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2000

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Abstract

We describe an informal experiment in which students from two different universities collaborated remotely, through email, on a class project. Students enrolled in a course in quantitative decision making at both the University of Hawaii (UH) and Southern Methodist University (SMU) were paired in teams to analyze and solve a complex linear programming case problem. In addition to making a series of decisions related to the case, students were asked to devise a team strategy for working as a remote team. Despite some shortcomings related primarily to time constraints and miscalculations in planning, the majority of students involved in the experiment made quality decisions and thought the experience was valuable. We describe the project and report on the lessons learned in designing and implementing remote email collaboration among students. We also provide suggestions for other educators interested in conducting similar projects.

Introduction

Teamwork is a fact of modern corporate life. A significant amount of research has focused on group dynamics (Delbecq and Van de Ven, 1971; Hackman and Kaplan, 1984; McGrath, 1984) and the support required, including technological support (Dennis et al., 1988; Kraemer and King, 1988), to help teams perform more effectively. The globalization of business has added a challenging dimension to the management of teamwork posing the question, how can remote team members collaborate effectively? The motivation for the project described in the paper stems from our interest in understanding ways in which university students might become more productive and effective team members in a remote collaborative setting.

A variety of computerized support environments have been developed for use in business. Group authoring and design tools (Jarvenpaa et al., 1988; Stefik, et al., 1987), group decision support systems (DeSanctis and Gallupe, 1985; Nunamaker et al., 1987), computer conferencing (Hiltz and Turoff, 1981; Kiesler et al., 1984), groupware products such as Lotus Notes™, and electronic mail (Eveland and Bikson, 1987) are among the dominant computer tools designed to facilitate human communication. Dennis et al., 1988, describe a useful categorization of computerized environments using group size, group proximity, and time dispersion as factors affecting tool selection. For another review of work in this area see (Kraemer and King, 1988). We selected electronic mail as the medium for remote collaboration among students for a couple of reasons. First, electronic mail is the most mature and widely used tool among the group communication tools currently in use. Second, students involved in the project described in this paper were all familiar with electronic mail and it was the only computerized communication tool available to both groups of students at the time the project was undertaken.

Project Description

Students at both the University of Hawaii and Southern Methodist University involved in this project were taking the same course, Quantitative Decision Making, using the same textbook. In this course students are introduced to several quantitative methods that aid in the decision making associated with complex problems in both business and industry. The students learn how to model and solve complex business problems and then provide recommendations for action to management along with justifications for their action plans. The domain areas are varied and cover functional units such as finance, marketing, management, and manufacturing. Students use a software package to solve the mathematical models they develop but are responsible for interpreting the computer output and making decisions based on their model assumptions and solutions generated. The course typically culminates in a team project in which students solve a business case that is generally much more complex than problems encountered during the semester.

Student team composition

For this project teams were constructed by pairing students from the University of Hawaii with students from Southern Methodist University. A total of fifteen teams of four students each were formed by pairing two students from UH with two students from SMU. Students in the subgroups were asked to select their local partners and then matched to their remote teams by their respective professors. In an attempt to provide motivation, subgroups from both schools were matched with team members of the opposite sex whenever possible. At both schools the instructors were teaching two sections of the same course. The section not involved in the remote

collaboration completed the same project with local team members only.

Tasks

After the teams were formed students were asked to (1) make initial contact with their remote team members to develop a strategy for collaboration, and (2) collaborate with their remote team members on an assigned linear programming case.

Task 1. To establish a workable team dynamic, students were required to make initial contact with their team members several weeks before the actual cases were distributed. They were asked to find out the following information about their remote team members: the name or nickname each team member preferred, the place where team members were born and lived while growing up, each member's major and year of study, places each team member had traveled, musical preferences, hobbies, favorite sports team, and any other information that might help to trigger a connection among the remote members. Students received project points for submitting a report containing information about their remote team members. Students were then asked to communicate with their remote team members to develop a strategy for collaboration and communication that would take into account task assignments, a plan for making and evaluating decisions, individual schedule and time zone inequities, and any other challenges they expected to face in remote collaboration.

Task 2. The primary team activity was the analysis of a linear programming case problem. Each remote team was randomly assigned one of five different case studies. Thus three unique remote teams were assigned the same case. This was done for the following reasons:

1. Each case contained incomplete information and varying levels of ambiguity in the problem description. This was intentional to force students to make assumptions they decided were logical and justifiable based on case facts. They were asked to link their assumptions and justifications to their recommended action plan.
2. One of the goals of the project was to help students understand there may be more than one "correct" solution to any problem. By assigning the same case to three separate teams who had intimate details about the case, we thought students would have the motivation to evaluate other teams' solutions in a systematic and logical way. At the very least, we wanted them to recognize that even though different solutions are acceptable, one or more may be better than others.

The explicit decisions to be made by the remote teams included the following:

a) the assumptions needed to clarify ambiguities in the problem statement coupled with a logical justification for each assumption
b) the decision variables and notation to be used to solve the problem
c) the parameters that needed to be manipulated to calculate coefficients for the model
d) the precise linear programming model reflecting the team's assumptions
e) the linear programming solution (or solutions if their was disagreement about any of the components of the model) to the case
f) the results of a thorough sensitivity analysis, and
g) an action plan for management supported logically by the previous activities

One of the toughest challenges facing each remote team was to develop a strategy for conflict resolution if they did not agree on any of the above. Students were encouraged to resolve conflicts though email communication and to submit one team report. However, they were given the freedom to select an alternative method of operating as long as an attempt was made to reach an agreement. With the exception of one team, the remote teams took the task seriously and thought it was their responsibility to operate as one team, submitting one report that reflected the team's joint decisions. Students included an appendix in the report of all email communications between remote team members. This helped us analyze the process students engaged in and its evolution over time. They were also issued a questionnaire eliciting their responses to specific elements of the remote collaboration process.

Results of the remote collaboration effort

The project was not without snags. However, in general, the student teams performed as well as, if not better than, teams in other sections of the course who were not involved in the remote collaborative aspect of the project. From student comments and questionnaire responses it was apparent the remote collaborative dimension did pose an extra challenge for the students and placed an additional burden of responsibility on them to perform well not only for the professor but also for their remote team members. This may explain the overall quality level of the reports.

The following is a synopsis of students' perceptions of the project experience:

- Certain aspects of the project were frustrating. For example, because of the five hour time difference between Hawaii and Texas, students needed to plan their real time email communications very carefully.

Sometimes remote team members were not available to respond to questions or comments. Despite the frustrations, nearly every student thought the project was challenging, valuable, and fun.

- Not all teams clicked. There was one of the fifteen teams that decided to work without the remote members because the remote members never responded to their emails. Students who established a good rapport with their remote team members felt they learned a lot from the suggestions and/or criticisms they received from their remote partners. Many stated they felt a sense of satisfaction in having their ideas and decisions confirmed by their remote team members.
- Some teams commented on how satisfied they felt when they discovered an error or inconsistency in their remote team members' suggested models or assumptions. They claimed they gained confidence in their own analytical abilities by evaluating others' contributions.
- Students commented on how valuable their email discussions with their remote team members were, allowing them to think about the problem in depth to obtain the best solution.
- All of the students commented on how this project made them realize how important effective communication is, especially when working with team members who cannot engage in face-to-face communication.
- Many students commented that the greatest benefit of the project was that it improved their writing skills. The constraints of email communication forced them to think very carefully about what they wanted to say before sending an email message. They said clarity and conciseness were the keys to successful communication via email and this project really brought home that message.
- Many students remarked on the limitations of email for collaboration on decision making and how important it was to establish a plan early on in the project. They also said flexibility was a very important ingredient in the plan.
- All of the students enjoyed the social aspect of the project. Some of them actually made plans to pose as tour guide for their remote partners should they visit one another's home state. Several students stated their friends from other classes were envious that they had this opportunity to communicate with students from other schools (the project occurred pre-chatrooms).

Discussion of the Project Outcome

Many of the experiments in electronic group support have focused on same place/same time environments called "decisions rooms". In this type of system, a group is located in the same room using computer tools to accomplish its goals. In our project the groups were physically dispersed and used the computer tool asynchronously. Eveland and Bikson, 1987, report on a field experiment with electronic mail similar to ours, but with a longer time frame (1 year), a more involved task (preparation for and discussion of retirement), and larger group sizes (10 group members, on average). Their findings were consistent with ours in many ways. Groups who were physically dispersed throughout the city were able to accomplish their task as well as groups located in the same place. They were able to overcome time schedule differences similar to, though less extreme than, the time-zone differences overcome by our students. Participants thought the electronic communication was "fun" and "gratifying" and reported a higher evaluation of their group accomplishment than did the non-electronic groups. There have been other formal studies in dispersed group electronic communication with conflicting results (Gallupe and McKeen, 1990), however, many of the elements of the experiments were quite different from ours. In particular, the teams in the studies were artificially working as remote teams. This appeared to have a bearing on team effectiveness since team members knew they could work face-to-face with one another. Whereas in our study, as in Eveland and Bikson's, the remote dimension of the task was real, not artificially imposed. This forced team members to take their task more seriously and develop realistic strategies for communication and conflict resolution with remote team members.

Lessons Learned

The most glaring miscalculation we made regarding this project was the amount of time required to complete the project. The experience was unique for all the participating students and they needed time to adjust to the process and establish workable strategies for communication. Also, the case problems they were asked to evaluate were considerably more complex and difficult than problems they had encountered during the semester. Despite the shortcomings, the performance and comments of the students indicate the project was a success and worth repeating, possibly in a more formal experimental setting to determine the best settings for a variety of variables. Specific suggestions for others attempting such a project follow:

(1) To prevent the convolution of task and process, match teams with their remote members early on and require students to collaborate on smaller but increasingly difficult tasks. This would help students progressively establish a strategy for working together and allow them to create a workable dynamic.
(2) Separate elements of the culminating project should be addressed at discrete intervals throughout

the semester. If, for example, remote team members were asked to evaluate homework assignments, students could develop a methodology for providing constructive criticism and feedback. This may also help eliminate any unforeseen glitches before the final project begins.

(3) Distribute the final project case at least one month before the final report is due. Clearly define milestones for the students and require documentation of their progress.

(4) The participating professors must coordinate all aspects of the project in advance. For example, the weight of the project in the overall course grade should be identical for all participants. Also, if the classes involved end on different dates, this should be taken into account so that all due dates are the same for remote team members.

(5) Devise a Plan B for students who are unable to establish a workable relationship with their remote team members. Flexibility is essential in a project of this nature in which surprises are more the norm than the exception.

A well-planned remote collaboration project among students can be rewarding to both students and professors. Coordination and realistic expectations, however, are key to project success.

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