USING COLLABORATIVE WORK AS A LEARNING STRATEGY TO DEVELOP PROJECTS: A CASE STUDY IN A HIGHER FEDERAL INSTITUTION

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Abstract. *Collaborative work is gaining visibility as a good practice in today`s market because of the advantage associated to this new way of work. Taking into consideration the actual technological stage of our society, many organizations and educational institutions are increasingly taking ownership of this kind of work in their productive processes, especially in learning activities, just because of its benefits, mainly when referring to the dimensions of time and space. Those dimensions of time and space change drastically the perception among the members of a working team. In today's world, to work in a collaborative manner requires some prerequisites and organization structure that is quietly different from the face to face work. In this context, using a systemic view of collaborative working environment, this article frames collaborative work analyzing several aspects of it, including the collaborative work concept, collaborative tools, characteristics of the collaborative work and differences between face to face and collaborative work. In order to analyze a real experience of a collaborative work environment, a group of students from a master program of a Higher Federal Technological Institution – Centro Federal de Educação Tecnológica Celso Suckow da Fonseca - CEFET/RJ was commissioned to develop an activity just using collaborative tools. The experience was repeated in two consecutive years, in which, each class was able to select a specific project to be developed. In order to report the students' experience, a questionnaire related to personnel, management and technological aspects of collaborative work was applied. In this context, this article searches to identify, analyze and document the practical experience related to the group of students that worked on the projects.*

Keywords: Collaborative Work, Learning Groups, CSCW.

1. INTRODUCTION

Throughout the latest three decades, information and communication technology is becoming an important tool to drive strategic initiatives for government, business organizations and educational institutions to increase their presence in a global world, especially because of the benefits it brings when referring to improve and automatize activities to provide better services for the clients and the society.

In this context, Castells (1999) refers to this new paradigm of modern organizations activities as the Information and Knowledgment Society, which is mainly characterized by gathering any kind of stuff (organizations and people, for instance) through the Internet, in other words, an infrastructure that gathers people from different countries, places and cultures.

Since we´re living and experiencing this turbulent modern society, the use of information and communication technology changes drastically the way we have to deal with our partners when working and studying. Having this scenario as background and in order to experience this new concept of performing work in teams remotely, the students from a Higher Federal Technological Educational Institution have developed two projects just using collaborative tools to perform their tasks' portfolio.

From this point of view, this article aims to analyze several aspects of collaborative work which includes its concept and tools and the differences between face to face and distance work. In addition, the students from a master degree program have answered a questionnaire referring to their experience in performing the tasks considering three dimensions (human, technological and management) related to the development of a distance/remote activity which the authors analyzed in detail.

2. A SYSTEMIC VIEW OF COLLBORATIVE WORKING ENVIRONMENT

According to Grudin (1994), Computer Supported Cooperative Work (CSCW) is a discipline of multidisciplinary research to study the techniques and methodologies related to working groups and the ways technology can assist this kind of work. This author also emphasizes that it`s the assemblage of different computer technologies that aim to support cooperation between individuals that are parts of the working teams.

CSCW encompasses the way people work as a group, what they need to work in groups and how computers and communication tools can contribute to assist and facilitate this type of work (Baker, 2001). The referring author defines this discipline as a computer-assisted coordinated activity such as communication and problem solving, carried out by a group of collaborating individuals.

In this context, Jablonski (1996) stated that there are three key pillars to CSCW (Fig. 1): organization, technology and work. Organization of CSCW refers to the way the work is organized, which includes functional structures, designed responsibilities and the procedures to perform the tasks; technology refers to the infrastructure related to information and communication flows used to support the work and integrate the members of the working teams; whereas tasks refer to the work itself, that is the procedures, activities or jobs to be performed by the working team.
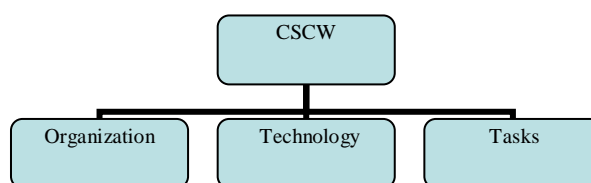

Figure 1. Principal supports for CSCW – Jablonski, 1996

Most authors states that there are several benefits for adopting CSCW, in which we can highlight teleworking, that is enabled by communication facilities and costs reduction related to travels, and paper flows and mainly because it contributes to a better information gathering to facilitate the integrated tasks (Wilson, 1991).

In the Information and Knowledgment Society, several tasks, such as meetings, learning activities, knowledge management and group discussions can be conducted by using new technologies (e-mail, VOIP, web sites, blogs). Since managing a working team is quite difficult and a challenging task, the leader/broker of the groupware must have some specific qualities (Heldman, 2003). The use of technology to support the execution of different type of activities creates a new way of work that can be classified as shown in Fig. 2 (Rodden, 1994). The 4-Square Map of Groupware Options (Johansen, 1991) taxonomy is also another way to address the different technologies available to support the Computed Supported Collaborative Work and it will be discussed in more details later in this article.
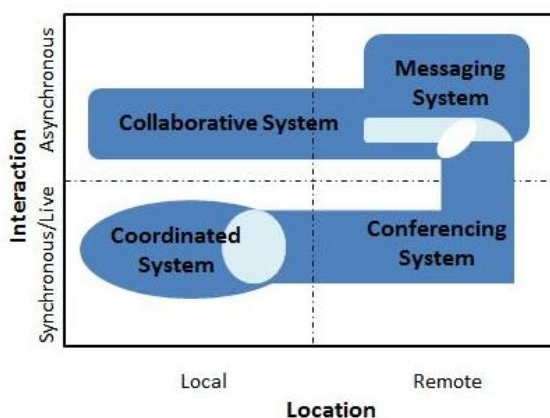

Figure 2. Classification for Applications in the Collaborative Place – Rodden, 1994

The use of new applications and the adoption of new ways of performing work and learning activities via new technologies and in a collaborative scenario is growing and being applied by organizations or educational institutions. As a matter of fact, the computer, as an information and communication system, can function as a resource for many working teams, especially because the problems to be solved are getting into a bigger dimension and are becoming more complex, what requires the involvement of more specialized people because the solution for these problems, most

of the times, requires specific competencies (Jablonski, 1996). In summary, the new generations are getting much more familiarized with CSCW applications and keeping in mind this new paradigm. In this context, this article transformed the CSCW theory into practice by analyzing a group of master students from a strictu sensu program at CEFET/RJ, which will be explored along this article.

3. A PRACTICAL EXPERIENCE OF STUDENTS PERFORMING A COLLABORATIVE REMOTE PROJECT

In order to analyze a real experience of a collaborative working environment, a group of students from a master program of a Higher Federal Technological Institution – Centro Federal de Educação Tecnológica Celso Suckow da Fonseca - CEFET/RJ was commissioned to develop an activity just using collaborative tools and work remotely. The experience was repeated twice, in the years of 2009 and 2010, in which, each class was able to select a specific project to be developed. The class of 2009 selected a project to build a popular house, based on a government initiative called "Minha casa minha vida" issued by a Federal Financial Institution and the 2010 class selected a project to develop a Web Portal for the master program that they are members of, as students. The classes were divided in groups, in which each actor had a specific responsibility and focus area.

3.1 The 2009 collaborative working team
In the 2009 class, four groups were formed and each one was responsible for a crucial activity of the project "Minha casa minha vida". The groups were responsible for Legal, General Planning and Schedule, Financial and Engineering planning, as shown in Fig. 3. Each group had three participants and a broker was selected to manage the overall project and to engage the proper resources as needed. Each group also had a leader that was in charge to coordinate the work of its group and to interact with the broker, when necessary.

Figure 3. Organization chart of the 2009 class project team. Project developed by the students of a Higher Federal Technological Institution – Centro Federal de Educação Tecnológica Celso Suckow da Fonseca - CEFET/RJ.

3.2 The 2010 collaborative working team

In the 2010 class, three groups were formed and each one was responsible for a crucial activity of the project: Legal/Institutional, Modeling/Technical and Management, as shown in Fig. 4. Each group had an average of three participants and a broker was selected to manage the overall project and to engage the proper resources as needed. Each group also had a leader that was in charge to coordinate the work of the group and to interact with the broker.
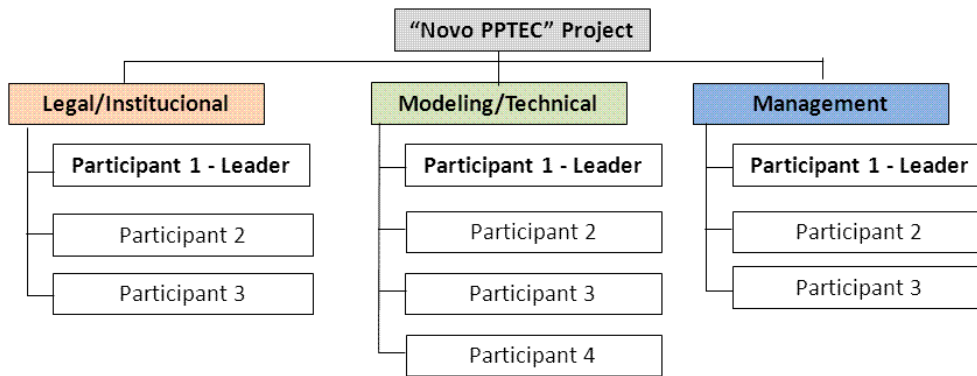
Figure 4. Organization chart of the 2010 class project team. Project developed by the students of a Higher Federal Technological Institution – Centro Federal de Educação Tecnológica Celso Suckow da Fonsenca - CEFET/RJ.

The tools selected to support the work being developed by both groups (2009 and 2010) were Skype, Google docs, e-mail and a blog. Each group managed the sessions to develop their pieces of the projects and several meetings with all the groups were also conducted to align the status of the overall work. The remote collaborative work was developed in approximately six weeks.

4. THE STUDENTS PERCEPTION OF THE COLLABORATIVE ACTIVITY DEVELOPED THROUGH HUMAN, TECHNOLOGICAL AND MANAGEMENT DIMENSIONS OF CSCW

In order to understand and analyze the CSCW experience of the students, while developing the projects mentioned before, a questionnaire addressing three dimensions of the collaborative work - Human, Technological and Management - was created by the authors and applied to the students of the two classes.

The dimensions of the questionnaire was adapted from Jablonski classification (Fig. 1) of CSCW and transformed as those shown in Fig 5.

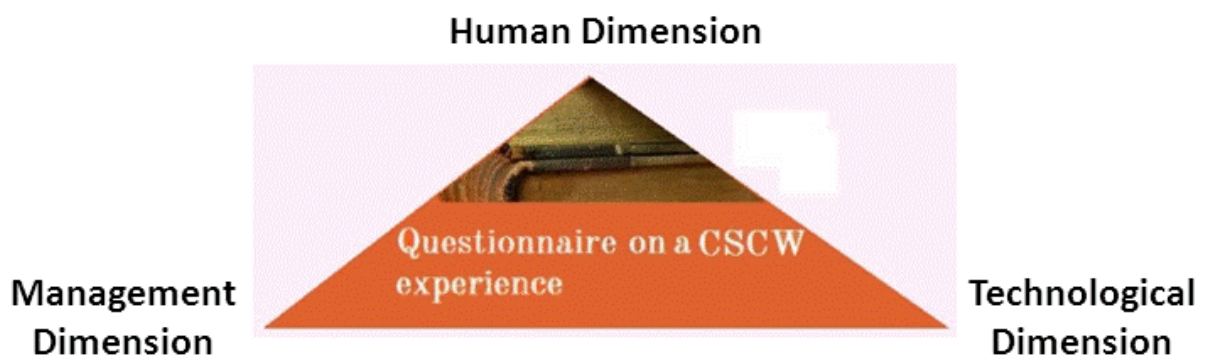Throughout this topic, the authors discus each dimensions in detail.

Figure 5. Questionnaire created by the authors addressing the three dimensions of the collaborative work

4.1 The Human dimension

The human dimension addresses how the participants behave in a CSCW environment, based on the fact that different behaviors and codes of conducts are expected in this type of environment. For this dimension the main points considered to develop the questions were:

- The challenges associated with the fact that people need to move from their personal working area to a group working area, which is shared with others and it is different from their personal one (Greenberg and Roseman, 2003).

- The gap between the desire to work collaboratively and taking the action to establish a groupware session or to engage peers and participants to work using CSCW tools (Greenberg and Roseman, 2003).
- The transition back and forth from an electronic workplace to the traditional one, with paper and pen and the challenges on how to decide how to take notes, store documents and others (Greenberg and Roseman, 2003).
- The inhibitors associated with making the work visible while it is being created and the potential criticisms that this may generate contrasted with the traditional way to manage the work - individually and only shared when it is done and ready (Ackerman, 2001).
- Clear norms for using the collaborative systems and tools and the possibility to negotiate and change those norms (Ackerman, 2001).
- Incentive and rewards to ensure the proper commitment of the participants, considering that both play a key role in CSCW (Ackerman, 2001).

4.2 The Technological dimension

The technological dimension addresses the technology itself, that is, the application and infrastructure used to support and develop the collaborative work process. The questionnaire was based on the 4-Square Map of Groupware Options (Johansen, 1991), which is one of the most referred models when talking about collaboration and technology. The two dimensions considered in this taxonomy are time and place, in which, the participants of a working group may be working simultaneously or at different moments. They may be also sharing the same place, meeting room or office or they may be on different physical places. The four squares considered in this taxonomy are:
- Different time and same place: People working on the same physical working area, but interacting on different times (not simultaneously, working asynchronously). An example is the usage of a messaging board in an office.
- Same time and same place: People sharing the same physical working area at the same time. An example is a meeting in a meeting room.
- Same time, but different place: People interacting at the same time (simultaneously or synchronously), but from different locations. An example is the use of synchronous collaborative tools like virtual meeting applications.
- Different time and different place: People interacting in different moments and from different locations. An example is the use of asynchronous collaboration tools, like e-mail.

There would be an additional dimension the any time and any space one addressing the need of the companies to interact with their clients 24 hours a day, using technology and the four squares to support this need. A similar classification created by Rodden (1994) was also shown before in this article.

The new technologies and the attempts to address the social-technical gap (Ackeman, 2001) causes variations in this taxonomy. The social-technical gap marks the division from what is needed to be supported socially and what can be supported technically in CSCW. Manage this gap means to create systems that can fully support the social environment. The Collaborative Virtual Environments (Olivier and Pinkwart, 2007) is an example of an attempt to properly address the social environment, reducing the strictness and hardiness of the technology. This type of environment is characterized by the use of 3D representations of the users via avatars and it`s mostly used in games and with less expression for education and commercial purposes. The place dimension of the classic taxonomy mentioned before gets a new interpretation in the Collaborative Virtual Environment because this type of environment tries to produce the sensation of a common space, allowing a visualization of the users via their avatars on a common virtual place.

Besides the four basic squares of the classic taxonomy used to create the question in the questionnaire, the quality of the technical infrastructure and the potential use of new technologies and of the Collaborative Virtual Environment were also addressed, when the authors applied the questions.

4.3 The Management dimension

Finally, the Management dimension includes planning, execution and control/management of the activities related to the tasks to be performed, as well as the skills, abilities and attitudes needed by the project leader or broker, because of its importance for the overall project (PMBOK, 2009). Since there is no bibliography that defines or classifies the management process of a remote collaborative work, the authors linked the typical presented Project Management activities from the PMBOK (2009) to those of a remote work, in a CSCW environment.

So, in order to apply questions related to the management dimension, the authors made a correlation between the nine areas of the Project Management Book of Knowledge (PMBOK, 2009) established by the Project Management Institute (PMI) and took into consideration the scope related to the activities developed by the master students in their collaborative work. As a result of this research, the following six areas of importance were defined and used in the questionnaire:

- Integration Management: It includes the processes needed to ensure that the different elements of the project are properly coordinated and managed. It also involves the compensation between the objectives and competitive options available to deploy the project, objecting the achievement or over achievement of the needs and the expectations of the project`s stakeholders.
- Scope Management: It includes the processes needed to be monitored and the control of all the work necessary to complete the project.
- Time Management: It addresses the processes needed to ensure that the project will be delivered on time.
- Quality Management: It manages the processes needed to ensure that the project will satisfy the needs for which it was created.
- Human Resources Management: It manages the processes needed to effectively use the human resources involved in the project, including all the stakeholders (sponsors, clients, society and others).
- Communication Management: It manages the processes needed to ensure the effective creation, generation; distribution, storage and control of the project information, allowing critical connections between people, ideas and information that are needed for the success of the project.

When the authors developed the questions, besides the three dimensions mentioned before, some profile questions were also included, addressing items like: age, graduation area, previous experience with CSCW and others. The questionnaire was created by the authors using the "Forms application" available at Google doc and it was sent electronically to the twenty students that have taken the discipline in the years of 2009 and 2010. The students had the opportunity to answer the questions during twelve days. An e-mail was first sent to the students, and a reminder note was sent a couple of days after. The teacher of the master class also encouraged the students to answer the questions. The questionnaire was developed using the linkert scale using options as agree or disagree (strongly or partially) and indifferent.

5. ANALYZING THE ANSWERS

The 2009 class was responsible for 60% of the answers and the 2010 class for the rest of them. The majority of the responders were male (80%) and from the total, 55% was graduated on hard sciences, 35% on human sciences and 10% had other type of graduations. The ages of the students was concentrated on the range of 31 and 45 years old as shown in Fig. 6.
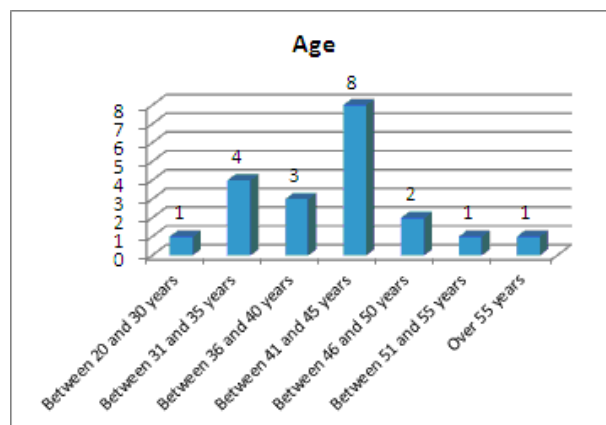

Figure 6. Age of the responders from the Questionnaire on a CSCW experience created by the authors.

Only 25% of the total were teachers. The majority of them had some previous experience with CSCW, but 40% had no previous experience before the work developed for the discipline, as shown in Fig. 7.
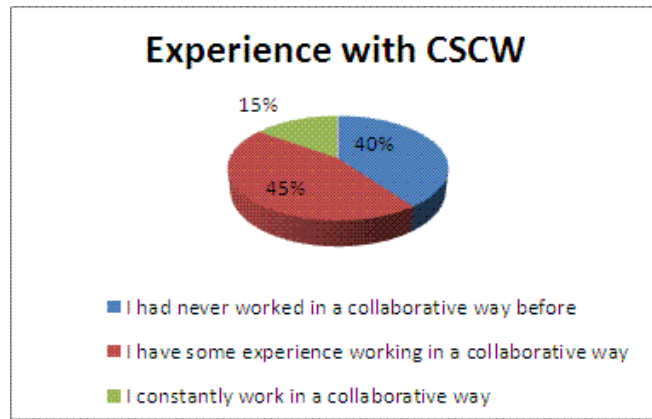
Figure 7. Previous experience with CSCW from the Questionnaire on a CSCW experience created by the authors

Analyzing the answers given in the Human dimension's questions, it was clear that the students had no major issues in participating or knowing how to behave in the meetings. Out of the ten questions in this dimension, nine had 75% or more positive answers as shown in Fig. 8. Only one of them had 55% of positive answers only and what is intriguing is the fact that this question asks if the person preferred to work alone using tools in his/her computer and only share the work with the team after it is done or drafted. The answers show that more than 50% of the students agreed in some degree that they preferred to have some work done on their own, before they shared it with the team. A similar question that asked if the they felt comfortable sharing their ideas and comments related to the work being developed, knowing that they were being observed by the team had 95% of positive answers, what may point to the fact that although the students were filling comfortable sharing their ideas remotely and working as a team, they were not totally comfortable developing the work on the fly. This may be related to inhibitors associated with making the work visible while it is being created or it may be associated with productivity concerns, as the students could be trying to have some preparation work done before the meetings. It may be also related to the age of the students, what may cause them to do not be so comfortable with the tools being used.
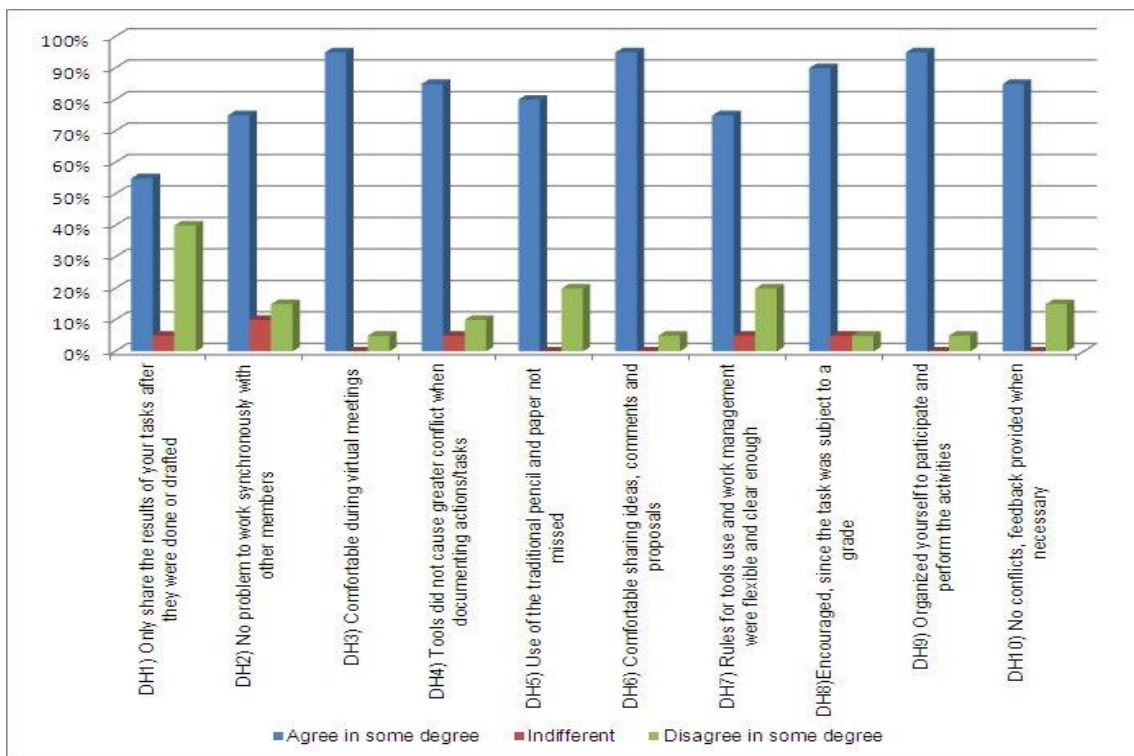

Figure 8. Summary of the answers for the Human dimension from the Questionnaire on a CSCW experience created by the authors.

The two questions related to the transition back and forth from an electronic workplace to the traditional one and the decisions on how to take notes indicated that this was not a problem for most people. The questions got 80% or more of positive answer agreeing in some degree that this was not a problem. When the answers are analyzed by class, it seems that the 2009 class had fewer issues with this type of transition than the 2010 class. This may be related to the fact that 67% of the students from the 2009 class are from hard sciences against 38% of the 2010 class, but 42% had no previous experience in CSCW against 38% of the 2010 class. By analyzing the answers, It`s clear that norms for using the collaborative systems and tools were clear and flexible enough too for at least up to 75% of the participants.

Analyzing the answers given in the Technological Dimension's questions, it can be noted that 65% of the students characterized the infrastructure as good. The type of tool most used to complete the work was the synchronous communication tools and the students would be open and willing to use a Collaborative Virtual Environment where a 3D representation of the users, via avatars, could be used giving a feeling of a common space.

Most of the tools used one of the collaboration tools in other tasks to other disciplines and 65% of them had some previous knowledge of the tools as presented in Fig. 9. Although the majority of the students said that the tools were effective and properly used and that the collaborative work was a success because of the infrastructure used, when asked to compare the productivity of this experience with the traditional face to face work, their answers were polarized with 45% agreeing in some degree that the CSCW way would be as productivity or more than the face to face one and 40% saying it would not. This result was in some ways driven by the students of the 2010 class, where only 38% answered in a positive way against the 50% of positive answers from the 2009 students, what may be related to the fact previously mentioned that 67% of the students from the 2009 class are from hard sciences against 38% of the 2010 class, making them more open to CSCW.
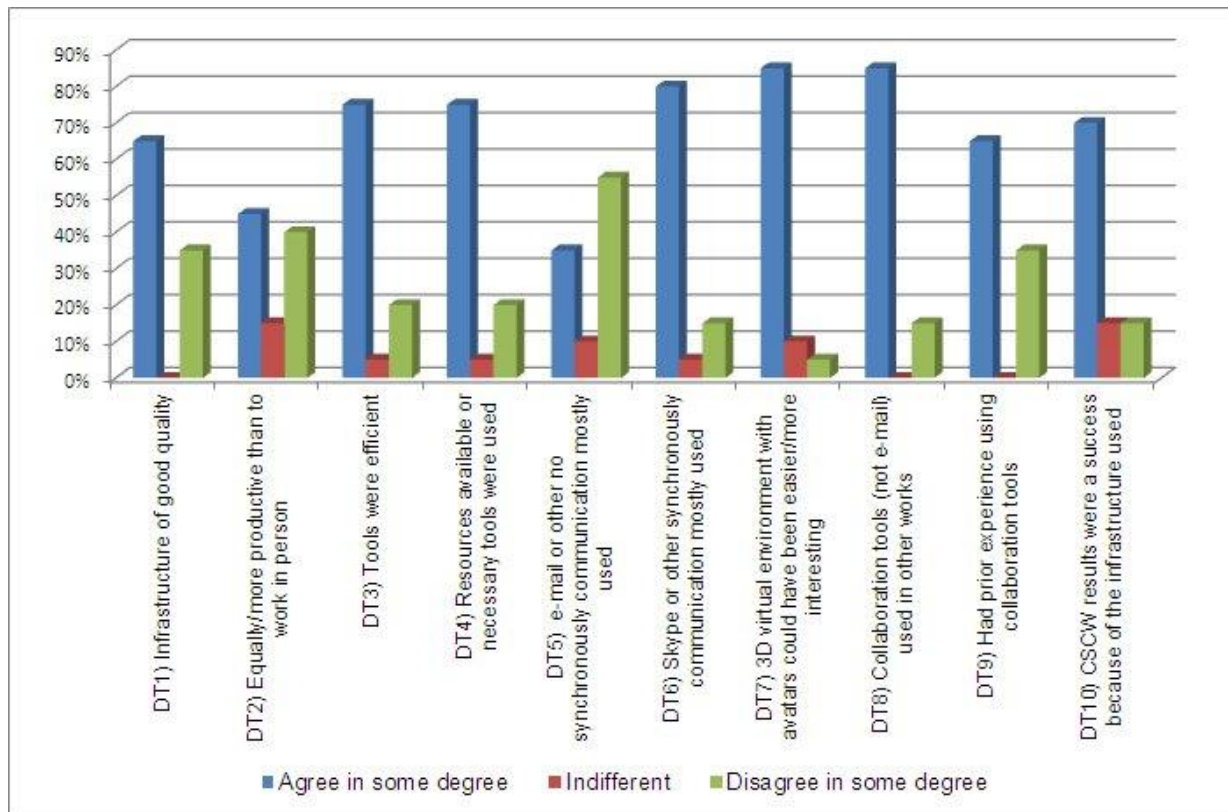

Figure 9: Summary of the answers for the Technological Dimension from the Questionnaire on a CSCW experience created by the authors

Analyzing the answers given in the Management Dimension's questions, it can be concluded that the management of the CSCW experience was properly conducted. Most of the questions achieved 70% or more of agreement in some degree of the efficiency and correct management of communication, information, planning, leadership of the teams and quality of the work associated to the participation of their members as presented in Fig. 10. The question that had a different result was the one related to the work of the broker. This question only got 50% of positive answers and the results were driven by the answer of the students of the 2010 class, where only 25% agreed in some degree that the leadership and management of the broker was effective against the 67% of positive answers from the 2009 class. This is probably associated to some issued that happen during the execution of the work by the 2010 class, related to lack of time or skills of the broker.
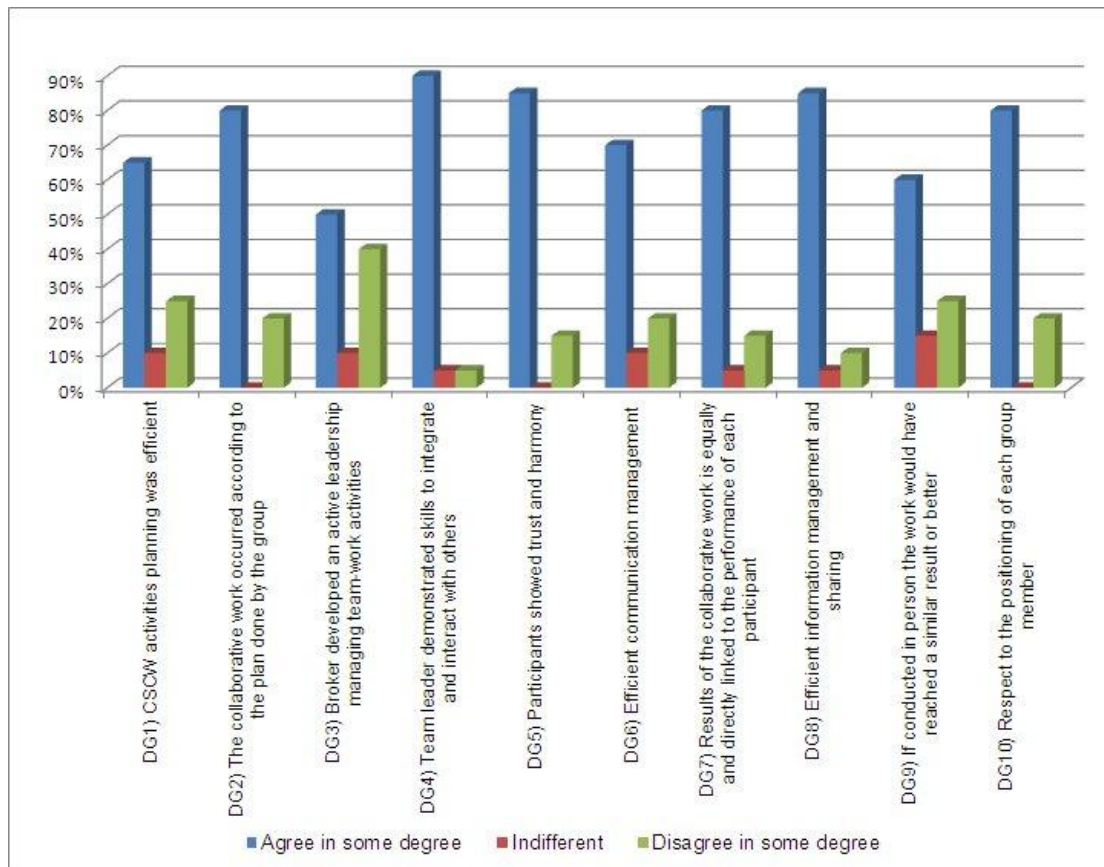
Figure 10. Summary of the answers for the Management Dimension from the Questionnaire on a CSCW experience created by the authors.

One more time, although the majority of the students said that the management of the CSCW experience worked well in most areas, when asked to compare the results of this experience with the traditional face to face work, 60% of the students agreed in some degree that the face to face way would be as productivity or more than the CSCW one. This result was again driven by the students of the 2010 class, where 75% agreed that the face to face work could be more productivity against 50% of 2009 students. This may be related to the area of graduation distribution previously mentioned, but it may be also related to the issues around the leadership of the broker noted in the 2010 class answers. The good leadership of the broker in this type of work is key and facing issues may influence the quality of the work delivered and add anxiety and worries to the team. Although this seems to be an area that not worked well, the group seems to have overcame this issue, because the answers related to the results and use of the tools were positive in their majority.

6. FINAL CONSIDERATIONS

Although collaborative work is expanding its utility in organizations, and educational institution through the years, specially because of the several technological issues that have been associated to this kind of activity, it´s interesting that, when the experience of the master students from a the Federal Technological Educational Institution are analyzed, it can be affirmed that not only technological artefacts are important in CSCW. We have to bear in mind that besides each computer there is a human being who is the most important part in any type of task to be developed.

So, in a remote workgroup, people have to face some challenges when concerning a CSCW environment, specially because the perception from the group is quite different from a face to face work. As the members of the group may not interact at the same time and as they are not together, good leadership and work management are key to achieve the proper results.

One fact that comes to mind is that the average group age may have contributed to some challenges, what in some ways can be confirmed by the fact that the students preferred to do the job first by their own and then share with their team. The fact that most of the students come had hard science backgrounds helped to be more opened to the use of the tools.

In this scenario, the leader of the group must have some qualities to conduct the working teams. These qualities are somewhat associated to the presence tasks, in which the project manager gets an important role for the project success. The role of the broker in the case study analyzed was a key one, because he/she would in some ways work as the project manager. The results confirmed that when the role of the broker for some reason was not perceived as a well performed, the believe on the success of the CSCW was impacted.

Another characteristic that results from this group case is the fact that although most of the students felt they have properly used the tools and were confortable sharing their knowledge, comments and in participating in the meetings, they are still not sure if the CSCW approach would work as well as the face to face one, what shows that there is still some uncertainties and anxieties about working remotely and mainly via the use of tools. Those anxieties and uncertainties need to be overcame in order to allow CSCW to gets to its full usage and to have its benefits fully perceived.

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