learning or inquiry learning) (Goodyear, 2005).

Moreover, patterns devoted to diverse didactics for specific subject matter are also relevant when designing a script for a specific discipline. While strategies related to eliciting desired social interactions are common between the scripts, insights and experiences of, for example, teaching statistics in MBA programmes or mathematical games are also helpful in the design of scripts for such domains.

Therefore, CSCL scripting PLs are embraced by larger PLs regarding pedagogical approaches and are complemented by other PLs capturing the educational experience of specific knowledge domains. A similar approach is taken in architecture patterns (Alexander et al., 1977), where, for example, a PL for
building a porch completes a larger PL for designing a house; and in organizational patterns for agile software development (Coplien & Harrison, 2005), which proposes that a ‘Project Management PL’ complements a ‘People and Code PL’.

**Aggregation model and types of connecting rules**

The conceptual model for CSCL scripting PLs comprises an aggregation model and the types of connecting rules that relate patterns situated at the same and at different levels of aggregation. The aggregation model (Figure 2) fits in well with the target design space, since good practices applied when creating CSCL scripts can be grouped at different granularity levels: sets of activities that are organized in CL flows vs. single activities vs. the resources (materials and tools) that supports the single activities. Patterns at the different levels are complementary and need each other for completeness, so they can be aggregated or related forming a hierarchical structure.

![Figure 2: Aggregation model of CSCL scripting pattern languages](image)

Some authors already distinguish between macro scripts and micro scripts (Fischer et al., 2007). Coarse-grained (or macro) scripts describe general flows of collaborative (or non-collaborative) learning activities (e.g. those following the jigsaw strategy). Fine-grained (or micro) scripts give detailed support within specific activities (e.g. scripts for argumentative knowledge construction). Thus, the highest (coarser) aggregation or granularity level for CSCL scripting patterns is related to the CL flow: the sequence of activities that make up a learning process. Some examples of patterns at this level are JIGSAW and PYRAMID patterns, whose solutions form a generalization of actual learning flows. Other patterns directly related to the learning flow, but not necessarily proposing a flow structure, are also
situated at this level. Another granularity level refers to the activities themselves. An example of a pattern at this level is DISCUSSION GROUP (Pattern 2.2). In addition, we propose a third (finest) granularity level that includes the resources (materials and tools) needed to support the activities. Some examples are the patterns proposed in Chapter 2 and Georgiakakis & Retalis (2006) such as MANAGEMENT OF ON-LINE QUESTIONNAIRES.

Some aspects, such as roles or common collaborative mechanisms (namely, group formation, floor control and awareness), can be directly connected to some of the patterns at any of the aforementioned granularity levels. For example, roles can be defined globally at the level of the whole learning flow, within activities or/and within collaborative tools (e.g. usage of the FACILITATOR pattern). Thus, the patterns that state a principle about these aspects are usually integral parts of learning flows, activities or resources.

The connection rules between patterns are as much part of a PL as the patterns themselves. A pattern serves to embellish higher-level patterns, to work alongside patterns at the same level, and to provide a context for lower-level patterns. This organization provides a powerful way of expressing educational design knowledge and formulating comprehensible guidance. In particular, four different types of connecting rules are identified:

- **Complete (embellish):** following the idea of composition indicated by the aggregation model and other pattern-based approaches (Alexander et al., 1977), patterns at higher levels need patterns at lower levels for completeness. Resources complete activities that, in turn, complete CL flows. Roles and common collaborative mechanisms complete resources, activities or CL flows. Patterns at the same level can also complete each other. In all these cases the pattern that is completed with other patterns determines the range of the whole.

- **Complement:** patterns at the same level may complement each other. A pattern that complements another pattern does not refine or modify the principles of the second pattern (as happens with the ‘complete’ connecting rule). On the contrary, these patterns form two parts of a larger whole, not previously embraced by any of the patterns. As an exception, patterns at the activity level may complement those at the learning flow level by adding (instead of refining) new phases to the flow.

- **Alternative to:** some patterns can tackle the same category of problem within a context whose particular details derive from alternative solutions. Alternative patterns can be interchanged, but they cannot be used in a complementary way – probably because of contradictoriness or redundancy (Harrer, 2006).

- **Specialize:** patterns at the same aggregation level can formulate principles that range from general design ideas to their reusable specialization (David, Delotte, Chalon, Tarpin-Bernard, & Saikali, 2003). Patterns that formulate general design ideas have more ‘degrees of freedom’ than patterns that formulate their reusable specializations. ‘Degrees of freedom’ in this context can be understood as the number of design options that the solution of the pattern does not suggest; these are free to be varied creatively.

These dependencies between the patterns provide guidance for their application and prevent a conjoining of scripting strategies that do not make sense together from a pedagogical perspective or which even inhibit each others’ effects (Harrer,
Now we will use a hierarchical structure (representing the aggregation levels) to illustrate how the PL included in the Appendix fits in with the conceptual model.

An illustrative CSCL scripting pattern language: hierarchical structure

The patterns listed in the Appendix are organized according to the proposed conceptual model forming a hierarchical structure (Figure 3). The structure is represented as a graph (Hernández-Leo, Villasclaras-Fernández, Asensio-Pérez, Dimitriadis, & Retalis, 2006): the patterns are identified with nodes, which are related by edges. The graph shows that there are many paths through the patterns that guide their application. Because of representational limitations, not all the possible connections between patterns are drawn in the figure. However, all the relationships presented by the proposed PL are documented in the corresponding fields of the patterns.

There are two clear manifestations of the ‘is alternative to’ and ‘specialize’ relationships. FREE GROUP FORMATION (Pattern 4.2) is alternative to CONTROLLED GROUP FORMATION (Pattern 4.3). Both are CL mechanisms devoted to group formation. ASSEMBLING GROUPS is needed to complete the suggestions of patterns at the CL flow activity level and also at the resource level (cf. STRUCTURED SPACE FOR GROUP TASKS). However the specific characteristics of the problem that arise from (slightly) different contexts (e.g. a large demanding assignment vs. an assignment that benefits from diverse or conflicting knowledge) lead to divergent solutions that are mutually exclusive.

On the other hand, preparing fruitful discussions using surveys and enriching discussions by generating cognitive conflicts are specializations of DISCUSSION GROUP. That is, they adapt DISCUSSION GROUP to a more specific context and thus related problem, undergoing specialization. DISCUSSION GROUP is framed within a context that requires organizations forms for knowledge sharing, questioning and critique. The other two patterns add to this context the issue that the participants may consider their previous results or ideas before sharing the knowledge. In this sense, the solutions of the specialized patterns are more concrete in their suggestions, offering fewer design options to the users, so that the essence of the pattern is not lost.
PREPARING FRUITFUL DISCUSSIONS USING SURVEYS (Pattern 2.3) and ENRICHING DISCUSSIONS BY GENERATING COGNITIVE CONFLICTS (Pattern 2.4) also form a good illustrative example of how two patterns at the same level complement each other, shaping a whole not previously embraced by any of them. While Pattern 2.3 proposes preparing a survey for students to answer before the discussion to organize their ideas, Pattern 2.4 suggests providing students with their classmates’ answers so that they can reflect on potentially different approaches and thus generate new questions and issues for discussion. The answers to the surveys organized following the purpose according to Pattern 2.3 can be complementarily used as indicated by Pattern 2.4 for a different purpose. Together, Patterns 2.3 and 2.4 represent a debate strategy that spans two different phases, whose range is not considered separately by either of them.

There are many other examples manifesting the ‘complement’ relationship in the PL. For instance, the GUIDING QUESTIONS can be presented to the students according to MANAGEMENT OF ON-LINE QUESTIONNAIRES. A FACILITATOR complements the pattern CONTROLLED GROUP FORMATION since this may be the role in charge of assembling the groups. Moreover, the learning flow of a whole educational unit might comprise a pattern at the CL flow level; e.g. JIGSAW,
complemented with another flow, e.g. PYRAMID, that follows or precedes the flow suggested by the former pattern. Again, the limits of the whole resulting from this concatenation of patterns is determined by the two patterns (one of them indicates the start of the learning flow and the other its end).

The ‘complete’ connecting rule also appears when combining two patterns at the CL flow level. In this case, a phase suggested by a pattern is organized according to another pattern (which can be eventually the same, Hernández-Leo et al., 2006b; Hernández-Leo et al., 2006c). For example the ‘expert group’ phase of the JIGSAW may be structured following the PYRAMID. The base learning flow, indicating the start and the end of the learning flow is not modified. In contrast, the proposal of the JIGSAW is refined, being in the resulting design the PYRAMID an integral part of the adapted JIGSAW.

This type of relationship clearly intervenes between patterns at the different levels. The knowledge of THE ASSESSMENT TASK AS A VEHICLE FOR LEARNING (Pattern 2.5) may be considered when completing the design of any of the activity types orchestrated in JIGSAW. Similarly, STRUCTURED SPACE FOR GROUP TASK (Pattern 3.1) refines Pattern 2.5 by indicating the type of resources that may be useful for supporting the activity. A FACILITATOR may also complete the activity design ideas indicated by Pattern 2.5 or the behaviour of certain collaboration tools according to Pattern 3.1.

The hierarchical structure depicted in Figure 3, which emphasizes the rules that connect the patterns, provides guidance regarding the order in which the patterns are to be applied. We argue that all the CSCL scripting PLs that conform to the conceptual model proposed follow similar hierarchical structures. This fact allows the definition of general guidelines for applying those PLs.

**General guidelines for applying the PL described with the conceptual model**

How can we apply the patterns of a CSCL scripting PL described with the conceptual model? Authors of pattern-based proposals for other design spaces (for example, Alexander et al., 1977; Coplien & Harrison, 2005) suggest that we start at the top level and work towards the bottom. When a pattern points to several subtending patterns, they can also be applied or not in any order, taking into account the semantic differences indicated by the four types of relationships. Deciding whether or not to apply a pattern depends on the context. A PL can be considered as a map collecting numerous meaningful paths, but the path that is chosen will depend on the circumstances.

For patterns to be selected, they must be helpful and feasible in a specific situation. The point is not to use as many patterns as possible, but to choose those patterns that solve the problems that actually appear in an educational situation. Progression through the PL requires a prior knowledge of the patterns or reflection on the different design possibilities before their selection. In fact, this analysis is enabled by the PL, which also provides a basis for discussion. The result is a set of interrelated patterns that together generate a sequence (a story) that shapes the design of a specific script.
Evidently, each PL has a limited number of patterns. A PL represents the experience of someone (or a community of practice) when creating CSCL scripts. However, the educational context of an external person using the PL may have specific needs that request new patterns or different versions of the patterns. Additionally, a user of a PL (for example, the PL of the Appendix) might need to apply a pattern in a way that is not considered in the map of established relationships. The special characteristics of the educational domain and the unpredictable characteristics of CL situations demand flexibility when applying PLs. In general, teachers should be able to consider a new pattern, or try a pattern that is out of sequence, if their intuition leads them to do so. The constant evaluation of the effects of the resulting script enables the evolution of the PLs.

All in all, if we provide a teacher with a CSCL scripting PL, the desire is that the selected sequence of patterns keeps the essence of the constraints that are intrinsic to the pedagogical principle of each pattern in the sequence. The extrinsic constraints, in contrast to the intrinsic ones, necessarily derive from the application of the patterns to particular situations. These extrinsic constraints represent the (arbitrary) design decisions reflected in a script that are suitable for being modified (Dillenbourg & Jermann, 2007). This idea is in line with the proposal of preserving structure discussed for architecture patterns by Alexander (2003). Alexander proposes a process that involves step-by-step applications of patterns in such a way that the whole increases by structure-preserving transformations. These transformations gradually add symmetries (described as centres) that enable the unfolding of the whole.

Some of Alexander’s ideas (Alexander, 2003), also considered by Coplien & Harrison (2005), can be adopted as general iterative guidelines when applying the CSCL scripting PLs:

– Consider your educational situation as a whole, get a feeling for how the course is working, and try to identify its ‘weak points’. Perhaps you have recently applied another pattern, which left you in a new context or produced explicit forces that are not yet resolved.

– Focus on what can be done to enhance the script, considering the target objectives. Are you striving for development of a specific skill? Or are you seeking to motivate your students? Read the patterns so that you can find help to resolve these questions.

– Find a place where the application of a new pattern – the consideration of a new role, the addition of a new structured activity, changing the learning flow – will achieve your goal. Will any of the patterns help you? Do you know of other strategies that will help? Apply the patterns (or other strategies) locally.

– Look at the structure of the PL. Each pattern indicates which patterns may come next as complements or refinements.

– Reflect on the application of the patterns. Do they work? Evaluate the effects of the pattern-based script so that the conclusions provide you with feedback for further designs.

The following example of an actual script, generated using the PL from the Appendix, further expresses the different aggregation levels and relationships that connect the patterns. It also illustrates how the hierarchical structure conceptually
guides the process that can be followed when applying the patterns. Note that the patterns selected for the example themselves form a small PL.

APPLYING THE CSCL SCRIPTING PATTERNS: AN EXAMPLE

This example is drawn from real-life experience of a computer network protocols course at the University of Valladolid, Spain. The script used was designed by explicitly applying the CSCL scripting patterns (in the Appendix) from scratch. Hernández-Leo, Asensio-Pérez, & Dimitriadis (2006) detail the characteristics of the course’s educational context, together with findings from evaluating the experience. They demonstrate fruitful results from following the good practice captured by the patterns.

In this chapter we describe the scripted experience as a story that shows a process of growth. Other possible sequences that can be described with the same PL are the two case studies (NNTT and CA) used as a starting point to identify the patterns. The sequences offer different paths (from the many possibilities for the PL) that result in particular wholes (scripts).

Pattern-based design of the ‘computer network protocols’ script

Considering the educational situation as a whole, and the weak points identified in experiences of previous years, the course teachers selected a sequence of patterns belonging to the PL in the Appendix. The main weak point of this course was that the large set of protocol mechanisms under study demanded that students set up a correspondingly large set of traffic interchange scenarios. Students’ efforts were directed, to a significant extent, at performing repetitive configuration tasks. This hampered them from focusing on understanding the protocol mechanisms themselves, the circumstances under which they are intended to be useful and their mutual influence (Hernández-Leo et al., 2006a). Teachers wanted to find ways to resolve these problems.

Having this objective in mind, and starting at the top level, the teachers selected JIGSAW as the basis to structure the CL flow of the script. They also decided to complement this pattern with PYRAMID, by refining the ‘jigsaw group phase’ with a two-level pyramid structure. The result was a CL flow that combined the JIGSAW and PYRAMID patterns (Figure 4).
The formulation of both patterns in the Appendix indicates the context in which they can be applied and what they suggest, along with the educational benefits that they foster. This information indicated that the selected patterns would be helpful and feasible for the conditions of the situation faced. For example, the adequateness of JIGSAW is, among other issues, manifested by the fact that the list of protocol mechanisms (and thus scenarios of traffic interchange) can easily be divided into sets.

Students belonging to the same pair worked together on the common set of protocol mechanisms and studied a particular set. (These tasks are all part of the

<table>
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<tr>
<th>JIGSAW (group formation according to FREE GROUP FORMATION)</th>
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<tr>
<td>Jigsaw phase: “individual (or initial group) work”</td>
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<tr>
<td><strong>INTRODUCTORY ACTIVITY: LEARNING DESIGN AWARENESS</strong></td>
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<tr>
<td>- Explanation of the educational design</td>
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<tr>
<td>- Each pair works on the common set of protocol mechanisms</td>
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<td>- Each pair works on an assigned set of mechanisms and</td>
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<tr>
<td><strong>THE ASSESSMENT TASK AS A VEHICLE FOR LEARNING</strong></td>
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<tr>
<td>- Write a report to be shared in BSCW, a STRUCTURED SPACE FOR GROUP TASKS</td>
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<th>DISCUSSION GROUP</th>
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<tr>
<td>PREPARING FRUITFUL DISCUSSIONS USING SURVEYS</td>
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<tr>
<td>- Questionnaire on the common and assigned set of mechanisms with GUIDING QUESTIONS and MANAGEMENT OF ON-LINE QUESTIONNAIRES</td>
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<tr>
<td>ENRICHING DISCUSSIONS BY GENERATING COGNITIVE CONFLICTS</td>
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<tr>
<td>- Discussion on the results guided by the teacher, the result is a list of controversial points to be used as GUIDING QUESTIONS in a discussion with other “experts”</td>
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<th>DISCUSSION GROUP</th>
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<tr>
<td>“jigsaw group” (I)</td>
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<td>Each pair in a “super group” explains to the others the mechanisms of its assigned set</td>
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| “jigsaw group” (II) |
| Analysis of “combined scenarios” according to: |

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<th>PYRAMID</th>
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<tr>
<td><strong>Pyramid level 1</strong></td>
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<td>- Each pair works individually</td>
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<tr>
<td><strong>Pyramid level 2</strong></td>
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<tr>
<td>- The whole “super group” compares and discusses the obtained results and tries to obtain a common consensus. Teachers act according to FACILITATOR</td>
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*Figure 4 Schema of the script designed using the illustrating PL*
For assessment purposes, but also with the aim of training students’ writing skills, the teachers asked the students to write a report on the assigned set of mechanisms. Following the ASSESSMENT TASK AS A VEHICLE FOR LEARNING the teachers gave students a lot of control over how they carried out the elaboration of the report, making sure that they had sufficient time to plan and execute it well. The reports had to be shared at least between the pairs that joined in a ‘jigsaw group’ in the tenth session. Therefore, a STRUCTURED SPACE FOR GROUP TASKS that facilitates sharing these resources was provided to the students. (The teacher selected the collaboration system BSCW as the actual tool to support this functionality.)

Furthermore, the teachers planned to organize a DISCUSSION GROUP about their progress in the study of the TCP mechanisms before finishing the report. That discussion aimed at clarifying detected misunderstandings and generating new questions on the mechanisms intended to motivate further work and collaboration. In this way, the teachers applied PREPARING FRUITFUL DISCUSSIONS USING SURVEYS and, consequently, arranged an on-line survey with questions related to the different mechanisms, so that students answered the survey before the discussion and organised their ideas and arguments supporting them. The answers from the survey were then used by the teachers with the aim of ENRICHING DISCUSSIONS BY GENERATING COGNITIVE CONFLICTS in the actual discussion. The students had the opportunity to read their classmates’ answers and to notice that their results might be wrong, thus generating new doubts that could be discussed. The questions proposed in the survey were used by students and teachers as GUIDING QUESTIONS to identify the important issues to be discussed. This was facilitated with a tool that enabled the MANAGEMENT OF ON-LINE QUESTIONNAIRES.

Following the number of interconnections with other patterns indicated in JIGSAW and PYRAMID, the teachers decided to complete the learning flow with the principles proposed by patterns at other levels. In the first session the teachers, according to INTRODUCTORY ACTIVITY: LEARNING DESIGN AWARENESS, planned to explain the whole learning design so that the students were aware of and understood it.

Moreover, the teachers gave the students, as the outcome of the discussion, a list of controversial points that were also used as GUIDING QUESTIONS in the ‘expert group’ phase of JIGSAW. In this phase, the pairs that had worked on the same set of mechanisms joined to perform a DISCUSSION GROUP about the controversial points related to their set of mechanisms. The discussion was not formally structured by the teachers. However, following the FACILITATOR pattern; they monitored and occasionally intervened when necessary. The outcome of the discussion was a list of discussed topics and agreed conclusions.

In the ‘jigsaw group’ phase of the JIGSAW each pair explained to the others (who had studied a different set of mechanisms) the mechanisms of its assigned set. After that, following a PYRAMID structure, they worked on ‘combined scenarios’. At the first level of the pyramid the work was accomplished in pairs, and then the results were discussed and compared in ‘super groups’ at the second level of the
pyramid. The teachers also acted according to the FACILITATOR pattern in these activities.

It is also worth mentioning, that with the aim of achieving a greater involvement of students in the course, and because the tasks involved demanding assignments, students took a part in deciding, at the beginning of the course, how to form ‘super-groups’ and how to assign mechanism sets to each pair. Thus the teachers applied the principles of FREE GROUP FORMATION and not of CONTROLLED GROUP FORMATION.

CONCLUSION

This chapter proposes a conceptual model of PLs for CSCL scripting. We have explained the different types of patterns, and the relationships among them, that can be used for generating CSCL scripts. The types of patterns are described in an aggregation model that differentiates the patterns according to their granularity: CL flows, which comprises activities, which are supported by resources (tools and material). Roles and common CL mechanisms are modelled as elements that are integral parts of flows, activities and resources. The patterns associated with the different elements of the model can be related with connecting rules, indicating that a pattern completes another pattern (by refining the principles of the completed pattern), or that a pattern complements a second pattern (forming a new larger whole). Patterns at the same level may also complement and/or complete each other, may represent alternative patterns (mutually exclusive) and specialize other patterns. The connections between the patterns provide guidance for their meaningful application and prevent the bringing together of patterns that do not make sense from a pedagogical perspective. Thus, we have set out some general guidelines for applying the PLs that can be described with the proposed conceptual model.

The feasibility of the conceptual model is demonstrated by our use of a specific PL for CSCL scripting. This comprises 18 patterns and illustrates the different types of patterns and relationships considered in the model. New patterns can be added to this PL or other PLs (reflecting the experience of other communities of practice) can be proposed. For example, we are currently incorporating assessment patterns in the PL (Villasclaras-Fernandez, Hernández-Leo, Asensio-Pérez & Dimitriadis, submitted). The initial results indicate that the general model does not change as a result. We believe this conceptual model represents a starting point towards an agreed high level structure that enables the sharing and communication of good scripting practices within and between communities (see Chapter 8).

We have also shown how a script applied in a real situation can be generated using the example PL. Considering that other possible sequences of patterns can be described with the same PL (the case studies from which some of the patterns are identified), it is possible to state that proposed PL and potentially any PL situated in the conceptual model comply with the properties of generative ness, coherence and moral preoccupation (achieving effective scripts that lead to learning). CSCL scripting patterns offer inspiration and guidance based on equilibrium between rigour and prescription that enables creativity. They impose constraints that are related to the intrinsic knowledge of the patterns. In this sense, they close off a
number of design options while still allowing an infinite number of possible specific scripts.

Regarding the (automatic) generation of coherent scripts, we are also working on the implementation of some of the patterns (mainly patterns at the CL flow level) as templates in authoring tools (Hernández-Leo et al., 2006c). A complementary approach is to add other patterns as assistants. Following the metaphor of Alexander (Alexander, 2003), the genes are the functionalities of the software tools that facilitate the generation of potentially effective scripts adapted to particular situations according to the decisions of the user. If these tools are accepted and widely spread through the educational institutions and the scripts can be implemented or interpreted by as many as possible e-learning environments, we are contributing to the technological enhancement of teaching and learning practices.

REFERENCES


HERRÁNDEZ-LEO, ET AL.


A.1 Collaborative learning flow level (Collaborative Learning Flow Patterns)

Pattern 0.1 JIGSAW **

... within a collaborative learning scenario in which SCRIPTED COLLABORATION (pattern 11 from (E-LEN, 2005)) is seen as a remedy for situations where free collaboration does not lead to learning, it may be necessary to plan how groups will perform a set of interrelated activities. This pattern gives the organization of a collaborative learning flow for a context in which several small groups are facing the study of a lot of information for the resolution of the same problem.

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If groups of students face resolution of a complex problem/task that can be easily divided into sections or independent sub-problems, an adequate collaborative learning flow may be planned.

The flow of collaborative learning activities to be followed in order to solve a complex divisible task should promote the following educational benefits (Aronson et al., 1992; Clarke, 1994; Johnson & Johnson, 1999):

- To promote the feeling that team members need each other to succeed (positive interdependence)

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1 This appendix is also published as part of: Hernández-Leo, D. (2007). A pattern-based design process for the creation of CSCL macro-scripts computationally represented with IMS LD, PhD Thesis, University of Valladolid.
- To foster discussion in order to construct students’ knowledge
- To ensure that students must contribute their fare share (individual accountability)

However, the solution for structuring collaboration in order to tackle this problem may be complex and probably more appropriate for collaborative learning experienced teachers and learners. It may be best suited for the end of the semester when the students are comfortable with group work. Therefore:

**Structure the learning flow so that each student (individual or initial group) in a group (“Jigsaw Group”) studies or work around a particular sub-problem. Then, encourage the students of different groups who study the same problem meet in an “Expert Group” for exchanging ideas. These temporary focus groups become experts in the section of the problem given to them. At last, students of each “Jigsaw group” meet to contribute with its “expertise” in order to solve the whole problem.**

Patterns that **complement** this pattern: the learning flow of a whole educational unit might comprise this Jigsaw structure preceded or followed by other set of activities, which can be organized as other patterns at the collaborative learning flow level – PYRAMID (Pattern 1.2), BRAINSTORMING (Pattern 1.4), TPS (Pattern 1.3), SIMULATION (Pattern 1.5), TAPPS (Pattern 1.6). If necessary, the learning flow can be enriched according to ENRICHING THE LEARNING PROCESS (Pattern 1.7) or preceded by INTRODUCTORY ACTIVITY: LEARNING DESIGN AWARENESS (Pattern 2.1).

Patterns that **complete** this pattern: some of the Jigsaw phases might be planned according to other collaborative learning flows – PYRAMID (Pattern 1.2), TPS (Pattern 1.3), BRAINSTORMING (Pattern 1.4), TAPPS (Pattern 1.6), or activities – INTRODUCTORY ACTIVITY: LEARNING DESIGN AWARENESS (Pattern 2.1), DISCUSSION GROUP (Pattern 2.2), THE ASSESSMENT TASK AS A VEHICLE FOR LEARNING (Pattern 2.5). The groups indicated by the Jigsaw structure may be formed according to FREE GROUP FORMATION (Pattern 4.2), CONTROLLED GROUP FORMATION (Pattern 4.3).
Pattern 0.2 Pyramid ** (aka Snowball)

… within a collaborative learning scenario in which scripted collaboration (pattern 11 from (E-LEN, 2005)) is seen as a remedy for situations where free collaboration does not lead to learning, it may be necessary to plan how groups will perform a set interrelated activities. This pattern gives the organization of a collaborative learning flow for a context in which several students face the collaborative resolution of the same problem.

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If groups of students face resolution of a complex problem/task, usually without a concrete solution, whose resolution implies the achievement of gradual consensus among all the students, an adequate collaborative learning flow may be planned.

The flow of collaborative learning activities to be followed in order to solve a complex task, whose resolution implies the achievement of gradual consensus, might promote the following educational benefits (Davis, 2002; Gibbs, 1995):
- To promote the feeling that team members need each other to succeed (positive interdependence)
- To foster discussion in order to construct students’ knowledge
- To enable the development of negotiation skills

The risk involved in structuring collaboration so that a gradual consensus is achieved is medium. That is, the experience needed in collaborative learning needed is not too high.

Therefore:

Structure the learning flow so that the students start (individually or forming an initial small group) studying the problem and proposing an initial solution. Then, encourage groups (usually pairs) to compare and discuss their proposals and, finally, propose a new shared solution. Guide the students so that the groups join in larger groups in order to generate new agreed proposals. At the end, all the students may propose a final and agreed solution.

Patterns that complement this pattern: the learning flow of a whole educational unit might comprise this Pyramid structure preceded or followed by other set of activities, which can be organized as other patterns (or even the same pattern) at the collaborative learning flow level – JIGSAW (Pattern 1.1),
BRAINSTORMING (Pattern 1.4), TPS (Pattern 1.3), SIMULATION (Pattern 1.5), TAPPS (Pattern 1.6). If necessary, the learning flow can be enriched according to ENRICHING THE LEARNING PROCESSES (Pattern 1.7) or preceded by INTRODUCTORY ACTIVITY: LEARNING DESIGN AWARENESS (Pattern 2.1).

Patterns that complete this pattern: some of the Pyramid levels might be planned according to other collaborative learning flows – JIGSAW (Pattern 1.1), TPS (Pattern 1.3), BRAINSTORMING (Pattern 1.4), TAPPS (Pattern 1.6), or activities – INTRODUCTORY ACTIVITY: LEARNING DESIGN AWARENESS (Pattern 2.1), DISCUSSION GROUP (Pattern 2.2), THE ASSESSMENT TASK AS A VEHICLE FOR LEARNING (Pattern 2.5). The groups indicated by the Pyramid structure may be formed according to FREE GROUP FORMATION (Pattern 4.2), CONTROLLED GROUP FORMATION (Pattern 4.3).

**Pattern 0.3** THINK-PAIR-SHARE (TPS)**

… within a collaborative learning scenario in which SCRIPTED COLLABORATION (pattern 11 from (E-LEN, 2005)) is seen as a remedy for situations where free collaboration does not lead to learning, it may be necessary to plan how groups will perform a set interrelated activities. This pattern gives the organization of a collaborative learning flow for a context in which students are paired to solve a challenging or open-ended question.  

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**If groups of students face resolution of a challenging or open-ended question, an adequate collaborative learning flow may be planned.**

Students are much more willing to respond after they have had a chance to discuss their ideas with a classmate because if the answer is wrong, the embarrassment is shared. Also, the responses received are often more intellectually concise since students have had a chance to reflect on their ideas with the one another. The flow of collaborative learning activities to be followed in order to solve a challenging or open-ended question, might promote the following educational benefits (NISE, 1997; Millis & Cottell, 1998):

- To promote the feeling that team members need each other to succeed (positive interdependence).
- To foster discussion in order to construct students’ knowledge.
- To focus students’ attention on a particular topic.
- To give a chance to formulate answers by retrieving information from long-term memory.

The solution for structuring collaboration in order to tackle this problem may be ideally suited for individuals who are new to collaborative learning. Therefore:

**Structure the learning flow so that each student has time to think about the question. Then, encourage them to pair and discuss their ideas about the question. Finally, they may comment or take a classroom “vote”**.
Patterns that **complement** this pattern: the learning flow of a whole educational unit might comprise this TPS structure preceded or followed by other set of activities, which can be organized as other patterns at the collaborative learning flow level – JIGSAW (Pattern 1.1), PYRAMID (Pattern 1.2), BRAINSTORMING (Pattern 1.4), SIMULATION (Pattern 1.5), TAPPS (Pattern 1.6). If necessary, the learning flow can be enriched according to ENRICHING THE LEARNING PROCESSES (Pattern 1.7) or preceded by INTRODUCTORY ACTIVITY: LEARNING DESIGN AWARENESS (Pattern 2.1).

Patterns that **complete** this pattern: some of the TPS phases might be planned according to other collaborative learning flows – JIGSAW (Pattern 1.1), PYRAMID (Pattern 1.2), BRAINSTORMING (Pattern 1.4), TAPPS (Pattern 1.6), or activities – INTRODUCTORY ACTIVITY: LEARNING DESIGN AWARENESS (Pattern 2.1), DISCUSSION GROUP (Pattern 2.2), THE ASSESSMENT TASK AS A VEHICLE FOR LEARNING (Pattern 2.5). The groups indicated by the TPS structure may be formed according to FREE GROUP FORMATION (Pattern 4.2), CONTROLLED GROUP FORMATION (Pattern 4.3).

**Pattern 0.4 BRAINSTORMING** (AKA ROUNDTABLE)

… within a collaborative learning scenario in which SCRIPTED COLLABORATION (pattern 11 from (E-LEN, 2005)) is seen as a remedy for situations where free collaboration does not lead to learning, it may be necessary to plan how groups will perform a set interrelated activities. This pattern gives the organization of a collaborative learning flow for a context in which several students face the generation of a large number of ideas.

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If groups of students face the resolution of a problem whose solution requires the generation of a large number of possible answers/ideas in a short period of time, an adequate collaborative learning flow may be planned.

The flow of collaborative learning activities to be followed in order to solve a task, whose resolution implies the generation of a large number of possible answers/ideas in a short period of time, might promote the following educational benefits (NISE, 1997; Millis & Cottell, 1998):
To encourage learners to take risks in sharing their ideas
- To demonstrate students that their knowledge and their language abilities are valued and accepted
- To teach acceptance and respect for individual differences
- To focus students’ attention on a particular topic

The solution for structuring collaboration so that a large number of ideas are generated may be ideally suited for newly formed groups, since they do not need to clarify their ideas.

Therefore:

Structure the learning flow so that students in the same group write down their answers to stated question. Explanations, evaluations, and questions are not permitted as the ideas are generated. This process might continue until students run out of possible solutions. After that, encourage each group to review and clarify their ideas. If needed, the group may present the generated ideas to the rest of the class.

Patterns that complement this pattern: the learning flow of a whole educational unit might comprise this Brainstorming structure preceded or followed by other set of activities, which can be organized as other patterns at the collaborative learning flow level – JIGSAW (Pattern 1.1), PYRAMID (Pattern 1.2), TPS (Pattern 1.3), SIMULATION (Pattern 1.5), TAPPS (Pattern 1.6). If necessary, the learning flow can be enriched according to ENRICHING THE LEARNING PROCESSES (Pattern 1.7) or preceded by INTRODUCTORY ACTIVITY: LEARNING DESIGN AWARENESS (Pattern 2.1).

Patterns that complete this pattern: some of the Brainstorming phases might be planned according to other collaborative learning flows – JIGSAW (Pattern 1.1), PYRAMID (Pattern 1.2), TPS (Pattern 1.3), TAPPS (Pattern 1.6), or activities – INTRODUCTORY ACTIVITY: LEARNING DESIGN AWARENESS (Pattern 2.1), DISCUSSION GROUP (Pattern 2.2), THE ASSESSMENT TASK AS A VEHICLE FOR LEARNING (Pattern 2.5). The groups indicated by the TPS structure may be formed according to FREE GROUP FORMATION (Pattern 4.2), CONTROLLED GROUP FORMATION (Pattern 4.3). Each brainstorming group may comprise a FACILITATOR (Pattern 4.1).
Pattern 0.5 SIMULATION **

(aka ROLE-PLAY)

… within a collaborative learning scenario in which SCRIPTED COLLABORATION (pattern 11 from (E-LEN, 2005)) is seen as a remedy for situations where free collaboration does not lead to learning, it may be necessary to plan how groups will perform a set interrelated activities. This pattern gives the organization of a collaborative learning flow for a context in which the members of one or several groups perform a character in a simulation.

***

If groups of students face a problem whose resolution implies the simulation of a situation in which several characters are involved, an adequate collaborative learning flow may be planned. The flow of collaborative learning activities to be followed in order to solve a task, whose resolution implies the simulation of a situation in which several characters are involved, might promote the following educational benefits (Paulsen, 1995):

- To promote the feeling that team members need each other to succeed (positive independence)
- To ensure that students must contribute their fare share (individual accountability)
- To help students feel as well as understand the dynamics of a complex situation

The risk involved in charring out a simulation/role play is medium or high. Role-plays are usually hard to organize in large classes and that students may feel too shy or too time restricted to participate effectively in real-time simulations.

Therefore:

Structure the learning flow so that each student consults information about the problem/situation to be simulated and prepare the role of their character. Then, encourage the students in the same simulation group (usually small groups) perform a particular situation related to the problem. After that, the trained simulations may be performed to the rest of the class (large group). Finally, the whole class may discuss and share their conclusions about the problem.
Patterns that complement this pattern: the learning flow of a whole educational unit might comprise this Simulation structure preceded or followed by other set of activities, which can be organized as other patterns at the collaborative learning flow level – JIGSAW (Pattern 1.1), PYRAMID (Pattern 1.2), TPS (Pattern 1.3), BRAINSTORMING (Pattern 1.4), TAPPS (Pattern 1.6). If necessary, the learning flow can be enriched according to ENRICHING THE LEARNING PROCESSES (Pattern 1.7) or preceded by INTRODUCTORY ACTIVITY: LEARNING DESIGN AWARENESS (Pattern 2.1).

Patterns that complete this pattern: some of the Simulation phases might be planned according to other collaborative learning flows – JIGSAW (Pattern 1.1), PYRAMID (Pattern 1.2), TPS (Pattern 1.3), TAPPS (Pattern 1.6), or activities – INTRODUCTORY ACTIVITY: LEARNING DESIGN AWARENESS (Pattern 2.1), DISCUSSION GROUP (Pattern 2.2), THE ASSESSMENT TASK AS A VEHICLE FOR LEARNING (Pattern 2.5). The groups indicated by the TPS structure may be formed according to FREE GROUP FORMATION (Pattern 4.2), CONTROLLED GROUP FORMATION (Pattern 4.3).

**Pattern 0.6 THINKING ALOUD PAIR PROBLEM SOLVING (TAPPS)**

… within a collaborative learning scenario in which SCRIPTED COLLABORATION (pattern 11 from (E-LEN, 2005)) is seen as a remedy for situations where free collaboration does not lead to learning, it may be necessary to plan how groups will perform a set interrelated activities. This pattern gives the organization of a collaborative learning flow for a context in which several students are paired and given a series of problems.

If students face a series of problems whose solutions imply reasoning processes, an adequate collaborative learning flow may be planned.

The flow of collaborative learning activities to be followed in order to solve a series of problems whose solutions imply reasoning processes, might promote the following educational benefits (NISE, 1997; Millis & Cottell, 1998; Slavin, 1995):
- To foster discussion in order to construct students’ knowledge
- To permit students to rehearse the concepts and produce a deeper understanding of the material
- To encourage analytical reasoning skills
- To support problem solving skills

The risk involved in structuring collaboration so that a series of problems are reasoned in pairs is medium. That is, the experience needed in collaborative learning needed is not too high. Therefore:

Structure the learning flow so that students are paired and given a series of problems. Give the two students specific roles that switch with each problem: Problem Solver and Listener. The problem solver reads aloud and talks through the solution of the problem. The other (the Listener) follows the Problem Solver’s steps and catches any errors that occur. The Listener may ask questions if the Problem Solver’s thought process becomes unclear. The question asked, however, should not guide the problem solver to a solution nor should they explicitly highlight a specific error except to comment that an error has been made.
Patterns that **complement** this pattern: the learning flow of a whole educational unit might comprise this TAPPS structure preceded or followed by other set of activities, which can be organized as other patterns at the collaborative learning flow level – JIGSAW (Pattern 1.1), PYRAMID (Pattern 1.2), TPS (Pattern 1.3), BRAINSTORMING (Pattern 1.4), SIMULATION (Pattern 1.5). In necessary, the learning flow can be enriched according to ENRICHING THE LEARNING PROCESSES (Pattern 1.7) or preceded by INTRODUCTORY ACTIVITY: LEARNING DESIGN AWARENESS (Pattern 2.1).

Patterns that **complete** this pattern: the phase N+1 of the TAPPS phases might be planned according to other collaborative learning flows – JIGSAW (Pattern 1.1), PYRAMID (Pattern 1.2), TPS (Pattern 1.3), BRAINSTORMING (Pattern 1.4), or activities – DISCUSSION GROUP (Pattern 2.2), THE ASSESSMENT TASK AS A VEHICLE FOR LEARNING (Pattern 2.5). The groups indicated by the TPS structure may be formed according to FREE GROUP FORMATION (Pattern 4.2), CONTROLLED GROUP FORMATION (Pattern 4.3).
Pattern 0.7 Enriching the Learning Process

… within a collaborative learning scenario in which scripted collaboration (pattern 11 from (E-LEN, 2005)) is seen as a remedy for situations where free collaboration does not lead to learning, this pattern proposes how to enrich the learning process for a synchronous context in which the process of the concurrent activities included in a scrip, which are performed simultaneously by different groups, is not the same.

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How can the learning process be designed so that the (group of) students that perform some activities at faster rates can employ the time till the rest of the group finish (note that in collaborative learning synchronization of group activities is a key issue) to escalate the level and quality of the learning experiences?

The reasons of why the progress of different group of students is different may be, for instance, the different backgrounds of the members of the groups, their organizational skills or the particular skills needed to perform a particular task (artistic skills, technological skills). Apart from the feeling of boredom that can appear among the groups that finish first (and might wait for the rest of the groups before continuing with the next activity, maybe because they have to form different groups), in Education it is advisable to provide students with the opportunities, resources and encouragement necessary to achieve their maximum potential without decreasing their motivation (Renzulli & Reis, 2005).

Therefore:

Apply the know-how of gifted education to improve the learning process (the collaboration script) in a way that some enriching challenging complementary activities are provided for the (groups of) students that already completed any (basic or curricular) activity of the design. Note that enriching activities might be planned following an organized approach with clear goals (related to the general objectives of the whole learning design) and a definable structure. Three types of enrichment activities can be considered: type I suggest exposing students to a wide variety of topics, hobbies, places that would not ordinarily be covered in the curriculum, type II consists of training general activities that promotes the development of processes such as creative thinking or communication skills, and type III may be devoted to students who become interested in pursuing a self-selected area and have the time necessary for advanced content acquisition and process training in which they assume the role of a first-hand inquirer.
Patterns that complement this pattern: enriching activities may precede, follow or be included within collaborative learning flow structures – JIGSAW (Pattern 1.1), PYRAMID (Pattern 1.2), TPS (Pattern 1.3), BRAINSTORMING (Pattern 1.4), SIMULATION (Pattern 1.5), TAPPS (Pattern 1.6).

Patterns that complete this pattern: enriching activities may be planned according to other collaborative learning flows – JIGSAW (Pattern 1.1), PYRAMID (Pattern 1.2), TPS (Pattern 1.3), BRAINSTORMING (Pattern 1.4), TAPPS (Pattern 1.6), or activities – DISCUSSION GROUP (Pattern 2.2), THE ASSESSMENT TASK AS A VEHICLE FOR LEARNING (Pattern 2.5).

A.2 Activity level

Pattern 0.1 INTRODUCTORY ACTIVITY: LEARNING DESIGN AWARENESS *

... within a scripted collaborative learning scenario whose flow of activities may be structured according to patterns at the collaborative learning flow JIGSAW (Pattern 1.1), PYRAMID (Pattern 1.2), TPS (Pattern 1.3), BRAINSTORMING (Pattern 1.4), SIMULATION (Pattern 1.5), TAPPS (Pattern 1.6), this pattern proposes to consider an introductory activity explaining the collaborative learning design for a context in which meaningful learning and positive interdependence are desired to be fostered.

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Students may be aware of the collaborative learning process that they will perform so that their learning is potentially meaningful and so that positive interdependence among the members of the groups is encouraged. This pattern discusses how this might be accomplished.

One of the principles of instruction is that learning is facilitated when learners are shown the task that will be able to do or the problem they will be able to solve as a result of completing a module or course, i.e. learning is facilitated when learners are engaged at the problem or task level not just the operation of action level (the actions and operations that comprise the tasks). Showing learners the task or problem they will be able to solve is more effective that stating abstract learning objectives (Merril, 2002). On the other hand, many researchers (such as (Dillenbourg, 1999a)) in order to differentiate cooperation vs. collaboration, emphasise the contributions of group members and associate cooperative with division
of labour procedures and collaborative with equality of contributions to the same problem solution. In this sense, collaboration scripts, which are often complex (risky) learning processes, need a high degree of positive interdependence so that the performance and interaction in a collaborative learning setting is successful (Strijbos et al., 2004). Positive interdependence refers to the perception that a member of the group is linked with others in a way so that (s)he cannot succeed unless they do (and vice versa); i.e., their work benefits (s)he and her/his work benefits them (Johnson & Johnson, 1999). It promotes cohesion and a heightened sense of belonging to a group.

In order to promote the feeling that team members need each other to succeed, it is necessary to let students be aware of the whole collaborative learning process they will perform, so that they understand: Why are going to collaborate? How is going to be the collaboration (coordination among groups, etc.)? How dependent is their performance on the performance of the others?

Therefore:

*Include in the learning flow an introductory activity that explains the whole learning design: present the task (or problem) they will solve and the flow (sequence) of activities they will perform (including the different groups they may form) in order to complete the task.*

1. Explain the learning design. The **task/problem** needs to be clear and measurable
2. Explain the objectives to ensure transfer and retention (objectives may be stated as outcomes)
3. Explain the principles and strategies students need during the design and relate them to their past experiences
4. Explain the procedures (flow of activities, group formation, etc.) the students are to follow in completing the task
5. Ask students specific questions to check their understanding of the learning design
6. Ask the questions the task will focus on to (a) establish expectations and (b) organize in advance what they know about the topic

Patterns that **complement** this pattern: this type of introductory activity might precede other activities – DISCUSSION GROUP (Pattern 2.2), THE ASSESSMENT TASK AS A VEHICLE FOR LEARNING (Pattern 2.5).

Patterns that **complete** this pattern: a FACILITATOR (Pattern 4.1) may be in charge of keeping awareness of the whole learning design. Use GUIDING QUESTIONS (Pattern 3.3) to check if the learning design has been understood.
**Pattern 0.2 DISCUSSION GROUP**

A version of this pattern appears in (Goodyear, 2005).

... within a scripted collaborative learning scenario whose flow of activities may be structured according to patterns at the collaborative learning flow JIGSAW (Pattern 1.1), PYRAMID (Pattern 1.2), TPS (Pattern 1.3), BRAINSTORMING (Pattern 1.4), there may be activities devoted to discussion. This pattern is mainly concerned with the establishment of appropriate organizational forms for knowledge sharing, questioning and critique.

***

**Discussion groups are the most common way of organizing activity in networked learning environments. The degree to which a discussion is structured, and the choice of structure, is key in determining how successfully the discussion will promote learning for the participants.**

Discussions can be relatively structured or relatively unstructured, and they may also change their character over a period of time. It is not uncommon for a teacher to set up a discussion in quite a formal or structured way, and for the structure then to soften as time goes by - for example, as the participants take hold of the conversation, opening up and following new lines of interest.

The structure of a discussion should be such that it increases the likelihood of:

a) an active and substantial discussion, with plenty of on task contributions
b) the students coming away from the discussion with a good understanding of the contributions made
c) contributions being made by all members of the group and 'listened' to by all other members of the group.

Unstructured discussions run the risks of (for example)

- not getting going properly within the time available
- dissipating into a number of loosely related strands that fail to engage effectively with subject being studied
- dissolving into monologues or two way conversations that fail to involve the whole group.

(Pilkington & Walker, ) have demonstrated the value of assigning explicit group roles in online discussion groups. Some writers, for example, (McConnell, 2000) are not sure about the validity of the teacher setting specific structuring devices, preferring to make the group itself responsible for determining how it wants to discuss things, or carry out its work more generally.

Therefore:

**Start the discussion by establishing its structure. Make the rules and timetable for this structure explicit to all the members of the group. Where there is little time available to the group for the discussion, and/or the members of the group are inexperienced at holding online discussions, the teacher/facilitator should set the structure. Where the students are to set their own structure, the teacher/facilitator should give them support and ideas about how to do this, and encourage them to do so in a fair and timely way.**

***

Patterns that complement this pattern: this type of activity might follow or precede other activities – INTRODUCTORY ACTIVITY: LEARNING DESIGN AWARENESS (Pattern 2.1), THE ASSESSMENT TASK AS A VEHICLE FOR LEARNING (Pattern 2.5).
Patterns that specialize this pattern: PREPARING FRUITFUL DISCUSSIONS USING SURVEYS (Pattern 2.3), ENRICHING DISCUSSIONS BY GENERATING COGNITIVE CONFLICTS (Pattern 2.4).

Patterns that complete this pattern: GUIDING QUESTIONS (Pattern 3.3), FACILITATOR (Pattern 4.1), FREE GROUP FORMATION (Pattern 4.2), CONTROLLED GROUP FORMATION (Pattern 4.3).

**Pattern 0.3 PREPARING FRUITFUL DISCUSSIONS USING SURVEYS**

... an activity organized according to DISCUSSION GROUP (Pattern 2.2) may consider the results of a previous activity or their ideas about a subject posed by the teacher.

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The exploration of contradictory views in a discussion can promote a deeper understanding of a subject. It can stimulate each participant to develop their own opinions and explore their reason for them.

Discussions are not sometimes much fruitful because of a lack of structure of the ideas to debate. Another reason that causes this problem is that very often participants do not know the opinions and ideas of the rest of participants (Gómez et al., 2002; Martínez-Monés et al., 2005).

Unstructured discussions run the risks of:

- not getting going properly within the time available,
- dissipating into a number of loosely related strands that fail to engage effectively with subject being studied,
- dissolving into monologues or two way conversations that fail to involve the whole group.

Therefore:

**Before the discussion takes place, prepare a survey or questionnaire with questions related to the topics that might be particularly discussed. The students might answer the survey thus enabling them to organize their ideas and helping them to find arguments to defend their opinions on the main topics.**

***

Patterns that complement this pattern: this organization may precede ENRICHING DISCUSSIONS BY GENERATING COGNITIVE CONFLICTS (Pattern 2.4) and might follow or precede other types of activities – INTRODUCTORY ACTIVITY: LEARNING DESIGN AWARENESS (Pattern 2.1), THE ASSESSMENT TASK AS A VEHICLE FOR LEARNING (Pattern 2.5).

Patterns that complete this pattern: MANAGING OF ON-LINE QUESTIONNAIRES (Pattern 3.2), GUIDING QUESTIONS (Pattern 3.3), FACILITATOR (Pattern 4.1).
Pattern 0.4 Enriching Discussions by Generating Cognitive Conflicts *

... an activity organized according to DISCUSSION GROUP (Pattern 2.2) may consider the results of a previous activity or their ideas about a subject posed by the teacher.

***

Sometimes students are reluctant to challenge each other’s different views on a particular subject or the results from a particular activity during a discussion.

When a student raises a different view or result after having being asked by the facilitator, the others have not reflected on the potential causes of the different approaches. Therefore, the other students avoid being involved in the discussion as they are not confident on what to argue (Johnson & Johnson, 1999; Gómez et al., 2002; Martínez-Monés et al., 2005).

Therefore:

Before the discussion takes place, the students should know, in advance, the others’ point of views or their outcomes from the learning activity they are going to discuss about. Also, they should have enough time to reflect on why there are different approaches. Sometimes, those reflections may generate cognitive conflicts enabling the students to notice that their opinions or their results may be wrong, thus generating new questions and new approaches to the discussed issue they had not thought of and thus generating learning. Sometimes (especially when there is not a unique answer to a question) the reflection on the differences may help the students to think of arguments to reinforce their opinions or to defend their results. The availability of those arguments may motivate the student to take part in the subsequent discussion.

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Patterns that complement this pattern: this organization may follow PREPARING FRUITFUL DISCUSSIONS USING SURVEYS (Pattern 2.3) and might follow or precede other types of activities – INTRODUCTORY ACTIVITY: LEARNING DESIGN AWARENESS (Pattern 2.1), THE ASSESSMENT TASK AS A VEHICLE FOR LEARNING (Pattern 2.5).

Patterns that complete this pattern: STRUCTURED SPACE FOR GROUP TASKS (Pattern 3.1), GUIDING QUESTIONS (Pattern 3.3), FACILITATOR (Pattern 4.1), FREE GROUP FORMATION (Pattern 4.2), CONTROLLED GROUP FORMATION (Pattern 4.3).

Pattern 0.5 The Assessment Task as a Vehicle for Learning

A version of this pattern appears in (TELL, 2005a) by S. Bartoluzzi and P. Goodyear.

... within a scripted collaborative learning scenario whose flow of activities may be structured according to patterns at the collaborative learning flow JIGSAW (Pattern 1.1), PYRAMID (Pattern 1.2), TPS (Pattern 1.3), BRAINSTORMING (Pattern 1.4), there may be activities devoted to creation of an artifact to be assess. How we assess students’ work is one of the most significant decisions we make in educational design, not just because of issues of fairness and accuracy but also because how we set out to test students affects how they approach their work as learners. Assessment techniques need to be valid and reliable but they also drive learning.
Assessment regimes which prioritize technical measurement issues, such as validity and reliability, may ignore the effects of the test on students’ approaches to learning. On the other hand, we do need to assess students’ work, and our approaches must be fair and reasonable. Students take assessment tasks very seriously, especially when the grade they get for a task affects their final qualification, or the speed with which they progress to the completion of their studies. The nature of the assessment regime on a course unit affects how students approach their study (Biggs, 1999). For example, if the assessment regime consists mainly or exclusively of an end-of-course formal examination (time limited, unseen exam paper, no access to books or notes, etc), then students are much more likely to take a surface approach to study. This tendency will be strengthened further if they feel the curriculum is overloaded with content. Surface study strategies include rote memorisation and avoidance of reading material that is outside the core of the course. The knowledge developed through surface approaches tends to be inert and fragmented – hard to apply (Renkl, Mandl, & Gruber, 1996). Since we value the acquisition of flexibly organised, well-integrated and applicable knowledge – what can be called working knowledge – then we need assessment strategies that favour deep rather than surface learning (Biggs, 1999). Deep learning involves the personal construction of meaning, learning for understanding, learning processes which transform current conceptions, etc). Rather than leaving assessment till the finish of the course, where it marks the end of learning, it can be possible, and advantageous, to make the assessment task the vehicle for learning (Knight, 1995). An example is where the students’ main activity on a course is a project-like assessment task. This can also change the relationship between the materials students read and the assessment task. Instead of the assessment being a test of how well the materials have been memorised, the materials become a resource for the assessment project. A key aspect is that the assessment task must be one of the main things – if not the main thing – on which the students focus during their period of study. It is possible for the students’ work to be distributed across a small number of such tasks, but too great a number will create an incoherent learning experience. Therefore:

Put a project-like assessment task at the heart of your course unit. Give students a lot of control over how they will carry out the task and make sure they have sufficient time to plan and execute it well. Let them have a strong voice in deciding exactly what the assessment task will consist of. Do not introduce other assessment tasks unless really necessary – such things can easily act as distractions and will dissipate the student’s intellectual energy.

Patterns that complement this pattern: this type of activity might follow or precede other activities – INTRODUCTORY ACTIVITY: LEARNING DESIGN AWARENESS (Pattern 2.1), DISCUSSION GROUP (Pattern 2.2).

Patterns that complete this pattern: STRUCTURED SPACE FOR GROUP TASKS (Pattern 3.1), GUIDING QUESTIONS (Pattern 3.3), FACILITATOR (Pattern 4.1), FREE GROUP FORMATION (Pattern 4.2).
A.3 Resource level

**Pattern 0.1** STRUCTURED SPACE FOR GROUP TASKS

A version of this pattern appears in (TELL, 2005a) by S. Bartoluzzi and P. Goodyear.

… a collaborative activity – ENRICHING DISCUSSIONS BY GENERATING COGNITIVE CONFLICTS (Pattern 1.7), THE ASSESSMENT TASK AS A VEHICLE FOR LEARNING (Pattern 2.5) – may require an online space to facilitate their work.

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**Sometimes students require an online space that facilitates their collaboration.**

In some situations, it makes sense to leave to each group the decisions about what tools, etc., they will use. This is particularly important where one of the intended learning benefits is that students become more capable at organising and managing their own online collaborative activity. (Learning to become a virtual team-worker, etc). However, in many cases, it simply distracts the group’s attention from the main task at hand and can make the early part of their work together much less effective.

This is another case where getting the right balance between structure and freedom can be achieved through providing an adequate starting framework – in this case, a reasonably well-configured online space for a small group task – but ensuring that groups can modify the space to suit their own preferences and emerging needs.

In many small group tasks, the group members need (i) somewhere to discuss their work (a space for planning, and monitoring the work as it goes along), (ii) somewhere to share a growing pool of relevant resources (e.g. useful papers they have identified, etc), (iii) somewhere to lodge the evolving versions of their joint product. Neither a discussion-oriented tool nor a shared editing tool is quite right for all purposes. Discussion tools, such as a threaded discussion forum are good for helping with the structure and flow of a discussion about planning, but don’t help much with document management, version control, etc. Document repositories can be good for sharing resources, and some will allow annotation. But they aren’t good for discussion. Collaborative writing tools, such as a wiki, are good for some kinds of joint document production, but aren’t so useful for discussing the process of document production. Ideally, one needs to be able to provide each of these things, in some reconfigurable, customisable environment. If students do not have the will or the skills to do the customisation, then what you provide must be adequate for their task. But it should not imprison those students who do have the skills and the will to improve the tools to hand.

Therefore:

**Ensure that the set of collaboration tools you make available to students can support sharing of resources and products and group processes.**

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Patterns that complement this pattern: MANAGING OF ON-LINE QUESTIONNAIRES (Pattern 3.2). Patterns that complete this pattern: depending on the collaboration tools available in the structured space the principles of other patterns may be considered – FACILITATOR (Pattern 4.1), FREE GROUP FORMATION (Pattern 4.2), CONTROLLED GROUP FORMATION (Pattern 4.3).
**Pattern 0.2 MANAGEMENT OF ON-LINE QUESTIONNAIRES**

A version of this pattern appears in (Avgeriou et al., 2003; TELL, 2005a)

… a collaborative activity – PREPARING FRUITFUL DISCUSSIONS USING SURVEYS (Pattern 2.3), THE ASSESSMENT TASK AS A VEHICLE FOR LEARNING (Pattern 2.5) – may require the use of web-based questionnaires.

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**How can web-based questionnaires be created, delivered and graded?**

The administration of on-line tests for the assessment of students is a common task for the majority of learning systems. The creation and delivery of questions and tests over the Web is a complicated task due to the interactive, sophisticated nature of the web-based questionnaires. Therefore:

- Provide a mechanism for the creation of on-line questions: closed-end questions with predefined answers, that are able to be automatically graded and open-end questions, which need to be graded by an instructor. Allow the Instructors that create the questions, to be able to allocate a grade to each question. Also give them the ability to announce the schedule of on-line tests so that students are informed in time. Develop a run-time system for the delivery of the tests at the time scheduled, the automatic grading of closed-end questions, the automatic submission of answers to open-end questions to the Instructors and the storage of the results into the students’ records. In case of self-assessment questionnaires, assign particular questions to learning units where the student should check the knowledge she/he is supposed to have obtained. The run-time system should make these questions available to the students whenever they access the particular learning units.

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Patterns that complement this pattern: STRUCTURED SPACE FOR GROUP TASK (Pattern 3.1).
Patterns that complete this pattern: GUIDING QUESTIONS (Pattern 3.3).

**Pattern 0.3 GUIDING QUESTIONS**

… a collaborative activity – DISCUSSION GROUP (Pattern 2.2), ENRICHING DISCUSSIONS BY GENERATING COGNITIVE CONFLICTS (Pattern 2.4), THE ASSESSMENT TASK AS A VEHICLE FOR LEARNING (Pattern 2.5) – may provide some hints supporting decision making about the completion of tasks.

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A group of students that collaboratively perform a learning task are not sure on the criteria for deciding whether they have completed it or whether it fulfils the expected results.

For some learning tasks in which the students do not have a clear knowledge of the expected outcomes, it may be difficult for them to decide when the task is completed. This may be due to their fear of not having done enough work or lack of ability for judging themselves. Some kind of conflict resolution (Johnson &
Johnson, 1999) might be used for achieving a consensus on that but it would just be based on personal opinions and therefore the students, for the same reasons, would not be very confident on that. Also, the teacher might take the decision (or even just impose a time constraint) but the students would still not know why the task is completed. Therefore:

Provide the students with a list of questions that they might be capable of answering as they advance with the task. The questions might not only deal with procedural issues (e.g., have you finished the introductory section of the document?) but mainly with the content of the activity itself. These questions would help the students to focus on important issues of the task as well as potentially generate cognitive conflicts with their previous knowledge or with the knowledge they are producing by means of the activity itself. Also, the students may be aware of the importance of self-posing questions on what they are learning as a way of enhancing and enlarging their knowledge (i.e. there might not only be an improvement of the task “tangible” outcome but also an improvement of the learning process itself).

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Patterns that complement this pattern: STRUCTURED SPACE FOR GROUP TASK (Pattern 3.1), MANAGING OF ON-LINE QUESTIONNAIRES (Pattern 3.2).

A.4 Roles and common collaborative mechanisms level

Pattern 0.1 Facilitator*

Facilitating the work that a group has to collaboratively accomplish is a recurring problem in the context of collaborative learning flows – BRAINSTORMING (Pattern 1.4), activities – DISCUSSION GROUP (Pattern 2.2), THE ASSESSMENT TASK AS A VEHICLE FOR LEARNING (Pattern 2.5) and supporting tools – STRUCTURED SPACE FOR GROUP TASKS (Pattern 3.1), MANAGEMENT OF ON-LINE QUESTIONNAIRES (Pattern 3.2).

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Students might be guided towards greater independence (autonomous learning) in collaborative learning situations and, at the same time, towards effective collaboration.

Autonomous learning is an important issue in education, which foster a greater independence of the students. This issue may be also considered in collaborative learning. Promoting self-organization helps to a large extent the achievement of greater independence. A group self-organizes by developing and sharing roles for team members, sharing workloads, etc. (Martínez-Mónes et al., 2005). Allowing students to freely form groups and organize the work within groups might also promote students’ responsibility. However, fostering this independence should not damage effective collaboration (Paulsen, 1995; Davie, 1989).

Therefore:

Become a facilitator: motivate, introduce deadlines, help people get started, give them feedback, weave the contributions of different participants together, get it un-stuck when necessary, make
sure all have opportunity to participate and learn, deal with individuals who are disruptive or get off the track, bring in new material to freshen it up periodically, and get feedback from the group on how things are going and what might happen next.

Patterns that complement this pattern: FREE GROUP FORMATION (Pattern 4.2), CONTROLLED GROUP FORMATION (Pattern 4.3).

**Pattern 0.2** FREE GROUP FORMATION

Partly based on the patterns FORMING GROUPS FOR GROUP WORK WITHIN A CLASSROOM CONTEXT and FORMING GROUPS FOR COLLABORATIVE KNOWLEDGE BUILDING included in (E-LEN, 2005) by Gaby Lutgens.

Forming groups is necessary to comply with the types of groups indicated by collaborative learning flows – JIGSAW (Pattern 1.1), PYRAMID (Pattern 1.2), TPS (Pattern 1.3), BRAINSTORMING (Pattern 1.4), SIMULATION (Pattern 1.5), TAPPS (Pattern 1.6), the specific groups demanded by activities – DISCUSSION GROUP (Pattern 2.2), THE ASSESSMENT TASK AS A VEHICLE FOR LEARNING (Pattern 2.5) and, even, the functionality provided by supporting tools – STRUCTURED SPACE FOR GROUP TASKS (Pattern 3.1). This pattern gives an approach to group formation for a context in which a group of students tackle a large demanding assignment.

**How can a group of students be formed when they are asked to work on a large demanding assignment?**

Generally, groups should be heterogeneous, should not isolate minority students and should be formed by the teachers (NISE, 1997). However, it is important that students feel comfortable, especially when the assignment is large, demanding and product-oriented and have a strong importance related to grading. Simply allocating the same mark of every student in a group can lead to the problem of free-riders (Cronholm & Melin, 2006). In fact, there are many problems related to difference preferences that may emerge and obstruct learning. Different wishes about working times, geographical distance between the students, diverse study techniques or ways of thinking, differences in motivation (different level of ambition related to grading, commitments to the task and to the goal of the course) may lead to group conflict and non-creative group climate. Social sensitivity is an important aspect when assembling groups (Cronholm et al., 2006).

Therefore:

**Ask students their opinion related to group formation. Let them form the groups themselves, if they prefer so. You might instead opt for a semi-free group formation approach where the students only select part of the members of their group.**

Patterns that complement this pattern: FACILITATOR (Pattern 4.1).

Patterns that are alternative to this pattern: CONTROLLED GROUP FORMATION (Pattern 4.3).
Pattern 0.3 Controlled Group Formation

Partly based on the patterns Forming Groups for Group Work within a Classroom Context and Forming Groups for Collaborative Knowledge Building included in (E-LEN, 2005) by Gaby Lutgens.

Forming groups is necessary to comply with the types of groups indicated by collaborative learning flows – Jigsaw (Pattern 1.1), Pyramid (Pattern 1.2), TPS (Pattern 1.3), Brainstorming (Pattern 1.4), Simulation (Pattern 1.5), TAPPS (Pattern 1.6), the specific groups demanded by activities – Discussion Group (Pattern 2.2), The Assessment Task as a Vehicle for Learning (Pattern 2.5) and, even, the functionality provided by supporting tools – Structured Space for Group Tasks (Pattern 3.1). This pattern gives an approach to group formation for a context in which a group of students tackle an assignment for limited duration and which benefits from diverse or conflict knowledge.

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How can a group of students be formed when they are asked to work on an assignment to collaborative build knowledge?

Heterogeneous groups with members with different skills and knowledge are considered to be more effective than homogenous groups in terms of sharing ideas and experiences to learn about topics or gain new insights. Heterogeneous groups provide opportunities to meet new people or people with different profile or divergent knowledge. This improves skills such as conflict management, ability to understand other people’s needs, communication and the ability to collaborate. They also prevent the isolation of minority students. However, it is difficult to find a method that guarantee balanced groups (NISE, 1997). On the other hand, randomly allocating students to groups is considered closer to real future professional life of the students (Cronholm et al., 2006).

Therefore:

There are many ways to form potentially heterogeneous groups. Assemble heterogeneous groups taking into account student outcomes in previous activities, their profile, or their academic strengths. You may instead form the groups randomly (e.g. count off students with numbers and ask the students who have each number meet), or considering a common characteristic not related with the task (e.g. ask the students born in the same month join).

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Patterns that complement this pattern: FACILITATOR (Pattern 4.1).
Patterns that are alternative to this pattern: FREE GROUP FORMATION (Pattern 4.2).