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ENHANCING SOCIABILITY OF COMPUTER-SUPPORTED COLLABORATIVE LEARNING ENVIRONMENTS

Abstract. Most computer-supported collaborative learning (CSCL) environments are purely functional, that is, they concentrate on a specific pedagogy. This is not surprising since their design and use is based on educational grounds and is driven by educators, educational technologists and educational researchers. Unfortunately, these functional environments do not always enable collaborative learning because they miss social interaction, a key element in collaborative learning. One approach for stimulating social interaction is using specific pedagogical techniques that enforce collaborative learning. This chapter presents an alternative approach that is based upon an affordance framework for designing sociable collaborative learning environments. This affordance framework is materialized by devices that enhance group awareness for users of CSCL environments.

1. INTRODUCTION

Successful collaboration, whether in face-to-face groups or in distributed computer-supported groups, is based upon common trust, beliefs, norms, values, et cetera. These social aspects do not occur 'by themselves'. In an educational environment where effectiveness and efficiency are often at the top of everyone's list, we - as educators, educational researchers, and instructional designers - cannot wait for these aspects to appear and develop by themselves. We must construct educational environments in its broadest meaning (i.e., from the traditional classroom setting through virtual teams), making use of the technological, educational and social tools and techniques that we have. To do this we not only have to focus on what technology we use and what pedagogy we implement, but must also pay specific attention to the socio-emotional aspects of group forming and dynamics. Only in this way can we promote the necessary accountability, interdependence and interaction for successful collaborative learning.

Affordances - technological, educational or social - determine how individuals or groups interact with the different aspects of their environments and with each other (Section 5). Technology that is easy to learn and easy to use will allow different use than technology that isn't. Pedagogy that gives control to team members affords different learning than pedagogy that it instructor centred. Finally, being able to experience where others are and what they are doing in a distributed group affords different learning and social contacts than where this is invisible. This chapter concentrates on social affordances of *computer-supported collaborative learning* (CSCL) to improve the socio-emotional climate and learning.

2. AN EDUCATIONAL SHIFT

Collaborative learning is seen by many as the answer to many of our educational problems and CSCL environments as the tool that permits:

- educators to make use of current constructivist insights in teaching and learning that rely heavily on learning in groups, encompassing dialogue and social interaction between group members;
- learners and instructors to be geographically dispersed so that they can engage in learning at any place, relaxing the need to be co-located to learn, teach, and contribute; and
- learners and instructors to be temporally dispersed so that they can engage in learning at any time, relaxing to need for to be co-present to learn, teach and contribute.

These characteristics allow us to move from traditional real-time contiguous learning in groups where knowledge is constructed by those who can take part at any one moment as is the case in traditional problem-based learning, to asynchronous distributed learning in groups (DLGs) where the barriers of time and place do not exist (Figure 1).

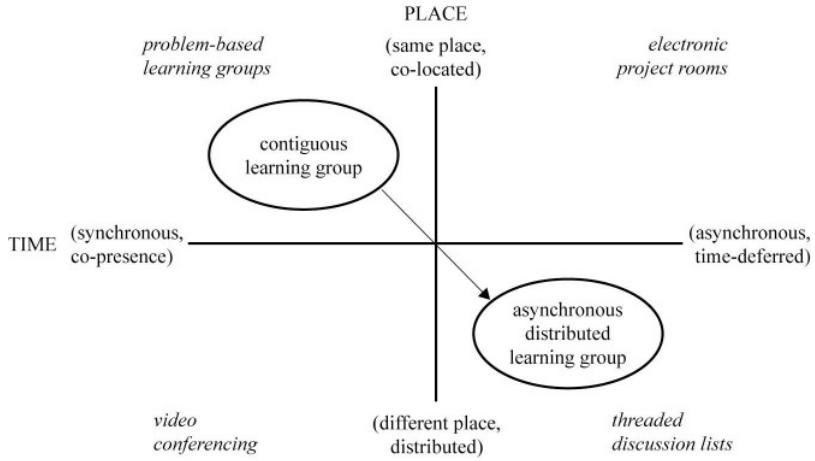

Figure 1. The shift of education thanks to CSCL

Despite this potential, research on the use and effectiveness of CSCL-environments shows that the effectiveness of such environments is at best inconclusive and at worst negative. Researchers, educators, and designers have reported both positive (Brandon & Hollingshead, 1999) and negative outcomes. The negative outcomes are predominantly based on low participation rates and/or

varying degrees of disappointing collaboration. For example, Hallett and Cummings (1997) observed that by "having the majority of assignments in public forums with the entire class posting at a given time, and with numerous prompts and encouragement from the instructor, it was hoped that interaction among students would occur naturally. This was not what took place" (p. 105). Generally, low learning performances in terms of quality of learning and learner satisfaction in CSCL environments are the consequences.

Gunawardena (1995) explains the negative experiences from her observations in computer conferences where "the social interactions tend to be unusually complex because of the necessity to mediate group activity in a text based environment. Failures tend to occur at the social level far more than they do at the technical level" (p. 148). In other words, there is all the more reason to take a closer look at the social and social psychological aspects of collaborative learning in (a)synchronous distributed groups and how they can be supported.

3. COLLABORATIVE LEARNING

Collaborative learning can lead to deep learning, critical thinking, shared understanding, and long term retention of the learned material (e.g., Garrison, Anderson, & Archer, 2001; Johnson & Johnson, 1994). It can also provide the opportunity for acquiring social and communication skills, developing positive attitudes towards co-members and learning, and building social relationships and group cohesion (Johnson & Johnson, 1989, 1994).

Many of the variables that potentially influence the effectiveness of collaborative learning (e.g., group size, group composition, nature of task, learning styles) are, in one way or another, related to *social interaction*. Hooper and Hannafin (1991) found that "achievement differences attributable to group composition correspond to differences in intra-group interaction" and that "the nature of intra-group cooperation is potentially of greater importance than group composition per se" (p. 28). Hiltz (1994) stressed that "the social process of developing shared understanding through interaction is the 'natural' way for people to learn" (p. 22). Gilbert and Moore (1998), Gunawardena (1995, 1997), Liaw and Huang (2000), Northrup (2001), and Wagner (1994, 1997), just to name a few, confirm the notion that social interaction is a *conditio sine qua non* for collaborative learning. If there is no social interaction then there is also no real collaboration (Garrison, 1993; Johnson, Johnson, & Stanne, 1985; Soller, Lesgold, Linton, & Goodman, 1999).

3.1. Enhancing Collaborative Learning

Fischer, Bruhn, Gräsel, and Mandl (2002) report "an array of studies … has shown that efficient learning rarely is achieved solely by bringing learners together" (p. 216). Placing students in groups, apparently, does not guarantee collaboration (Brush, 1998; Johnson & Johnson, 1989, 1994; Soller, 1999). The incentive to collaborate has to be structured within the groups. A complex of simultaneously applied instructional approaches, each reinforcing and complementing the other can

enhance collaborative learning and social interaction amongst group members. All these *instructional approaches* result in group members socially interacting in ways that encourage elaboration, questioning, rehearsal, and elicitation. Basically, there are three approaches to this, namely a cognitive approach, a direct approach, and a conceptual approach.

The *cognitive approach* is aimed at specific activities in the learning task that promote epistemic fluency: "the ability to identify and use different ways of knowing, to understand their different forms of expression and evaluation, and to take the perspectives of others who are operating within a different epistemic framework" (Morrison & Collins, 1996, p. 109). This can be achieved by applying a set of epistemic tasks within the group learning tasks (Ohlsson, 1996) including describing, explaining, predicting, arguing, critiquing, evaluating, explicating and defining – all in the context of a discourse (Table 1).

Table 1. Epistemic tasks (Ohlsson, 1996, p. 51)

Task	*Meaning*
Describe	Fashion a discourse referring to an object or event such that a person in that discourse acquires an accurate conception of that object or event
Explain	Fashion a discourse such that a person in that discourse understands why that event happened
Predict	Fashion a discourse such that a person in that discourse becomes convinced that such and such an event will happen
Argue	State reasons for (or against) a particular position on some issue thereby increasing (or decreasing) the recipient's confidence that the position is right.
Critique (evaluate)	Fashion a discourse such that a person in that discourse becomes aware of the good and bad points of that product
Explicate	Fashion a discourse such that a person in that discourse acquires a clearer understanding of its meaning
Defining	Define a term is to propose a usage for that term

The *direct approach* involves using specific collaborative techniques to structure or script a task specific learning activity (Table 2). These techniques are very specific and well defined so that teachers can quickly learn and apply them. Each specific technique can be used as a template for adaptation to a slightly different learning activity. Examples are Student Teams-Achievement Divisions (Slavin, 1986), Jigsaw (Aronson, Blaney, Stephan, Silkes, & Snapp, 1978; Slavin, 1990) and Structured Academic Controversy (Johnson & Johnson, 1993). For an analysis of the different methods see Johnson, Johnson, and Stanne (2000). For examples of very innovative use of these techniques, as well as a discussion of how they influence true collaboration, see Dillenbourg (2002).

Table 2. Cognitive approaches

Approach	*Description*
Student Teams Achievement Divisions	Distinguishes three stages: • teaching: the teacher presents the learning material • teamwork: students in heterogeneous teams help each other build a shared understanding. • individual assessment: team members show their individual knowledge on a quiz (or equivalent procedure) without any help. The team is rewarded based on the degree to which team members have improved over their own past records.
Jigsaw	Segments the content into as many sections as there are team members in heterogeneous groups. Members have to study their section with members of the other teams assigned to the same section; together they form an 'expert group'. After they have become 'experts', they return to their teams to share what they have learned. Team members are assessed on their individual knowledge of the whole content. Because there is no team reward, this technique is high in task interdependence and low in reward interdependence
Structured Academic Controversy	Based upon the premise that conflicts arising from controversies, it drives and motivates students to be intellectually engaged with the learning material and, as such, fits situations where controversial subjects are discussed. A group of four is split into two pairs and assigned opposing positions. Pairs develop their position and have to advocate their perspective to each other. The aim is that the two pairs seek a synthesis that takes both perspectives and positions into account, representing the collaborative learning part of the technique.

Finally, the *conceptual approach* involves tailoring a general conceptual model of collaborative learning to the desired or chosen circumstances such that specific types of collaboration can be created or enforced (Johnson & Johnson, 1989, 1994). The conceptual model can be applied in any subject area for any age student, and are highly adaptable to changing conditions. Johnson and Johnson (1974, 1994) developed one such conceptual model that is based upon the theory of cooperation and competition that Deutch (1949, 1962) derived from Lewin's (1935, 1948) field theory. The model comprises five pedagogical principles: individual accountability / personal responsibility, positive interdependence, promotive interaction, inter-personal and small group skills, and group processing. The first three principles will be elaborated in more detail in the next sub-section, because they form the core of the conceptual model.

3.2. The Social Basis for these Approaches

The direct approaches discussed in the previous section are specialized adoptions of a conceptual model with an emphasis on the social aspects individual accountability, positive interdependence, and promotive interaction.

Individual accountability (Slavin, 1980), as concept, was introduced to counter a number of deleterious effects of working in groups. The *free-rider* or *hitchhiking* effect exists when group members exert less effort as the perceived dispensability of their efforts for the group success increases (Kerr & Bruun, 1983). In other words, they feel that the group is doing enough and that they don't have to contribute. *Social loafing* (Latané, Williams, & Harkins, 1979) exists when group members exert less effort as the perceived salience of their efforts for the group success decreases. In other words, as the group size increases so does the anonymity and the non-participation. The social loafer differs from the free rider in that the first lacks the motivation to add to the group performance, while the last tries to profit from others while minimizing essential contributions. Finally, the *sucker effect* (Kerr, 1983) exists when the more productive group members exert less effort as the awareness of co-members free-riding increases Those group-members refuse to further support non-contributing members (they refuse to be 'suckers') and therefore reduce their individual efforts. Individual accountability not only conceptually helps counteract the inability to control and assess individual learning and contribution, but also allows the institution to operationally counteract it. By allowing for and even stressing individual accountability, what the group does as a whole doesn't become less important, but the individual contribution becomes more important. It is perfectly valid that in a group environment, each group member be held individually accountable for his or her own work. For example, in many problem-based learning environments students' sense of individual ownership is increased by also grading them for their individual effort, irrespective of the group's performance.

Positive interdependence (Johnson, 1981) reflects the level to which group members are dependent upon each other for effective group performance (enhanced intra-group interaction). Team members are linked to each other in such a way that each team member cannot succeed unless the others succeed; each member's work benefits the others (and vice versa). The concept holds that each individual can be held individually responsible for the work of the group and that the group as a whole is responsible for the learning of each of the individual group members. Essential here is social cohesion and a heightened sense of 'belonging' to a group. Positive interdependence is evident when group members in a project-centred learning environment carry out different tasks within a group project, all of which are needed in the final product. This interdependence can be stimulated through the task, resources, goals, rewards, roles or the environment itself (Brush, 1998).

Positive interdependence provides the context within which *promotive interaction* takes place. According to Johnson and Johnson (1996), promotive interaction "exists when individuals encourage and facilitate each other's efforts to complete tasks in order to reach the group's goals. … Promotive interaction is characterized by individuals providing each other with efficient and effective help and assistance, exchanging needed resources … acting in trusting and trustworthy ways, being motivated to strive for mutual benefit. … Promoting each other's success results in group members' getting to know each other on a personal as well as a professional level" (p. 1028-1029).

Individual accountability, positive interdependence, and promotive interaction are social tools that counter the tendency towards hiding and anonymity and thus improve social interaction.

4. SOCIAL INTERACTION IN CSCL ENVIRONMENTS

If the importance of social interaction in collaborative learning is so evident, then why don't educators, instructors, and researchers pay it the needed attention when they deal with asynchronous distributed groups of learners who depend entirely on CSCL environments for their communication and collaborative activities? Our premise is that at least two factors can be identified (Kreijns, Kirschner, & Jochems, 2003) to explain this.

First, interactivity must be *organized* if it is to occur and be meaningful (Kearsley, 1995; Liaw & Huang, 2000; Northrup, 2001). If we discount the fact that most educators do not know what they have to do in order to *encourage social interaction* (Kearsley, 1995; Rourke, 2000a) because they haven't learnt to apply those pedagogical techniques discussed in the previous section, what remains is that a majority of educators -consciously or unconsciously- apparently take social interaction for granted. They think that because social interaction is 'easy' to achieve if not already present in face-to-face learning groups, the same patterns will be encountered in DLGs. But even in contiguous learning groups it is often difficult to achieve positive social interaction (Brush, 1998; Johnson & Johnson, 1989, 1994; Soller, 1999). Social interaction in computer mediated situations such as computer conferences - even if there are facilities for aiding this - can no more be taken for granted than it can be in face-to-face settings such as lecture halls or small seminar settings (Rourke, 2000b).

These observations lead us to the conclusion that we must not take for granted that social interaction will automatically occur in DLGs just because the environment makes it technologically possible. Although such environments allow social interaction to take place (to a certain degree), it is no more a matter of course in there than it is in contiguous, face-to-face settings, and perhaps even less because the opportunities for (non-verbal) communication are very limited in CSCL environments. Olson and Olson (2000) noted "with the invention of groupware, people expect to communicate easily with each other and accomplish difficult work even though they are remotely located or rarely overlap in time" (p. 139). They concluded that this is a mistake. Wagner (1994) concluded that the 'conventional wisdom' that an increase in the ability of a system to allow interaction will cause a concomitant increase in instructional interaction is unrealistic. In other words, just providing group members with more communication media and/or tools than they already have neither fosters nor ensures social interaction. Although such tools can contribute to a more suitable condition for the execution of the communication tasks, it is not a guarantee that the desired social interaction will take place.

Second, educators often tend to limit their actions to the *task context* (i.e., to so-called on-task activities: activities directly related to the functional execution of the learning tasks) and/or to the educational dimension (i.e., pedagogical techniques:

techniques solely in the service of the cognitive processes or other educational purposes). In other words, they concentrate solely on the earlier described educational techniques. This, however, might not be enough.

Working in a team requires team members be open and truthful with other team members, that compliments are given when earned and criticism is made when necessary, and that team members accept both compliments and criticism gracefully. Rourke (2000b) remarks that "if students are to offer their tentative ideas to their peers, if they are to critique the ideas of their peers, and if they are to interpret others' critiques as valuable rather than as personal affronts, certain conditions must exist. Students need to trust each other, feel a sense of warmth and belonging, and feel close to each other before they will engage wilfully in collaboration and recognize the collaboration as a valuable experience" (2). Northrup (2001), Gunawardena (1995), and Cockburn and Greenberg (1993) all stress the need for relationship building and sharing a sense of community and a common goal for working in teams. Finally, Wegerif (1998) noted "forming a sense of community, where people feel they will be treated sympathetically by their fellows, seems to be a necessary first step for collaborative learning. Without a feeling of community, people are on their own, likely to be anxious, defensive and unwilling to take the risks involved in learning" (p. 48).

This research suggests a *social (psychological) dimension* of social interaction in collaborative learning which relates to the socio-emotional aspects of group forming and group dynamics. In other words, social interaction not only relates to educational processes, but also to processes that have to do with getting to know each other, committing to social relationships, developing trust and belonging, and building a sense of on line community. However, Hobaugh (1997) observed that the absence of these processes is "often the major cause of ineffective group action; unfortunately, either very little attention is devoted to it, or is not well understood by instructors or students, or both" (Planning for Interaction). Furthermore, because these processes are not directly related to the task in strict sense, facilitating them, for example by providing off-task contexts, is often considered a 'waste of time', a belief that underlies the second factor. Contrary to this, Mulder, Swaak, and Kessels (2002) noted a marked increase in task/domain related work following sessions in which there was a high degree of social activity between group members.

If group members are initially not acquainted with each other and the group has zero-history (which is often the case in distance education institutions, but is also become a normal aspect of other - more traditional - forms of education), group forming, developing group structure, and group dynamics are very important for developing a learning community. If this is disregarded, there is a very high risk that learners become isolated and depressed because they are confronted with a lonely learning experience. Contemporary CSCL-environments appear not to provide adequate opportunities for social interaction and for the development of friendships and camaraderie (Clark, 2000; Hiltz, 1997, 1998).

The gap between the educational and the social (psychological) aspects of collaborative asynchronous working and learning can, in our opinion, best be bridged by the concept of affordances and its application in CSCL environments.

5. AFFORDANCES

James Gibson proposed the concept of affordances (i.e., opportunities for action) in 1977. In his thinking, affordances refer to the relationship between an object's physical properties and the characteristics of an actor (user) that enables particular interactions between actor and object. According to him (1977), "the affordance of anything is a specific combination of the properties of its substance and its surfaces with reference to an animal" (p. 67). In other words, it is a specific property (or specific combination of properties) of a thing that gets its meaning and value only through the existence of a unique reciprocal relationship between the property (combination of properties) and the characteristics of the animal. This reciprocity emphasizes the notion that animal and environment have to be evaluated as one inseparable entity. Animal behaviour cannot be studied by considering the animal apart from its context. The context is the environment with its structure, building elements, and relationships between them, including all other creatures living in that environment. Also, an environment cannot be studied as single whole without the animal in it. Co-evolution of animal and environment has determined that they complement each other and have to be considered as a Siamese twin. A pond, for example, affords a surface to walk on for certain species of flies, a place to drink for certain land animals, and a living environment for certain species of fish. In addition to this reciprocal relationship, Gibson also related animal behaviour to the notion that the interaction of the animal with its environment is a result of the coupling between what is being perceived and the consequent action on that perception. This is the principle of *perception-action coupling*. What is perceived is what the properties of the environment afford to the needs and the affectivities (i.e., capabilities for action) of the animal. The properties of the environment that have the *ability* to afford a function are particularly important as an explaining mechanism for animal behaviour. It should be noted that in Gibson's view, affordances need not necessarily be perceived. Irrespective of whether or not affordances are perceived, they exist as the objective properties of the environment.

Don Norman (1988, 1990) and Bill Gaver (1991, 1996) appropriated the term as a conceptual tool for discussing the design of usable (i.e., easy to learn and easy to use) interactive systems and respectively speak of perceived and perceptible affordances. In their view, it's not only about the existence of the affordance, but also of its *perceptibility* to the prospective user (i.e., being there is not enough, it also has to be seen as such). Here Norman and Gaver deviate from Gibson's original concept which did not include the constraint of perceptibility. Therefore, a hidden door is in Gibson's view still an affordance while it is not in Norman's or Gaver's view, because hidden or not, a door intrinsically affords the passing from the one room to the other.

Although the concept of affordances is developed in a totally different knowledge domains (i.e., ecological psychology and usability engineering), the concept and its principles can be applied in the design of CSCL environments as well. All learning environments are a unique combination of the technological, the

social, and the educational context. Take, for example, a lecture and project work in a school. Both represent learning situations, but the contexts in the two are completely different along all three dimensions. The educational contexts are different (competitive versus collaborative), the social contexts are different (individual versus group), and the technological (physical) contexts are different (individual workspaces with minimal assortment of materials versus group workspace with a rich assortment of materials). In CSCL, the educational context is one of collaborative learning, the social context is the group, and the technological context is a computer-mediated one. At the Open University of the Netherlands, for example, it is a computer-mediated communication environment where the lowest common *user* denominator determines the choices. The educational context is competence-based learning grounded in social constructivism. The social context is one of minimal direct contact, maximal guided individual study, and primarily asynchronous, text based contact (email, discussion lists, and electronic learning environments). Other institutions have other priorities.

When technology mediates the social and educational contexts we speak of 'technology affording learning and education'. Therefore, we may distinguish between three types of affordances - educational, social, and technological.

5.1. Technological affordances

According to Norman (1988) affordances are the perceived and actual properties of a thing, primarily those fundamental properties that determine how the thing could possibly be used. Some door handles, for example, look like they should be pulled. Their shape leads our brains to believe that is the best way to use them. Other handles look like they should be pushed, a feature often indicated by a bar spanning the width of the door or even a flat plate on the side. Others, and here is the problem, do not present a clue. Norman (1988), thus, related affordances to the design aspects of an object suggesting how it should be used. He links affordances to an object's usability, and thus these affordances are designated technological/technology affordances (Gaver, 1991).

Usability, however, is a multi-facetted dimension (Nielsen, 1994; Shneiderman, 1998) and when creating CSCL-environments it is, therefore, important to consider all its facets, otherwise we risk creating CSCL-environments that contain all the needed educational and social functionality, but cannot be handled by their users (i.e., the learners) because they are difficult to learn, access, and/or control. With respect to CSCL-environments the five facets of usability can be seen in:

- *Learnability*: The CSCL-environment should be easy to learn for novice users and should allow them to rapidly start using the environment doing some basic tasks.
- *Ease of use*: Once the user becomes an experienced user, the CSCL-environment should be easy to use allowing for high levels of productivity. Access to and using the various parts of the environment should almost be

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an autonomous act. Learnability and ease of use are not independent of each other.

- *Memorability*: If a CSCL-environment is not used for some time, the user should still be able to use it without to learn everything all over again. Therefore, its use should be easy to remember.
- *Error frequency*: Ideally, a CSCL-environment should prevent users from making errors. In practice this is impossible and users will make errors. Thus, the environment should take care that the error rate is kept low, that the consequences of making errors are not catastrophic, and that a means is provided to recover easily from errors.
- *Satisfaction*: A CSCL-environment should also be pleasant to use and may have some aesthetic appeal making the environment attractive. Users will be subjectively satisfied when they use this environment.

Technology affordances offer a framework from which all the aspects affecting usability can be studied. As Gaver (1991) put it, "the notion of affordances is appealing in its direct approach towards the factors of perception and action that make interfaces easy to learn and use. (…) More generally, considering affordances explicitly in design may help suggest ways to improve the usability of new artifacts" (p. 83).

5.2. Educational Affordances

Kirschner (2002) defines *educational affordances* as those characteristics of an artefact (e.g., how a chosen educational paradigm is implemented) that determine if and how a particular learning behaviour could possibly be enacted within a given context (e.g., project team, distributed learning community). Educational affordances can be defined as the relationships between the properties of an educational intervention and the characteristics of the learner or learning group that enable particular kinds of learning by him/her and the other members of the group.

Educational affordances in collaborative learning encompass the same two relationships that all types of affordances must meet. First, there must be a *reciprocal relationship* between group-members and the environment provided for the group work. This means that the environment must fulfil the learning intentions of members as soon as they crop up (i.e., we must meet with each other and discuss some important aspect of the project) *and* that it must be meaningful and support or anticipate those intentions as soon as they crop up (i.e., the project rooms must be open and available at every given moment, in other words all teams must have their own project room that is open to them 24/7). Second, there must be a *perception-action* coupling. Once a learning need becomes salient (perception), the educational affordances will not only invite but will also guide her/him to make use of a learning intervention to satisfy that need (action). This means that the project rooms must contain the necessary tools for effectively, efficiently and satisfactorily carrying out the needed work. The salience of the learning intervention may depend upon factors such as expectations, prior experiences, and focus of attention.

5.3. Social Affordances

Kreijns, Kirschner, and Jochems (2002) define *social affordances* as the "properties of a CSCL environment that act as social-contextual facilitators relevant for the learner's social interaction" (p. 13). Objects that are part of the environment can realize these properties; hence they are designated social affordance devices. When social affordances are perceptible, they invite learners to engage in activities that are in accordance with these affordances, i.e., there is social interaction. Very similar is the definition posited by Bradner, Kellog, and Erickson (1999) who define a social affordance as "the relationship between the properties of an object and the social characteristics of a group that enable particular kinds of interaction among members of that group" (p. 153). The physical world is a rich and very social space. Although a hallway in an office complex affords little interaction (except for people passing in them), if the doors are open or if the area next to the door is fitted with glass, then the hallway now affords more awareness of and contact between employees.

In the 'physical' world (Figure 2), affordances abound for casual and inadvertent interactions.

Figure 2. Off-task interaction?

In the 'virtual' world, social affordances must be designed and must encompass two relationships. First, there must be a reciprocal relationship between group-members and the CSCL-environment. The environment must fulfil the social intentions of members as soon as these intentions crop up while the social affordances must be meaningful and support or anticipate those social intentions. Second, there must be a perception-action coupling. Once a group-member becomes salient (perception), the social affordances will not only invite, but will also guide another member to initiate a communication episode (action) with the salient member. Salience depends upon factors such as expectations, focus of attention, and current context of the fellow member (Figure 3).

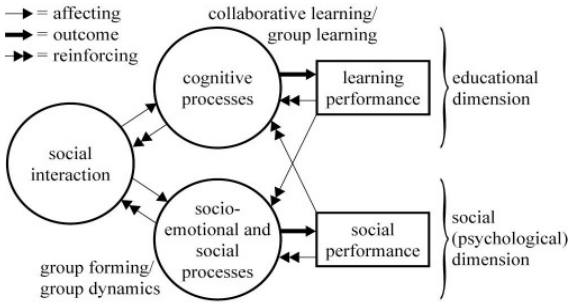

Figure 3. The two relationships of social affordances in a CSCL environment

ICQ® and MSN Messenger® are online instant messaging programs that can be seen as simple social affordance devices. They are conferencing tools used by individuals to chat, e-mail, perform file transfer, et cetera. Once downloaded and installed, lists of friends, family, business associates (buddies) who also have the program on their PCs can be created. ICQ® and Messenger® use these lists to find buddies and notify the user when they have signed on. If online, these buddies become visible to each other, creating an awareness of who is where. The user can then send messages, chat in real time, play games, etc.

5.4. Affordances and Useful CSCL-Environments

Jacob Nielsen (1994) distinguished between utility and usability. Utility has to do with the functionality that a system offers to the user. A system that is usable but does not have the functionalities to support the user in what (s)he wants to accomplish is, de facto, worthless. Nielsen (1994) defined usefulness to be utility plus usability. In CSCL-environments the utility is determined by both its educational *and* social functionality. From the previous sections we make a plea for designing and implementing educational and social functionalities from the perspective of educational and social affordances, and that usability matters should be resolved from the perspective of technology affordances (Figure 4). Only then can useful CSCL-environments be created. In addition, because social functionality

is incorporated in the CSCL-environment, this environment is designated to be a sociable CSCL environment.

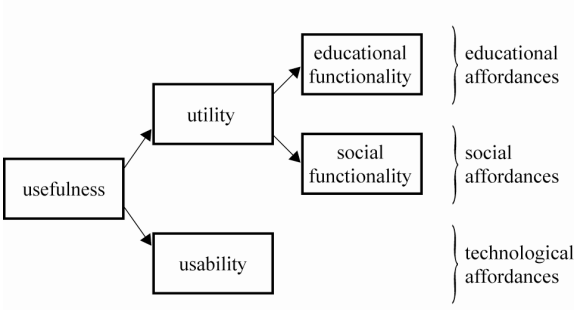

Figure 4. Usefulness is determined by the different various types of social affordances

The remainder of this chapter focuses on a particular social affordances device, the group awareness widget.

6. OPERATIONALISING SOCIAL AFFORDANCES: GROUP AWARENESS WIDGETS

Social affordance devices can be operationalised by group awareness widgets (GAWs). These widgets consist of group awareness, history awareness, and a set of communication media.

6.1 Group Awareness

Group awareness is the condition in which a group member perceives the presence of the others and where these others can be identified as discernible persons with whom a communication episode can be initiated. (cf., Borning & Travers, 1991; Gajewska, Manasse, & Redell, 1995). Dieberger (2000) considers such awareness to be an essential ingredient for collaborative work. Group awareness can be generated in different ways. A common way is the application of media spaces, which involves the use of cameras in variable and fixed positions, monitors, audio connections, and computers. Alternative but less commonly used ways to create group awareness are the application of audio cues and the application of signal processed audio and visual cues, resulting in distorted audio or other forms of sound cues like sound-scapes and in abstracted, blurred or other forms of visual cues.

6.2 History Awareness

History awareness is the structured collection of all traces caused by the various activities group members were engaged in. History awareness is provided here as a means for bridging the time gap imposed by working and learning in a time-deferred

mode. Each trace can be used for getting in touch with each other. However, the provision of history awareness may have more implications. It does not only give insight in when and for how long a group member is engaged in a particular activity, but it also gives insight into this group member's behaviour patterns with respect to that activity. This insight is enlarged when this behaviour pattern is combined with the behaviour patterns of all the other activities the group member is engaged in. The resultant overall behaviour pattern summarizes how the member is learning, when certain activities are given priority over other activities, when periods of inactivity are, and so forth. One step further is combining all the behaviour patterns of the group members, which give insight in how the group is functioning, if it is indeed a performing group or a group that has not yet started. It may reveal the temporal rhythms of members, but also whether some group members are active participants or not.

Also, history awareness information can be used for inferring certain behaviour and based upon the inferences can notify group members. For example, a member may not be active for a while causing the system to notify other members about this situation suggesting that the inactive member possibly needs some help. Certain 'agents' are based upon this.

Research on the impact of the history awareness on the activities of a group member is limited. Begole, Tang, Smith, and Yankelovich (2002) have analysed visualizations of history awareness of distributed groups. Their aim "was to explore how patterns in people's work activity would help identify convenient times to make contact" (p. 334). Traces in *their* history awareness, however, cannot be used for getting in contact with those who caused the traces; they function only as picture elements for building an overall view of the work activities.

6.3 Set of Communication Media

A question that now arises concerns the composition of the set of communication media accompanying the awareness information. What kind of communication media should this set contain? One suggestion is to use the default set commonly present in CSCL environments, which traditionally consists of the following CMC typed media: chat (i.e., text-based, synchronous), computer conferencing (i.e., text-based, asynchronous), and e-mail (i.e., also text based, asynchronous).

From the viewpoint of social presence (Short, Williams, & Christie, 1976) and media richness theory (Daft, Lengel, & Trevino, 1987), it is important not to restrict media selection to CMC typed media since media richness research concludes that "CMC, because of its lack of audio or video cues, will be perceived as impersonal and lacking in normative reinforcement, so there will be less socioemotional (SE) content exchanged" (Rice & Love, 1987, p. 88). Similarly, from the perspective of social presence, CMC typed media being low in social presence may potentially lead to de-individuation and de-personalization because the communication is less social and more task-oriented (Connolly, Jessup, & Valacich, 1990; Rice & Love, 1987)). Therefore, from the media richness perspective and from the social presence perspective, the use of such a default set of communication media seems not to be a

good idea and this set should be extended with other types of communication media. However, assumptions and predictions of media richness theory and classical social presence theory are not fully supported by research.

From the perspective of media richness and social presence theories, Walther (1999) found that the use of photographic images or video connections yields no better task performance and dampens hyperpersonal effects when compared to CMC type media. For this reason, he concludes that visual cues have little place in CMC. He explained the persistent preference for multimedia from the principle of least effort in media preferences, which in his opinion may provide less effective communication. His findings suggest being wary of using pictures of group members or video conferencing systems.

Gay and Lentini (1995) found that different communication media are used in different ways to increase the depth and breadth of the interaction of the communication task the participants of the study were involved in. Their findings suggest that DLGs will be more productive when they have different communication media at their disposal. In addition, medium choice cannot be predicted and, thus, members should have a pool from which they can select.

Finally, it is important that the communication media are tightly coupled with the displays of awareness data and that each medium is directly accessible. Any threshold that may hinder getting in contact with the other as soon the need for this crops up must be removed (cf., perception-action coupling). "In a social environment users can be quite capricious and it is important to capture the moment when he or she feels the need to write a specific message or chat with a user; the command set must be easily accessible." (Vallée, 1992, p. 185).

6.4 Group Awareness Widgets

A GAW is a social affordance device that graphically displays a set of group awareness data (representing the group members engaged in the various activities) in an appropriate way while at the same time it enables users to socially interact with each other by providing a set of communication media to them. GAWs augment the CSCL-environment. We conjecture that GAWs will increase (informal) social interaction which, in turn, will positively affect the social performance of the group. As a result, this will positively affect the learning performances of the group as well as of each individual member.

GAWs also include history awareness and will display all the traces along a time axis. This way, past group awareness remains available for the group members. Both history and group awareness data are continuously updated at regular (short) time-intervals: recent group awareness data become part of the history, and up-to-the-minute group awareness data become recent data. By inspecting the history, the DLG member can, for example, see where fellow members were at an earlier time and what they were doing. Inspection of the recent group awareness data shows which fellow DLG members are also currently online.

6.5 A First Prototype of the GAW

The GAW's user interface consists of a sidebar visible on the right side of the computer screen. There are also two tickertapes on the top of the screen (see Figure 5).

This *sidebar* can contain a number of segments, each segment providing group awareness information about the members regarding a particular activity. The sidebar can be made smaller or larger by dragging the left edge of the sidebar with the mouse. The segments display history awareness information; the patterns of online behaviour of the group members. Black areas indicate that the GAW has not yet been installed. Red (grey) areas indicate periods of time that the GAW is closed and green (white) areas indicate periods of time that a member has opened the GAW indicating that at these time periods the member has been online and was engaged in her or his working and learning activities. The small part at the left side displays online awareness information. In this case, red (grey) means the member is offline and green (white) that the member is online.

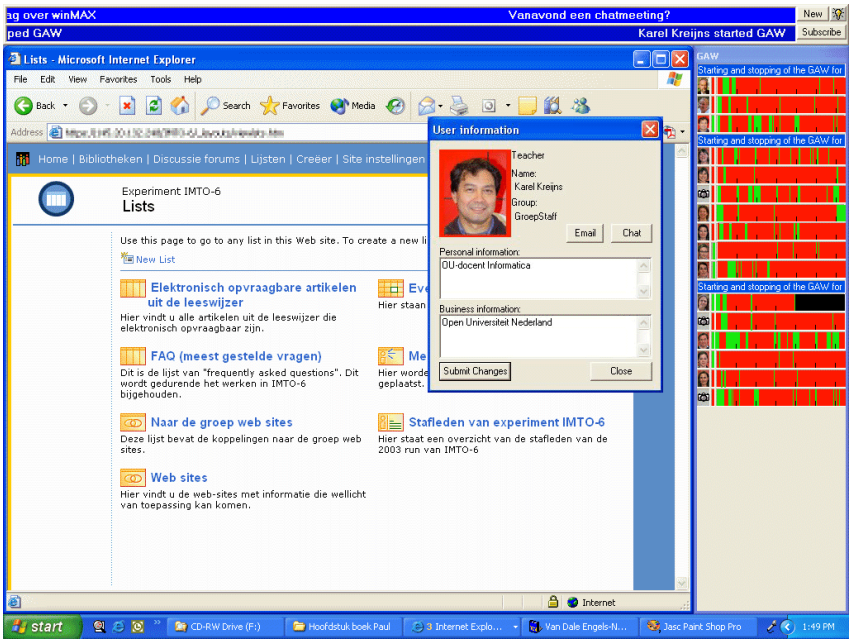

Figure 5. First prototype of the GAW

The segments may be used to contact other members. Clicking on a picture causes a dialog box to pop-up that contains the member's information as well as buttons for opening a chat and for writing an e-mail message.

A *tickertape* is a scrolling one-line window for displaying short messages that will disappear or fade away. Tickertapes occupy a minimum of screen space, and thus can always be visible without disturbing the user. The GAW's user interface includes two tightly integrated tickertapes, both at the top of the screen. The upper tickertape of the GAW allows for *interpersonal interaction*. The lower tickertape is meant for displaying *notifications* such as when members open or close the GAW. Members may subscribe to the types of notifications they want to see; the GAW, as noted, has defined nine different types of notifications. Members may apply a filter to each type of notifications.

The GAW has nine types of activities/engagements that can be detected and, thus, can be associated with group awareness information (Table 3).

Table 3 Group Awareness Information in the GAW Prototype

Types of group awareness information	Precise text that appears in the GAW user interface
Connect , disconnect from internet	Going on- and offline (internet)
Opening and closing the client	Starting and stopping the GAW
Posting a tickertape message	User (tickertape) message
Posting a tickertape idea	New ideas from users
Browsing the course web site	Visits to course web-sites
Opening and closing e-mail client	Visit to the mail-server
Opening chat-client	Visit to the chat-server
Posting an e-mail message	Entering a chat message
Posting a contribution to the forum	Posting a forum message

7. A STUDY OF THE USE OF THE GAW PROTOTYPE

A preliminary study to a series of experiments attempted to determine how the elements of the framework presented – directly and indirectly – affect social interaction in CSCL environments and thus affect both the creation of a social space and the establishment of a community of learning. The hypotheses were:

H_1: Social affordances contribute to the degree of perceived sociability of the CSCL environment

H_2: A higher perceived sociability of the CSCL environment increases the likelihood of the establishment of a sound social space

H_3: A higher perceived sociability of the CSCL environment increases the degree of perceived social presence

H_4: A higher perceived social presence increases the likelihood of the establishment of a sound social space.

7.1 Method

From the 129 students enrolled in the distance course *Interactive Multimedia* at the department of Informatics, 67 students (52.7%) volunteered to participate in the study. From these, 33 participants were assigned to the experimental condition (these participants had a plain CSCL environment that was augmented with the GAW prototype together with a web-based chat and e-mail client; the plain CSCL environment incorporated a discussion board). The remaining 34 participants were assigned to the control condition (these participants only had the plain CSCL environment). Participants in each condition were further assigned to one of seven groups. All participants were distance students of the Open Universiteit Nederland.

An (electronic) questionnaire was administered during the three month course. This questionnaire contained instruments for measuring social space, sociability, and social presence (Kreijns & Kirschner, 2004).

7.2 Results

The study did not provide the required data for testing the hypotheses due to a number of reasons. First, quite a number of participants left the study as non-starter (22 participants) or as dropout (five participants). In addition, ten participants continued individually and five more participants were exempted from the course. Furthermore, from the remaining 26 participants (including one exempted participant who decided to continue the participation) only 14 responded to the questionnaire (eight in the experimental condition and six in the control condition).

Second, the GAW was hardly used. From the 33 initial participants in the experimental condition, 21 (63.6%) of them installed the GAW prototype. Participants did not, however, install it right at the beginning of the course and tended not to use it as intended. After installation, the pattern observed was that the majority of them started to use it only for 'spying', that is, to see if other group members were also online, which – of course – was rarely the case because the others spied as well. This spying involved opening the GAW, quickly glancing at the awareness information, and then closing it. The general picture was that after spying a couple of times, participants stopped using it because 'nobody' was online.

7.3 Discussion and Conclusions

The study showed that the GAW prototype was realised and fully functional. However, because of the number of participants that left the study and because the number of responses was low, the study cannot empirically show whether the four hypotheses hold. However, the study does make clear that there is a tension due to the misalignment between collaborative learning (that exhibits high coordination and time constraints, but attracts learners with a collaborative learning style) and the typical characteristic of distance education (freedom of time, pace, and place, therefore, attracting independent learners). The implications of this misalignment

with respect to the introduction of collaborative learning in distance courses require further exploration. The study also makes clear that if collaborative learning is applied in distance courses, the incentive of collaborative learning should be much stronger, for example, through the structuring of positive interdependence into the learning tasks. Collaborative learning based upon individual accountability alone (as was the case in the study) is too weak; participants tend to wait for others to do something and, thus, do not effectively collaborate.

The final conclusion is that the study showed that a field experiment using a standard distance course yields a number of variables that are difficult to control. Although not preferable, laboratory experiments should be conducted first and only then be followed by field experiments.

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