Symba: a Framework to Support Collective Activities in an Educational Context

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Abstract: Symba is a Web-based framework designed to support collective activities in a learning context. It has been constructed with a double objective, (1) make students explicitly work out their organization and (2) provide tailorability features to allow the students to decide about the tools and resources they want to be accessible in order to achieve the tasks they have defined. Symba dissociates an "organizational level" and an "activity level". The organization level allows students to organize their activity as a set of phases, each phase being structured as a plan (sequence of tasks). When expliciting a task, students can define the tools and the resources that should be available at the activity level to achieve it. This allows combining the two objectives: students can benefit from an activity level tailored according to their wishes by explicitly defining their organization.

Introduction

The general context of this work is the design of computer-based frameworks that support Collective Activities[1] in a Learning Context (CALC). Within this general context we are more particularly concerned with the problem of providing students with a framework that conducts them to work out organizational features, e.g. address problems such as decomposition of the work to be done into different individual and collective tasks, scheduling of the tasks or identification of the resources and tools to be used to perform these tasks.

Our work is founded on the basic ideas that (1) it is important to make students explicitly work out organization features and (2) a framework that supports collective activities must provide tailorability features in order to (2.1) allow the students to organize themselves in a way that meets their views on the work to be done and (2.2) provide tools that correspond to the way the students intend to achieve this work (by opposition to proposing an *a priori* predefined set of tools).

In this paper we present Symba, a Web-based framework designed to combine these objectives. Symba proposes an explicit dissociation of an "organizational level" and an "activity level". The organization level allows students to conceptualize and describe their organization as a set of phases, each phase being structured as a plan (sequence of tasks). When expliciting a task, students define different features (e.g., the subject or the constraints) and, in particular, what resources and tools should be available at the activity level to achieve it (e.g. a file exchange service and a Chat). This approach allows linking the different objectives: students look forward to working out organizational features because (1) this facilitates their work and (2) it is a means to benefit from a tailored framework that proposes the tools they want to use to achieve the tasks they have defined.

[1] The "activity" term will used in this paper to denote both what students are asked to do (the "pedagogical activity") and in the broader sense of "students' activity". Additional precision will be made when the context is not clear enough to distinguish these meanings.

In section 2 we briefly present the context and methodology of this work and the lessons learned from previous experiments. In section 3 we present Symba key features: dissociation of an organization level and an activity level, reification of the organization and generation of the activity level. Section 4 summarizes the first feed-backs from a preliminary experiment.

Context and Methodology

Context

We use as an experimental field the fifth year of a Computer Science curriculum that mixes face-to-face and distance students. For the last three years, students have been offered a collective activity that alternates a Research (individual) phase, a Structuring (individual) phase and a Confrontation (collective) phase[2]. Every phase is described by its general objective (how to achieve this objective is the students' responsibility). As an example, the activity proposed in 2002 (from which we take the examples presented in this paper) addresses the "conceptual map" notion: they have to identify how conceptual maps can be used to describe a curriculum (Research), propose different individual points of view (Structuring) and then construct collectively, from their individual productions, a conceptual map describing their curriculum (Confrontation).

From a pedagogical point of view, the objective is double. First, initiate students to collective activities and make them work out organization features (necessity and difficulty of organizing the work and the group, difference between the planned activity and the effective activity, specificities of communication through Chat and Forum, etc.) and, at a second level, develop competencies such as synthesis, criticism or argumentation. Second, contribute to the fight against the problem of isolation of distance students and encourage a community feeling by creating a context where they have to communicate and work with other students. In coherence with this objective, the groups mix distance and face-to-face learners.

Methodology

From a methodological point of view, the work presented in this paper aims at contributing to a better understanding of collective activities via computer-based frameworks in a pedagogical context. We do not attempt to evaluate formal hypothesis through controlled experimentations but to design, implement and test innovative frameworks designed to provide data that will enable us to progress in our conceptualization of the domain and its intrinsic phenomena.

The design of Symba is therefore iterative. It is based on principles issued from the literature (importance of the negotiation of a strategy (Dillenbourg & Baker, 1996), use of plans as resources (Bardram, 1997), modeling of the tasks inspired from the Activity Theory (Engeström, 1987)) and analysis of experiments (successive design experiments). During the first two years we have proposed such a RSC collective activity through a simple interface limited to communication tools (Chat, etc.) and document browser (Betbeder & Tchounikine, 2002) and through Symba in 2002. The work is performed by computer science researchers helped, for the analysis of the experiments, by a mediated-communication specialist.

Lessons Learned From Previous Experiences

In order to understand how students organize themselves we analyzed the different Chat, Mail and Forum discussions from past experiments through a communication acts grid dissociating organizational features (e.g.,

[2] An activity whose phases are all collective is too constraining. The RSC cycle allows an alternation of individual and collective phases, the fact that the production of a phase is the resource of the next one introducing a specific motivation for the students (they have to build up their personal idea in order to prepare the collective confrontation (Betbeder & Tchounikine, 2002) An activity can propose a single or several of this RSC cycle.

description of the tasks to be achieved) and activity features (e.g., achieving a given task). The main points highlighted by this analysis are (see (Betbeder & Tchounikine, 2002) for more information about the analysis, the grid and detailed results):

- Such activities appear interesting both as a means to make students experience collective work and enhance social awareness.
- How the groups will organize themselves and what tools they will use cannot be predicted. An environment designed to support CALC must not impose a predefined organization and predefined tools, it must allow students do decide on their organization and on the tools they want to use.
- One must not overestimate the autonomy of the students and their capacity to organize themselves. A CALC that aims at making students practice a reflective activity on their organization must support this activity.
- The academic quality of the collective production and the emergence of social relations (as they appear through the interactions) are not strictly correlated with the amount of interactions nor the degree of organization of the group. However, a basic level of organization is necessary to achieve the work and it seems that within a group that succeeded in producing a work of high quality interactions are more related to a common referential (their activity) and denote a common feeling of "accomplished work". Supporting the group is therefore necessary both for helping students to understand how to manage collective work and to encourage a community feeling.
- Students interact to negotiate the organization both before action (typically, through Chats that prepare synchronous meetings) and during the action. Action is situated (Suchman, 1987), organizing an activity must not be understood as adopting an intangible plan that determines the course of the work.

This conducted to the following key features that we study through this research and serve as general specifications for Symba:

1. The framework must dissociate an organization level and an activity level.
2. The organization must be reified.
3. When achieving a task, the students must be offered tools that meet their wills (i.e.: the activity environment must be tailorable).

The Symba Environment

Dissociation Of An Organisation Level And An Activity Level

Within RSC activities students have to confront their individual productions and produce a collective work in a limited time. We observed that although a large amount of communication is concerned with coordination features (what tasks to achieve, who will achieve them, etc.), students experience difficulties in structuring their organization. Providing some groups with a proposed organization (they could follow or adapt) whilst others had to organize themselves from scratch highlighted that groups that are not supported more or less fail in their goal of coordinating their work, and this leads them to face problems when achieving their collective work (Betbeder & Tchounikine, 2002).

Collaboration requires negotiating at different levels from which, in particular, problem-solving strategies (Dillenbourg & Baker, 1996). Within our context it appears very clearly that students do not explicit their problem-solving strategy. Although one of the principals goals of the activity is to get them initiated in collaborative work (and this is explicitly stated), they attach more importance to the result to be produced than to the effectiveness of their collaboration, and do not understand that this lack of explicitness has a negative impact on the final production. It therefore appears necessary to help students to clarify their organization and encourage an analysis on the articulation of the collective work by expliciting and supporting this task. This requires a framework that makes them work out these features (the objective is not to propose automatically the best organization and tools to the students, but to bring them to work out these questions).

In order to emphasize the importance of working out organization features Symba dissociates two environments, an organization and an activity environments. The organization environment aims at supporting learners in being conscious of the specific task of organizing their collective work by tackling explicitly and collectively an abstract high-level task: organization. Within this environment, students have to define (collectively) a plan, i.e. decompose the general activity into a set of tasks to be realized and specify the tools and resources they want to be proposed with in order to achieve each of these tasks. For this purpose, Symba proposes specific interfaces, the plan and task editors (see *infra*). Once the plan is defined the students can achieve its tasks within the activity environment. For a given task, the activity environment provides the tools and resources that have been asked for by the students at the organization level, in the task description.

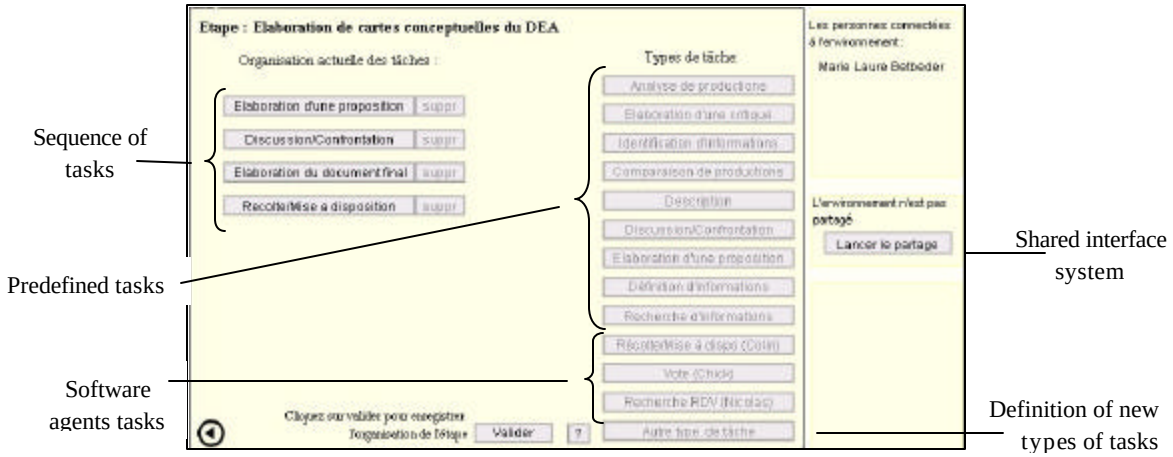
From a pedagogical point of view, we propose for the first steps of the activity predefined plans and tasks descriptions that students can follow or adapt. This helps them in starting on a good basis and avoids complete breakdowns. Later on, they organize themselves completely.

Reification Of The Organization As A Plan

Symba proposes editors that enable students to describe their organization as a plan. A plan defines how the students intend to decompose the general tasks into subtasks, how these tasks will be scheduled, who (an individual or a subgroup) will be responsible for the task and what tools will be used to achieve it.

Plans are used here as proposed in (Bardram 1997), i.e., means to organise the work and reflect the responsibility of the involved actors. A misunderstanding would be that we want the students to bury their activity in a predefined intangible plan. We argue (with others, (Bardram 1997)) that expliciting a plan is not in contradiction with the fact that activity is situated (Suchman, 1987). The plans we are concerned with here are (1) means to make students work out organisation features (before, while and after achieving the work) and (2) resources to carry out the work. A plan does not intangibly determine the students activity nor does it constrain the tools they can use, it reifies how they perceive (*a priori* or *a posteriori*) their organization.

First Level: A Plan As A Sequence Of Tasks



Snapshot of a plan constructed by students (2002 experiment). The plan is: elaborate a proposition (in the context: how can concept maps be used to model a curriculum), discuss/confront (the different individual propositions), elaborate a final document (collectively; this task has been created by the students) and make it available.

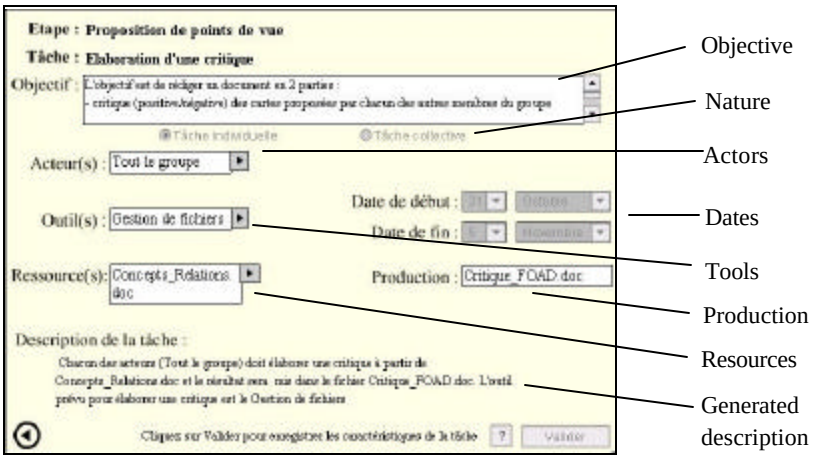
Figure 1: Defining a plan as a set of tasks

At a first level, learners have to define each phase as a set of tasks through a specific interface (Fig. 1). The right part of the interface proposes a set of predefined abstract tasks such as "search for information", "analysis of a production", "discussion", "vote", "search for a meeting time", etc (this list can of course be customized for a given application). A plan is defined by selecting some of these tasks and ordering them (left part of the interface)[3]. Students can also define new types of tasks if required (as an example, in our experiment they defined "elaborate a final document"). The interface is shared, students can connect themselves synchronously and browse the plan while it is being defined: all of the students see the interface, one of them can modify it (alternatively, using a shared interface system). When defining a plan students can discuss synchronously through a Chat (not visualized in Fig. 1).

Second Level: Definition Of The Tasks

At a second level, the students describe the different tasks of the plan. The notion of "Task" in Symba is conceptualized according to the activity theory and, more precisely, the Engeström triangle (Engeström 1987) and the mediation relationships it highlights (subject, object, community ; rules, tools, division of labor)(Lewis, 2000).

Symba's task description interface (Fig. 2) is isomorphic to the Engeström triangle (although this is not presented in this way). For every task, the students have to define the objective (in natural language), the nature of the task (individual or collective), the subject (an individual, a sub-group, all the group), the beginning and ending dates (rules), the tools (that will be accessible at the activity level), the resources (files names) and the production (files names). The system dynamically generates a natural language explicitation of the description in order to avoid possible misunderstandings of the interface. Similarly to the description of the plan, the task description interface is shared and coupled with a Chat.



The description in natural language generated by the system is: every actor (of the group) must elaborate a criticism from the file "Concept_Relation.doc" and put the result in the file "Critique_FOAD.doc". The tool that will be used for this purpose is a file exchange service.

Figure 2: Defining a task

[3] This is a very simple approach of planification. However, it appears sufficient to help students to reify their organization. It will be interesting to propose in a future work, within the same Symba framework, different approaches to the description of a plan, in order to analyze what types of representations are used by students and how they use them.

A Tailored Activity Level

As stated before, the analysis of the previous experiments highlighted that every group adopts its own organization (including groups that are presented with a proposed plan). It is not possible to predict this organization and, consequently, the tools that will be used by the students. A CALC must be tailorable enough to allow the learners to decide on their organization (phases, tasks) and on the tools and resources that should be accessible at the activity level to achieve these tasks.

This tailoring feature is proposed in Symba by the fact that students can decide at the organizational level (in the task description) what tools they want to be provided with in order to achieve the task. Symba generates from each task description a Web page that proposes, in an integrated frame, an access (a hyperlink) to the different tools that have been asked for. Fig. 3 presents a snapshot of an activity-level generated for a task whose associated tools are a browser and a Chat. This Web page corresponds to the frame within which the students will achieve the task. An important point to be noted is that this approach allows students to tailor their environment without having to deal with any programming notions.

The principle we have adopted in Symba is not to embed the framework with specific tools but to allow the access from the framework to external tools. Symba can therefore easily be adapted / upgraded: adding a tool to Symba (i.e., enabling the students to use it) only requires describing the tool in order to allow the students to understand its possible uses and programming a piece of software that generates an access to this tool. Component-integration is a research domain in itself, and how heterogeneous software components can be integrated is the object of a large amount of computer science studies (Bourguin & Derycke, 2001). The way we integrate tools in Symba is a simple approach, but, given our objectives, sufficient.

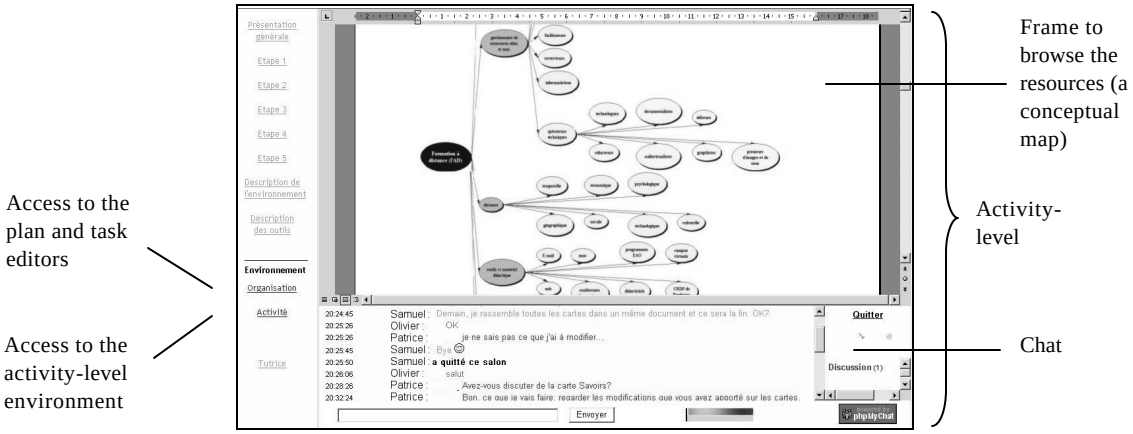


Figure 3: Snapshot of a generated activity-level environment

Another aspect (not emphasized here) that enables students to adapt the system potential to their needs is the fact that some tasks (e.g. find a date or organize a vote) can delegated to software agents (Taurisson & Tchounikine, 2003).

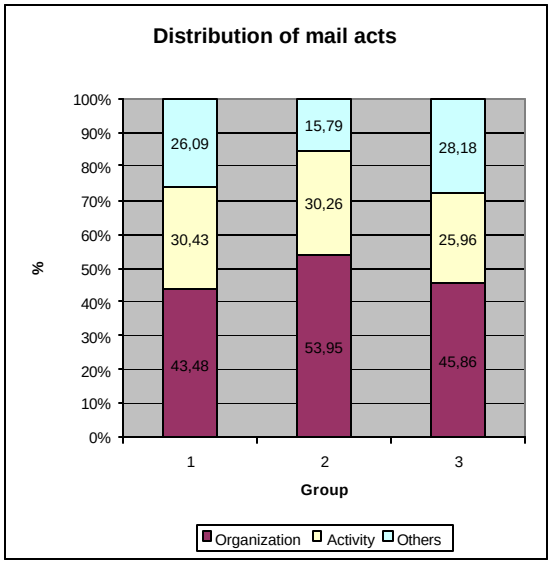
First Feedback

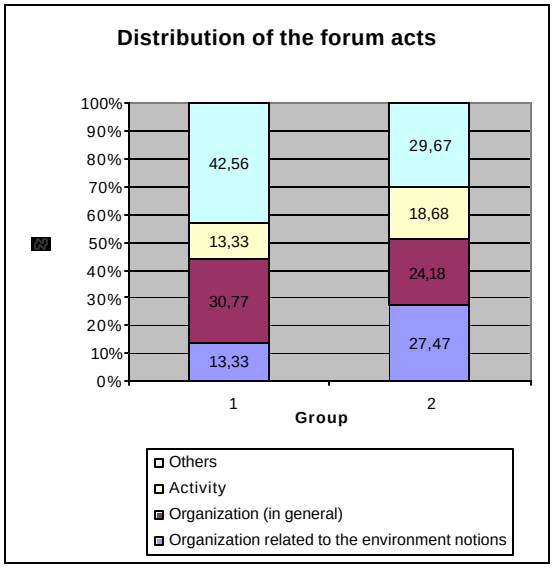
Here below we present the first lessons learned from an experiment (two months' activity performed by two groups of 7 students). As explained before, this corresponds to a preliminary experiment that helps us to understand how the students use Symba, how it impacts their activity and how we can improve the framework design.

We have analyzed the different Chat, Mail and Forum discussions through the same communication acts grid as the one we had used in the previous experiments, that took place with a general environment that only provides general

tools (Chat, Mail, etc.) and do not propose a plan and task editor to help students to organize themselves. Within this grid we further differentiated organisation acts that are related to Symba notions, therefore dissociating acts that correspond to organization issues (in general), organization issues related to Symba notions (e.g., plans or tasks), activity issues and others (e.g., social interactions). Figure 4 presents the overall analysis for 3 groups using the basic framework and 2 groups using Symba.

As one can see from (Fig. 4), the amount of communication acts related to organization issues remains almost the same (in %) as in the previous experiments, but 1/3 to 1/2 of these acts are related to the notions (e.g., plan and task notions) enhanced by the framework (due to space restriction we do not elaborate further on this aspects and, in particular, the interesting differences between the uses of the Mail / Chat / Forum tools). The qualitative analysis highlights different strategies adopted by the groups using Symba. Within the group 1 a small sub-group worked out an organisation and proposed it to the rest of the group, which adopted it: the number of interactions related to the organisation is small, the group focused very quickly on the domain activity (large number of interaction). The group 2 adopted a more collective strategy and spend more time on the organization before focusing on the plan achievement. In both cases, the qualitative analysis highlights the major role of the organizational features proposed by the framework. The plans we propose for the first steps helped students to begin the activity and, when they were left to their own, they extensively used the framework to reify their organization. Although they were offered a shared interface system that allowed to define the plan collectively and synchronously, it appears that in certain cases some students took a leader position and more or less elaborated a plan on their own or by pairs and then proposed the plan for validation to the others (this is a very classical situation, that happened similarly in our previous experiments). However, whether it had been defined or not through the Symba communication tools (shared interface and Chat), the adopted organization was reified with the plan and task editors as tasks described in details.





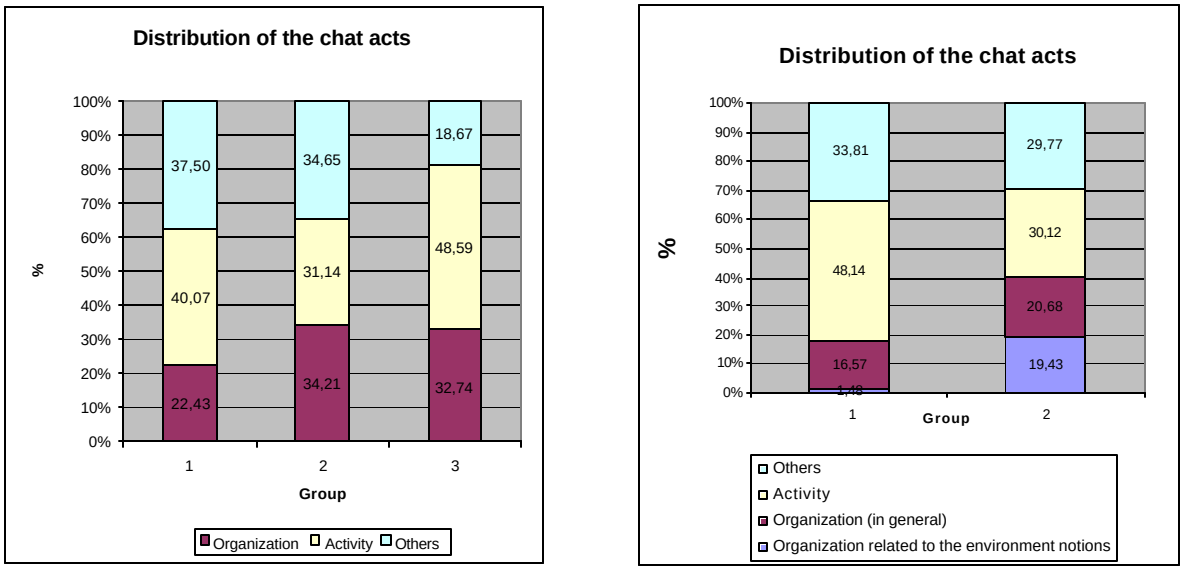


Figure 4: Quantitative results from the interactions analysis

The qualitative analysis also highlights that students' plans and tasks descriptions appear coherent. Obviously, they serve as a resource for achieving the activity. In particular, students extensively use the "objective" slot (description in Natural Language, see Fig. 2) as a reference for a common understanding of the problem-solving strategy. It appears that, when performing some tasks, the students considered that the organization should be modified: the plans were then modified according to the result of the negotiation. The evolution of the plans[4] and the fact that the students use (or not) the tools they asked for at the organization level are one of the points under study (the Chat and Forum traces denote both the evolution of the tasks' achievement and the negotiation of the plans). However, let us recall that there is no expectation that students would follow the plan, but rather that they would use it as a resource, which is the case.

A certain number of innovative uses of the framework have been identified such as using the "objective" description slot of a task to identify internal subgroups and decompose the tasks into subtasks. This could be interpreted as the fact that students internalized the organization underlying principles promoted by the framework (explicit definition of subtasks, delegation to subgroups) whilst not using the tool to do so (they could have defined these subtasks at the top-level). As said before, the experiment also helped us discovering two different emergent uses of the framework: some students focused principally on the production to be delivered and used Symba for what it could help them (e.g., a leader proposes a plan by Mail and just reifies it in the tool, c.f. Group 1) when some others "played the game" (c.f. the high percentages - 27.47% and 19.43% - of organization acts related to the environment notions in Goup 2) and focused on how to organize themselves (e.g., synchronous meetings to collectively define the plans). The analysis also highlights different ergonomic issues for the next version of the framework.

Conclusions

The experiment we made highlights the positive impact of the use of a framework such as Symba in the way students organize themselves. The modeling notions and principles that underlie Symba (plans as sequences of tasks, tasks modeled according to the Engeström triangle) appear convenient and useful for the students and allow them to specify a tailored activity level without having to deal with any programming notions. Such a framework can be used

[4] In particular, it will be interesting to study (through successive experiments) the crystallization that could denote the definition and reuse of new types of tasks and/or of plan patterns.

by a group of students in different ways, as a tool to describe an adopted organization and/or as a means to work out the articulation of their collective work and/or to benefit from a tailored activity level. We believe that how it turns out depends on (1) the pedagogical activity that is proposed to the group, (2) the institutional context and (3) the internal dynamic that emerges from the group. From another point of view, Symba is also a very interesting tool for researchers to study how groups deal with such collective activities/frameworks.

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