Recurrent routines in the classroom madness: pushing patterns past the design phase

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Abstract

The notion of pedagogical patterns has proved very useful in the field of learning design, especially with regard to activities for complex educational scenarios, such as computer-supported collaborative learning (CSCL). However, CSCL designs (pattern-based or not) also have to be enacted by teachers, and very often ambiguities, difficulties and deviations arise in this enactment. This paper reports recent experiences in an authentic primary school setting, aimed to study teachers who are not technology experts, designing, enacting and even improvising with a CSCL tool. This study uncovered a set of recurrent routines in the design of activity scripts (which we could see as implicit design patterns), as well as a limited set of routines in the enactment of these activities. The comparison of the designs and their enacted counterparts revealed that the designed routines were completed with additional sets of unexpected routines, bridging the gap between high-level designs and the concrete classroom performance. This paper discusses the idea of eliciting an extensible set of enactment patterns/routines and the level of formalization needed, especially regarding its potential usefulness as a tool (mediating artifact) to support practitioners in enacting CSCL activities in a more flexible and effective way.

Keywords

Patterns, teacher routines, design, improvisation, enactment, CSCL.

Introduction

For more than thirty years now, the notion of *design patterns* has been proposed as a way to help practitioners in designing artifacts (Alexander, Ishikawa, & Silverstein, 1977), and it has been applied to a variety of fields, from architecture to computer science and education. In the field of *computer-supported collaborative learning* (CSCL) (Dillenbourg, Järvelä, & Fischer, 2009), patterns and pattern languages have been posed as a useful tool to reduce the enormous complexity of designing activities that foster the kinds of collaboration that are more likely to produce learning (Hernández-Leo, Villasclaras-Fernández, Asensio-Pérez, & Dimitriadis, 2009).

While there are evidences that pedagogical patterns are an effective strategy for CSCL designers to communicate their expertise and create novel activity designs (Mor & Winters, 2008), it remains open to question whether such abstractions can be useful *for teachers*, either in the role of designers or, especially, during the enactment of CSCL activities. Enacting CSCL activities is a very complex endeavor, which entails the orchestration of different groups of students, doing different kinds of tasks, using a variety of tools (Dillenbourg, et al., 2009).Thereby, scripts can be seen as a way to relieve teachers from part of this burden. However, even if the teacher has carefully scripted the activity, classroom events can force (or make it recommendable) to deviate from the original design (Dillenbourg & Tchounikine, 2007).

This document presents evidence from a set of experiences in an authentic educational scenario, aimed at studying how teachers design and enact activities using GroupScribbles (groupscribbles.sri.com) – a simple, flexible CSCL tool. The analysis of the observed activities uncovered a set of *activity design routines* (which could be seen as design patterns' seeds) but, more interestingly, teachers also showed a limited number of *enactment routines* that completed the designs and served to transpose their high-level designs into concrete enactments in the classroom. These enactment routines could help to minimize recurrent decisions with respect to (low-level) pedagogical problems, thus positioning them close to the Alexandrian conception of pattern. The

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rest of the document describes, first, the *context and goals* of our research. Later, the *recurrent design routines* observed are briefly presented, and two real *examples of enactment* are described, highlighting both the routines that appeared in the original design, as well as the routines that emerged in the enactment of the activity. Finally, the consequences of these findings are discussed, especially with respect to the potential definition and usefulness of a set of *enactment routines* that could help in making the transition from abstract designs to enacted activities in a teacher-friendly way, and what level of formalization would be most convenient for this endeavor.

Studying design and enactment with GroupScribbles in primary classrooms

In an attempt to understand how teachers design, enact and even improvise with a CSCL tool in computer-integrated classrooms, a qualitative case study (Stake, 2005) was carried out in the educational setting of a *primary school* located in a village in Spain (Prieto, 2009). The school is publicly funded and it was located in a rural environment. Moreover, it is equipped with a considerable amount of technological resources, including digital whiteboards and tablet PCs. For 6 months, we supported and observed the activities of three K6-7 and two K7-8 teachers in their first steps in the integration of GroupScribbles (GS from now on) in their face-to-face classrooms. Each classroom had between 18 and 25 students[1] of ages 6-8 (depending on the classroom and the day of the observation).

GS is a CSCL tool that was designed in order to allow social coordination of activities, having flexible activity enactment and improvisation in mind. This software is based on well-known metaphors such as public and private boards, where ideas are shared, organized and improved, in the form of adhesive stickers, where teachers and students can draw and write text, using an ink-based interface. GS was designed with face-to-face scenarios in mind, and it is especially well suited to be used in classrooms with an electronic whiteboard and tablet PCs. The election of GS for our study was motivated by its affordances for flexibility and improvisation (Roschelle, et al., 2007), including previous experience with GS by our own research group (Dimitriadis, et al., 2007).

For this inquiry we collected data using a variety of qualitative techniques: three semi-structured in depth interviews and one focus group with teachers, as well as 31 participant observations of classroom enactments. Screen, audio and video recordings, scripts of teacher's activities and other documentation, were analyzed in order to provide triangulated conclusions supported by enhanced evidence. The result was a set of emerging activity patterns or *routines*, not unlike others presented in this symposium (Alevizou, Conole, Culver, & Galley, 2010). However, in our case, observations focused on recurrent elements of practice in the design and enactment of the activities.

Recurrent routines in design and enactment

The observation of teachers *designing with GS* showed that teacher scripts tended to describe high-level tasks for the most part. Such a "high-level task description" means that large portions of the activity, spanning several minutes and involving teacher decisions and complex interactions between the teacher and the students, are taken care of with one small sentence in the written design, as it can be seen in the following excerpts from a teacher's notebook:

"Each student has to solve a simple arithmetical operation in order to know what is their task."
"Write down buildings, places or services that are common in the cities and in the villages. Divide the class into two teams."
"Team quiz. One point per correct answer / one point less for each repeated the answer."

Teacher A's notebook (2009.04.28)

The analysis of the designs also uncovered a set of *patterns* (not as explicit, formal patterns used for designing, but rather *recurrent routines*), such as those shown in Table 1. It is worth noticing that many of these routines had already been identified independently by the research team that developed the application, in a recent field research work with GS in the United States (DeBarger, Penuel, Harris, & Schank, 2009). However, four of them were observed for the first time in our rural school context. This partial coincidence of design routines among very different contexts could be explained by GS's design and the metaphors it is based upon (e.g. "Where is on

[1] By law, primary classrooms in Spain should not have more than 25 students.

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this image?" can be directly traced back to the ability to put background images in public boards in GS), but also by teachers finding creative ways of taking advantage of the tool's flexible design in activities with diverse student groupings (e.g. "Team Quiz").

Table 1: Common design routines encountered in activities of the Cigales School

Routines	Description	# app.	1st seen by *
Representing Information/Questions	Students generate questions or ideas related to a certain topic	22	DeBarger et al.
Classification	Organize stickers in a public board, according to certain hierarchies or classification criteria	15	DeBarger et al.
Distributed Problem Solving	Each student takes a sticker from the public board, representing a different task, solves it and puts it back to the public space	9	DeBarger et al.
Clues	Each student chooses a task, by solving a riddle (e.g. the consonants presents in the student's name)	9	Prieto
Team Quiz	Teams are formed inside the class, and points are awarded to each team according to the resolution of the activity sub-tasks	2	Prieto
Poll	Students vote which, among a set of options, is their favorite (normally for later usage in the activity)	1	Prieto
Pipeline	Each student takes a task from a public board, which represents a part of a bigger problem; after the student solves it, another student uses it for solving his/her sub-task, and so on	1	DeBarger et al.
Self-Task	Students choose which is the next task to be done	1	Prieto
Where is on the image?	The teacher poses a question, and students answer by marking over a background image in the public board	1	DeBarger et al.

* "DeBarger et al." refers to (DeBarger, et al., 2009). "Prieto" refers to (Prieto, 2009).

As an example of how these activities were enacted in the classroom, we present here the routine analysis of a significative sample of two activities. Screenshots from one of the activities being enacted with GroupScribbles is shown in Figure 1, and additional images from these sessions are available at http://gsic.tel.uva.es/~lprisan/20090430Materials.zip and http://gsic.tel.uva.es/~lprisan/20090416Materials.zip, respectively.

The first activity was performed by a K6-7 teacher in a Natural Science class. The activity involved a group of 18 students working in pairs with tablets PCs. The main goal of the activity was for students to be able to recognize typical objects, buildings and professions that are more usual in rural contexts, in contrast with others commonly found in the cities. The activity flow consisted on each student taking a different task (from the public board of GS), solving a riddle related with the common theme of the lesson (e.g. "it is the place where you take ill people to", "it is the place where wine is made"), and classifying the results, according to whether the item could be found in villages or in urban areas. In order to distribute the tasks among the different students, each one was associated with a simple arithmetical operation (e.g. "one ten plus seven units", "twelve minus five", etc), whose solution was the list number of the corresponding student. The teacher coordinated the distribution of tasks socially, by asking students about these arithmetical operations randomly. Finally, the class was divided into two teams and there was a brainstorm in order to review more objects that could be found both in villages and in cities.

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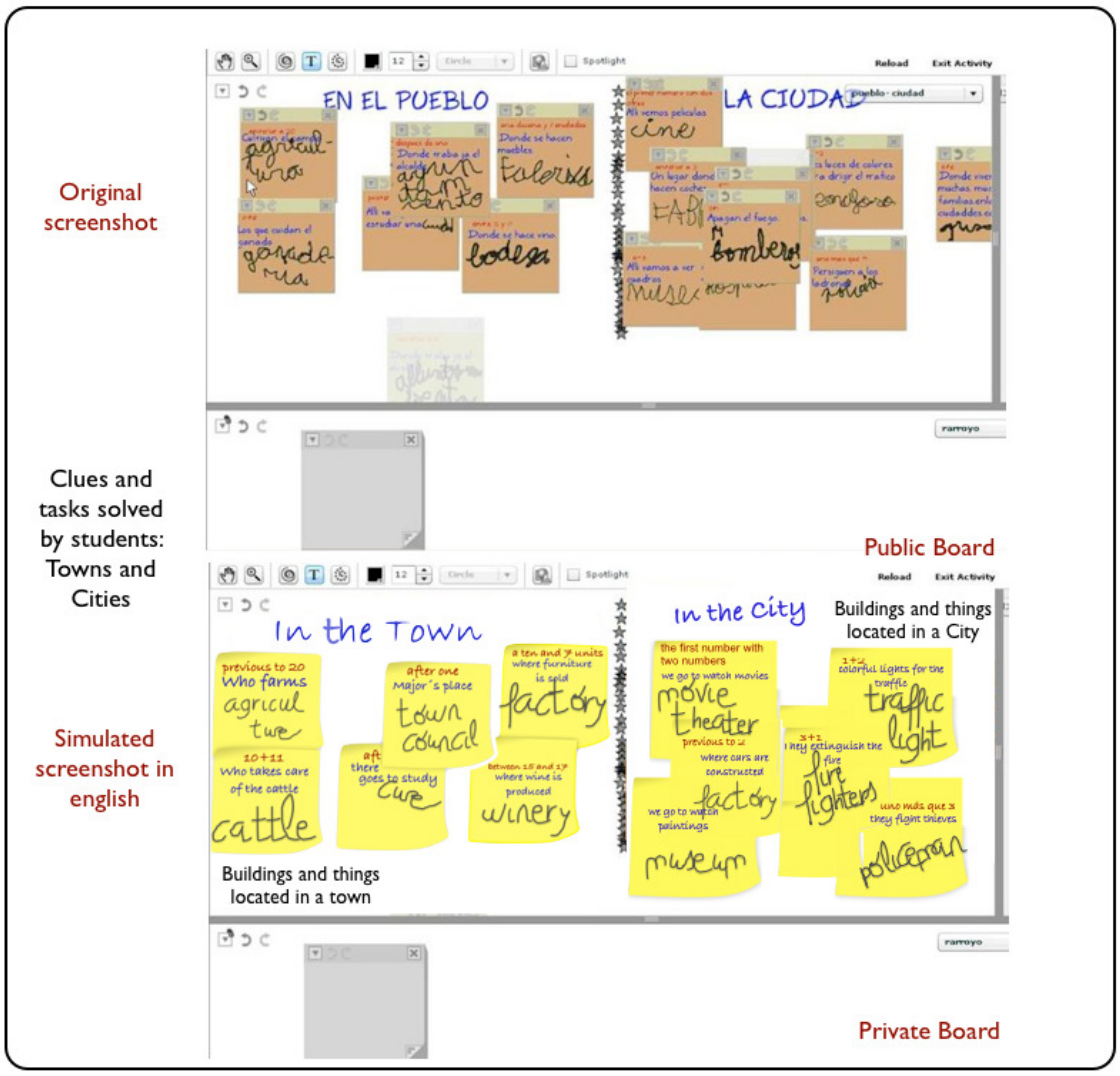

Figure 1: Screen capture of one of the example GroupScribbles activities, about villages and cities

The second activity was performed by the same K6-7 teacher in the same setting. The aim of the activity was to guide students (again, two students for each tablet PC) in learning on the usage of the different coins in the European coinage system. The activity flow consisted of each student taking a different task (to buy one object from a picture in GS showing several priced items), and writing with GS how many coins (and of which values) were necessary to buy the object. Then, the different objects were graphically classified as cheaper or more expensive than a given one. In order for the students to know which task to solve, the tasks were identified with simple arithmetical operations whose results mapped the task to the student's number in the class list. Additionally, paper replicas of coins were handed to the children in order to aid them in solving the main task.

Figures 2 and 3 represent the complexity involved in the enactment of the aforementioned activities, by using a variant of the task-swimline kind of representation of the learning design (Conole, 2010). These diagrams, however, show not only the design but also the enactment flow and the routines detected in both situations, paying attention to the social planes in which they occurred (i.e whole-class activity, individual work, or small group work) and the routines that were associated to each phase of the activity.

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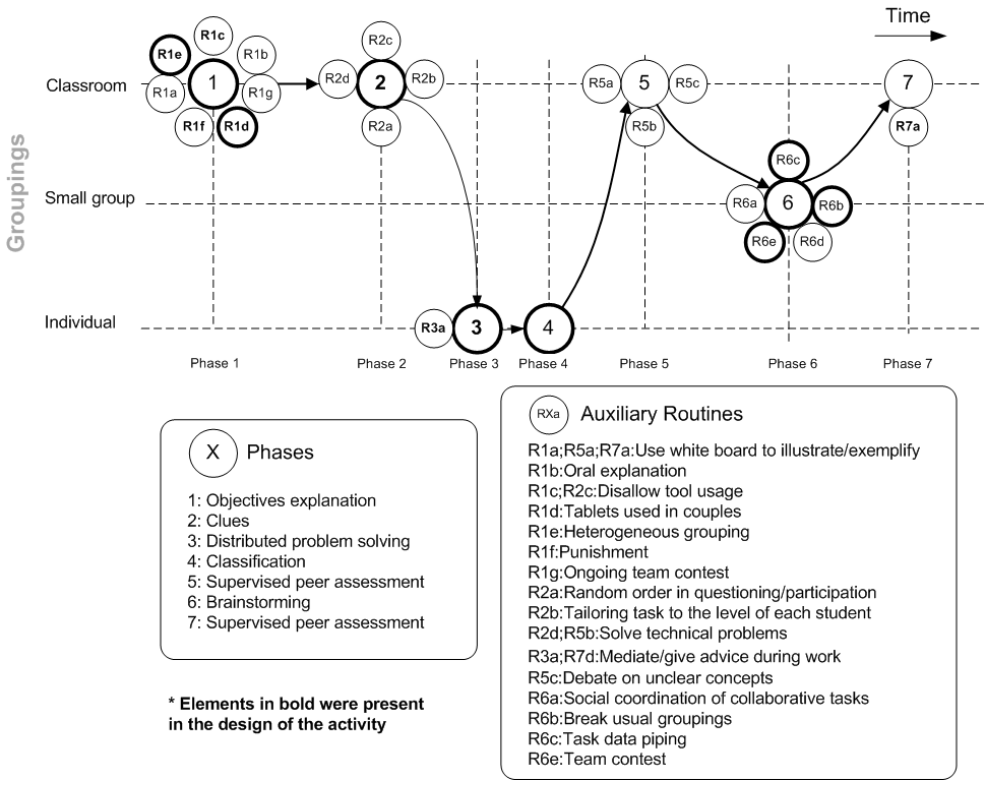

Figure 2: Enactment flow and routines detected in the first example activity about villages and cities

These diagrams distinguish the routines that were explicitly present in the teacher's *design* (in bold face, e.g. the "Clues" routine marked as **2** in both figures, or the usage of "Paper tangibles", marked as routine **R3a** in Figure 3) from the routines that *emerged* during the enactment of the activity. Among these emergent elements, we can also distinguish two kinds of routines: those which are necessary for the teacher to bridge the gap between the higher-level design of the activity and the concrete actions in the classroom (e.g. "Use whiteboard to illustrate/exemplify", marked as **R1a** in both figures), and those which were not part of the original plan at all, and thus can be considered *improvisations*. These improvisations arise from real-time decisions of the teacher in order to confront *problems* (e.g. "Disallow tool usage", marked as **R1c** in Figure 2) or take advantage of emergent *opportunities*. For example, in the enactment of this activity, after the planned tasks were finished, the teacher used the remaining time to improvise additional phases (i.e. tasks marked **9**, **10** and **11** in Figure 3), in which students were polled for an additional operation to execute over the solutions of the previous task. In this case, an ordering of the costs of the objects was chosen and performed.

As the reader may have noticed, both designs share a surprising number of what we have called *design routines* (see Table 1), even if the topics of the activity are very different. Not only that, but also the emergent routines that appear in the enactment of the designs form a limited set of enactment routines, which can be tied back to the *tools* the teacher is using and their affordances (e.g. "Use the white board to exemplify"), or to the kind of *task* that is being performed (e.g. "Random order in questioning/participation", "Debate on unclear concepts"), but also to *unexpected occurrences* in the classroom (e.g. "Punishment", "Disallow tool usage", or the improvised tasks marked as **9-11** in Figure 3). It is also worth noting that, even in the case of improvised parts of an activity, where the teacher lets the students choose the next task to be done, the choice was not completely free. Thus, the teacher remained within the scope of routines that were *familiar* to her (e.g. in the second example activity, the "Poll", "Brainstorming" and "Classification" routines appearing in table 1).

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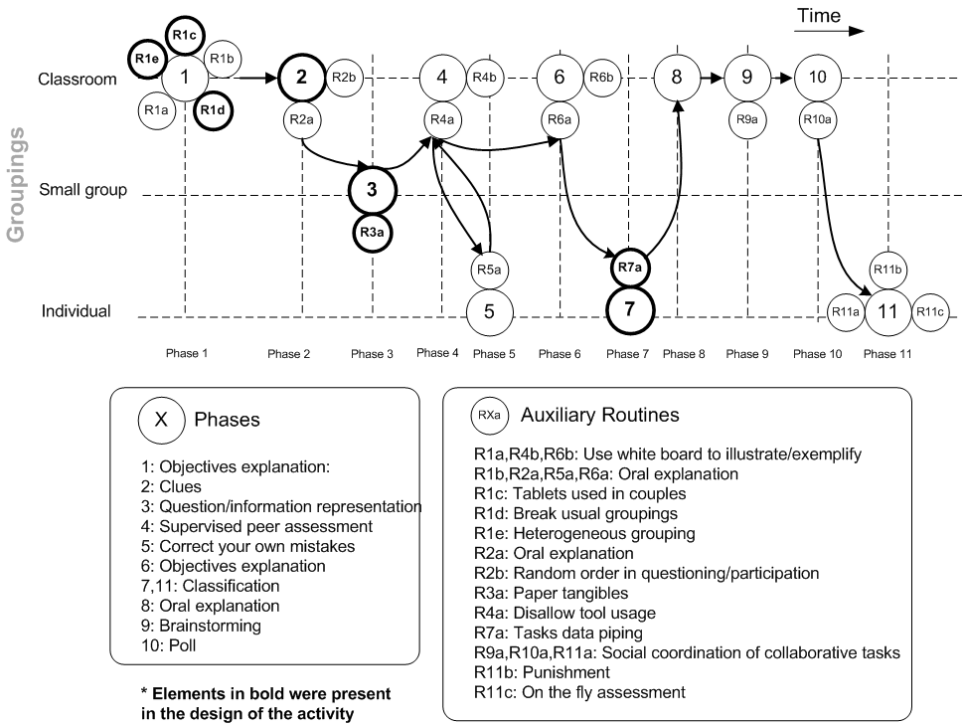

Figure 3: Enactment flow and routines detected in the second example activity about usage of coins

The discovery of these recurrent routines, not only in the design of the activities, but also in the parts of the enacted activities that were not specified in the design, shows that teachers' designs tend to be *high-level* and *incomplete*. This is possibly due to lack of time for detailed planning and preparation of the lessons, but also because teachers consider the usage of small amounts of improvisation to be commonplace (e.g in response to children's input or last-minute changes and occurrences in the classroom). Two different explanations can be found in teacher's enactment literature, regarding incompleteness issues (which have been acknowledged extensively). It can be caused by the fact that not all the envisioned plans of teachers make it to the written form of the designs (Schoenfeld, 1999). Alternatively, incompleteness can be due to sheer *time limitations* for designing that teachers usually face in authentic educational settings, as expressed by teachers themselves (and as observed in our own stay in the school context):

"So, you do not have time to do that sort of thing [design activities], so each one does it at home, or whenever it is possible…" "That's right, we do not have a specific time for that."

Interview with teacher B (2009.03.12)

"... but I think that in this school a problem for the preparation [of activities] is the lack of time at school for you (individually or as part of a team) to have a session."

"... but the lack of time and that lack of training makes it [designing activities with digital technologies] a bit more frightening."

Focus group with teachers C, D, E, F and G (2009.03.17)

It is also interesting to note what kind of reflections are made by teachers after enacting their classes (when this reflection is present at all):

"With this design, I have improved the development of the classroom. When I have to design an activity, I have to provide clear guidelines and show clearly what I expect of my students"

Teacher A's notebook (2009.04.30)

We can see that the evaluation is also high-level, scribbled in a few seconds on the teacher's notebook, and concentrating on aspects of classroom enactment (i.e. how the explanations are to be delivered), rather than on

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the pedagogical design of the activity. All these pieces of evidence hint at the importance that the issues of classroom enactment bear in teachers' minds. It also supports the idea that teachers' enactment practice (especially, enactment with new technologies) is organized around a limited set of activity patterns.

Discussion

In the previous sections, we have presented evidences about how a set of primary school teachers designed and enacted their lessons as they tried to integrate a new collaborative technology into their technology-enabled classrooms. By analyzing these evidences, we have discovered a set of recurrent activity patterns, or *routines*, both when designing activities and when enacting those designs. These routines could be seen as tools that help in bridging the gap between the abstract, relatively high-level designs and the concrete enactment that is done in the classroom.

From the analysis presented, we can see that the uncovered routines often appear *associated* to other designed or improvised routines (e.g. routines **R1a** and **R1b** in Figure 2 and Figure 3), or are *alternatives* to one another towards similar goals (e.g. phase **4** "Supervised peer assessment", versus routine **R11c** "On-the-fly assessment" in Figure 3). This, coupled with the fact that in most of these routines we can see *attempts to solve recurrent, specific educational problems*, hints at the possibility of finding what we could call an *"enactment pattern language"*, in the Alexandrian sense of "accepted solutions to recurrent problems" in the enactment of CSCL activities. These patterns could be creatively combined to produce activity enactments, and they could be used by practitioners (in this case, not learning designers, but rather the teachers that have to enact the activities) both to improve their practice and to communicate about it among themselves.

Still, it is arguable whether the invention of "yet another pattern language" would clarify or complicate our understanding of the enactment and orchestration of CSCL activities, both for us as researchers and more importantly, for their intended target users: teachers. Previous efforts in eliciting design pattern languages for education have found that teachers are not comfortable with such abstractions (Winters & Mor, 2009). Moreover, how such a pattern language is formalized (e.g. for later usage in technological tools) could also prove problematic, since the more formalized the pattern is, more powerful can be the automation of such patterns and routines, but that will also make the tools more rigid. Since lack of flexibility has long been one of the main criticisms posed about enacting CSCL scenarios (Dillenbourg & Tchounikine, 2007), the provision of enough "degrees of freedom" in the application of such patterns should also remain foremost in our minds when exploiting those patterns.

Thus, the question of what the exact nature of these patterns should be is still *open*, both regarding their level of *complexity* (since they have to be employed in a timely manner during enactment), and the level of *formalization* that those patterns would require in order to be an effective teaching and communication tool. Moreover, the scope of application of these routines has to be further delved into, to determine the relationship between these routines and other *contextual elements* of the situation, such as the tools that are used, the pedagogical approach, or the subject matter and the goals of the lesson. For example, particular ways of orchestrating lessons (formulated as enactment routines) could be very useful when designing a collaborative course to foster creative thinking (Retalis, et al., 2010), but not in other cases of collaborative learning. Most probably, no routine will be adequate to every educational context.

Another aspect that also remains open has to do with technological tools that could be devised to take advantage of these patterns/routines to support teachers in enacting CSCL activities in a flexible and effective way (for example, by defining a computational representation of such patterns and exploiting it in an enactment-oriented tool). Our immediate future work will be aimed towards eliciting more of these patterns, and working out with teachers on the issues of formalization and level of abstraction related to those enactment routines. Such a field study may enable us to adopt an approach based on this new source of evidence, as well as to provide insights on how to provide a sufficient degree of freedom in pattern enactment, in a new round of routine use and reuse.

We believe that, as other colleagues have pointed out in this symposium (Conole, 2010), making good practices explicit (e.g. visually) can be an invaluable help to practitioners in "thinking more creatively" and "having new insights and understandings". We argue that this help is needed, not only when designing learning situations, but also when enacting (or reflecting on the enactment and re-designing of) those situations. The routine diagrams presented above (Figure 2 and Figure 3) are just a first attempt in representing these elements of practice in a

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meaningful way. Further efforts are needed in order to improve these representations and assess their effectiveness.

Learning design and design patterns have the affordance to improve teaching practice and learning outcomes. However, it is designers, teachers and students who turn affordances into learning outcomes (Dillenbourg, 2008), as they enact those designs. Studying and understanding the differences between learning designs and the enactment of those designs (e.g. in the form of routines) in authentic, daily practice, has the potential for highlighting the affordances of technology and fostering practices of value. We believe that this kind of approach could prove a very valuable advancement in technology-enhanced learning practice.

References

Alevizou, G., Conole, G., Culver, J., & Galley, R. (2010). *Ritual performances, collective intelligence and expansive learning: theoretical frameworks for analysing emerging activity patterns in Cloudworks*. Paper presented at the Networked Learning 2010 Conference.

Alexander, C., Ishikawa, S., & Silverstein, M. (1977). *A Pattern Language: Towns, Buildings, Construction* (Vol. 2): Oxford University Press.

Conole, G. (2010). *An overview of design representations*. Paper presented at the Networked Learning 2010 Conference.

DeBarger, A. H., Penuel, W., Harris, C. J., & Schank, P. (2009). Teaching routines to enhance collaboration using classroom network technology.

Dillenbourg, P. (2008). Integrating technologies into educational ecosystems. *Distance Education, 29*(2), 127-140.

Dillenbourg, P., Järvelä, S., & Fischer, F. (2009). The Evolution of Research in Computer-Supported Collaborative Learning: from design to orchestration. In N. Balacheff, S. Ludvigsen, T. de Jong, A. Lazonder & S. Barnes (Eds.), *Technology-Enhanced Learning*: Springer.

Dillenbourg, P., & Tchounikine, P. (2007). Flexibility in macro CSCL scripts. *Journal of Computer-Assisted Learning, 23*(1), 1-13.

Dimitriadis, Y., Asensio-Pérez, J. I., Hernández-Leo, D., Roschelle, J., Brecht, J., Tatar, D., et al. (2007, July). *From socially-mediated to technology-mediated coordination: A study of design tensions using Group Scribbles.* Paper presented at the Computer Supported Collaborative Learning 2007 Conference, CSCL 2007.

Hernández-Leo, D., Villasclaras-Fernández, E. D., Asensio-Pérez, J. I., & Dimitriadis, Y. (2009). Generating CSCL scripts: From a conceptual model of pattern languages to the design of real scripts. In P. Goodyear & S. Retalis (Eds.), *E-learning Design Patterns Book*: Sense Publishers.

Mor, Y., & Winters, N. (2008). Participatory design in open education: a workshop model for developing a pattern language. Journal of Interactive Media in Education.

Prieto, L. P. (2009). *An Exploration of Teacher Enactment of CSCL Activities in Computer-Integrated Classrooms.* Escuela Técnica Superior de Ingenieros en Telecomunicaciones, Universidad de Valladolid. Available at http://gsic.uva.es/~lprisan/Prieto2009_ExplorationEnactmentCSCLCiC.pdf

Retalis, S., Katsamani, M., Bitter-Rijpkema, M., Sloep, P., Georgiakakis, P., & Kargidis, T. (2010). *Designing collaborative learning sessions that promote creative thinking and innovation*. Paper presented at the Networked Learning 2010 Conference.

Roschelle, J., Tatar, D., Chaudbury, S. R., Dimitriadis, Y., Patton, C., & DiGiano, C. (2007). Ink, Improvisation, and Interactive Engagement: Learning with Tablets. *Computer, 40*(9), 42-48.

Schoenfeld, A. H. (1999). Models of the Teaching Process. *Journal of Mathematical Behavior, 18*(3), 243-261.

Stake, R. (2005). Qualitative case studies. In N. Denzin & Y. Lincoln (Eds.), *The SAGE handbook of qualitative research* (pp. 443-466): Sage.

Winters, N., & Mor, Y. (2009). Dealing with abstraction: Case study generalisation as a method for eliciting design patterns. *Computers in Human Behavior, 25*(5), 1079-1088.

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