Computer Supported Cooperative Work (CSCW): Some Comments

By

Chukwunonso Franklyn
Department of Information Technology
Federal University of Technology, Yola
franklynonso@yahoo.com, franklyn@futy.edu.ng

Abstract

The use of computer technologies in groups’ activities goes under the name Computer Supported Cooperative Work (CSCW). CSCW is a field that covers anything which has to do with computer support for activities in which more than one person is involved. Software and hardware products which provide support for CSCW are called “Groupware,” and the branch of this discipline takes the name of “Computer Supported Collaborative Learning (CSCL).” When supporting collaborative reflections and discussions, computers provide a support for communication known as “Computer Mediated Communications (CMC).” Furthermore, since in the academic and educational world, knowledge artifacts, as well as annotations and discussions usually take the form of writing, we cannot but consider the factors related to “Computer Supported Collaborative Writing (CSCWriting).” Finally, since the advent of the Internet and World Wide Web has changed greatly the technological landscape we will consider its influences and relations with respect to groupware technologies. Thus, this paper takes both a reflective and analytical approach in looking at all these groupware technologies with intent of finding its implication to e-learning.

Introduction

Grief coined the term “Computer Supported Cooperative Work” in 1984, in order to describe an interest shared by researchers from various disciplines on how technology can support people’s work (Grudin, 1994). In Grudin”s words, “the conditions encouraging this new interest were the relatively low cost of hardware, which made it available ‘to all members of some groups’, the technological infrastructure supporting communication and coordination, the widening familiarity with computers, and maturing single user application domains that pushed developers to seek new ways to enhance and differentiate products.” Grief (1988) further defined the term, as referring to a set of concerns about supporting multiple individuals working together with computer systems.” CSCW referred to the work of groups, which may vary in size between the two (not included) extremes of single individuals (supported by single-user applications) and organizations (supported by information systems) (Grudin, 1994b).

Its vague connotation made it possible for this field to become a meeting point for researchers with different backgrounds and techniques, where technologists could learn from “economists, social psychologists, anthropologists, organizational theorists, educators, and anyone else who can shed light on group activity” (Grudin, 1994, p.19). If the field so described is rather broad, analyzing the words composing its definition individually will not help narrowing it. Nineteenth Century economists used the term “Cooperative Work” to indicate work involving more than one person. Nonetheless, as Ehn (1998) points out, all work is essentially cooperative, since the success of performance always depends on others without even taking into consideration Ehn’s point of view, we must observe that cooperative work cannot be limited to that conducted collectively by a group whose members work in direct contact with each other. As a matter of fact, work conditions can emphasize the aspects of communication, coordination and collaboration at varying degrees and cooperative work can also be distributed and indirect (Rodriguez, 2003). The activity of semi-autonomous workers who change their behaviour as a consequence of other members’ actions is of cooperative nature, as well as that of people communicating with each other in an impersonal way (e.g by changes in the work artifacts).

Considering the great variety of activities included in CSCW, its core issues are the articulation of cooperative work, the sharing of an information space and the reciprocal adaptation of technologies and organizations.
In order to enhance cooperative work relations, computers should support cooperative ensembles’ self organization and help the retrieval of information filed by other workers, controlling the dissemination of information (Bannon & Schmidt, 1991).

Since its introduction, CSCW has influenced the development of everyday technologies for computer-based work. Now that the Internet is a mass phenomenon, “technologies such as workflow and groupware have moved out of the research laboratory and into everyday computational practice” (Dourish and Bellotti, 1992), and promise to “provide the kind of support to networked groups that individual productivity software like word processors and spreadsheets grant individuals” (Stahl, 2002, p.7).

**Groupware**

“Groupware” can be defined simply as the software that supports groups. More specifically, what differentiates this field of studies from CSCW is its technical focus: “Groupware addresses the technical problems of enhancing the human-computer interface by providing multiple-user facilities for, in principle, any application program” (Bannon & Schmidt, 1991, p.8). More precisely, in the software taxonomy, groupware applications can be allocated between applications supporting a single user and information systems, designed to support organizations (Grudin, 1994b).

It is sometimes hard to decide whether a tool belongs to this field or not, and in the first half of the nineties this fact led to a dispute between different theorists about what should or should not be considered to be groupware. According to Ensor (1990), network file servers belong to this category, since they are fundamental to the interaction across networked PCs, and therefore provide support for workgroup collaboration. On the other hand, Ensor (1990) looked at email and advanced groupware systems as the only successful CSCW applications and did not consider multi-user databases to be groupware technologies (regarded instead as so by Grudin and Poltrock, 1991: in their opinion, multi-user databases are groupware technologies because they provide multiple access to a shared content). Ensor supported his statements by saying that most databases do not support different roles or group communication needs, and therefore cannot qualify as groupware. For similar reasons, Allen (1990) also excluded email from groupware technologies, and took into consideration only tools specifically aimed at group support. In order to decide whether a specific product belongs to this category, it is often necessary to consider it in a particular setting. We should therefore begin by asking ourselves whether a certain technology was designed to support groups and then, in case of uncertainty, whether it actually supports groups or not (Grudin, 1994b); “there is no rigid line between systems that are considered groupware and those that are not” (Ellis et al., 1991, p.40).

Despite the aforementioned uncertainty as to what should or should not be regarded as groupware, there seem to be no controversy regarding the correctness of the system based on time and space used to classify these applications. De Sanctis and Gallupe introduced it in 1987, and many other scholars applied it during the following years. Among these scholars are Grudin (1994), Johansen (1991) and Ellis, Gibbs and Rein (1991). According to the criteria of this method, groupware technology products supporting synchronous and asynchronous interaction belong to different categories, as well as those supporting interaction between people in the same place or in different places. The matrix in Figure 1 illustrates such classification.

<table>
<thead>
<tr>
<th>Same Place</th>
<th>Synchronous</th>
<th>Asynchronous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meeting Rooms</td>
<td>-</td>
<td>Group Authoring</td>
</tr>
<tr>
<td>Different Places</td>
<td>Video Conference</td>
<td>Email</td>
</tr>
<tr>
<td>Instant Messaging</td>
<td>-</td>
<td>Bill Boards</td>
</tr>
</tbody>
</table>

[Figure 1: classification of interaction based on time and space criteria Source: Ellis, 1991]

Of course other elements could be added to the matrix, such as the kinds of interaction supported, the groups’ size or the predictability or unpredictability of different times/places (Grudin, 1994). Furthermore, other taxonomies of groupware have been proposed by different scholars, based for example on the “strategic intent of the technology” (Wenger, 2001) or on the kind of collaboration or data supported (Coleman, 2002).
Groupware Evaluation

Grudin (1994b) enlisted difficulty of evaluation as one of the new challenges of groupware technologies. The complexities and subtleties characterizing group dynamics make these technologies’ design and evaluation processes more sophisticated than those of single-user software; “A (groupware) system performance may depend on the varied behaviours and personalities of the group members, the effect of social, motivational, economic and political dynamics, and the relevance of time as a factor in understanding interaction changes” (De Araujo et al., 2002, p. 223).

Such complexity resulted in the wide variety of techniques applied nowadays to evaluate groupware systems. Both scientific, engineering and social science methodologies are being used, and there seems to be no agreement regarding which one has to be applied in a certain circumstance (Pinelle and Gutwin, 2000). Nonetheless, laboratory experiments and field studies, conducted predominantly through observations, interviews and questionnaires, seem to be the most used types of evaluation (Pinelle and Gutwin, 2000). As Twidale, Randall and Bentley (1994) pointed out, what characterizes groupware evaluation is the importance that needs to be given to context. Also De Araujo et al (2002) stressed the importance of context, and illustrated its influence on all other evaluation dimensions. Nonetheless, there may still be real value in out of context evaluation, if conducted early in the development phase (Pinelle and Gutwin, 2000).

Several inspection techniques traditionally applied to single user applications or Web pages have been modified and tested as instruments for the evaluation of groupware. For example, Ereback and Hook (1994) proposed the use of Cognitive Walkthroughs, while Baker et al. (2001) developed a set of heuristics. In cognitive walkthroughs, evaluators choose a set of representative tasks and go through the actions performed by a fictional user, comparing the user’s goals and the actions expected from the interface. Heuristic Evaluation, instead, defines a particular interface inspection process where evaluators examine an interface and judge its compliance with carefully selected usability principles called “heuristics.”

Computer Supported Collaborative Learning (CSCL)

Using the formula-style definition that Margaret M. McManus gave of it:

\[ CSCL = CSCW + CL \]

where CL stays for Collaborative Learning

Collaborative Learning happens when students work together in groups to achieve a common academic goal, such as the completion of an assignment, a worksheet, or a project (Glass and Putnam, 1998). Collaborative Learning differs from Cooperative Learning in the way in which the task is divided. In the former the task is split into independent subtasks (and coordination is only required when assembling partial results), while in the latter there is a continuous attempt to construct and maintain a shared conception of a problem (Roschelle & Teasely, 1995, quoted by Dillenbourgh et al., 1995). Examples of CL activities are peer learning, tutoring and project-based learning (Wasson, 1998). In peer learning, groups of people with similar roles and complementary needs in a particular area help each other with knowledge based on their experiences (Website #1). Tutoring, instead, is the activity of a teacher supervising a (usually small) group of students learning together. Finally, project-based learning can be defined as a model of teaching/learning that “shifts away from the classroom practices of short, isolated, teacher-centred lessons and instead emphasizes learning activities that are long-term, interdisciplinary, student-centred, and integrated with real world issues and practices” (Website #2).

CSCL considers the use of computers in such activities (Kerr and Hiltz, 1992), focusing especially on Information and Communication Technology (ICT). In a collaborative learning environment, the role of technology is to help students learning together effectively. This goal is achieved through the provision of support to group processes and group dynamics in ways that are not achievable by face-to-face meetings (Website #3), aimed at facilitating the students in maximizing the use of their intelligence and knowledge.

What differentiates specific CL tools from generic e-learning instruments is that the former do not necessarily provide modules enabling teachers to manage teaching activities, supply didactic contents and evaluate students’ performance through formal evaluation tools. Collaborative Learning tools are also different from unspecific CMC environments (discussed later on in the text). The main difference is that the former often include a specific structuring of dialogue dynamics, to enhance iterations within the learning community. The first people to introduce such structuring, under the name of thinking types, were Scardamalia and Bereiter (1983), who did so in order to provide procedural facilitations in writing. Then, they developed them further.
into Scaffolds, and included them in the CSILE (then known as Knowledge forum) system (Website #4). In Scardamalia’s words (2004): “Scaffolds give ideas defined roles in such processes as theory refinement and constructive criticism. The opportunistic rather than mandated use of scaffold support helps students embed these forms of discourse in their everyday work with ideas. [...] The Scaffold support additionally serves as searchable parameter.” This kind of organization is often achieved through the adoption of semi-structured interfaces, which allow users to communicate only through a set of predefined argumentative or communicative typologies. Such interfaces force students to focus on their assignment (Bonaiuti, Website #5) and are used for this purpose in several applications (e.g. Synergeia, Website #6, and Shadow Net Workspace, Website #7).

**Computer Mediated Communication (CMC)**

A broad definition of Computer Mediated Communication defines it as “any form of interpersonal communication that uses some form of computer technology to transmit, store, annotate or present information that has been created by one or more participants” (Wolz et al., 1997, p.51). Such communication can be graphic, text-based, auditory and, in certain cases, tactile.

Applying a criterion already used for the classification of Groupware, we can divide CMC into synchronous and asynchronous. In the former the receiver processes the message immediately, while in the later he does so at a later point in time. Asynchronous communication minimizes time and space as barriers to interaction, and allows people to participate at the time and pace most convenient to them (Kerr & Hiltz, 1982). Contemporary asynchronous and synchronous CMC is mainly text-based. Typical tools for text-based CMC are email and instant messengers. This fact makes it difficult (when not impossible) for participants to represent or transmit extra-linguistic attributes such as body language and gaze. Such attributes have both expressive and deictic functions; for example, somebody’s gestures can emphasize her feelings or show what she is referring to during her speech.

According to Galegher and Kraut (1990), the communicative constraints of written communication make it harder for participants to get to know each other and collaborate. As they observed (p.155), “tasks that involve ambiguous goals, multiple perspectives and information that is susceptible to multiple interpretations [...] are typically associated with high levels of direct, informal, face-to-face communication.” The necessities to refer to and manipulate a shared artifact and to know other people’s activity are among the reasons why people prefer personal meetings to CMC. Nonetheless, the formers are becoming harder to plan as contemporary educational and business environments tend to be more geographically and temporally distributed. Tools for CMC try to satisfy these conflicting needs by providing functions allowing people to interact with shared documents and supporting awareness.

Awareness, defined as “an understanding of the activities of others which gives a context for your own activity” (Dourish & Bellotti, 1992, p. 107), makes it possible for individual contributions to be relevant to the group’s activity. Moreover, it allows an examination of individual actions with respect to group goals and progress (Dourish & Bellotti, 1992). Information provided by awareness mechanisms can regard present or past activities, and can be explicitly generated and kept separated from the shared work object or passively collected and distributed. In the later case, such information is presented in the same shared workspace as the object of the collaboration. Examples of contemporary awareness systems are the symbols used by Instant Messengers to provide information about other users’ status, or the different colors used by Synergeia to inform about its users’ activities (Stahl, 2002).

Closely related to the concept of awareness is that of role. Role defines an individual’s relationship with other participants, automatically implying a set of actions a person can or cannot perform. In such way, it provides information about the character of the person’s activities, even though not informing about its content. It is important to note that during collaborative activities roles can be dynamically negotiated and reassigned. Therefore, role switching should be facilitated by CSCW systems. Roles are also one of the group issues emerging during collaborative activities.

**Computer Supported Collaborative Writing (CSCW)**

Collaborative writing is a complex activity. Its complexity is due, among other factors, to co-writers’ different strategies, social interactions and personalities. In order for new technologies to support this activity, providing former single-user tools with functions for multiple users is not enough, and several cognitive and social issues should be considered. Such issues can be divided into: Task Issues, Group Issues, Communication Issues and
External Representation Issues (Sharples et al., 1993). Furthermore, since writing is an open-ended and recursive task, it can be accomplished in several different ways, depending for example on the interactions between the processes of planning, translation (the transformation of plans and ideas into text) and reviewing (Flower & Hayes, 1981, cited by Sharples et al., 1993): "writing [can] bring new ideas, which may lead the writer to revise goals and to embark on a new phase of planning and translation" (Sharples et al., 1993, p. 12). Figure 2 illustrates the possible interactions between planning, translation and reviewing.

![Figure 2: Possible interactions between planning, translation and reviewing]

Source: Sharples et al., 1993

Internet-Based and Web-Based Groupware Technologies

The first generation of complex groupware technologies was based on private networks and proprietary communication protocols and clients. Such technologies provided users within a limited area with rich user interfaces and customized functions. The advent of the Internet changes these characteristics, making it possible for groupware systems to be extended to users in different areas, countries or even continents. Changes have been even bigger if we consider the tools that make use of Web technologies, which give potentially any PC equipped with a Web browser access to advanced resources.

The World Wide Web itself can be considered to be collaborative technology in a weak sense of the word (Dix, 1996). Berners-Lee et al. (1994, p.76) declared that the web was developed to be a "pool of human knowledge, which would allow collaborators in remote sites to share their ideas and all aspects of a common projects". As a matter of fact, the Web gives users connecting from all over the world the means to share information (in the form of files) across what looks like a unique large file system (Crow et al., 1997). Anyway, as Dourish and Bellotti (1992) (in Crow et al., 1997) noted, the main value that has made the Web a positive "allied" of groupware is not access, but its integrative aspects. In other words, the fact that even though the Web was not created for audio/video streaming, interactive applications, etc., it has the power of delivering all of these services within a coherent context, which is a characteristic that it is highly functional to the needs of complex groupware tools. For example, thanks to this aspect of the Web structure, in order to start a chat session there is no need to know the address of a user's machine or a chat server, since one can just navigate to the appropriate Web page, click and connect (Dix, 1996).

Another aspect that positively characterizes the Web in relation to groupware is its innate deictic function. In the World Wide Web, every document is identified through a Uniform Resource Locator (URL) and this offers an ideal method to support the continuous deixis (the act of referring to external factors) characterizing communication and collaboration.

Also because of these assets, along the years the use of Web-based collaborative tools increased fast, especially in the field of project teams support (Wheeler et al., 1999). Other reasons for this fast proliferation are the open network client standards characterizing Internet and the World Wide Web (Wheeler et al., 1999). Such standards enable any-place-any-time interaction, and make it possible to use standard browsers
as clients (in the case of Web-based tools), freeing new users from the necessity to install new software. This interoperability is very useful to widely dispersed working groups, where the localization of people in different organizations and countries used to make deploying existing groupware technologies very hard (Bentley et al., 1997). Other positive consequences to the use if standard browsers are a reduction in the users’ need for training and set-up costs, and the Web’s suitability to be used as an interface. As a matter of fact, it combines platform independence and rapid distribution, two factors that are highly appreciated as interface characteristics.

Despite all these assets, Internet-based and Web-based groupware tools also encounter a series of new problems and challenges. Among the disadvantages associated with Internet-based and Web-based groupware tools are slowness and unreliability, uncertainty and perceived insecurity. For example, the HTTP protocol does not guarantee any specific transmission rate between servers and clients. As a matter of fact, this also depends on factors such as networks and servers loading, which may vary greatly even during the same session (Bentley et al., 1997). Problems were more evident with the first generation of Web-based collaborative tools. In fact, these technologies’ slowness, partially due to the low permeation of geographical broadband connections, was combined with a lack of advanced functions due to the limitations imposed by the original standards and protocols. Advanced Web-based groupware has now partially overcome these last limitations, thanks to relatively new technologies such as Java, XML and CORBA (Wheeler et al., 1999). Nonetheless, speed partially remains a problem, and several systems that work without any problem on broadband intranets suffer performance problems in low bandwidth environments, which are still largely in use for occasional, long-distance connections. Problems associated with Web-based groupware technologies can also be strictly related to their assets. For example, the same interoperability factors which positively make Web documents available to people using different platforms also generate uncertainty as to how a certain document will be displayed. The appearance of a document may change when it is viewed in different browsers, and users can also customize their view by selecting different options. Hackers’ attacks to big networks and findings of security bugs in commercial products are everyday news, and poor security is in no doubt one of the major barriers to a wider adoption of Internet-based systems.

Conclusion

The Information Revolution is a phrase we use to refer to the dramatic changes taking place during the last half of the 20th century in which service jobs (ranging from high technology, highly skilled professions to low-skill jobs like short-order cooks) are more common than jobs in manufacturing or agriculture. The product of skilled professionals is the information or knowledge they provide. The information revolution began with the invention of the integrated circuit or computer chip. Those chips have revolutionized our lives, running our appliances, providing calculators, computers, and other electronic devices to control our world.

Since the advent of the Internet and World Wide Web has changed greatly the technological landscape, it is still early to predict precisely what all of the implications of the computer supported cooperative work will be for social, economic and educational life especially with regards to learning. But clearly changes such as the information superhighway permitting people to communicate using computers all around the globe, fax machines, satellite dishes, and cellular phones are changing how teachers teach, the way students learn, the kind of work we do, and many other aspects of our lives.

References


Website #4: Knowledge Forum.

Website #5: Giovanni Bonaiuti – Ambienti CSCL.
http://formare.erickson.it/archivio/marzo_04/bonaiuti.html.

Website #6: ITCOLE – About Synergeia.

Website #7: Shadow Networkspace.