

Going Global, Locally: The Socio-Technical Influences on Performance in Distributed Collaborative Learning Teams

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With the increasing use of distributed knowledge work in a range of industrial, scientific, and organizational environments, understanding how to support such work has become increasingly important. From previous field and laboratory studies, we know that a range of socio-technical factors influence performance and satisfaction in distributed teams. Among the most important of these factors are trust, leadership and the level of media richness in the computer-mediated communications environment. We also know that specific socio-technical interventions can help to build trust in CMC environments. However, many of these studies have not taken into consideration sufficiently the impact of cross-national cultural factors on distributed teams. This paper reports the preliminary analysis of a thirteen week qualitative and quantitative quasi-experimental field study of distributed collaborative learning teams, consisting of 35 post-graduate students from four research universities, two in the United States and two in South Africa. These teams completed a series of unstructured strategy and decision-making tasks, using a suite of rich-media CMC tools. Data are reported from participant surveys, narrative evaluation essays, and observations.

Categories and Subject Descriptors: K.3.1 [Computing Milieux] Computers and Education, Computer Uses in Education – *Collaborative learning; Computer assisted instruction; distance learning*; K.4.1 [Computing Milieux] Computers and Society – *Public Policy Issues; Regulation*; H.5.3 [Information Interfaces and Presentation]: Group and Organizational Interfaces – *Collaborative Computing; Computer Supported Cooperative Work; Organizational Design; Synchronous interaction; Web-based interaction; Asynchronous interaction* J.4 [Computer Applications] Social and Behavioural Sciences – *Sociology*

General Terms: Design, Experimentation, Human Factors, Performance, Theory

Additional Key Words and Phrases: Globalisation, cross-cultural learning, trust, leadership, long-distance collaboration, collaboratories

1. INTRODUCTION

As the processes of globalisation continue to unfold, the global economy is becoming increasingly reliant on information, and the international trade in services. The percentage of world trade consisting of trade in services now comprises 60-70% of production and employment in developed countries and has been the fastest growing component of world trade for the last 15 years, accounting for \$1.3 billion dollars in 1999 alone (World Bank). For developing countries, participation in the global trade in services, which has grown at a rate even faster than in developed countries from 14% 1985-89 to 18% from 1995-98, is perhaps even more critical (World Bank, 2002). Those services that are traded globally (e.g. research, accounting, legal, consulting) can be tremendously knowledge intensive and most such activities involve the active manipulation of symbolic information, often through the extensive use of information and communications technologies (Reich, 1991; Burton-Jones, 1999). Many firms, scientific research facilities, policy formulation bodies, and even non-governmental organizations are employing computer mediated communications (CMC) to allow this 'knowledge work' to be conducted in a distributed nature, without all of the participants having to be geographically co-located. As a result, developing sufficient levels of human capacity to conduct 'distributed knowledge work' is becoming progressively more important.

In order not to fall further behind in this historical period and to capitalize on the new opportunities provided by globalisation and an information economy, many African and other developing countries, are developing strategies to meet these challenges and to harness the digital economy for socio-economic development (Cogburn & Adeya, 1999; 2001). However, successful participation a knowledge-intensive global economy requires development of the appropriate knowledge, skills, and abilities. Increasingly, this means developing the ability to engage in distributed collaborative knowledge work. Ensuring the development of these knowledge, skills, and abilities is one of the most important elements of a development strategy in the information age (Cogburn, 1997).

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Unfortunately, many African institutions lack the human and institutional resources to build these capacities alone. Partnering with US and European academic institutions may help, but in their traditional form, many of these arrangements are often costly and unsustainable. Further, many academics and scientists in developing countries feel isolated, and unable to participate sufficiently in global research communities.

One way to address some of these challenges may be through the use of a new organizational form called a 'collaboratory' and to increase the use of and training in distributed collaborative learning. A 'collaboratory' is comprised of both technologies socio-processes which are blended into this new, networked organizational structure that operates as a 'laboratory without walls.' As such, a collaboratory allows scientists, students, researchers, and workers to share equipment, data, resources, and to collaborate over long distances (Wulf, 1989; Finholt, 1997). While most of these collaboratories have been in the physical sciences, they are increasingly being explored in the social sciences, and even in policy and development communities (Cogburn, manuscript).

However, working in these kinds of globally distributed environments present numerous challenges (Olson & Olson, 2000). Some of the challenges include building trust and common ground (Rocco, 1998; Zheng, et al, 2002), coordinating the communications and work activities of the distributed team (Kiesler, Siegel, & McGuire, 1984), and controlling the discussions (Kraut et al., 1982). These problems are complicated even further when they include a mixture of participants from both developed and developing countries. Some of these unique challenges include managing the inter-institutional and cross-national cultural differences (McCroskey, 1990), variation in experiences with computer mediated communications and levels of technology access and support (Gersick, 1988; Cogburn, 2002).

It may be that through the principled design of a highly interactive, rich-media, learning environment and utilizing a pedagogical model that promotes collaborative learning, coupled with regularized FTF faculty interaction, some of these difficulties can be mediated. This paper explores that prospect and seeks to identify the social and technical factors that may make it possible to overcome some of these challenges, creating in the process a globally distributed learning environment that utilizes complex, cross-national learning teams in an actual university course setting. Our broad goal is to better understand the socio-technical factors that affect the conditions under which scientists, workers, and students from the developed world can collaborate more effectively in geographically distributed knowledge work with those from the developing world. This understanding will help to strengthen our ability to build effective distributed learning teams, comprised of both developed and developing country participants. Further, this ability could create new opportunities for socio-economic development within the context of a global knowledge based information economy.

2. LITERATURE REVIEW

A broad body of literature explores the impact of various socio-technical factors on the work of distributed teams including collaborative learning teams (Cadiz et al, 2000). However, most of these studies have been conducted in laboratories and not across national and cultural boundaries in real academic and work settings. As such, the impact of culture, institutions, time-zones, and other cross-national factors may not have been as prominent as they might be in the conduct of knowledge work in real world, globally distributed collaborative environments. Here, we briefly review four major categories of this literature, which are as follows (1) group dynamics (2) distributed group dynamics (3) distributed and collaborative learning; and (4) technology to support distributed collaboration.

2.1 Dynamics in FTF and Distributed Groups

From the social psychological literature on group dynamics, we know that a range of factors affect group work in any environment. Some of the most important factors include, social facilitation and social loafing; deindividuation; and leadership style. Other important factors that are known to affect group dynamics are culture, common ground, and trust. In this section, we review and compare this important literature as it relates to our study of group dynamics in both face-to-face and distributed teams.

2.1.1 *Social Facilitation/Social Loafing*

Social facilitation theory suggests that when people are working in the presence of other people, including their group members or co-workers, then they are more likely to perform better on tasks than if they were performing those tasks alone (Zajonc, 1965; Guerin, 1999). On the contrary, social loafing theory proposes that the opposite occurs; that when people are working in groups, there will be a decrease in the effort put forth by individuals (Steiner, 1972; Latane, et al 1979; Williams, et al, 1981; North, et al, 2000). It appears that social loafing exists in many different cultures on different types of tasks (Gabrenya, et al 1983; 1985), and that it can be mediated by gender (Kugihara, 1999), and moderated by one's perspective on individualism or collectivism (Earley, 1989) and task motivation (Williams & Karau, 1991; George, 1992; Price, 1993). In this study, we are not testing for social loafing, but have designed the team and their tasks to maximize any possible social facilitation effect and minimize a social loafing effect.

2.1.2 *Deindividuation*

The deindividuation thesis proposes that participation in groups might lead some people to behave in more aggressive, uninhibited, and socially unacceptable ways than they might otherwise exhibit as an individual (Diener, 1980; Prentice-Dunn & Rogers, 1980, 1982, 1989; White, 1977; Zimbardo, 1970). This uninhibited behaviour has also been shown to exist in CMC environments where ‘flaming’ and ‘mail storms’ are becoming increasingly prevalent (Reicher & Levine, 1994a). Since we know that this behaviour exists in both FTF and distributed groups, this study will look for evidence of deindividuation and any impact that it might have on other factors being studied.

2.1.3 *Leadership*

Another aspect of group dynamics related to our study is leadership style, particularly emergent leadership (e.g., the type of leadership that emerges in natural settings when the group is initially leaderless). The literature on leadership shows two distinct types of emergent leadership, one is called *Task-Focused Leadership* and the other *Relationship-Focused Leadership*. On one hand, Task-Focused Leadership is seen as direct. It focuses almost exclusively on accomplishing the task at hand, often associated with dominance behaviour (e.g., initiating structure). On the other hand Relationship-Focused Leadership is indirect. It focuses on improving group cohesion, often associated with affiliative behaviour, such as democratic decision-making. Task-Focused Leadership is seen to be more effective than Relationship-Focused Leadership. However, on unstructured tasks, Relationship-Focused Leadership is seen to offer some advantages and may even be more effective than Task-Focused Leadership (Fiedler, 1976; Stogdill & Coons, 1957), especially amongst mixed gender groups (Yamaguchi, et. al, 2002).

2.1.4 *Culture, common ground and trust*

Several factors can contribute to the degree of ease or difficulty of establishing common ground within a group (e.g., shared cultural background, experiences, previous conversations, surroundings). According to Clark (1993, 1996) this ‘common ground’ of knowledge is required in order for two or more people to understand each other. Similarly, according to Rogers (1999) homophily and heterophily (similarity and difference on certain attributes) influence the degree to which an innovation can be diffused into a group. Distributed teams may have less initial common ground, and the constraints of CMC may make it more difficult to identify or build common ground than in FTF teams.

We also know that communications media affects cooperation and self-reported trust in group work. In FTF groups report highest levels of cooperation, followed, by video, audio and then chat conditions (Bos, et al, 2002). Higher levels of group participation have been found in CMC environments. CMC groups may also be more ‘disorganized, democratic, unrestrained, and perhaps more creative than groups communicating more traditionally’ (Kiesler, et al, 1984; Williams, 1977). However, this increased democratisation may lead to more difficulties in decision-making in CMC environments (Kiesler, et al, 1984). Thus, we expect to find differences in these areas in our FTF and Distributed teams, and will be exploring those differences in the study.

2.2 Distributed and Collaborative Learning

Since the type of knowledge work that we are interested in often requires the ability to learn with others working in collaborative teams, we have explored the literature on distance-independent and distributed collaborative learning. While there have been some notable exceptions (e.g. Jarvenpaa and Leidner (1998); Contractor, et al; Crampton et al; Cadiz, et al), most studies of Computer-Supported Collaborative Learning have been of asynchronous approaches (Hazemi, et al, 1998). Nonetheless, from this important body of literature, we know that learning is social, and ‘peer networks’ or collaborative learning is equally important to faculty interaction, and can enhance student performance (Brown and Duguid, 2000; Hiltz, 1999). Tiffin and Rajasingham (1995) suggest that the balance between *human-interaction and computer-interaction* is a critical factor in the success of a virtual learning environment. Brown and Duguid (2000) suggest that this balance is even more important when the learning environment becomes more complex, and geographically distributed. Hiltz (1990) finds that ‘*collaborative learning*’ enhances student ratings of virtual courses. Thus, we expect that students engaged in virtual teams (Global Syndicates) that evolve into ‘learning communities’ will have more collective and individual success in the seminar, and will have a higher degree of satisfaction with the seminar.

2.3 Technology for Distributed Collaboration

Finally, we have explored the tools and social processes required to support the kind of distributed knowledge work under investigation here. Nearly all of the CSCW literature suggests that the appropriate *mixture of technologies* is important to support the development of distributed collaborative communities. More sophisticated and media-rich CMC environments, such as those that include video, audio, electronic messaging, multi-media visual stimuli, and shared tools, may help to minimize any differences between CMC and FTF environments (Kiesler, et al, 1984). Also, students are often more willing to interact with their professors in CMC environments than in FTF (Welsch, 1982; Kiesler, et al, 1984). However, due to the instantaneous nature of electronic communications, students may have

increased expectations for immediate feedback and become frustrated and dissatisfied when that does not occur (Kiesler, et al, 1984). As such, there are seven key design considerations to keep in mind for our technology environment. The considerations include the following: (1) creation and manipulation of virtual spaces; (2) multiple forms of representation; (3) continuous but not continual communication; (4) management of the metaphor; (5) diversity of access points; (6) interactivity; and (7) socialization (McLellan, 1997; Norman, 1998; Tiffin and Rajasingham, 1995). We expect to find that the students overcame what may have been initial fears to become comfortable with both the synchronous and asynchronous technologies used in the seminar.

3. RESEARCH QUESTIONS AND HYPOTHESES

3.1 Primary and Subsidiary Research Questions

The primary research question for this field study is the following: ‘In a *globally distributed collaborative learning environment*, what is the effect of: (1) Group Mode, (2) Faculty Mode, and (3) Geographic Location on satisfaction and group development (i.e., the development of a learning community) when working on unstructured tasks over an extended period of time?’ A subsidiary research question explores the relationship between leadership style, satisfaction and performance on unstructured task over time. We have developed four primary hypotheses from this research question that are tested in this paper, and they are as follows:

3.2 Hypotheses

1. *Hypothesis 1 (a) and (b): Impact of Group Mode:* Students working in the *FTF Group Mode* (a) will develop higher levels of satisfaction than students working in the *Distributed Group Mode* and (b) will have higher perceptions of their group as a ‘learning community.’
2. *Hypothesis 2 (a) and (b): Impact of Faculty Presence:* (a) The presence of the faculty member will have a small but measurable effect on the satisfaction of the students and (b) participants from South Africa will be less concerned with faculty presence than participants from the United States.
3. *Hypothesis 3 (a) and (b): Impact of Geographic Location:* (a) Participants from South Africa will have higher levels of satisfaction than their US counterparts and (b) they will find greater value in their syndicates as learning communities.
4. *Hypothesis 4 (a), (b) and (c): Impact of Leadership:* (a) Those teams exhibiting RFL are expected to be more ineffective on unstructured tasks than those teams exhibiting TFL, (b) but will exhibit higher levels of satisfaction and (c) perception of the team as a learning community.

3.3 Definitions

We define a *collaborative learning environment* as a highly interactive pedagogical approach using web-based technologies to create an infrastructure to support the synchronous and asynchronous requirements of distributed learning teams. We define *globally distributed* as an event conducted across multiple time-zones, countries and cultures involving participants from both developed and developing countries in their home environment.

For *Group Mode*, there are two possible conditions. In *FTF Group Mode*, all members of a group are students at the same university and using voice, sight and shared tools to communicate. *Distributed Group Mode* means that all group members are virtual (not at the same university) and using audio only and shared tools to communicate. Both groups have the same asynchronous tools to use as they choose. For *Faculty Mode* there are also two conditions. In *FTF faculty mode*, the professor is physically at one university, but interacting with all students using audio, video and shared tools to communicate (even the students in the *FTF* location are interacting with the professor primarily using CMC tools). In *Distributed faculty mode*, the professor is not physically at the university but interacting with all students using audio, video and shared tools to communicate. For *Geographic Location* there are two conditions, those participants located at a university in the United States and those students located at a university in South Africa.

In the remainder of this paper, we present an overview of our field study where *group mode* (*FTF* vs. *Distributed*), and *faculty mode* (*FTF* vs. *Distributed*) are manipulated, with *geographic location* being a third experimental factor (*United States* vs. *South Africa*). Second, we present the initial results from our study. Finally, we discuss the conclusions and implications of the study, with a comment about future research.

4. OVERVIEW OF THE STUDY

This study builds on a three-year pilot study (1999-2001) in geographically distributed collaborative learning between the United States and South Africa. It is a thirteen-week quasi-experimental field study of distributed collaborative learning teams, consisting of 35 post-graduate students (there was one exception allowed for an advanced undergraduate student to participate in the seminar) from four research universities, two in the United States and two in South Africa. All of the students participated in a thirteen-week seminar entitled ‘Globalisation and the Information Society: Information, Communications Policy and Development.’ Participants were divided into teams, half as face-to face teams, and the other half as distributed teams. These teams completed a series of unstructured strategy and decision-making tasks, using a suite of rich-media CMC tools. The seminar ran from January –April 2002.

4.1 Study Design

Following Cresswell (1994), this study uses a ‘dominant/less-dominant’ design that is primarily qualitative with quantitative components. The study has a quasi-experimental design loosely organized as a 2 x 2 x 2 factorial between subjects design, with *group mode* (FTF vs. Distributed), *faculty mode* (FTF vs. Distributed), and *geographic location* (United States vs. South Africa) being the factors. In order to control for prior experience of the participants, the first seminar session was devoted to training. Each participant received three hours of contextually-based training on the collaboration tools to be used in the study. These students were assessed, and deemed to be able to achieve an acceptable level of proficiency in the required skills. Next, at each university, students were randomly divided into two groups (Group 1, Group 2). For the next six weeks of the thirteen-week seminar, students in Group 1 operated as a local FTF team (with all of their team members at their university). Correspondingly, students in Group 2 operated as a completely distributed team (with no more than one team member located at any university). Both sets of teams (FTF and Distributed) were comprised of 3-5 graduate students. According to the so-called ‘diversity thesis’, these distributed teams should have the highest level of conflict and lowest levels of trust due to the tremendous variability in the team members.

During each week of the study, the teams participated in a three-hour seminar session consisting of the following elements: (1) one hour introductory discussion and presentation of information and ideas to be used in the task; (2) one and one-half hour to engage in an unstructured decision-making task; and (3) thirty-minutes to report back on the assigned task (this report-back was one of the mechanisms used to reduce any social loafing effect). Students participated in the seminar from a computer lab, located at each university, and illustrated below in Figure 1. (There was one exception, when a student in South Africa was allowed to take the seminar from home, and other ad hoc exceptions when a student was allowed to attend a session from their offices, a hotel room or cybercafe).



Figure 1. Overview of typical lab configuration for each participating university.

In addition to manipulating *group mode*, we manipulated *faculty mode*. Each session the faculty member’s location changed, so in some sessions the professor was face to face with one group of students (some of whom were working in FTF others in distributed teams) and distributed with others (this is also why the term ‘distance-independent learning’ is so appropriate for this seminar). Also, while the faculty member moved around in this ‘circuit-rider’ model, each university had an assigned site coordinator (usually an advanced graduate student or staff member) who was physically present in the lab during each session, and available to answer both logistical and substantive questions.

4.2 Settings/Sites

Participants in the study were drawn from the graduate programs at four major research universities, two in the United States (one a major mid-western research university and the other an urban research university on the Eastern seaboard) and two in South Africa (both leading research universities in urban areas). At each university, a computer lab was prepared for the seminar. Each computer lab had the following common elements: Internet connectivity, Pentium III machines or higher, Internet Explore web browser (at version 5 or higher), and the client for the web-conferencing software used in the seminar, Centra Symposium™, pre-loaded on each machine.

Each student logged in individually on a computer, and had a headset/microphone to speak and hear. Each site also had an assigned site coordinator, usually an advanced graduate student or staff member at the university. No collaborative (or ‘team’) teaching was involved. However, occasionally there were guest lecturers that participated virtually. In addition, the faculty, staff, site coordinators, and technical staff held weekly lab meetings using the same web-conferencing and collaborative tools to raise questions, discuss the progress of the study, analyze data, critique relevant literature, and coordinate the overall seminar and this study.

4.3 Participants

35 post-graduate students participating in the study were from a major research university in the mid-western United States (n=7), a research university located on the Eastern seaboard of the United States (n=9), a South African research university located in Johannesburg (n=10), and a South African research university located in Pretoria (n=9). There is a possible selection bias present in the study because these students self selected into the *Globalisation Seminar* on their campus. However, on each campus, advertisements were placed in relevant departments and schools, as well as sent out to relevant e-mail lists. The students came from various disciplinary backgrounds, including the School of Information, School of International Service, School of Public and Development Management, and the School of Public Management and Administration. The subjects were not paid, but did participate for academic credit, continuing education, and a certification of participation.

4.4 Tasks

The degree of realism in a particular task and its duration may affect individual and group performance, with more realistic and sustained tasks leading to higher levels of performance in most groups (Arrow et al, 2000). As such, in this study we have tried to design very realistic tasks (very relevant to policy formulation and strategic decision-making environments). In both semi-semester, all subjects engaged in a series of related tasks, leading up to a more significant final task. Each task was an unstructured decision-making task very similar in structure to each other. In the task instructions, teams were asked to do each of the following:

1. *Decide* on a stakeholder grouping in the world-system for the group to represent (i.e. global and multi-national corporations, developed country national governments; developing country national governments; intergovernmental organizations; or non-governmental and community-based organizations);
2. *Decide* how to best represent that stakeholder grouping (e.g., choose a specific company or organization);
3. *Organize and conduct* the necessary research in order to understand the background to the organization and to engage in internal debate as to its relevant goals, norms, principles, values, and enforcement mechanisms;
4. *Develop* a strategy for the organization to influence specified global information and communications policy formation processes; and finally;
5. *Prepare* two PowerPoint slides for presentation back in the main room to the entire seminar. Participants were told that these assignments were to be graded on the following criteria:
 - a. *Style*: grammatical correctness, quality of language, correctness of the spelling, and the appropriateness of the statement as a recommendation to the policy-making body;
 - b. *Adequacy*: the degree to which the recommendations effectively considered the problem and all its aspects; and
 - c. *Persuasiveness*: the degree to which a policy-making body would be influenced to accept the recommendation presented.

Rocco (1998) has shown that the use of get acquainted games can help build trust in distributed environments, and to minimize the differences in performance between FTF and Distributed groups. Since we are not studying the impact of these get acquainted activities, we decided to apply them evenly to both FTF and Distributed groups. Thus, before beginning the first task, all of the teams went into virtual breakout rooms and went through a ‘Getting Acquainted Exercise.’ This exercise included two components: (1) a personal information exchange exercise; and (2) a team building exercise. The personal information exchange involved each team member using audio/voice and text to provide the following information: name, brief background, education, family, travel experiences, work experiences, languages, hobbies, special skills and resources, and interests in the seminar. For the team building exercise, each group was asked to define a team charter. Table 1 below presents an overview of each task and focus.

4.5 Collaborative Learning Environment

Following the design considerations identified in the preceding literature review, we have designed a highly interactive collaborative learning environment, consisting of both synchronous and asynchronous collaboration tools. Our environment is based on a suite of commercially available tools, chosen because they allow for the following seven actions: (1) creation and manipulation of virtual spaces; (2) multiple forms of representation; (3) continuous but not continual communication; (4) management of the metaphor; (5) diversity of access points; (6) interactivity; and (7) socialization.

Creation and Manipulation of Virtual Spaces: The primary synchronous tool is Centra Symposium™. Centra symposium allows for the creation of a virtual seminar room. As such, this software is the centrepiece of our highly interactive collaborative learning environment.

Multiple Forms of Representation: Within the Centra environment, all of the participants in a virtual session are represented continuously by their nickname. Holding the cursor over his or her nickname icon can identify the first and last name of each participant. In addition, the leader of a session is clearly identified, as are all of the participants. Participants may be promoted to co-leader at any time during the course of a live session.

Table 1. Overview of Task Scenarios	
1 st Semi-Semester	
Task	Strategic Focus for Group
1. Trust	Exchange of personal information and introduction of group
2. WTDC	Influence WTDC meeting in Turkey
3. WEF	Influence the WEF meeting in NY
4. WTO	Influence the WTO Doha trade talks
5. Final	Prepare and present paper (15-pages) and presentation (15-minutes) on group's GII/GIS regime strategy
2 nd Semi Semester	
1. Trust	Exchange of personal information and introduction of team
2. Nepad	Influence NEPAD planning process
3. ICANN	Influence ICANN board meeting
4. Culture	Address key cultural challenges
5. Labour	Harness ICTs for capacity building
6. Final	Prepare and present paper (15-pages) and presentation (15-minutes) on group's GII/GIS regime strategy

Continuous but not Continual Communication: Communications are critical to learning and collaboration. Our CMC environment consists of several ways to provide continuous communications, such as Voice Over Internet Protocol (VOIP), video over IP, and text chat. Anyone on the seminar room can raise their hand, be given a microphone, and then allowed to speak in the seminar. However, the leader of a session has the ability to control the microphones, and may take away that privilege at any time.

Management of the Metaphor: The Centra system uses the metaphor of a symposium, which we articulate as a 'seminar room.' The metaphor is maintained and strengthened through the media window, recognition and identification of the seminar room participants. Further, 'break-out rooms' may be used for small group discussions and team assignments. The groups performed their experimental tasks within the break-out rooms.

Diversity of Access Points: While students are primarily accessing the seminar room from within a computer lab at their university, the software allows for access to the seminar room from anywhere that one has access to the web. On occasion, both the professor and students access the seminar from a range of locations (e.g., cyber café, hotel room with dial-up connection, IT training centre, office computer). Also, given that there were differing levels of technology access within the seminar, our CMC environment had to be able to accommodate this diversity, including lower bandwidth environments. Centra allows for content to be pre-cached. The Centra video over IP allows for video webcasts to be transmitted to the participants with a variable frame rate ranging from 5, 10, 15, 20, 25, or 30 frames per second. The actual frame rate is based on the leader's video hardware and the available bandwidth. The average video broadcast to the seminar is estimated to have been 15 fps. Finally, the symposium sessions were all recorded, and made available to the seminar participants asynchronously.

Interactivity and Socialization: Interactivity is seen as one of the most important aspects of learning, and one that often gets lost in CMC environments and distributed learning projects. Our system facilitates high levels of interactivity, both during a synchronous seminar session, and beyond. During a session, any participant may 'raise his hand' at any time. The computer is able to queue the questions, and the leader may give the participants the floor in any order. Participants may continuously indicate their agreement or disagreement with questions or issues by clicking green checks (to indicate 'yes') or red crosses (to indicate 'no'). Additionally, emotions such as laughter or applause can be indicated while in a session by clicking on a 'happy face' or 'applause' emoticon. Participants may also be polled or surveyed at any time during a session, allowing them to indicate their perspectives and knowledge on particular issues. Throughout a session, all participants also have the opportunity to send text chat messages to all other seminar participants, and a private message to the instructor or anyone else sitting on the stage as a co-presenter. Even though this version of the software does not allow participants to send individual messages between participants (a major limitation in our opinion), participants did socialize extensively through the use of this text chat feature. Participants may also participate interactively in a session through 'Application Sharing', which allows any person in a session to remotely control any application on any computer connected to the seminar room. All of these features were used during the course of this study; most were used for each of the weekly seminar sessions. A range of multi-media content for a session can contribute to interactivity as well. Types of content available within a Centra session include: PowerPoint slides, websites, Windows movies, graphic images, PowerPoint slides, white boards. Finally, any or all participants may, at any time, be given 'mark-up tools' which can be used on a white board, or to mark up the PowerPoint slides.

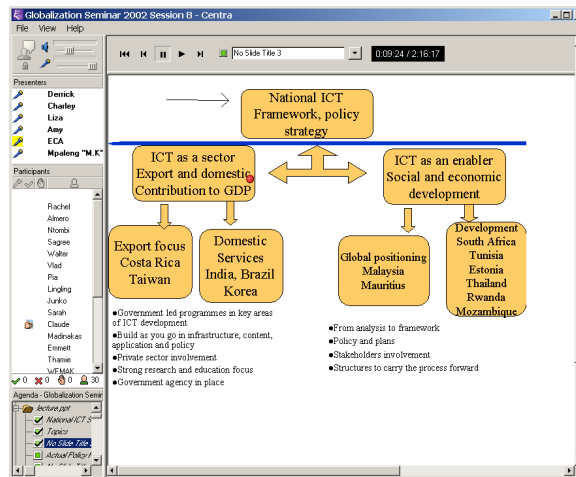


Figure 2. Screenshot of the Centra Symposium™ Interface from a recorded session of the Global Graduate Seminar, 2002 showing the applause indicator, and screen mark-up capabilities.

We also made extensive use of presence awareness packages, such as AOL Instant Messenger, MSN Messenger, and ICQ. All seminar participants had access to the PA address of all seminar participants, site coordinators and the professor. In addition to these synchronous tools, we added UM.Worktools as an asynchronous shared workspace for the seminar. Worktools allows participants to access course material, files, e-mail archive, and the digital library for the seminar. Further, each team (both FTF and distributed) had their own Worktools site and was able to use it as they desired.

4.6 Questionnaires

Three questionnaires were administered in the study. The pre-test questionnaire collected demographic data on the participants (age, gender, nationality, language, education, and income) and baseline measures of their pre-existing perspectives on their communities and society at large – encapsulated as ‘social capital.’ (Putnam, 2000). The other two questionnaires were given in the middle and the end of the term, each of which had two parts and collected general perspectives on the seminar and the levels of trust and social capital developed within their syndicate teams.

In addition, seminar participants were asked to complete mid-term and final narrative evaluation essays, following a template of ten open-ended questions designed to assess a range of measures including satisfaction, learning experiences and the working style of their syndicate team.

4.7 Procedure

At the beginning of the semester, an initial pre-test questionnaire was administered to the subjects using a web-based survey tool. Following this pre-test, participants engaged in a three-hour training session and were assessed on their performance on the collaborative tools.

For each successive week of the seminar participants attended a three-hour session of the *Globalisation Seminar* in a computer lab located at their respective universities (there were occasions when a participant was allowed to dial-in from home/hotel, their office, or a cyber café). Participants gathered at their local computer lab and logged into the Centra Server. From there, they were brought into the virtual seminar room. A site coordinator was always physically present in the computer lab to answer any substantive, administrative or technological questions. For the first hour of the session, the professor engaged the students in a detailed discussion of the assigned reading material for that week, and probed them for understanding of the concepts and issues to be encountered in the task. Following a short break, the participants then went into virtual break-out rooms with their team members (both the FTF and Distributed teams) and were presented with the task instructions for that week, and any supporting documents or background material. The teams then had one and one-half hours to complete the task.

After another short break, the participants would come back into the main virtual seminar room and were asked to present the results of their assignment to the entire seminar. During the components of the session in the main virtual seminar room, live video of the professor was being broadcast to all of the participants. During the sixth and twelfth sessions (middle and final session), the teams were required to present the results of their six weeks of effort in the form of a 15-page strategy paper and 10-minute presentation. Following this session, participants were given the post-test questionnaire (again web-based) and provided with the template for their narrative evaluation essay.

4.8 Measures

The variable *Satisfaction* was measured in two ways. First, the mid-term and final survey contained three questions relating to the level of satisfaction of the seminar participants, including a direct question about satisfaction, their

willingness to take a similar seminar, and their willingness to recommend it to a friend. Second, participants were provided with a template for their mid-term and final narrative evaluation essays that included one open ended question related to level of satisfaction. The variable *Learning Community* was also measured by questions on the mid-term and final survey, and questions on the mid-term and final narrative evaluation essays. Finally, the variable *Leadership Style* was measured using a four-question scale from Yamaguchi (2002, adapted from Stogdill & Coons, 1957). For example, participants were asked to select from the following two statements those that best reflect their own personal leadership style within their team. This respondents selecting the first two (i.e., ‘In our discussions, I suggested how we could all work together better. I made sure that everyone in my group was listening to one another’) were coded as relationship-focused leaders; and those selecting the third and fourth statements (i.e., ‘I took charge of what the group should do during our assignments and meetings. I gave directions on how we should accomplish our goals’) were coded as task-focused leaders.

5. RESULTS

Since we are using a quasi-experimental design, we are assuming the existence of non-equivalent groups. Our initial survey reports data on 20 respondents (12 from the United States, 8 on distributed teams, and 11 male). The mid-term survey reports data on 18 respondents (13 from the US, 8 on distributed teams, and 5 male). The final survey reports data on 15 respondents (7 from the United States, 7 on distributed teams, and 6 male). We are also reporting on data from 16 mid-term narrative evaluation essays (7 from South Africa, 11 on distributed teams, and 7 male), and 24 final narrative evaluation essays (12 from South Africa, 12 on distributed teams, and 14 female). The results are presented in four sections corresponding to our four study hypotheses primarily using our qualitative data analysis.

5.1 Impact of Group Mode

We hypothesized (H1) that students working in the *FTF Group Mode* will: (a) develop higher levels of satisfaction than students working in the *Distributed Group Mode* and (b) will have higher perceptions of their group as a ‘learning community.’

Upon initial analysis, we *reject* H1(a), there appears to be no significant relationship between group mode and any of the measures of satisfaction. On all measures taken, participants reported very high levels of satisfaction. The vast majority of participants remarked that their personal and academic goals of taking the globalisation seminar had been achieved. Students showed satisfaction with both the content of the seminar and the form of teaching and learning used here. For example, one student said that,

Therefore, my objectives as well as my expectations have been more than met. This class has successfully provided me with a new prospective on telecommunications and helped me to formalize my long-term goals.

However, based on our initial analysis, we *confirm* H1(b). We expected to find that students working in FTF teams had a higher perception of their syndicate as a learning community than those in working in Distributed teams. This hypothesis was confirmed by the data. Generally speaking, most students (68%) when working in *both* global and collocated teams, agreed that their team became a ‘learning community’ and that their team members contributed to the their understanding the material in the seminar. Several participants noted that they benefited from discussions with their other team members. One female participant from the United States working in a FTF team said that:

discussions and collaborative work with syndicate group members were great opportunities for me to consider the global issues...I learned from them a lot...

A number of students remarked that the diverse backgrounds and geographic locations in Distributed teams played positive role in their learning experience in the seminar. One female SA participant from a distributed team commented that:

The syndicate contributed to a large degree. As explained before, one of the unique values of this course was to put people together from different backgrounds.

Another distributed syndicate member said that:

Brainstorming with my group members definitely contributed to the overall learning experience because of the different backgrounds we come from.

In terms of the collaboration tools used in the seminar, one participant commented that:

I think the seminar provided an excellent hands-on interactive experience and boosted my confidence in using various IT innovations to improve quality of work; I am very impressed by the way that technology can help you to study from any part of the world.

While both groups of students valued their team as a learning community, participants working in FTF teams valued their team as a learning community more frequently (75%) than did those participants working in Distributed teams (63%).

5.2 Impact of Faculty Presence and Absence

We hypothesized H2 that (a) the presence of the faculty member will have a small but measurable effect on the satisfaction of the student and (b) participants from South Africa will be less concerned with faculty presence than participants from the United States.

From our analysis of the participant evaluation essays we find that H2 (a) is confirmed, a little over half (55%) of the participants voiced a preference for the physical presence of the faculty member (for various reasons). For example, one male student from the United States participating in a distributed team argued that that the seminar session was more productive for him with the faculty member present. He said that:

I benefit enormously from the nuances of live interaction and feel that face-to-face communication invites dialogue....

Some students remarked that the physical presence of the faculty member made them feel more connected to the whole seminar, because they were more comfortable asking questions. The face-to-face direct communication with the faculty member also encouraged more motivations and interactions of the students. For example, a South African female student said that:

‘The student[s] at the University of Pretoria [definitely] worked harder and was [sic] on time when the lecturer was visiting TUKS. In other cases they were more relaxed and late. It was also difficult to motivate the students to attend when the lecturer was not here.’

However, interestingly, a large number of participants (45%) did not perceive any major difference in the seminar whether the faculty was physically located with them or not. For example, one female student from the United States participating in a distributed team said that:

I actually believe that the professor’s physical presence made no difference in terms of the lecture of the session. I never felt that the professor’s physical absence had any sort of negative impact on the lecture.

Another participant in a distributed team, a male from South Africa said that:

there is definitely no need for [presence] based on the nature of the seminar.

Further, a female participant in a FTF team from the United States said that:

if the learning environment is technologically well-supported like this seminar, I do not feel any big differences between physical and remote location.

In fact, four participants (10%) reported that they actually preferred the seminar when the professor was participating from a remote location. One male student from the United States, participating in a distributed team, expressed strong preferences for the absence of the professor. He argued that he feels freer to listen more when the professor is participating from a remote location.

...when you were present it was hard to pay full attention, because of the echo and you were loud....when you weren’t physically located, it made it easier to listen and participate.

We also hypothesized H2 (b) that participants from South Africa would be less concerned with faculty presence than participants from the US. This hypothesis is *not supported* by the data. We found no significant differences between participants from South Africa and the US in their preference for faculty presence and absence. Table 2 summarizes this data.

	TOTAL	No differences	Prefer presence	Prefer absence	No comments
Dist.	24	11(46%)	9(37.5%)	3(12.5%)	1(4%)
FTF	16	7(44%)	6(38%)	1(6%)	2(12%)
US	22	10(45%)	7(32%)	3(14%)	2(9%)
SA	18	8(44%)	8(44%)	1(6%)	1(6%)

5.3 Impact of Geographic Location

We hypothesized H3 that (a) participants from South Africa will have higher levels of satisfaction than their US counterparts and (b) they will find greater value in their syndicates as a learning community. Based on our analysis of the qualitative and quantitative data, both parts of this hypothesis are *supported*.

All (100%) of the South African participants would recommend the course to a friend without reservation or any changes. Only 70% of the US students voiced such strong support for the seminar, saying that they would recommend the course, “but only with this instructor.” Table 3 below presents an overview of the analysis of the perceptions of team as a learning community.

	TOTAL	Positive (68%)	Negative (25%)	No comments
Dist.	24	15(63%)	7(29%)	2(8%)
FTF	16	12(75%)	3(19%)	1(6%)
US	22	15(68%)	7(32%)	0
SA	18	12(66%)	3(17%)	3(17%)

More interestingly, students from South Africa valued their syndicate more than those from the United States. Only three (17%) of the participants from South Africa that submitted the evaluation essay said that other syndicate members did not contribute much to their own understanding of the seminar. In contrast, the participants from the United States had more diverse attitudes to viewing their syndicates as learning communities. Some of them attributed the failure to the inefficiency and difficulty in communicating with their SA team mates, and the insufficient commitment of SA students as well.

5.4 Leadership

We hypothesized H4 that (a) those teams exhibiting relationship-focused leadership are expected to be more ineffective on unstructured tasks than those teams exhibiting task-focused leadership, (b) but will exhibit higher levels of satisfaction and (c) perception of the team as a learning community.

In our preliminary analysis this far, we have been *unable to either accept or reject* this hypothesis. Much more work is needed before we can address this question. However, what we have found that is interesting is that there are indeed, two very distinct styles of leadership that did emerge within the seminar.

On the self-reported measures of leadership style, the vast majority of the participants in the first semi-semester (94%) said that they adopted relationship-focused leadership. In contrast, a much smaller number (67%) of participants in the second semi-semester self-reported as taking a relationship-focused leadership approach.

Upon initial quantitative analysis, we *reject* H4 (b), there appears to be no significant relationship between leadership style and satisfaction in either of the two semi-semesters.

Two very distinct leadership styles did emerge within the study. The first follows the task-focused leadership style and a 'strong' leader emerged within the team. The second leadership style was more relationship focused, which illustrates a highly cooperative leadership approach. There was no one 'strong' leader and the work was divided amongst the team members who put it together at the end. In this sense leadership may be more crucial for distributed teams than for FTF teams, although the process is difficult and not necessarily successful. For example, a male participant from the United States working in a distributed team said that

...however, none of us proved to be a strong leader (which we needed) and that made things somewhat difficult....

6. DISCUSSION

There are many potentially interesting findings in this study, especially when one considers what they might portend for the future of geographically distributed collaborative knowledge work between developed and developing countries, and between developing countries themselves. First, since we found no significant relationship between group mode and satisfaction, we could begin to explore even more ways of using geographically distributed collaborative learning teams for more of courses, research projects, and knowledge work. If satisfaction levels can be as high in these distributed teams, we should perhaps explore their use more frequently in order to reap the added benefits of global diversity. However, this optimism is slightly countered by the finding that, as expected, those participants working in FTF teams found them to be more helpful in their overall learning than did those students in distributed teams. Remember, however, that these are self-reported measures and it may be that the perception of a learning community and its existence may not be exactly parallel.

We are particularly excited by the finding that almost half of the seminar participants found no difference in the seminar whether the faculty member was present or absent (with further support in rejecting the hypothesis that this finding might be geographically based). This begins to confirm our tacit hypothesis that learning is best stimulated by the pedagogical model used (in this case, an inquiry-based approach using simulation exercises), rather than the simple physical presence. This finding encourages us to explore the distance-independent aspects of the study even further. Implications of this finding could include the increased use and acceptance of seminars similar to the *Global Graduate Seminar* for human capacity building, especially in the kinds of skills necessary to enhance the socio-economic development objectives of the developing world.

Further, the finding that South African participants had higher levels of satisfaction than their US counterparts and found greater value in their virtual teams as learning communities is even more encouraging for developing countries. In our work exploring the success factors for scientific laboratories, we have found that 'collaboration readiness' is

one of the most important indicators (Olson & Olson, 2000; Olson, Finholt & Teasley, 2000). By exhibiting high levels of satisfaction and value for distributed collaboration, these South African participants are demonstrating some of the important skills necessary for successful participation in collaborative work.

7. CONCLUSIONS

There are many unanswered questions in this phase of the study, many of which are being addressed in the current phase. As we mentioned, we presented some of our initial findings in this paper, which are primarily based on the participants' self-reported evaluation essays. We have yet to incorporate many of the quantitative data from the surveys and software logs. Our next phase of research is to build a more comprehensive statistical dataset, including both the quantitative and (coded) qualitative data.

In addition, we are looking forward to comparing the results of this study to previous data collected in the *Global Graduate Seminars*, and to data from related studies being conducted by other faculty members teaching other subject matter. Another interesting implications of this work is that while the CMC environment discussed here is a fairly expensive commercial product (and thus, unattainable for most universities and non-governmental organizations), the National Science Foundation has funded a project at Old Dominion University that has developed an Open Source version of a similar tool. When this tool becomes available, it will allow us to consider generalizing the applications described here to a wider range of organizations, even through an Applications Service Provider (ASP) model.

One limitation of our study is the sample. As a quasi-experiment, the study was unable to control the number or composition of our sample. As a result, the sample size is very small limiting the ability to do many of the statistical analyses that we would like. Further, participants were self-selected from the four universities, most of whom took the seminar for academic credit. However, the seminar has enrolled increasing number of students over the four years as a result of its broader influences in the participating universities. We expect that the sample limitation will be eliminated in the near future. Further, we are also planning to enhance the external validity of the findings as we expand the study to additional courses and faculty members.

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