From socially-mediated to technology-mediated coordination: A study of design tensions using *Group Scribbles*

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Abstract. It is well known that scripts based on good practices can enhance the collaboration effectiveness and efficiency in CSCL environments. Yet, to achieve rich, interactive, and creative collaborative learning settings CSCL tools need new flexible, dynamic and lightweight metaphors. This design tension between social and technology-mediated coordination is difficult to resolve and worthy of close analysis. In this paper, we study such a tension through the use of the *Group Scribbles* (GS) CSCL tool, developed at SRI International, a GUI-based approach that enables the creation and enactment of lightweight CSCL scenarios. The potential of GS, as well as its limitations and possible extensions are studied in relation to design scripts based on Collaborative Learning Flow Patterns. Preliminary experiences in an authentic environment illustrate several facets of the design tension, such as the participants' workload and awareness, or the adaptation to emergent situations. On the other hand, this study points out the need for a new flexible architecture that complements *Group Scribbles*.

Introduction to the coordination design tension in CSCL scripts

CSCL, with its emphasis on both the disciplines of engineering and education, is about balancing competing forces, a familiar challenge to any emerging multi-disciplinary paradigm. On the one hand researchers advocate open, flexible, technology-mediated environments that support situated learning. On the other hand, student experiences are often measured against rigid learning goals. Furthermore, designers of a CSCL tool must often compromise their notions for an ideal learning environment in light of limited resources for designing, implementing, evaluating the tool. Thus, practitioners face the task of resolving many design tensions (Tatar, 2007) as they make decisions about appropriate technology and learning situations. These design tensions underlie and motivate design patterns in the field of technology-enhanced learning. While the CSCL literature is replete with descriptions of the final configurations of technology and learning situations, there is a paucity of reflective writing on how designers converged on their approach through an analysis of tradeoffs. The field needs more case studies of design to exemplify known tensions and identify new ones, so as to inform future CSCL projects. A particularly vexing design tension both in the field of CSCL and CSCW comes from the desire to use technology to structure group coordination, but at the same time support unanticipated, emergent coordinated activity.

> Design tensions conceptualize design not as problem solving, but as goal balancing. They draw explicit attention to conflicts in system design that cannot be solved, but only handled via compromise (Tatar, 2007, p. 3).

Based on this principle, a design tension helps us to identify relations between "what ought to be" and "what is", and therefore to search the few crucial emergent configurations that may make or break a system. In the case of activity-level coordination in CSCL scripts, one can observe several design tensions. These include scripted action vs. bricolage, script intrinsic vs. extrinsic constraints, and the balance between technology use driven by data capture and monitoring and technology use driven by activity-specific support. *"Scripted action vs. bricolage"* is indeed a major tension that has been studied in several contexts of fixed or mobile learning devices (Dillenbourg, 2002; Tatar, 2007). Balance has to be found in the compromise between active / discovery learning and a proper use of existing knowledge on good practices that increase the chances of effective learning. In the latter case, collabora-

tive learning flow patterns (CLFP), i.e. computational representations of scripts such as jigsaw, pyramid, etc. have been shown to be significantly useful in several CSCL scenarios (Hernández, Asensio & Dimitriadis, 2006). On the other hand, the balance of the *real-time improvisational demands as compared with authoring effort* must also be considered. A lightly scripted scenario may require a lot of creativity and improvisation by the students, while highly planned scripts involve a resource-consuming authoring process for the teacher. In addition, *dependence on external programmers / developers* increases to the extent that technology is involved in the scripts.

This paper focuses on activity-level coordination and awareness in face-to-face activity, and examines the tradeoffs between socially-mediated and technology-mediated coordination. It aims to provide an initial exploration of such a tension in the context of the use of a significant CSCL tool in an authentic situation. The ultimate aim of this approach is to provide valuable information on the intertwining variables of real settings, point to the conflicts and the associated compromises, and even to configurations that might provide design solutions. In this case, we have opted to employ Group Scribbles (GS) (SRI International, 2007) in a case study consisting of face-to-face tutoring sessions of a project-based course on Computer Architecture.

Group Scribbles is based on a simple, research-based set of GUI elements, which help the user create and move easily between lightweight public and private arrangements of information. Among other capacities, it allows the teacher (or other user) to design, present and edit representations of processes. Since GS supports lightweight, flexible social coordination, it serves as a good candidate for the study of the aforementioned design tension. The *Group Scribbles* design stakes out a specific, and less well-explored, balance among the poles of the design tensions considered here. In particular, the support for colorful organizing backgrounds and the lack of support for canned scripts positions it much closer to the bricolage pole than the scripted-action pole of intended use. Similarly, its inclusion of few, but very firm, internal constraints (including the firm separation of public and private action, human- rather than machine-interpretable data, and uniqueness of objects) helps set the expectation that many, but not all, of the constraints must be supplied externally. Finally, in the current implementation, only such data capture as is a natural outcome of the underlying architecture is supported.

Discussion and conclusions based on the case study

The case study took place at the University of Valladolid, Spain in Fall, 2006. The context was a series of tutoring sessions in a collaborative and project-based course on Computer Architecture at the Telecommunications Engineering School. The specific topic of the tutoring sessions reported on here is “search and selection of reliable information sources” related to issues of benchmarking computer systems. The scenario integrated a combination of the Jigsaw and Pyramid collaborative learning flow patterns and it was enacted in two sessions of two hours, each involving two sets of different students (5 and 8 volunteers, respectively). The first session, *Experience1*, is entirely based on social coordination and involves both the use of paper (for collaborative activities on diagrams and conclusions) and general purpose software for Internet access, document viewing, etc., while the second session, *Experience2*, is supported by the *GS* tool. In other words, in this session, we used the tool to provide a low level of technology-mediated coordination. GS was initially set up with specific background images and sets of boards tailored for the activities. These two experiences cover an important but small range of solutions for the design tension under study. To reinforce our contrast, we are going to speculate on the expected results of a third experience, *Experience3* that uses strong technology mediation, since it can serve as a contrast point for our study. Although *Experience3* has not yet taken place expected features can be reasonably based on several previous experiences held out by the GSIC/EMIC group in similar contexts, as e.g. in (Hernández, Asensio & Dimitriadis, 2006). In *Experience3*, coordination will be accomplished through a highly prescriptive computational script, generated by the Collage editor of learning designs in IMS-LD and enacted within Gridcole, a tailorable service-oriented environment.

The data based on a simplified mixed evaluation method allowed us to analyze various aspects of the aforementioned design tension and provide evidence-based conjectures. The specific data suggest that the case study can be considered authentic, because it employs non-trivial activity flows, integrated in a meaningful way into a complex project-based and collaborative course. It also suggests that GS, as a CSCL tool, provides affordances that support and enhance activity-level coordination, as compared to the purely socially coordinated experience. It can be argued that GS’ lightweight character, together with the powerful underlying metaphor and the Tuple Spaces coordination language, enabled and strengthened embodied coordination through the awareness stickers, flexibility and adaptation to emergent situations, and less need for guidance by the teacher. Social coordination was also shown to be highly effective. Its benefits include utilizing very few resources, with the notable exception of teacher

creativity and improvisational ability. Additionally, we have confirmed the potential of using collaborative learning flow patterns (CLFP) i.e. good practices or formalized effective scripts, which contributed to the perception of a non-complex activity flow.

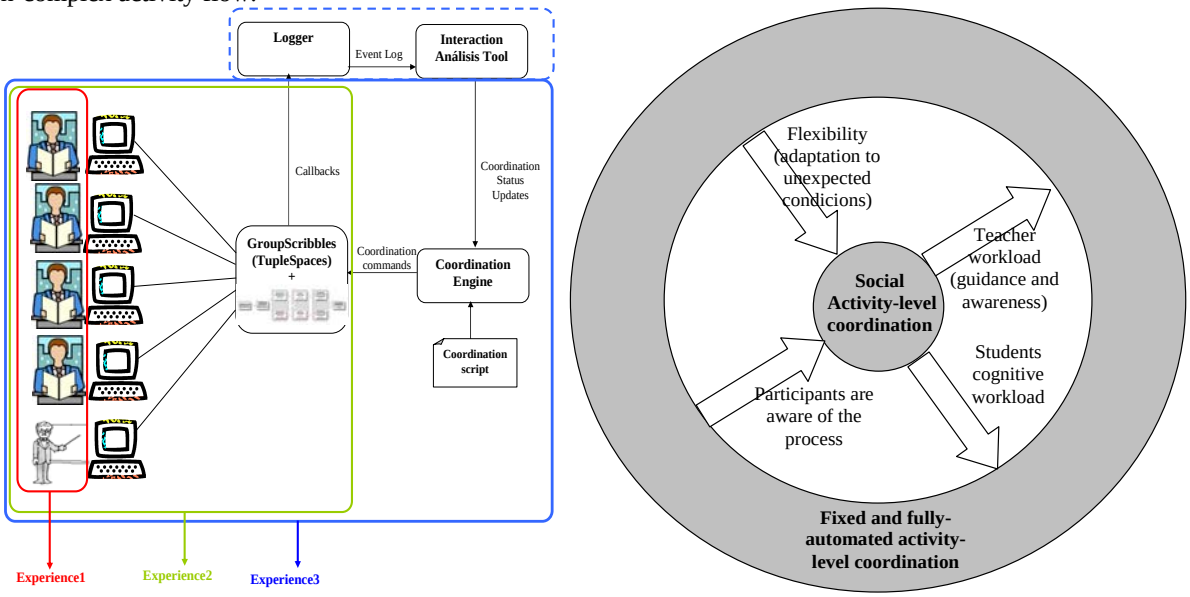

Figure 1: The envisioned architecture (left) and its relation to the design tension (right)

However, in both cases, that of GS and that of social-coordination, the role of the teacher is crucial. As anticipated in the design philosophy of GS, "the only limit is educator's creativity" (SRI International, 2007). Therefore, demands on the teacher are high in all phases of the activity: design, enactment and evaluation phases. The teacher had to design from scratch the activity flow, improvise, supervise, react, and finally monitor and analyze the experience based on "ephemeral" data. Improvisation, creativity and experience cannot be easily found among practitioners, and in any case they may pose a burden for an extensive use of lightweight CSCL tools, such as GS. On the other hand, the hope is that with time, just as with HyperCard, familiar patterns of use will emerge that will put less of a burden on the teacher. All these elements point out to the expected benefits from strong technology mediation, as the one envisioned in the third experience. Tools for design, enactment and evaluation may increase efficiency according to the engineering worldview. Based on the analysis of the design tension (see Figure 1 – right), we can point out to a new flexible architecture that encapsulates affordances of GS as a lightweight coordination technology support, and provides the possibility of using additional computer mediation. In this case, a designer or practitioner as a person involved in action / research may choose to use one or more of all the additional modules presented in Figure 1 (left).

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