Evaluating Collaboration in CSCL Application Domain within the CSCW Lab

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Abstract

The CSCW Lab is an environment for evaluating groupware within research groups. Four dimensions in assessing groupware were identified: context, collaboration, usability and cultural impacts. In this paper, we present a proposal to detail the collaboration level, specifically for CSCL domain applications. The model includes a set of guidelines to evaluate the usage of CSCL tools within a collaboration process defined along with the learning objetives.

1. Introduction

Several groupware tools have been implemented within CSCW and CSCL research groups in order to test ideas and concepts currently being studied. It is very important to perform pilot-evaluations with these software. Yet the evaluations must be done in such a way by following some kind of methodology so that the results make sense and can be used to enhance the research. The demand for groupware evaluation can be observed by the number of papers and research reports addressing this issue [1][2][3].

The CSCW Lab is an environment for evaluating research products [4]. The main goals are to guide groupware researchers in establishing a method for designing and conducting their evaluations and to be a repository of groupware evaluation knowledge. It intends to study existing methodologies applied to groupware evaluation as well as to define new methods, instruments and/or tools. An ontology that comprises the concepts related to groupware evaluation was defined and four main dimensions were identified: the context of the group, the groupware usability, the level of collaboration that the group achieves while working

with the software support and the cultural impacts provoked within the organizational environment [4].

Besides the dimensions, there are issues related to specific groupware domain applications that should be considered when designing an evaluation process. Therefore, since the CSCW Lab is a general environment, it is necessary both to analyze particular domains and specialize each of the four dimensions, in order to combine them, defining and applying appropriated methods.

In this paper, we present a proposal to detail the collaboration level specifically for the CSCL domain applications. The model includes a set of guidelines to evaluate the usage of a CSCL tool within a collaboration process defined along with the learning objectives.

The paper is organized into three more sections: Section 2 describes the CSCW Lab, which is the context of our work; Section 3 presents the proposal for the Collaboration dimension and Section 4 concludes the paper.

2. The CSCW Lab

The CSCW Lab is a laboratory for conducting groupware pilot evaluations. Besides the physical space, it includes guidelines and instruments for executing groupware evaluations. Groupware evaluation involves a great amount of effort. The planning, design, accomplishment and replication of an evaluation are costly activities [5]. The design of the experiment is an activity that should be carefully performed in order to guarantee that the results and measures obtained are relevant for interpretation.

The CSCW Lab is also a repository of information about groupware evaluations. The aim of this repository is to collect information about how previous evaluations were designed, their results and interpretations.

Browsing this repository, evaluators can find guidelines for planning their evaluations. Data of past evaluations could be used to compare against their own evaluation.

The strategy chosen to build this repository or knowledge base was to define and populate an ontology [4]. The dimensions in the CSCW Lab ontology are the core elements, associated with the other common concepts that exist in evaluations in general: instruments, data, products, results interpretations and so forth.

The four dimensions identified were a first step towards building a conceptual framework for our studies in the CSCW Lab. We consider that while evaluating groupware we may also address how to: describe and evaluate the **context** in which the application will be used; to evaluate the application's **usability** strengths and weaknesses; to evaluate the level of **collaboration** achieved while using the application; and to evaluate the technological and **cultural impact** achieved with its use over the course of time. Each dimension can be viewed as subsequent steps of a method for conducting groupware pilot-evaluations [4].

These dimensions have a close relationship with each other. For instance, depending on the group characteristics (its context), the reaction of using a specific tool can be quite different. Groups that are highly committed to an activity may try to overcome any usability problems that exist in the supporting tool. If a tool has too many usability problems, collaboration may be completely compromised. If a high level of collaboration is achieved through the use of a groupware tool, the cultural impacts can be of a greater dimension. The dimensions are quite adequate to configure the evaluation process of a groupware tool, however, we need to detail each one for the different kinds of groupware applications.

Each dimension implies in defining specific methods and issues to assess it. In this paper, we focus on the third dimension: level of collaboration. Collaboration may occur at many levels and depends a lot on the nature and objectives of the group's task. To evaluate collaboration it is first necessary to determine what the measures or variables are that determine how people collaborate. For instance, in a discussion forum, one possibility to measure collaboration is to count the number of contributions generated by the group. However, collaboration in a forum is only effective if contributions are not only inserted but also read by other participants.

Measuring collaboration also involves subjective metrics. Usually, people can feel if the members of the group they take part in collaborate with each other or not. By introducing instruments such as questionnaires or by incoporating direct observation, evaluators can be aware of participants' satisfaction and have an indication about the collaboration that occurs among group members.

Evaluating the collaboration process is a complex task. We decided to start our studies about collaboration within the context of a groupware support in CSCL (Computer-Supported Collaborative Learning) based on our previous experience on this theme [4][6][9][11][12]. Besides, the analysis of the CSCL area reveals the existence of a great number of cooperative environments. However, the way activities are proposed within a CSCL environment may not lead to collaboration, as several authors reported when evaluating the use of the environments in real situations [14]. Therefore, it would be a great contribution to this area to define a method for evaluating the usage of educational groupware. The next step is to extend the research to other domains of groupware application.

3. The Collaboration Dimension in CSCL Domain

Collaborative learning is a complex phenomenon. Understanding and analyzing the collaborative learning process and group dynamics requires a fine-grained sequential analysis of the group's interaction in the context of learning goals [6]. The computer-based learning topic originates from different academic backgrounds; most the Computing, Psychology and Education. Despite being inter-linked, problems may arise due to the different paradigms to which these disciplines belong. Indeed, on the issue of which criteria should be adopted for the evaluation of CSCL, three distinct schools of thought emerge: technical, social-psychological and cognitive.

Several researchers in the area of cooperative work take the quality of the group's outcome as success criteria. Traditional group work in solving problems tends to emphasize the product of the design and development process, but not the work process itself [7]. Nevertheless, recent findings are giving more importance to the quality of the *cooperation process* itself [10].

Success in collaborative learning means both learning the subject matter (collaborating to learn), and learning how to effectively manage the interaction (learning to collaborate). The effects of collaboration process cannot be measured along a single variable [8]; rather, a chain reaction occurs in which each event gives meaning to the next. Thus, selecting variables is a difficult task.

A *cooperative learning process* is typically composed of tasks that must be carried out by the

57

cognitive mediator or facilitator, and by the group of apprentices [10]. In order to evaluate the cooperative learning process, Collazos et al. [8] divide it into three phases according to its temporal execution: *pre-process*, *in-process* and *post-process*. Thus, *pre-process* tasks are mainly coordination and strategy definition activities and *post-process* tasks are mainly work evaluation activities.

The group members will perform the tasks concerning the *in-process* phase, to a large extent. It is here where the interactions of *cooperative work processes* take place. Guerrero *et al.* [11] have defined an Index of Collaboration based on the structure of a cooperative learning of the in-process phase. The indicators are based on the following activities proposed by Johnson & Johnson: use of strategies, intra-group cooperation, reviewing the success criteria and monitoring. The fifth indicator is based on the performance of the group.

Santoro [12] investigated a few methods for evaluation of collaborative learning processes. A compilation of them generated a set of criteria and measure units. The collaboration levels to be evaluated within the groups are based on four categories of study: communication, collective knowledge building, coordination and awareness. The communication is related with the interaction in terms of the quality of messages exchanged among participants (e.g., content, coordination or socialization messages). The collective knowledge building is observed from the contributions of the participants on discussions and on the artifacts produced. The contributions on other members' contributions such as comments and suggestions are also considered; it means the process of sharing ideas and building something together. The coordination means the ways groups articulate and design their strategies to solve the problems. The awareness is the perception of each group member about the process, the participation and the way the group carried out the work. We suppose that these issues can indicate whether a group is more or less collaborative.

Based on the work of Guerrero & Collazos and of Santoro about the evaluation of the collaborative learning process, complemented with the theory of the types of interdependencies [13], we propose a method and some issues that should be examined if evaluating a CSCL application that supports a well-defined collaborative learning process and its usage by groups of learners (See Figure 1).

As a final objective, we wish to evaluate whether people are stimulated to collaborate by using the groupware under study. It is necessary to "measure" the level of collaboration within the process and to compare the same situation without the groupware tool. Thus, the scenario of the method proposed is the following: we have a group (Group 1), performing a process, with a CSCL tool supporting it. We have another group (Group 2), performing the same process without the support of the CSCL tool. Both of them happen over a period of time (t_0 to t_1), with the same goal to reach.

We believe the first step of a method for evaluation is the characterization of the three important issues of this context: the **Group**, the **Process** and the **Tool**. Each group of collaborators differs from each other; therefore it is necessary to specify its particular characteristics. In collaborative learning, the work process is generally related to a technique (problem-based learning, jigsaw, learning together, etc.) proposed by the teacher. Thus it would not be possible to evaluate an educational groupware without considering the group characteristics and the work process.

Each of these issues (Group, Process and Tool) could be observed through a set of dimensions that describes them. Each dimension is provided with some characteristics. We propose as a first step of evaluation a questionnaire where we relate all the issues through their dimensions, resulting in a framework that reflects the conformity of the support provided by the tool to the process to be performed by the group. These questions could help to grade the groupware tool before putting it in use by the groups.
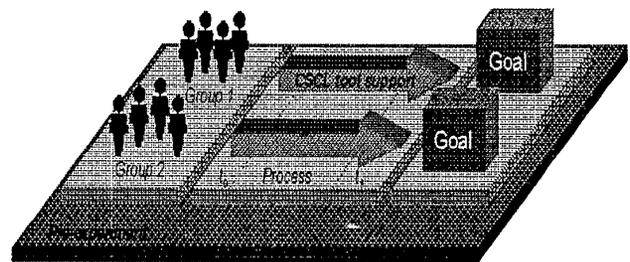

Figure 1. The Context of Evaluation

Aiming at evaluating the level of collaboration a group achieves supported by a CSCL tool, we defined an instrument that consists of a series of questions. The answers to these questions will establish the maturity level that a team could reach with the usage of the specific groupware tool. This instrument is following described in Table 1.

Table 1. The Level of Collaboration Issues

Issue	Dimension	Characteristic	Questions (G=Group, P=Process, T=Tool)
Group	Group Composition	▪ Sex ▪ Age ▪ Social-cultural level ▪ Background ▪ Commitment	G1. Describe the composition of the group in terms of the sex, age, social-cultural level, background and commitment. P1. According to the process to be performed, is this composition satisfactory? T1. Does the tool provide specific support to composition?
Group	Group Characteristics	▪ Homogeneity ▪ Members proximity ▪ Organization ▪ Organizational culture ▪ Number of members	G2. Describe the level of the group homogeinety/heterogeinety. P2. According to the process to be performed, is this homogeneity satisfactory? T2. Is the groupware tool appropriate to this homogeneity (consider the interface, help on line, commands)? G3. Describe the proximity of the group according to the tasks they are expected to perform. P3. According to the process to be performed, is this proximity satisfactory? T3. Is the groupware tool appropriate to this proximity (consider synchronous and asynchronous tasks)? G4.Describe the group organization (hierarchy). P4. According to the process to be performed, is this organization satisfactory? T4. Is the groupware tool appropriate to this organization (consider the issues anonymity, groupthink)? G5. How many members does the group have? P5. According to the process to be performed, is this size satisfactory? T5.1. Is the groupware tool interface appropriate to this size? T5.2. Are the communication channels appropriate to this size groups? T5..3. Is the performance of the groupware appropriate to this size groups? T5.4. Are the awareness mechanisms appropriate to this size groups? G6. Is it possible to have groups of different sizes? P6. According to the process to be performed, is it possible to have groups of different sizes? T6. Does the tool support different size groups? G7. Describe the group organizational culture. P7. According to the process to · be performed, is this organizational culture satisfactory? T7.1. Is the groupware tool appropriate to this organizational culture? T7.2. Does the tool provide support to socialization?
Process	Learning technique	No characteristics	P8. What collaborative learning technique is used? ( ) JIGSAW ( ) PBL ( ) Learning Together ( ) STL ( ) Other
	Intra-group cooperation	▪ Providing help ▪ Use of collaborative strategies	P9. Is there Intra-group cooperation among the group members? T8. Does the tool provide support mechanisms to intra-group cooperation?
	Kind of tasks	No characteristics	P10. What kinds of task must be used? ( ) Brainstorming ( ) Collaborative edition ( ) Meetings ( ) Negotiation ( ) Decision making ( ) Others

59

Process	Coordination	• Strategy definition • Use of strategy • Strategy improvement • Success criteria review • Monitoring • Rules definition	P10. Should the group use strategies in order to solve the task? T10.1. Does the tool have mechanisms to support the strategies definition? T10.2. Does the tool have mechanisms to support the strategies usage? T10.3. Does the tool have mechanisms to support the strategies improvement? T10.4. Does the tool allow verifying success criteria? P11. Should the groups be monitored? T11. Does the tool have mechanisms to support monitoring? P12. Should the apprentices follow pre-defined rules? T12. Does the tool help to maintain or observe the rules of work in group?
	Positive interdependence	• Goal • Celebration/reward • Resource • Role • Identity • Environmental • Fantasy • Task • Outside enemy	P13. What kinds of positive interdependencies are defined within the process? T13. Does the tool support the positive interdependencies defined?
	Collective building	• Individual contribution level • Group contribution level	P14. Does the process include collaborative building of artifacts? T14.1. Does the tool support individual contributions on collaborative buildings? T14.1. Does the tool support collective contributions on collaborative buildings?
Tool	Communication	• Asynchronous • Synchronous	P15. According to the process, what kinds of communication mechanisms are necessary? T15. Does the tool provide these mechanisms?
	Awareness	No characteristics	T16. What kinds of awareness, according to the process defined, does the tool provide? ( ) Organizational ( ) Task ( ) Situation ( ) Informal ( ) Social ( ) Group-structural ( ) Community ( ) Multi-synchronous ( ) Concept ( )Workspace ( ) Knowledge construction T17. Does the tool provide individual goal achievement awareness? T18. Does the tool provide group goal achievement awareness?

The questions in the instrument characterize precisely the three dimensions that should be taken in order to evaluate a CSCL tool. The questions related to the Tool dimension (T in the table) are not applied to the control group (Group 2), because this group does not use any groupware tool to support their work process.

4. Conclusions and Future Work

Evaluating the usage of CSCW tools is a hard but fundamental task for the researchers of the area. Each domain has its specific issues such as the collaborative learning, which comprises educational, social and technical aspects. In this paper we presented a framework proposal for evaluating the collaborative dimension of a CSCL tool within the context of the CSCW Lab [4].

The instrument proposed comprises a great number of questions, which should be answered in order to evaluate the support that the CSCL tool is delivering to the group. Two groups should configure the experiment design: the first group uses a CSCL tool and the second group, a control group, performs the same activity without computational support. After both groups execute their tasks, all the questions in the instrument start to be answered and the data obtained is analyzed. Comparing the results from both groups, it is possible to determine the real support provided by the CSCL tool to the collaborative process designed.

The work within the CSCW Lab is been carried out in two main directions: the first one is the development of the ontology, which will help to understand the complexity of groupware evaluations; the second one is the study of specific methodologies to support several domains. The research done until now is based on defining and refining the instrument, besides projecting the experimental environment. The next steps are to perform several experiments and analyze the results in order to validate our proposal.

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