Supports of Group Awareness for Synchronous and Asynchronous Collaboration

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Abstract: Dourish and Bellotti (1992) defined awareness as "an understanding of the activities of others, which provides context for your own activity." Knowing who is around, what is happening, and how the things are going is critical in establishing and maintaining collaborative relationships; however, establishing and maintaining awareness has been reported to be difficult without appropriate supported tools (Gutwin & Greenberg, 2002). In addition, researchers have reported a significant effectiveness of applying media technologies, such as chatting tools, shared workspace tools, video and audio tools, visualization representation tools, email, and notification tools in deliver awareness through groupware system. Therefore, the purpose of this study is to perceive how the group awareness affects students' interaction of collaborating in groupware system, and how students behave and interact when awareness supports are provided. We will conduct an experimental to investigate the differences of students' interactions when having group awareness supports.

Introduction

The constructivist theory presumes that learning occurs from the interactions between individual learner and the learning materials, while social theory, whose point complements the constructivist theory, assumes that learning is constructed when an individual interacts with others (Alai & Dufner, 2005). Collaboration, which has been reported more effective than individual work in facilitating higher development of learners' knowledge (Johnson, 1981; Stodolsky, 1984; Webb, 1983), is the most critical implementation of the constructivist approach (Duffy & Cunningham, 1996). In collaboration learning, students, being active participants, establish knowledge by utilizing concepts they have constructed into problems, elaborating their concepts through others' responses and ideas, and interactively communicating with instructors and peers (Alavi, 1994; Benbunan-Fich, Hiltz, Harasim, 2005). Some social or motivational factors are involved in collaborative interaction (Cohen, 1984). For instance, working with peers is presented to mediate soci-emotional variables (Harasim, 1990), and providing explanations for others improve explainers' current knowledge (Webb, 1982).

People who work collaboratively in face-to-face environment establish and maintain awareness of collaborative tasks, activities, others' presence and actions, and relevant information over time. They can easily know who they work with, what others are doing, and where, when, and how others are working because of physical proximity. Knowing who is around, what is happening, and how the things are going help people gain the informal awareness for collaborative interaction (Cockburn & Greenberg, 1993; Kraut, Egido, & Galegher, 1988). Previous research in computer supported cooperative work (CSCW) found informal awareness is crucial for collaborative work activity (Whittaker, Frohlich, & Daly-Jones, 1994; Kraut et al. 1990). Cockburn and Greenberg (1993) emphasized that informal awareness is the glue behind the interaction of collaboration, which helps people track and maintain a sense of who is around and what others are doing. A conclusion of Fish, Kraut, and Root, and Rice's study (1993) reported that it is insufficient for accomplishing tasks when the glue, informal awareness, was not able to promote shared context and culture. Whittaker, Frohlich, and Daly-Jones (1994) presented that due to the informal communication that supports the execution of work-related tasks, social interaction, and co-ordination of

group, people who are collocated physically in terms of physical proximity communicate frequently and have more relations. Similarly, previous studies (Allen, 1997; Kraut et al., 1990a; Kraut et al., 1990b) indicated that the proximity supports frequent collaboration and informal communication.

Though proximity plays a critical role in establishing and maintaining collaborative relationships, many distributed groups are not able to benefit from the proximity because of their space and time distribution. Since proximity is so important, there is growing interest in supporting distributed groups with a sense of proximity that is lost when team members are located in different areas (Tang, Isaacs, & Rua, 1994). The reason why proximity can promote frequent collaboration in physical interactive environments is because people gain a sense of situation of others and environment through the physical cues.

Dourish and Bellotti (1992) defined awareness as "an understanding of the activities of others, which provides context for your own activity." In a face-to-face setting, awareness is established by the physical cues, such as facial expressions, body language, gestures, postures, eye contact, and other socially-relevant action. Gallini and Helman (1995) found that distributed collaborators need more effective communicated information to collaborate successfully. However, establishing and maintaining awareness that conveys the contextual and social awareness information for collaborators in distributed groups has been reported to be difficult without appropriate supported tools (Gutwin & Greenberg, 2002; Gutwin, 1997). Additionally, Kreijns, Kirschner, Jochems, and Buuren (2004) presented that the nature of computer supported collaborative learning (CSCL) environment, which are non-verbal interaction and physical proximity lost, will impede social interaction that includes cognitive process and socio-emotional process. The idea of supporting awareness for collaboration in groupware systems is to make up for the lack of cues that helps people stay aware of their colleague's availability for integration and collaboration. It can solve the problems of remoteness by trying to provide the audio/visual cues lost during remote communication (Chen & Gellersen, 1999; Cheverst, Mitchell, Davies, & Smith, 2000).

According to the results of ethnographic field studies in CSCW (Happer et al., 1989b; Haper et al., 1989a; Heath and Luff, 1991), group members collaborate well when they notice what is happening in the learning settings. Some studies found that awareness is effective in collaborative learning in groupware systems (Convertino, Neale, Hobby, Carroll, and Rosson, 2004; Dourish, 1992; Gutwin, 1997; Xie & Salvendy, 2003), whereas some studies investigate on designing and testing the supported tools (Erickson, Smith, Kellogg, Laff, Richards, & Bradner; 1999; Gutwin, 1997). According to the result of effectiveness studies, Gutwin and his colleagues emphasized that when people's awareness is enhanced, the learning activities will be more "natural, spontaneous, and unforced," which can make the quality and productivity of collaboration in groupware systems be greatly improved (Gutwin, 1997; Gutwin, Roseman, & Greenberg, 1996). They have disovered the awareness is valuable in their study because students completed learning tasks quicker when they have more visual indication and continuous feedbacks of others' viewpoints, locations, and motions. According to the qualitative and quantitative data, Convertino, Neale, Hobby, Carroll, and Rosson (2004) found that participants' engagement level increased when they had more non-task related communication with their partners. The participants appeared to be more engaged in the activity when they had more informal communication because the informal communication made others more familiar and intimate. More research (Whittaker, Frohlich, Daly-Jone, 1994; 7; Tollmar, Sandor, & Schomer, 1996) also indicated that informal communication and social awareness are critical prerequisite of acquiring good collaboration. When they are removed, the effective collaboration decreases significantly.

Previous research emphasized that the effectiveness of CSCL depends on the social affordance of computer based communication of CSCW (Kreijns, Kirschner, Jochems, & Buuren, 2004). Hence, to make collaborative learning of groupware systems successful, social affordance providing cues of collaborative tasks, others' actions, and learning settings is necessary. The concept of affordance is described by CSCL researchers in discussing the interaction between the features of tools and actors who use the tools (Gaver, 1991; Kirschner, 2002; McGrenere & Ho, 2000). From a design perspective, the goal of affordance is to select software that fits learners' and teachers' needs. Also, the affordance tools should be able to address the types of collaborative interaction and the behaviors boosting collaborative learning. Some studies (Chen & Gellersen, 1999; Alavi & Dufner, 2005; Benbunan-Fich, Hiltz, Harasim, 2005; Johansen, 1992) apply various frameworks to classify the categories of affordance tools used in supporting awareness of group collaboration. According to a framework of Benbunan-Fich, Hiltz, Harasim (2005), there are four different modes of interaction along the time and place dimension, which are synchronous/proximate, anytime/same place (virtual), synchronous/ dispersed, asynchronous/dispersed (Table 1). The contextual factors of collaborative learning in groupware change according to settings of different modes (Johansen, 1992). In order to establish and maintain the contextual and social factors for collaborative work or learning, different supported tools have to be utilized based on the characteristics of the collaboration environment.

Table 1: Time and place dispersion

		Time	
		Same	Different
Place	Same	synchronous/proximate	anytime/ same place (virtual)
	Different	synchronous/ dispersed	asynchronous/dispersed

Soruce: Benbunan-Fich, Hiltz, Harasim (2005): adapted from Johansen (1992)

Since this study will focus on the distributed group work, two modes of this model, synchronous/ dispersed and asynchronous/dispersed, are utilized to classify the awareness supported tools and relevant studies.

- Synchronous/ dispersed: The supported tools classified into this mode involve real-time but distributed-location interaction. These tools include chatting room, video-conference, video and audio supported tools, and visual representation that can indicate others' situations, movements, and locations.
- Asynchronous/dispersed: The supported tools classified into this mode involve different-time and distributed-location interaction. These tools include e-mail, computer conferencing facilities (Hiltz & Wellam, 1997) which can support people collaborate successfully when they are distributed in different time and locations.

Synchronous/ dispersed supported tools

Research has reported a significant effectiveness of applying media technologies, such as chatting tools, shared workspace tools, video and audio tools, and visualization representation tools. Alavi (1994) indicated that synchronous online chatting tools and messaging exchanging tools (ie: MSN messenger, yahoo messenger, and ICQ) support collaborators to exchange text messages. These tools with indicators of collaborators' status, actions, and opportunities of communication can construct users' awareness of their groups and support collaborative work effectively in dispersed locations (Alavi & Dufner, 2005). The result of Tang, Isaace, and Rua's study (1994) indicated the capabilities of shared drawing and reviewing of collaborative tasks are necessary for collaborative work. Similarly, some researchers indicated that users need collaborative writing and editing tools for a web-based shared space (Alavi, Wheeler, & Valacich, 1995).

A study (Alvia, 1994; Alavi, Wheeler, & Valacich, 1995) presented that desktop video conferencing makes students committed and attracted to their groups. In addition, many researchers have suggested that always-on video and synchronous audio are effective supports of providing a sense of others' presence and availability awareness (Cockburn & Greenberg, 1993; Dourish & Bly 1992; Greenberg & Kuzuoka, 2000; Tang, Isaacs, & Rua, 1994; Zhao & Stasko, 1998). Steeples (2002) presented the participants in his study expressed that video or audio clips did help them require a sense of others' social presence and enable the learning community exchange their thoughts of professional practice.

Several design research, such Portholes (Dourish & Bly, 1992) and Montage (Tang & Isaacs, 1993) have implemented various ways to apply video and audio in supporting informal awareness. Dourish and Bly (1992) have been investigating various ways where media space technologies can support distributed collaboration through providing general awareness information. General awareness across distance leads to positive communication and interaction and contributes to a shared sense of community which is very useful in maintaining work relationships and informal communication among distributed collaborators. Tang, Isaace, and Rua (1994) designed Montage, a communication system with video and audio supported tools, to study how Montage supported distributed group collaboration. They reported that Montage provide tele-proximity for distributed group by conveying non-verbal cues and providing quick access to distributed groups. The video and audio tools not only provided a sense of awareness but also encouraged collaborators to contact each other when any issue was raised rather than waiting until having the opportunity of physical interaction.

In addition, other visual representation supports are also be utilized to improve the awareness of others' location, movement, and current situation. Erickson, Smith, Kellogg, Laff, Richards, and Bradner (1999) utilized social proxy to help users gain a sense of others. The social proxy indicated others' activities through the movement and position of the individual spots, which expresses who is joining the conversation and who is coming and going. Walther, Slovacek, and Tidwell (2001) investigated the differences of students' team work between groups with text-only media communication and with a digital photo gallery of the team members. They discovered that for a new group, seeing team members' pictures makes them construct the feelings of others' affection and attraction quickly though the photo effect did not appear consistently in long time period. Moreover, Suthers, Hundhausen, & Giradeau (2003) found that visual knowledge representation supports the discourse among the distributed learner more than that among the face-to-face learners.

Asynchronous/dispersed supported tools

Alavi (1994) indicated that email is an effective group supported tool which facilitates the messages' exchanging among collaborators in group interaction. An electronic bulletin board where people can communicate asynchronously through posting and responding messages and share relevant information by attaching digital files is capable of assisting collaborative communication. Particularly, a thread type of discussion board is indicated as an effective group supported tool in organizing and tracking the evolution of group discussion (Alavi & Dufner, 2005).

According to previous research, subscription or notification mechanisms can provide information in a user-specific manner and reduce the amount of information for the user (Arnold, Segall, Boot, Lloyd, & Kaplan, 1999; Fuchs, 1999), which can enhance users' awareness without increasing information load. Typically, notification systems provide awareness of others' presence, tasks, and actions of collaborators but not persistent and complex activities information (Carroll, Neale, Isenhour, Rosson, McCrickard, 2003). In addition, Shen and Sun (2002) indicated that notification strategy enhances users' awareness of people and workspace. The difference of notification strategies in supporting synchronous and asynchronous collaborative work depends on the frequency of propagating one user's actions to others.

These synchronous video and audio supported approaches are highly associated with privacy and interruption issues that was raised when researchers promote awareness in distributed groupware systems. Hudson and Smith (1996) presented a shadow-view filter can compensate with this concern. Boyle, Edwards, and Greenberg (2000) examined how a filtered video scene extract particular awareness and protect users' privacy simultaneously. They indicated that the effect of filtered video scene have a level suitable for providing awareness information and protecting users' privacy. The users could acquire basic awareness information within the blur level without violating others' privacy. In addition, Tang, Issacs, and Rua's study (1994) presented that people expressed their concerns about privacy in the beginning of using awareness supported tools, but when they have basic authority of controlling the awareness supported tools and they have tried the supported tools in their collaborative work, they did not refer to this issue any more. Furthermore, interruption is considered in designing video and audio supported tools. In Tang, Isaace, and Rua's study (1994), the users reported that they liked video feature of Montage system because it provided more attention from their collaborators but they did not like it when they were forced to pay more attention to other collaborators. They particularly like to control the features that allow them to decide when they could be connected with audio interaction. Thus, in this study, the privacy and interruption issues would be considered when identifying and providing video and audio supported tools.

Benbunan-Fich, Hiltz, and Harasim (2005) reported most groupware systems are blended modes rather than only support asynchronous/dispersed mode. However, most studies concentrate on either synchronous or asynchronous collaboration of groupware systems. It is rare that studies focus on the synchronous and asynchronous simultaneously. In addition, the empirical studies in CSCW often start from developing awareness supported tools, implementing tools, and evaluating effectiveness of the tools, whose research process is very time-consuming. In this century of rapidly innotivated technology, the design research could not catch up the invention of the technologies. Generally, when the researchers have developed and designed a supported tool, it is often that some available tools which are even more convenient and feasible in supporting collaborative learning are generated. Researchers suggested utilizing the media technologies developed to support awareness to investigate how collaborators behave and interact would be much beneficial for this field. Alavi and Dufer (2005) highly recommended studying how to combine different supported tools and their sequence of applying in distributed collaboration is interesting and supportive for distributed learning. They also suggested that further research needs to be expanded to explore the ways how technologies are engaged and utilized by students in facilitating interactions of collaborative work.

Therefore, effectiveness of awareness has been studied and presented by many studies, whereas how awareness influence students' interactions and behaviors of group work and the use of awareness supported tools are rarely studied. This study will not focus on proving the effectiveness of a particular awareness supported tool and designing or testing a new supported tool rather than studying the collaborative interactions of groupware systems with synchronous and asynchronous features. We will focus on supporting group awareness which affect students' synchronous and asynchronous interaction of collaborative learning simultaneously. Due to the time limitation, instead of starting with developing the tools of supporting group awareness, we will conduct this study by employing existing tools that facilitate synchronous and asynchronous collaboration in a groupware system which have basic support tools and allow users to embed other existing supported tools. Therefore, the purpose of this study is to perceive how the group awareness affects students' interaction of collaborating in groupware system, and how students behave and interact when awareness supports are provided. We will conduct an experimental research with a control group and an experimental group in order to investigate the differences of students' interactions when having group awareness supports. Basically, these two groups are in the same class and have same learning activities

and tasks. Students who are in the control group will not be provide any existing supported tools but basic tools in the Sakai groupware system, while students who are in the experimental group work together by using a notification tool, MSN 7.0, Email system, and Sakai groupware system.

Method

Research Question

How does the group awareness affect students' interaction of collaborating in a groupware system?
How do students behave and interact when awareness supported tools are provided?
How do students choose different media to exchange different types of information?
How do students respond to privacy and interruption issues when they use audio and video supported tools?

Based on the purpose of this study, we will triangulate students' interactions by collecting students' online collaborative artifacts and conducting interviews with students and the instructor. The artifacts include postings of discussion board, submitted group works, and discussion logs of collaboration. We will create an interview guideline to gather students' perspectives of using and not using supported tools, how they use tools, and their concerns about the privacy and interruption when using audio and video supported tools. In addition, in the interview of the instructor, we will collect how the instructor perceive students' performance of learning by having awareness supported tools and the success of using supported tools of students' collaborative work.

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