A Case Study on Collaborative Learning in Distributed, Cross-Cultural Teams

Authors:

Kristi Agerup, University of Oslo, kristi.agerup@kongsberg.com
Maurus Büsser, University of Applied Sciences, North Western Switzerland, m.buesser@fh-aargau.ch

Abstract — *The case study evaluated how students worked in distributed cross-cultural teams with an intervention called BrainSpace. This method allows sharing explicit knowledge, and ensures that all participants gain tacit knowledge within a collaborative process. The research was undertaken in a graduate-level course where students from US and Japan worked in a team to create a product requested by an industrial sponsor. Based on cultural differences the students' initiative to collaborate gradually faded. Instead of a mutual engagement that led to knowledge creation, only the lower level of a web-based coordination was reached. Related on an activity theoretical scheme it is shown how the aspect of creating a product became more important than knowledge creation. Upon these findings some recommendations to improve computer supported collaborative learning and working in cross-cultural teams have been made.*

Index Terms — *Collaborative Learning, Cross-Cultural Teams, CSCL, eCollaboration, BrainSpace.*

INTRODUCTION

As corporations face increasing demands to collaborate internationally, it is important to learn how these distributed teams can maximize knowledge sharing and problem solving. A challenge for higher education is preparing students for this distributed collaboration. Since universities often focus on models that support individual learning, there is a need to adapt by adopting more collaborative learning instruction in the classroom. In this development, information and communication technologies (ICT) also play an important role in supporting learning and teaching.

This paper describes how students worked in distributed cross-cultural teams with an intervention called *BrainSpace* [1], a method that enhances collaborative learning and knowledge creation. The research was undertaken in a graduate-level engineering course where students from different universities worked in teams to create a product requested by an industrial sponsor.

THEORETICAL FRAMEWORK FOR DISTRIBUTED CROSS-CULTURAL COLLABORATION

Learning Theory

The overall design in the course was strongly influenced by constructivism, as interpreted by Piaget [2]. In constructivism, individual development is a function of active discovery, and knowledge is not absorbed passively. Learning is constructed in an active collaborative process. Thus, individual outcomes are implicit in the joint problem solving of the teams.

The course under study was an introductory Mechanical Engineering graduate course (http://skunk.stanford.edu:8080/sparrow_2.0/pages/me310/index.html) held over three quarters (September – June). The underlying educational philosophy was described as Product Based Learning, where student teams designed an innovative product with a real need, and requested by a corporation. Class resources were distributed – by accessing information (using coaches, corporate mentors, teaching assistants, group members), sharing knowledge among team members, and creating new knowledge by collaboration within the student teams. Course activities were organized mostly through synchronous and asynchronous technologies (telephone and video conferencing, chat, e-mail, content management system).

Activity Theory for analyzing collaborative learning and working

Activity Theory (AT) has recently received growing attention as a conceptual framework in CSCW and CSCL studies. AT provides a new lens for analyzing learning processes and outcomes by focusing on activity systems that define developmental goals, behavioral opportunities and constraints, available resources and the human action outcomes [3]. AT constitutes a rich framework for studying different forms of practices as developmental processes, with both individual and social levels interlinked at the same time [4]. A basic assumption is that learning has to be understood as specific actions integrated in the complexity of social, institutional, cultural and historical practices. The unit of analysis is widened from viewing the individual as a solo learner to including the practice of all learners inscribed in activity systems [5]. In this study, AT is an interpretative framework that has the necessary elements to analyze processes of complex problem solving with a diversity of expertise.

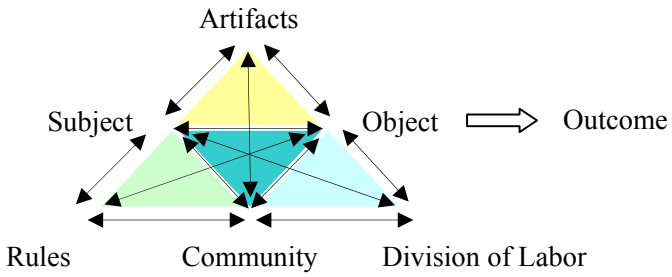

FIGURE 1
ACTIVITY SYSTEM

In Figure 1, key elements of an activity system are included in the top triangle: the subject, the object and the artifacts. Relating this model to the study, a team in the course represents the "subject". The "object" points to the outcome of the activity system, which was the product to be developed by the team. The top part of the triangle is the tool or artifact that mediates the activity, whether physical (hammers or computers), mental, or symbolic (systems or models). In this study, the tool was the experimental evaluation of *BrainSpace*. The center triangle describes how the subject and the community are co-constructing the object [3]. The right part of the triangle is connecting the object of the activity to the community by defining a division of labor. How work is regulated has much to do with what kind of working culture and climate it is between those who are involved in an activity system. In this study, the focus was on collaboration within the team. The left part of the triangle consists of the rules that organize certain aspects of the activity, and in this study the focus was on the cultural perspective of teambuilding.

Cultural perspective in teams

In corporations, working in cross-cultural teams has become more frequent as businesses globalize. According to Armstrong [6], the distance between members of distributed teams is multidimensional, including geographic distance, time difference, organizational distance, and cultural difference. In particular, Lemons [7] discussed cultural differences related to cultural and psychological dimensions of collectivism and individualism. An *allocentric individualist* describes the preference of in-group goals to personal goals, and the *ideocentric individualist* emphasizes personal goals rather than in-group goals. Lemons refers to a study of more than 60 countries, showing large differences in individualistic cultures (e.g. USA, Great Britain) versus more collectivistic cultures (e.g. Japan, Venezuela). One finding was that the working culture in Japan is "group-centered and collaborative," while American culture tended to be "competitive and individualistic."

Collaboration versus cooperation in teambuilding

Lehtinen [8] argues that there is a distinction between cooperation and collaboration, which depends on how individual participants in activity systems perceive their roles and tasks. Cooperative work is accomplished by the division of labor among the participants, where each person is only responsible for a portion of the problem solving. Collaboration is defined as involving the mutual engagement of participants in a coordinated effort to solve the problem together. Successful collaborative work requires a culture of collaboration, supporting leadership, common vision, information support system, and team processes.

To create a successful team, it is important that goals are partly shared by the participants; otherwise, the situation could lead to conflict [9]. To make a team work with less conflict and more focus, it is important to make sure that the participants have a shared understanding of vision, mission and strategy. It is also crucial to have a shared understanding about roles and accountabilities, to identify result-oriented performances, to develop methods to review progress and results, and to share best practices with other teams [10]. To create a successful cross cultural distributed team with a high degree of collaboration, the participants should have this knowledge, and have to be facilitated by appropriate tools.

BrainSpace: A method to improve collaboration in distributed teams

The intervention used in the case study was derived from *BrainSpace*. This method, invented by Büsser/Ninck [1], based on Team Syntegrity [11], where a polyhedral structure is used to organize a stable, non-hierarchical communication process. This architecture has been proven to be optimal in sharing information in group settings. Collaboration within a group leads to an integration of multiple points of interest about a topic. These different perspectives produce an environment rich in perturbations, where knowledge creation is beneficial. The *BrainSpace* design (type of polyhedron, topic definition, topic assignment, number of iteration steps, time per iteration, role combination, interpretation of the roles) is context- and tool-dependant, and must be individualized for each case.

In Figure 2, an example architecture of *BrainSpace* is illustrated by using an octahedron with six vertices and twelve edges, modeling twelve persons and six topics. Each member of the team is represented by one connecting edge. Each vertex corresponds to a topic. Four edges lead to each vertex; therefore four persons constitute a team, studying one topic. Each member is an active player on two different teams, and members not active in a team session can be critical observers and/or facilitators within other groups. By attending different teams, a member communicates what has been learned in an adjoining team. Available information is progressively distributed over the entire network. This structure together with the reverberation enable a balance between order and creative chaos.

BrainSpace expands upon the Team Syntegrity model by addressing issues in virtual space during a longer period. This is done by integrating heterogeneous groups with different perspectives; provoking knowledge creation by an environment rich of perturbations; pacing the process; creating democratic and non-hierarchical structures; building trust and commitment; and providing shared space and mediating tools for collaboration.

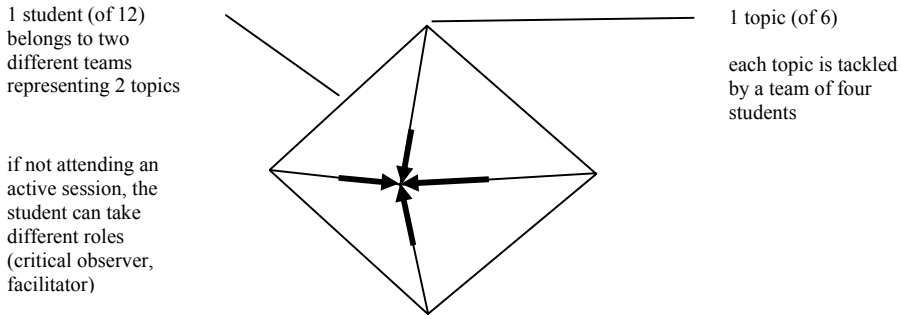

FIGURE 2
OCTAHEDRAL STRUCTURE OF THE *BRAINSPACE* MODEL

Tools to create a shared space and support *BrainSpace* tasks provide multiple asynchronous and synchronous communications among distributed team members. Important features such as application and file sharing, conferencing and messaging are covered by products like Groove, Centra or MS Sharepoint.

STUDYING *BRAINSPACE* EFFECTS

For this case study, a cross-cultural team was self-selected to participate in a *BrainSpace* intervention. This particular team was working on a project for an automotive company, and its assignment was to create a system for a car to interact with a sleepy driver to maintain awareness while driving. The team consisted of six students: three from Stanford University in the US, and three from the Tokyo Metropolitan Institute of Technology (TMIT) in Japan. Since TMIT did not have an equivalent formal course, the students were volunteers chosen by their professor. These students did not receive course credits, nor attended any equivalent lectures. The US students had a specific schedule with lectures, weekly meetings with their Teaching Team and specific deadlines for all tasks.

The research questions were: What are the instructional, social and institutional prerequisites to build a cross cultural learning community? How does *BrainSpace* influence collaboration and outcome of a team?

The hypothesis is that using *BrainSpace* would help a team focus on the structure and process for collaboration, and share information better. The team used in this case study tested *BrainSpace* in the second and third quarters of the course (January - June 2002). These studies were completed using participatory observation with the US group, and in five teleconferences between team members. At the end of the process, a focus group interview with the US Team and an equivalent survey for the Japanese team was conducted.

RESULTS

Cultural perspective

In general, students did not show any reluctance against working together from different cultures. They indicated that the cultural differences were interesting and useful. There were cultural differences both on the organizational and individual level.

Regarding the first, the US students said that they struggled more with the university system and structure. There was a rather distinct cultural atmosphere among the US students that shaped the interaction with all team members, which was a focus on specific deadlines and project requirements. In contrast, the Japanese students were more closely related to PhD researchers, content research and writing papers in a hierarchical relation to a professor.

The Japanese students characterized the US team as fast, stressful, and unstructured. The US students said that the Japanese were conservative and unemotional. Both the US and the Japanese students were polite to each other during all of

the meetings, perhaps excessively so. One US student described a situation where the Japanese students did not protest when the US students drove the project into a specific direction. He interpreted such a reserve as a way of avoiding being impolite. Data indicated that when US students were alone, they tended to critically comment the Japanese contributions. However, nothing was said openly in the team meetings.

In the beginning, communication was unequal between the two groups. This was evidenced by the US students dominating all conversations, which could be attributed to the Japanese students' lack of English skills (only one of the three team members spoke English well enough to converse with the US students). On the surface, it appeared that the US students were in charge of the project.

During the course, the US students felt that the Japanese students did not do their share of the work. They were surprised to receive a contribution from the Japanese students towards the end of the course.

Collaboration versus cooperation

Data showed that the team struggled to build a common identity due to a lack of common goals. This issue was frequently referred to by the facilitator and US students. Another reason was that the US students did not need the input from the Japanese students, who in turn felt that they were not expected to contribute. The latter held other views of the teambuilding process, looking at it as one team attending to two separate parts of the product. They felt there was an excellent cross-breeding of ideas resulting in direct inputs into final written reports. Thus two teams were created.

By the end of the course, the team separated to work on different parts of the project. The US team members worked well, but did not collaborate with the Japanese team members. Although the former were motivated to collaborate and build a strong team, they eventually gave up the idea that both groups could create something together. This happened in their last teleconference and the conclusion was that they should do separate things in two projects. One of the US students said that they went along very well in non-work settings, but were unable to make joint contributions to the project. He added that they needed more instructions on how to be successful on that objective.

Applying the *BrainSpace* intervention

For this team, the *BrainSpace* process was implemented in the following manner: 1) Kickoff and problem description (local): The students select six discussion topics. 2) Agenda-setting (virtual): Student pairs determine the meeting dates within a two-week timeframe. Observer and moderator roles are assigned, and become familiar with their roles. 3) First collaboration phase (virtual): The teams explore their respective topics. A moderator facilitates the meetings. Results and plans for subsequent actions are posted to a discussion forum, visible to everyone. Members from inactive student pairs observe discussions and give feedback. 4) Further collaboration phases (virtual): According to the results and team needs, further collaboration steps may be added.

In the kickoff phase, the US students traveled to Japan to meet each other and collectively choose the six discussion topics. In their first teleconference after returning to the US, they did not use *BrainSpace*. In this meeting, the US students talked most of the time. In their second teleconference, they started to use *BrainSpace*, with a facilitator leading the process. The US students prepared the agenda before the meeting related to the six topics they chose. The intent was for 2-4 persons to discuss each topic, represented evenly between the two institutions. One student was set up as critical observer. When a subgroup moved on to the next topic, all students changed roles, so that everyone participated in at least two discussions.

Field notes show that during the first collaboration phase, *BrainSpace* appeared to improve communication, and the Japanese members became more active. However, the observer role was not fully functioning, and the facilitator role was unclear. The facilitator used was one of the Teaching Team (TT) members who did not acquire the necessary class authority to be a facilitator.

In their third teleconference, after a briefing of the facilitator, he presented himself more explicitly explaining his role and the underlying philosophy. At the meeting start, one of the Japanese students feared that *BrainSpace* would focus student attention on the method instead of the product delivery. The Japanese student argued against using the method, whereas the facilitator and one of the US students argued in favor. After more discussion of *BrainSpace*, both groups agreed to continue with the method.

In their forth teleconference , the US team created a different agenda right before the videoconference. They did not follow the agenda sent out before the meeting, and no review of the different group roles was made according to the *BrainSpace* protocol. The facilitator was neglected, and one of the US students took the lead from the beginning. This forced a change in the system, since the meeting turned into a discussion about group decision-making processes. They decided that the US and Japanese students should work on different tasks on the product. The US student who led the meeting spent time

involving the Japanese students in the decision-making process, and the entire group was satisfied with the outcome of the meeting since it clarified the work plans ahead.

It is believed that the low investment of time and energy into *BrainSpace* stemmed from the conflict between a product and process focus. As one student summarized, "…the process came in the way of the product." This confirms that participants need to understand from the start how *BrainSpace* can be part of the problem solving process.

Conclusions related to Activity Theory

Findings are related to the Activity Theory framework as described in the introduction. Figure 3 shows the main artifact in the course was the underlying Product Based Learning philosophy. *BrainSpace* was the artifact that was introduced.

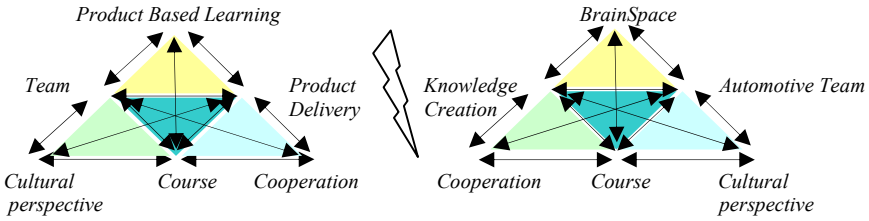

FIGURE 3
FINDINGS RELATED TO TRIANGLES IN THE ACTIVITY SYSTEM

It was two activity systems with different artifacts and mixed objectives that came in conflict with each other. The artifact "Product Based Learning" focused on the product creation, and tends to lose focus from defining problems suitable for reflection and learning. *BrainSpace*, the new artifact introduced to the class, focused more on those learning aspects and contradicted the production-focus. The object in the left activity system was the product delivery, but in the use of *BrainSpace* (right) was the knowledge creation, which should materialize into a successful process.

Did the group truly create new knowledge together in order to fulfill the assignments? The answer can be found by analyzing the other triangles in the activity systems. By looking at the triangles, the US and Japanese students were part of a greater community consisting of the other seven teams in the course, the Teaching Team, and the corporate mentors. The results show that the US Team was the only one to achieve some degree of community integration. Neither in the team being studied nor in the overall course were those qualities developed. According to the rules in the triangle, they had difficulties handling cultural differences, and results showed that the US students dominated the process, being "ideocentric individualists" [7]. The findings also show lack of common vision, and little shared understanding of their different roles and accountability [10].

The middle triangle discusses how the course community and specific team collaborated to achieve the mixed objectives of the projects. In the course community, the Teaching Team focused mainly on the product development with the US students, and little on the teambuilding process and knowledge creation of the specific team being studied. The remaining part of the triangles connects the object, which is creating a product versus new knowledge to the community by defining their division of labor. The findings show that initiatives to collaborate gradually faded, and a decision was made to split the work into special tasks for two groups; they cooperated and gave up the collaboration [8].

Related to the research questions, the findings show that there were very little of the social, instructional and institutional prerequisites to build a learning community. *BrainSpace* improved communication and collaboration, but eventually the creation of the product became more important than the collaboration process.

Most literature reviews of team development on the web focus on the characteristics and the different roles of facilitators [12] whereas our observations and conceptual framework suggest that researchers should look at the mediating tools that promote or hinders "co-construction" across cultural boundaries.

LESSONS LEARNED AND RECOMMENDATIONS

Based on the results, recommendations are made to focus on the lessons learned in order to enhance learning using collaboration in cross-cultural, distributed teams. First, it is important to learn about intercultural communication at the start of the course. Based on the student's awareness of cultural differences, they would be able to better analyze and judge their own ongoing collaboration with others. An institutional structure should make clear the common vision of the participating universities.

To start and enable a collaboration process within a distributed team it is important to integrate the heterogeneous groups with alternative world views and different perspectives and to make known each other and build trust and commitment. It is also important to structure and pace the process related to the time restriction, and to provide a shared space by mediating appropriate tools for collaboration. *BrainSpace* is built upon these recommendations, and this study shows that there is a need for such a method in web based environments. Additionally, an adequate course design should be set up in advance, and a process owner should be responsible for the method and the implementing. Suitable and coordinated tools (asynchronous and synchronous) for a shared space should be introduced, tested and supported prior to the course start and all participants should have information about the method, to make clear the process, the different roles and its purpose. Participants should be explicit in their desire to collaborate and share knowledge. The facilitator plays an important role. He or she should be carefully selected and trained. The person needs formal authority, awareness of open communication, and balanced participation [13].

Successful collaboration and knowledge creation should focus on the process. A powerful web based supported environment, built with *BrainSpace* that takes the above factors into account will create a shared space and a cognitive system for better problem solving in cross-cultural distributed teams.

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