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ABSTRACT

Faced with increased use of distributed project teams in industry, MIS students need to be trained to improve their awareness of and competence in distributed teamwork. This paper describes a curriculum initiative to incorporate distributed teamwork and collaborative technologies into software development and implementation projects for MIS students. There were two stages in the study; the first stage investigated co-located teams that engaged in project subtasks in a distributed format. The second stage investigated real distributed teams that engaged in a fully distributed project. Our study indicates that students increased their capacity to work in a distributed situation by using collaboration technologies. As instructors, we also learned ways to design and more effectively teach this type of class.

Keywords

Distributed Teamwork, Distributed Projects, Collaboration Technology, Awareness of Distributed Teamwork, Competence in Distributed Teamwork, Training in Distributed Teamwork.

INTRODUCTION

Over the past decade there has been an escalating trend toward the use of distributed projects due to business globalization, and advancements in IT (Evaristo & Fenema, 1999). Evidence of this trend is the expanding market for "distributed" or "collaborative" project management software. According to a recent report, sales of distributed project management software market is expected to increase from nearly 1 billion in 2002 to nearly $7.2 Billion by 2007 (Strategies, 2004).

IT outsourcing, a type of distributed project, is becoming widely used in the IT industry. According to an Asia Pacific outsourcing survey, 53% of companies reported outsourcing one or more IT projects in 2004 (2004). This high percentage of IT outsourcing indicates that IT professionals are likely to become involved in distributed projects at some point in their careers.

Even though distributed projects have the potential advantages of securing resources from different locations, generating synergy among team members, and being more cost-effective, they impose great challenges for communication and coordination (Bourgault, Lefebvre, Lefebvre, Pellerin & Elia, 2002; Jonsson, Novosel, Lillieskold & Eriksson, 2001). Team members must be able to cope with these challenges in order to make a distributed project a success. Therefore, formal training in distributed teamwork should be one component of an MIS curriculum. Although some MIS instructors have begun incorporating distributed projects into their classes (Beranek, 2005; Edwards & Sridhar, 2003; Massey, Montoya-Weiss & Hung, 2002; Paul, Seetharaman, Samarah & Mykytyn, 2005; Qureshi, Liu & Vogel, 2005; Sarker & Grewal, 2002; Sutanto, Phang, Kuan, Kankanhalli & Tan, 2005) training in distributed teamwork is typically not a formal component of MIS curricula.

One issue with many of the existing distributed teamwork classes is that have been primarily designed for research. Instructors implement distributed projects without the planned objective of improving students' capacity for performing in a distributed environment. Consequently, student learning may not be maximized due to lack of structure and active intervention from instructors. Moreover, instructors may fail to document their valuable teaching experiences, reflect upon them, and share them with colleagues in the format of publication. As a result, even though a number of teaching cases have accumulated over the years, training in distributed teamwork has not improved significantly.

We propose that MIS instructors incorporate distributed projects and collaboration technologies into their classes with the explicit purpose of providing training in distributed work. One challenge, however, is to determine the place to fit new course content. A relatively rigid curriculum structure prevents MIS programs from responding to the labor market in a flexible way (Rollier, 2002). MIS curricula are already crowded with traditional knowledge bodies, and it is difficult to add a new training component.

To address the challenge of fitting new content into an existing curriculum, Rollier (2002) proposed a short-run strategy called "double duty" course design, which attempts to *"find techniques for satisfying multiple learning objectives in the same time period*". This technique suggests that instructors teach distributed teamwork in the context of other topics. We experimented with teaching distributed teamwork in the context of software development and configuration projects, thus our approach implemented Rollier's technique. The dual objectives of the distributed projects were to 1) provide students hands-on experience in software development or configuration for simulated or real organizations, and 2) increase students' awareness and competence in distributed teamwork.

The concept of awareness and competence, borrowed from Rollier's (2002) article which discussed awareness and competence in the context of global economy, has been reinterpreted here in the context of distributed teamwork. Rollier classified global economic training for business students into two levels: the global competence level where students are prepared for actual positions in international business, and the global awareness level which is much more limited and trains students to simply be aware of the interconnections between various regions of the world and to consider national and cultural perspectives (Rollier, 2002). In other words, awareness of distributed teamwork refers to participants' knowledge, whereas competence in distributed teamwork emphasizes skill in employing that knowledge.

The primary objective of our study was to gain an initial understanding of distributed training in the context of IS projects and then use that understanding to improve the design and practice of distributed training in the future. Since distributed team members rely on information technologies for communication and coordination, learning how to use information technology was an integral part of the objective. The plan to achieve that objective unfolded in two stages. In stage 1, we taught two classes in which project teams did some of their work in a distributed format. The purpose of the stage 1 was to investigate what major difficulties team members would experience with distributed teamwork assignments and their use of collaboration technology. Feedback from stage 1 then was analyzed and used to guide the design and implementation of a truly distributed class. In stage 2, we taught a single distributed class with one group of students located in the United States and another group located in Germany. The rest of this article reports details of these two stages, and is divided into 3 sections. Section 1 introduces the classes, projects, and the collaboration technology used in the course. Section 2 reports what instructors and students learned and section 3 concludes with study limitation and recommendations for future classes which incorporate distributed teamwork.

CLASSES, PROJECTS AND COLLABORATION TECHNOLOGY

Classes and Projects

Stages 1 and 2 were completed in the Fall semester of 2003 and the Spring semester of 2004 respectively. Class A and B (in the U.S.) were involved in stage 1, while Class C (in the U.S. and Germany) was involved in stage 2. A portion of the data from the stage 2 study has been reported in Gardiner, Antonucci, Boykin & Morelli (2004), but data from Stage 1 has not been previously reported. All three classes developed or configured an information system during their respective semesters. Each class spent the first few weeks learning concepts related to the project, defining the project, building teams, and allocating tasks to individual teams. Following these initial weeks, individual teams started to work on the projects themselves. Instructors usually selected two or three students as overall project managers and each team was appointed a team leader. Both the class as a whole and each team individually met weekly to track progress on the class project. The majority of students' final grade was based on their team's performance and project deliverables. The projects were non-trivial. Students understood that they needed to put serious effort into the project, not only for their grade but also for system functionality.

Class A helped a fictitious company configure the SAP/R3 Enterprise Resource Planning (ERP) system. Research in ERP education indicates that learning an ERP system helps students understand business process across different functions such as accounting, manufacturing, and sales (Davis & Comeau, 2004). The purpose of our particular ERP project was to allow students to learn ERP system configuration as well as business processes.

The case for the SAP/R3 configuration project, which involves a manufacturer of railway equipment, was developed by an instructor in Germany and modified by the instructor of class A. The students were given a set of minimum configuration requirements describing each team member's role and the functionality they were required to develop for a minimally functioning firm (and a minimal grade). For a better grade, a team member would need to go beyond the minimum functionality for which they were responsible. Each team was required to document and demonstrate the system's processes. Nineteen students in the class were divided into five teams: FI (financial and accounting), PP (process planning), SD (sales and distribution), MM (manufacturing management), and PMT (project manager team). All teams had three members except SD, which had six team members.

Class B was a systems design and implementation class in which students studied existing information processing requirements then worked in self-directed teams to develop, test and document a functional system. The purpose of the class was to provide students an opportunity to practice skills they developed in prerequisite courses in systems analysis, database design, and computer programming. The project in Class B was a web-based system designed to maintain background information on faculty members, extract enrollment data from the university enrollment management system, and generate various summary reports required by the AACSB International (the premier accrediting agency for degree programs in business administration and accounting) in their role as the accrediting body for the College of Business. The information reported by the system consisted primarily of various summary ratios that, in part, would allow the AACSB to determine whether or not the Business School was maintaining a faculty sufficient to provide stability and ongoing quality improvement for instructional programs. Forty students in the class were divided into eight teams: DES (design), SW (software development), DOC (documentation), DB (database), TST (testing), QA (quality assurance), IMP (implementation), and MGN (management). The team size varied from three to six. The deliverables of the project were the working system, an installation manual and a users' manual.

Similar to Class A, Class C (in stage 2) helped a fictitious company configure SAP/R3. However, unlike Class A, this was a collaborative class consisting of two separate classes in two locations. One class was in a Germany university and the other class was in a university in United States. The academic schedules were different for two locations. The spring semester of the U.S.-based class started at the beginning of February, while the summer semester of the class based in Germany began in mid-March. There was an opportunity for about one month of distributed collaboration.

The case for the Class C project was the PIP (Perfect Image Printing) case that had been used before by other instructors at the U.S. location. PIP is a manufacturer of laser and ink-jet printers in Australia, North America and Europe. The case was modified somewhat to support the difference in the academic schedules and to facilitate learning of distributed teamwork. The Germany-based class would begin to learn project related concepts about the time the U.S.-based students were ready to start implementing their project. To successfully implement their division's IT solution, the Germany students would need to consult with their counterparts in U.S. to understand how they had planned the structure, data, and processes of their implementation. Table 1 describes the team name and composition for Class C.

Team	***Description***	***Number of students***	
		U.S.	***Germany***
CO	Internal Accounting	3	
FI	External Accounting	4	4
HR	Human Resource Management	2	
MM	Materials Management	3	2
Online	Internet Sales	2	
PP	Production Planning	2	2
SD	Sales and Distribution	3	3

Table 1 Team Name and Compositions of Class C

Collaboration Technologies

Our objective was to allow students to gain skill in distributed teamwork through engagement in their work. Because class A and B were co-located classes, we had to identify tasks for simulated distributed work and also identify a collaboration technology. The job that we identified for the distributed format was weekly team meetings. We chose weekly meetings because they were a common task for both Classes A and B, and because meetings are a typical task for distributed teams. The collaboration technology supporting the team meetings would need to support distributed interactions in synchronous or asynchronous format. There are a variety of technologies that can be used: video/ audio conferencing, electronic message boards, chat rooms, and Group Support Systems (GSS). After considering all aspects of these technologies, we decided to use Cognito, a Web-based GSS. One drawback of Cognito, however, is that communication via Cognito is primarily in text format. Text communication may be sufficient for co-located teams to engage in simulated distributed work, but it is not sufficient for actual distributed teams. Therefore, Cognito was supplemented with other communication technologies such as email, telephone, and WebCT for the genuine distributed teams.

Despite its drawbacks, Cognito has three main features that were expected to support our project classes. First, Cognito supports communication in both synchronous and asynchronous modes. Team members can choose an appropriate mode for different tasks. Second, Cognito provides structured group interactions. Users can configure a variety of GSS tools to form sequences which can support step-by-step group problem solving and decision makings processes (Kolfschoten, Briggs, Appelman & de Vreede, 2004). Third, messages posted on Cognito are saved automatically for later reference. The system works as a permanent group memory, which helps team members keep track of what they have discussed.

We configured Cognito tools to form a sequence, or template, for teams' weekly interactions. The template provided an interface with three layers (screens): a main screen (Figure 1), a discussion screen (Figure 2), and an annotation screen. The main screen had two panes: the left pane listed five categories for task progress reporting and the right pane held sub-topics for each category. The five categories listed were: Tasks completed in past week, Tasks for this week, Approaching deadline, Issues/Questions, and Agenda items. Double clicking on one of the categories in the left hand pane brought up sub-topics associated with that category in the right hand pane. Double clicking on a subtopic brought up the discussion screen for a particular sub-topic. The template was prepared in advance for each team's weekly meeting. Team leaders could then log in and supply more specific topics for each category. We expected that the layered interface would provide structure to group interactions, thereby making it easier for team members to locate a topic and retrieve related information.

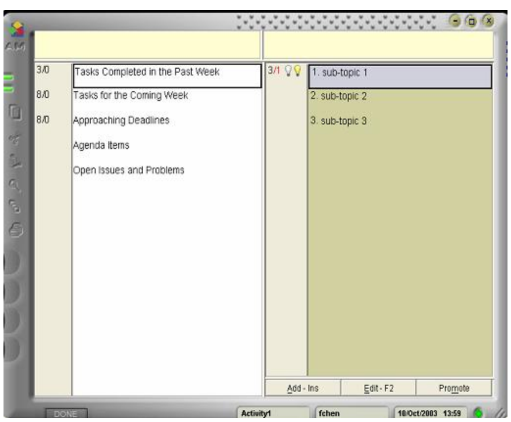

Figure 1 Main Screen

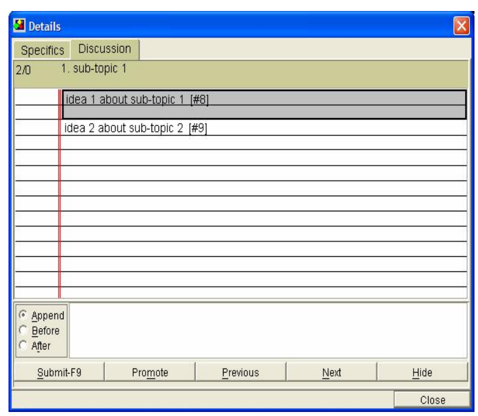

Figure 2 Discussion Screen

Two Interaction Modes

Real distributed teams often need to engage in two distributed interaction modes: synchronous-distributed, and asynchronous-distributed. Individual teams in Classes A and B had weekly Cognito-facilitated interactions for seven weeks. Each team experienced both distributed interaction modes and also face-to-face (FtF) mode. Since our emphasis is distributed modes, FtF mode won't be explained here. During week 1, students were trained to use Cognito in (FtF) format. They then used Cognito for team interactions in three interaction modes for six weeks. In synchronous-distributed interaction sessions, team members sat in two separate rooms, with all participants having access to the Cognito system via a computer network. Team members located in one room could engage in oral communication, but would have to communicate in text with team members in the other room. In asynchronous mode, team members simply logged into the system at any time and from any location on or off campus during a 48-hour period.

One author of the paper worked as a teaching assistant for all three classes. She assisted with all technology-related collaboration issues, participated in every synchronous session, logged into the asynchronous sessions frequently to observe group interaction, conducted informal interviews with participants, and collected online anonymous feedback about group interaction and system usage.

LESSONS LEARNED

Learning in Stage 1

The Class A SAP/R3 project involved a relatively high level of uncertainty and ambiguity at the beginning. Students were frustrated with this. Despite their frustration, students appeared to take ownership of the project. The project deliverable was good to excellent based on the instructor's experience of the similar projects in previous classes. Functionality was extended well beyond the minimum required. Students discovered many integration points in business processes when they discovered that they could not get their processes to work until people on other teams had completed prerequisite tasks. Due to numerous integration points, students were forced to resolve conflicts and cooperate with other teams. This type of project is a good candidate for students to learn collaboration in a distributed environment.

Students in Class B needed to adhere to a "waterfall" design method with a tight schedule for completion. A major issue with the software development project was that teams had disagreements over the design of the database structure and web-based user interface navigation. After six weeks, the design team was forced to deliver their design products even though some design deficiencies remained. Despite a rocky beginning, all teams worked diligently and delivered a functional system at the end of the semester. The primary client was mostly satisfied with the system but wanted a number of user interface modifications that the class had no time to produce. Therefore, the system was not put into production as originally intended. Overall, we felt that too much time was spent on development activities such as requirements definition, analysis, and coding, and little time was left for other valuable learning activities. Therefore, the instructors selected an SAP/R3 configuration project for stage 2.

We learned four things from these two classes. First, a simulated project may be a better candidate for distributed teams than a real project since real projects may be too time consuming and too complex for learning purposes. With simulated projects, the scope of the problem can be more clearly defined and the instructors have more control, e.g. they can manipulate the project parameters to suit the learning purpose.

Second, students generally did not like the simulated distributed teamwork. At first, many students argued that there was no point in incorporating distributed teamwork into their projects because it was fake and time consuming. Instructors explained that distributed teamwork was increasingly popular in industry, and training in distributed teamwork may increase their employability. It seemed that students had fewer objections to the distributed teamwork after that but students' buy-in of the simulated distributed teamwork was still an issue. Student feedback indicated that embedding distributed teamwork and collaboration technology into a non-trivial hands-on project over-loaded them. Therefore, we need to use a real distributed environment instead of using a simulated distributed environment, as the excitement and curiosity of working with team members in remote sites may increase student buy-in and, consequently, learning effectiveness.

Third, students suggested that there should be more intensive training in collaboration technology before they use the technology for their real jobs; otherwise, they are busy both learning the tool and solving problems at the same time. Some students were frustrated with Cognito at first; however, they quickly became familiar with it. A survey indicated that participants generally felt more satisfied with group interaction process in the second week than in the first week in the same mode (Mean Difference = 0.43, SD = 0.12, $p = 0.001$), and they also felt more satisfied with group outcome in the second week than in the first week in the same mode (Mean Difference = 0.41, SD = 0.12, $p = 0.002$). This indicated that repeated usage of the technology increased participants' satisfaction with both the tool and the distributed interactions; it also indicated that students became increasingly more competent to employ the tool to accomplish their jobs in a distributed format.

The fourth lesson learned was that we should have integrated the team building process with collaboration technology training. Before a team can perform as a cohesive unit, team members need to build relationships. Integrating collaboration technology training with the team building process may speed up the formation of a cohesive and competent team. For example, right after students are assigned to teams, we could start to train the class in Cognito, then encourage each team to use it to engage in some enjoyable group activities, such as discussing their backgrounds, hobbies, and major rules of effective teamwork practice. By executing these group activities with Cognito, team members would get familiar with peer team members as well as the technology. We adopted the approach of integrating team building activities with technology training in stage 2.

Students learned several things about distributed teamwork and using collaboration technology. First, students learned to establish conventions or norms to facilitate their distributed group interactions. When team members work in a distributed format, they have a high level of initial ambiguity concerning their interactions. Establishing interaction conventions or norms may reduce uncertainty and ambiguity of interaction and make communication more successful. In our study, a template was configured to support team interactions. The convention of using the template was quickly established, reducing the ambiguity and uncertainty involved in using the technology. Participants also formed another norm in distributed interactions. Participants often added "name tags" to posted messages. The norm of adding the nametag indicated that participants understood explicit communication was necessary to avoid misunderstanding when people interact in distributed mode.

Second, students learned that different interaction modes were more appropriate for different interaction situations. Students commented that synchronous interactions were necessary for serious discussion about complex issues, and that delayed asynchronous responses were disadvantageous in this scenario. They reported that simple information exchange lent itself quite well to asynchronous interaction and did not require a FtF meeting. They also learned that it was insufficient to have text communication for synchronous interaction mode; text communication was simply too tedious.

Third, students learned how to use a new collaboration technology, namely Cognito. Exposure to the new technology and its usage may have increased students' adaptability and learning ability. If MIS students are exposed to different types of information systems, they may be willing to audit and adopt new software technologies once they get into the job market.

Learning in Stage 2

The project deliverable for Class C was a working enterprise system for a multinational company. Our study did not directly measure quantitatively whether students increased their awareness of and competence in distributed teamwork. However, we did survey students' perception about collaboration. A 5-point Likert-type scale was used to assess students' perceptions of the collaboration (1 indicated strongly agree, and 5 indicated strongly disagree). The U.S. group felt that collaboration contributed to their understanding of Enterprise Systems issues more than the German group. In fact the difference in mean responses suggest that the U.S. group felt there was a contribution (mean = 2.74) where the German group felt there was little contribution (mean= 4.45). The US group had a more favorable perception of this collaboration as a simulation of international collaboration (mean= 2.16). However the German group was neutral about this (mean = 4).

One reason for difference in perception between the U.S. and Germany students is that the Germany students receive significantly more international business exposure during their education than do business students in the United States. This would explain the result that U.S. students saw the project as very beneficial while the Germany students were more neutral about the whole experience.

As for the collaboration technology usage, students were asked to rank Cognito, WebCT, and email from least useful (1) to most useful (3). There was no significant ranking difference for WebCT ($F = 2.321$, $p = 0.140$). WebCT was ranked as the most useful by both U.S. (mean = 2.12) and German (mean = 2.45) students. However, U.S. students and German students ranked Cognito ($F = 12.40$, $p = .002$) and email ($F = 4.63$, $p = 0.041$) differently. Germany students preferred email (mean = 2.55) over Cognito (mean = 1.00), whereas U.S. students reported a slight preference for Cognito (mean = 2.00) over email (mean = 1.88). One possible reason may lie in the fact that Cognito had been used in other MIS classes on the U.S. campus; therefore, the U.S. students may have been able to get help in using Cognito from other students.

Overall, Cognito was not used as much as expected due to two possible reasons. First, the learning curve for Cognito may be somewhat high, and students did not become familiar enough with the technology to use it comfortably. Second, Cognito usage at the beginning was not very successful and may have affected participants' perception of its usefulness and usability and, therefore, its subsequent usage. In stage 1, we learned that there is a need to provide intensive training in Cognito, and we should integrate its training with a team building process. However, due to the unsynchronized academic schedule and time pressures, we failed to provide intensive training in the technology or to integrate technology training with team building processes. The usefulness of integrating technology training and team building process remained untested.

STUDY LIMITATIONS AND RECOMMENDATIONS

This study explores our effort to incorporate distributed teamwork and collaboration technology into an MIS curriculum. Our approach has two major limitations. First, the approach was ad hoc than systematic. Second, since this is a pilot study, we collected mainly qualitative data rather than quantitative data. In a future study, we need to design measures and collect quantitative data to assess learning effectiveness in terms of increased awareness and increased competence.

Reflecting upon our hands-on experience, we concluded that three components are needed for a systematic approach to future research concerning instruction in distributed teamwork. First, we plan to conduct an extensive literature review to identify challenges and characteristics of effective distributed collaboration that can be manipulated in a learning environment. Distributed teamwork challenges may include aspects of language, culture, technology, time differences, and space dispersion. Principles of effective distributed collaboration may include principles that have been verified and reported by researchers such as conducting timely and predictable communication and communicating enthusiastically about teamwork (Jarvenpaa & Leidner, 1999). At the beginning of the semester, we might spend several class periods discussing these challenges and principles. Second, each team will write a detailed report at the end of the semester about their distributed teamwork experience: what challenges they encountered, what principles of effective collaboration they followed, what team norms they formed to help with their teamwork, what aspects of the learning environment (e.g., projects, team formations, and information technology) can be changed to enhance learning. Third, we will develop quantitative measures to measure the learning outcomes.

We believe that the proposed systematic approach will not only increase students' awareness of distributed teamwork but will also enhance their ability work effectively in distributed teamwork environments.

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