Learning About Emergency Management Information Systems Through Partially Distributed Team Projects

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ABSTRACT

What are effective ways to train students for designing Emergency Management Information Systems and for working with distant partners on EMIS projects? This paper describes the results of a project whose goal is to assess the effectiveness of Partially Distributed Teams (PDTs) as a pedagogical strategy. A PDT is one type of distributed team, in which two or more co-located subgroups use information and communication technology to collaborate on a task. Much of emergency management involves cross-organizational and often cross- national collaboration in this form. Students need, but lack, learning experiences focused on how to work effectively in such situations. This field study involved more than 700 students from universities in eight countries, working in 80 teams on an EMIS software requirements task. Results indicate that students report positive learning experiences, with international students in international teams reporting the most positive experiences. There are also significant differences among universities.

Keywords

Partially distributed teams, PDTs, "us vs. them", constructivist learning, training.

INTRODUCTION

The 21st century thus far has seen a great increase in both emergency management funding by governments and in courses and degree programs to train the personnel to fill these new jobs. In this paper we present evidence that one effective pedagogical technique for training students about EMIS and about working in teams on EMIS projects is to engage them in a realistic project using a "Partially Distributed Team" distributed between two classes in different universities.

Distributed teams and their variant, *globally* distributed teams, are an increasingly common means of accomplishing work in both EMIS and corporate arenas, as work environments have come to depend on international interactions and exchanges (Adya, Nath, Sridhar, and Malid, 2008). In particular, software teams are increasingly distributed around the world, collaborating both internally across the company and externally with partner organizations (Fryer and Gothe, 2008). A common configuration is the *partially distributed team* (PDT). Because of the necessity for coordination among a variety of governmental and NGO organizations in disaster preparation and response, PDTs are very common in the development, maintenance and use of Emergency Management Information Systems (EMIS).

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Partially distributed teams (PDTs) consist of two or more subteams that are separated geographically. In a PDT, the members of any given subteam are co-located, (thus they may meet face-to-face), but they collaborate remotely with members of other subteams using information and communication technology. Time zone differences and cultural differences may pose significant challenges to the groups (Carmel and Abbott, 2007; Hanisch and Corbitt, 2007). Thus, an essential professional skill is knowing how to communicate and work effectively in such teams. As Davis, Germonprez, Petter, Drum, and Kolstad (2009, p. 351) state, "As global, virtual teams become more prevalent in the workplace, it is imperative that we, as educators, prepare students for this trend." In this paper, we describe and assess student learning from a project in which they worked together in such Partially Distributed Teams on software requirements for an EMIS.

In the first two of five semesters of research, we were mainly interested in building and testing a theoretical model of the determinants of effectiveness of such teams. However, we noted that the students seemed very motivated by their participation in this project, and seemed to benefit from this particular type of collaborative learning. Thus, in the third semester we began to focus on the educational effectiveness of the PDT approach, and on training that would enhance the students' learning about how to work in such teams. We developed and fielded three training modules for students, designed to scaffold their PDT collaboration behaviors.

Following an action research method, we completed two semesters of quasi-experimental field studies incorporating student modules and faculty training materials. Findings from the first field study (semester 3) indicate that, with respect to their distant subteam, students *with* training reported significantly higher levels of team development (i.e., higher trust, shared team identity, awareness, coordination, perceived competence and less conflict) compared to students *without* training. Furthermore, students with training reported significantly higher levels of perceived team performance compared to their without-training counterparts. Details of the training modules, our action research approach, and of these impacts on students are presented in a recent paper (Ocker, Rosson, Kracaw and Hiltz, 2009). In the second field study (semester 4) we concentrated on analyzing the causes and impacts of "Us vs. Them" in PDTs and exploring factors that might decrease such in-group dynamics.

This paper presents the results of the third and most recent field study (semester 5), involving more than 700 students from eight universities in late 2009. Some of the teams were "global" or international, with one subteam located in the U.S. and the other in a different country, whereas some teams had both subteams located in the U.S. The focus of this paper is on three questions: (1) How effective is the PDT project in teaching students about emergency management information systems and about working in PDTs? (2) What are the differences in outcomes, if any, between international teams and all–U.S. teams? (3) Are there significant differences among universities? Following a brief literature review, we describe our methods, findings, and future research plans.

LITERATURE REVIEW

The Unique Problems of Partially Distributed Teams

In PDTs, coordination of work efforts is accomplished across multiple sites, such that members interact with both *co-located* and *remote* member groups. Given the prevalence of PDTs, there is a pressing need to understand and address the unique demands of this particular virtual team configuration (Connaughton and Shuffler, 2007). For example, recent research indicates that PDTs are prone to *ingroup team dynamics,* denoted by increased interaction with and preferential behavior towards members in one's site; and reduced trust and team cohesiveness as well as increased conflict between distributed sites (Panteli and Davison, 2005; Polzer, Crisp, Jarvenpaa, and Kim, 2006; Plotnick, Ocker, Hiltz, and Rosson., 2008). Members of PDT subteams conduct much of their team work via face-to-face interaction. The shared physical context coupled with the rich social cues present in face-to-face collaboration fosters cohesion, the development of a shared identity, and better conflict management *within* subteams (Armstrong and Cole, 2002; Hinds and Mortensen, 2005). However, ingroup team dynamics *between* subteams threaten overall team cohesiveness and development and can have dire consequences on team performance (Ockeret al., 2009). Thus, the training modules we developed for students were explicitly directed at increasing team cohesion, and decreasing ingroup team dynamics.

Using Constructivist Learning to Educate Students

Recent decades have seen a move away from "objectivist" pedagogy and towards constructivist approaches which provide more engaging and group-oriented or collaborative approaches to university courses (Hiltz and Goldman, 2005). In the objectivist approach, the faculty role is to transfer knowledge to students by presenting lectures and asking and answering questions. By contrast, constructivist learning is based upon a model that treats the student as an active participant in individual (or group) learning activities. The student becomes actively involved in constructing knowledge by applying concepts to problems, and/or formulating ideas into words, and these ideas are built upon through reactions and responses of others (Alavi, 1994; Bouton and Garth, 1983). A basic constructivist learning principle is that learning is conceived of as something a learner does, not something "done to" the learner (Johnson and Johnson, 1975). Thus, rather than just lecturing about how to work in virtual teams or how to design an EMIS, the constructivist approach supports students in learning about this through first-hand experience.

Our constructivist approach in the PDT project incorporates elements of Project-Based Learning, Team-Based Learning, and online collaborative learning. Project Based Learning (PBL) is "a systematic teaching method that engages students in learning knowledge and skills through an extended inquiry process structured around complex, authentic questions and carefully designed products and tasks" (Buck Institute). Team-Based Learning (TBL) emphasizes team development and has been shown to enhance motivation, long-term retention, critical thinking, and communication skills (McInerney, 2003). Learning online through collaborative group activities in Asynchronous Learning Networks or "virtual classrooms" has been shown to be very effective, especially as compared to having students work individually in online environments (Benbunan-Fich and Hiltz, 1999).

METHOD

Subjects

To recruit participating classes, each semester of the project an invitation was sent out on the AIS World (Association for Information Systems) list-serve, and invitations were also made to colleagues at professional meetings. In each semester after the first, some participating instructors were new, but many were repeats. The classes were related to IT (e.g., systems analysis and design, the impact of IT in organizations). There were 705 participants in this study, conducted Fall 2009. The participants came from 15 universities in 8 countries and were formed into 80 teams. Participating universities were located in Germany, Ireland, Lithuania, Mexico, Singapore, Spain, Switzerland, and USA. Each team had two subteams with an average of 5 members each, consisting of members of an undergraduate collocated face-to-face class. Each instructor was given the opportunity to assign students in his/her class to subteams. If they chose not to do so, the researchers made the assignments. The subteams were matched to form teams such that within a team each subteam came from different universities with at least one subteam from the US. Because there were more US classes participating than international classes, it was necessary to have some teams with two US subteams. While the collocated students had prior acquaintance and interaction, it is highly unlikely they had any prior experience with their distant team members.

Communication Media

Each team was provided with private space on Moodle, a free and open source course management system. It provided a file sharing repository, threaded discussion board, and a project calendar. Although encouraged to use it, participants were not required to do so except that all deliverables had to be posted there. Thus participants were able to use synchronous communication media (e.g. IM or Skype) as well as asynchronous media.

Task

The project was designed to be appropriate for students from different geographic regions and cultures. We focused on the front-end of the software development process because of the heavy emphasis on communication and on developing a shared understanding of the problem domain, key challenge areas in distributed work. Each team worked on determining the functional requirements, high level design, and related management decisions for an Emergency Management Information System (EMIS). The system was a Bioterrorism Management and Planning System (BTMAPS) for the country of Switzerland. The participants prepared their

final report, due at the end of the five week study, as if they were responding to a Request for Proposal (RFP). They were given a template for their final proposal and completed intermediate tasks to guide them in the preparation of the proposal. The intermediate, guided tasks included identifying stakeholders in the EMIS, brainstorming requirements for the EMIS, and designing the input and output screens for the EMIS' user interface. The grade on the final proposal contributed a significant percentage (usually around 20%) to the course grade, thus providing strong motivation to do a good job

Data Sources and Measures of Learning

All students participated in completing the task and intermediate deliverables. Participants also completed a background survey, post survey, and weekly personal reflections. Personal reflections are surveys which include open ended questions for which the students reflect upon their experience in the PDT during the prior week. Participation in the experimental instruments (i.e., surveys) was voluntary for US participants because of IRB requirements and mandatory for all other participants. Extra credit was given to those U.S. students who completed the experimental instruments. . Post survey responses were received from 509 participants for a response rate of 72%.

PEDAGOGICAL PROCEDURES

Training Modules for PDT Student Teams

Our earlier explorations and field studies indicated that students could benefit from training in how to work together in PDTs, and that faculty could benefit from project materials and support designed to help them facilitate their classes' participation. The student team learning materials for the first three weeks of this project draw from collaboration records and evaluation data we obtained during prior field studies. Each is designed to address a specific goal in terms of addressing challenges faced by PDTs, and contains subteam and team activities associated with a specific team deliverable as depicted in Figure 1. Note that the 4th and 5th weeks of the project were devoted solely to working on the task.

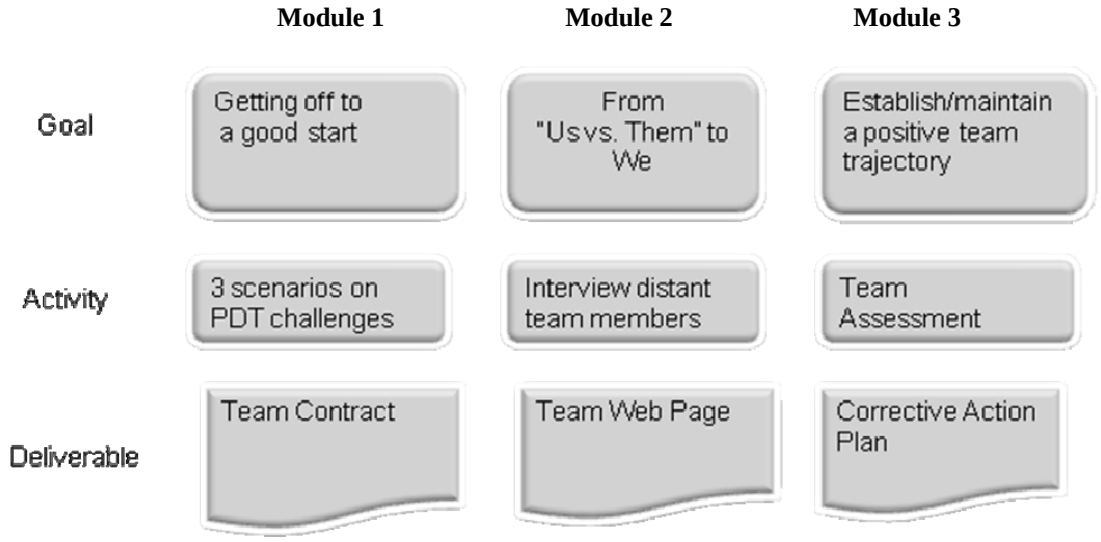

Figure 1. PDT Student Training Modules

In Module 1, teams completed activities designed to clarify team expectations and responsibilities, and to raise awareness of issues of working in PDTs. They drafted a contract that includes sections on how they would communicate (e.g., technology to be used, frequency of communication, acceptable timeframe for feedback), the frequency of team meetings, project management and team leadership structures, and procedures for addressing conflict between subteams.

The goal of Module 2 was to help move teams from "us vs. them" (separate subteam identities) to "we" (whole-team identity). Module 2 included a team building exercise in which students interviewed members of their counterpart subteam and created a team page of member biographies and team commonalities. Teams also

completed a brainstorming activity to generate a list of functionality for the proposed system.

In Module 3 the team assessment activity was designed to help students assess their team interaction and performance and reach agreement on an action plan for improvement. In terms of the task, teams created a detailed outline of the functional requirements for their proposed EMIS, based on the brainstorming list created during week two.

Faculty Training

Training aimed at orienting and supporting faculty was also developed and fielded. All faculty participated in a synchronous pre-project webinar to establish a shared understanding of project goals, milestones, deliverables, and timeline. Support materials were also developed and provided to faculty. Based on prior PDT faculty experiences and student feedback, a set of teaching notes was included for this study, each of which included a description of the weekly goal, an overview of the associated learning module (for weeks 1, 2, and 3), instructor activities to be completed during the week, student activities to be completed during the week, deliverables due at the end of the week, and helpful hints for successful completion of each week's activities.

RESULTS

We were interested in three aspects of perceived student learning: (1) learning related to working in partially distributed teams, (2) learning related to the emergency planning project task domain, and (3) an overall, general interest in learning associated with the PDT project. To measure these aspects, we adapted 16 questionnaire items from Hiltz (1994) and Alavi (1994), each of which is in the format of a 7-point Likert-type scale. A principal components analysis with Varimax rotation of the scale items confirmed the assumed three learning factors, with 83.95% of the variance explained. Three coherent scales were obtained with acceptable alpha reliabilities, based on 10 questionnaire items. These scales are shown in Tables 2-4. The three scales are moderately correlated with one another; Pearson's R varies from .494 to .582. Thus, besides the adequate internal consistency supported by the principal components analysis, the scales have adequate discriminant validity. In the remainder of the analyses in this paper, these scale indexes are used as the dependent variables.

The frequency distributions for survey questions relating to each learning dimension are shown in Tables 1-3. Students rated their learning positively across each dimension. All of the means are on the positive side of the 7-point scales where 4.0 is the midpoint. Learning related to PDTs was rated highest (5.30), followed by interest in the project (4.70) and then learning regarding emergency preparedness (4.11). Thus, though learning about emergency preparedness was slightly on the positive side, there is room for improvement in these pedagogical materials in future semesters.

ILooking in more detail at emergency preparedness learning, all scale items' means were rated positively (above the scale midpoint of 4.0. as displayed in Table 1) except for "additional readings about emergency preparedness." In particular, the PDT project increased students' understanding of the basic concepts of emergency preparedness, and helped them to learn factual material and identify central issues.

Interest in the project, as measured by reports of talking about it with people outside of the team, is substantial (Table 2). The frequency distributions for items on learning to work in partially distributed teams are even more positive, (all above 5.0) than for learning about the emergency planning software domain, as shown in Table 3. Specifically, students reported that the PDT project increased their skills at working in a distributed team, increased their skills and ability to team with others across distances, gave them good hands-on experience at collaborating across distance, and provided a real-world, hands-on experience in working on PDTs.

					Response							
Emergency Preparedness Learning	Survey Items	Mean	Std. Dev.		Str. Dis.1	2	3	4	5	6	Str. Agr. 7	Tot.
EP concepts	increased my understanding of basic concepts of emergency preparedness	4.47	1.67	%	6.1	9.2	10.4	21.0	23.2	19.3	10.8	100
				#	31	47	53	107	118	98	55	509
EP facts	helped me learn factual material about natural disasters	4.00	1.80	%	10.6	14.1	13.9	19.8	17.9	14.3	9.2	100
				#	54	72	71	101	91	73	47	509
EP central	helped me identify central issues in emergency preparedness	4.41	1.69	%	6.1	10.4	12.2	19.8	20.6	21.2	9.6	100
				#	31	53	62	101	105	108	49	509
EP read	I read about emergency preparedness and response outside of class	3.56	1.89	%	18.5	17.3	14.1	17.1	13.8	11.8	7.5	100
				#	94	88	72	87	70	60	38	509

Table 1. Emergency Preparedness Learning

					Responses							
Interest	Survey Items	Mean	Std. Dev.		Str. Dis 1	2	3	4	5	6	Str. Agr 7	Tot.
Non-team	I talked about the project with non-team members	4.58	1.84	%	8.3	8.4	10.8	15.9	19.4	20.6	16.5	100
				#	42	43	55	81	99	105	84	509
Interest friends	I talked to friends about working with my distant team members	4.83	1.77	%	6.3	6.9	9.0	15.9	18.3	24.8	18.9	100
				#	30	28	27	47	74	71	94	371

Table 2. Interest in Project

					Responses							
Partially Distributed Team Learning	Survey Items	Mean	Std Dev		StrDis1	2	3	4	5	6	Str. Agr 7	Tot.
PDT distance	increased my ability to team with others across distance	5.28	1.67	%	2.0	6.3	7.9	12.8	16.5	26.3	28.3	100
				#	10	32	40	65	84	134	144	509
PDT skills	increased my skills at working in a distributed team	5.33	1.59	%	1.8	5.9	8.1	10.0	18.3	27.9	28.1	100
				#	9	30	41	51	93	142	143	509
PDT hands-on	gave me good hands-on experience at collaborating across distance	5.30	1.69	%	4.1	3.9	8.3	12.0	14.9	27.1	29.7	100
				#	21	20	42	61	76	138	151	509
PDT real	provided me with a real-world perspective on distributed teams	5.29	1.63	%	2.9	4.7	8.1	13.2	14.5	28.9	27.7	100
				#	15	24	41	67	74	147	141	509

Table 3. Partially Distributed Team Learning

Variations in International vs. U.S. PDTs

To address the second research question, the data set was partitioned as depicted in Figure 2. In analysis (1), all respondents in international teams were compared to all respondents in U.S-only teams. Analysis (2) included only international PDTs, comparing international respondents to their U.S. counterparts. Analysis (3) was limited to only U.S. respondents, comparing those on international PDTs to those on domestic PDTs. The sample size for each comparison is contained in parentheses.

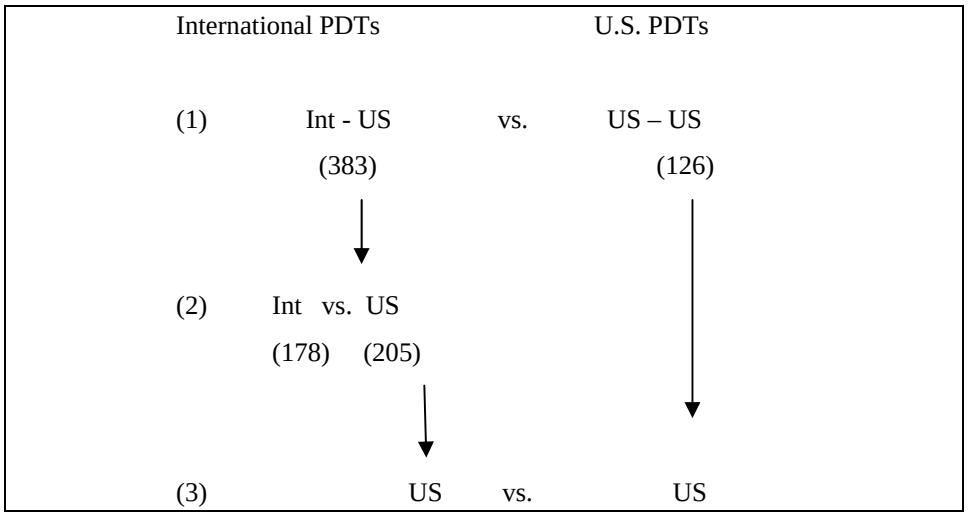

Figure 2. Partitioning of Dataset

	Emerg Prep Learning	PDT Learning	Project Interest
(1) Inter'l-US (n=383)	4.16 (1.54)	5.34 (1.53)	4.75 (1.66)
vs US-US (n=126)	3.97 (1.59)	5.18 (1.52)	4.56 (1.70)
(2) Inter'l (n=178)	4.37* (1.53)	5.37 (1.52)	4.88 (1.63)
vs US (n=205)	3.97 (1.53)	5.31 (1.55)	4.63 (1.65)
(3) US_{Int} (n=205)	3.97 (1.53)	5.34 (1.53)	4.63 (1.65)
vs US_{US} (n=126)	3.97 (1.59)	5.18 (1.52)	4.56 (1.70)
	* p<.05		

Table 4. Statistical Results for Learning Dimensions

ANOVA was used to conduct significance tests. First, responses of all students in international PDTs were compared to those of domestic PDTs. There was no significant difference regarding PDT learning, emergency preparedness learning or project interest. The second analysis involving only students in international PDTs revealed a single significant difference concerning emergency preparedness learning, with international students rating their experience higher (4.37 vs. 3.97, p=.010). In the third analysis with only US students, no differences were found in terms of any of the dimensions of learning. These findings are summarized in Table 4.

Variations in Learning by University

Fifteen universities participated in the PDT project. It is of interest to see if learning varied among them. The difference in sample size for each university varies a great deal. Therefore, rather than using ANOVA, which can be unreliable when samples have unequal variance (Gardner, 1975) a non-parametric Kruskal-Wallis test was conducted. Results suggested a significant difference for all dimensions of learning as shown in Table 5.

	Emerg Prep Learning	Interest in Project	PDT Learning
Chi-Square	82.612	25.892	57.689
df	14	14	14
Asymp. Sig.	.000	.027	.000

Table 5. Statistical Results for Learning by University

SUMMARY, DISCUSSION, CONTRIBUTIONS, AND FUTURE RESEARCH

This project confirms the benefits of having students work on virtual team projects as a technique for constructivist, collaborative learning. As Rutkowski, Vogel, Van Genuchten, and Saunders (2008, p. 310) concluded, "It is possible to let students experience what it means to work and communicate in a multinational virtual team" and "the students definitely benefit from such a course." The answers to our research questions can be summarized as follows.

RQ1: Students report positive learning outcomes from the project, in terms of learning about the subject matter (software requirements for EMIS) and about how to work well in distributed teams. They also report behaviors that indicate their interest in the project, such as talking to their friends about it.

RQ2: Results were that there was no difference between international teams and all-U.S. teams. However, in international teams, the international students reported the most positive experiences.

RQ3: There were significant differences among the universities.

As expected, student learning is affected not only by the composition of the full team, but also by the context of the subteam, that is, by the course/university and cultural context in which it occurs. Learning outcomes varied by university, supporting that thesis. Probably this is partially due to variations in the extent to which the instructors integrated the project as an important part of the course, rather than to cultural differences per se. In addition, though we provided guidelines and support for instructors, we found that instructors differed a great deal in how they provided for and supported the project as part of the course. For example, some instructors set aside some of the regular class meeting time for subgroups to work together, whereas others expected students to work on the project completely outside of class time. In the future, we plan to ask all instructors to set aside some regular in-class time each week for subgroup work.

In the future, we also plan to more actively pursue the development of a faculty community of practice centered on the design and use of PDT learning activities. We intend for the participating faculty to take charge of their own PDT joint projects, developing appropriate tasks for their courses and selecting training modules from the materials we provide. We hope to provide facilitation for such a community of practice, and also to continue research into the impacts of these and other innovations on the process and learning outcomes for the student teams. The intended result would be a much greater diversity in PDT implementations, covering a wider variety of disciplines and tasks and team configurations. For example, we used only two subteams of equal size from courses that also met face to face, so that all subteams could easily have face to face meetings. There is no reason why one could not have say three subteams, or teams of unequal size, or courses that are totally online, so that the subteams in fact cannot easily meet face to face. The impacts of these variations on student learning and project quality could then be assessed. In addition, all of our "international" teams included a U.S. team; it would be interesting to also have international teams in which all of the subteams were from nations other than the U.S. We hope to be able to explore the issues of cultural differences and cultural distance among subteams in Partially Distributed Teams more fully as we acquire a larger sample of participating countries. Instructors who are interested in having their classes participate should contact the third author. We are also interested in having "control" groups, , which would use the project tasks but only have subteams within the same course.

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REFERENCES

1. Adya, M., Nath, D., Sridhar, V., and Malid, A. (2008) Bringing Global Sourcing Into the Classroom: Lessons From an Experiential Software Development Project, *Communications of the AIS*, 22, 33-48.

2. Alavi, M. (1994) Computer-Mediated Collaborative Learning: An Empirical Evaluation, *MIS Quarterly*, 18, 2, 150-174.
3. Armstrong, D.J. and Cole, P. (2002) Managing Distances and Differences in Geographically Distributed Work Groups in P.J. Hinds and S. Kiesler (Eds.), Distributed Work: New Ways of Working Across Distance Using Technology, MIT Press, Cambridge, MA.
4. Benbunan-Fich, R. and Hiltz, S.R. (1999) Educational Applications of CMCS: Solving Case Studies Through Asynchronous Learning Networks, *JCMC*, 4, 3, http://jcmc.indiana.edu/vol4/issue3/benbunen-fich.html (retrieved July 31, 2009).
5. Bouton, C. and Garth, R.Y. (1983) Learning in Groups, Jossey-Bass, Inc., San Francisco.
6. Buck Institute of Learning, Project Based Learning Handbook, http://www.bie.org/index.php/site/PBL/pbl_handbood_introduction/#history (retrieved March 2009).
7. Carmel, E. and P. Abbott (2007) "Why 'Nearshore' Means That Distance Matters", *Communications of the ACM, 50(10), pp.* 40-46.
8. Connaughton, S. and Shuffler, M (2007) Multinational and Multicultural Distributed Teams: A Review and Future Agenda, *Small Group Research*, 38, 387-412.
9. Davis, A., Germonprez, M., Petter, S., Drum, S., and Kolstad, J. (2009) A Case Study of Offshore Development Across IS Courses: Lessons Learned From a Global Student Project, *Communications of the Association for Information Systems*, 24, 21, 351-372.
10. Fryer, K. and Gothe, M. (2008) Global Software Development and Delivery: Trends and Challenges, http://www.ibm.com/developerworks/rational/library/edge/08/jan08/fryer_gothe/index.html (retrieved Sept. 4, 2010).
11. Hanisch, J. and Corbitt, B. (2007) Impediments to Requirements Engineering During Global Software Development, *European Journal of Information*, 16, 6, 793-805.
12. Hiltz, S.R. (1994) The Virtual Classroom: Learning Without Limits via Computer Networks, Ablex Publishing Corp., Norwood, NJ.
13. Hiltz, S.R. and Goldman, R (eds) (2005) Learning Together Online: Research on Asynchronous Learning Networks, Erlbaum, Mahwah, NJ.
14. Hinds, P. and Mortensen, M. (2005) Understanding Conflict in Geographically Distributed Teams: An Empirical Investigation, *Organization Science*, 16, 3, 290-307.
15. Johnson, D.W. and Johnson, R.T. (1975) Learning Together and Alone: Cooperation, Competition, and Individualization, Prentice Hall, Engelwood Cliffs.
16. McInerney, M.J. (2003) Team-based Learning Enhances Long-Term Retention and Critical Thinking in an Undergraduate Microbial Physiology Course, *Microbiology Education Journal*, 4, 1, 3-12.
17. Ocker, R.J., Rosson, M.B., Kracaw, D., and Hiltz, S.R. (2009) Enhancing Learning Experiences in Partially Distributed Teams: Training Students to Work Effectively Across Distances, *ACM Transactions on Computing Education*, article 6, 9, 1.
18. Panteli, N. and Davison, R.M. (2005) The Role of Subgroups in the Communication Patterns of Global Virtual Teams, *IEEE Transactions on Professional Communication*, 48, 2, 191-200.
19. Plotnick, L., Ocker, R.J., Hiltz, S.R., and Rosson, M.B. (2008) Leadership Roles in Partially Distributed Emergency Response Software Development Teams: A Pilot Study, *Proceedings of the 41st Hawaii International Conference on System Sciences*, Hawaii, IEEE Computer Society, CD ROM.
20. Polzer, J.T., Crisp, B., Jarvenpaa, S.L, and Kim, J.W. (2006) Extending the Faultline Model to Geographically Dispersed Teams: How Colocated Subgroups Can Impair Group Functioning, *Academy of Management Journal*, 49, 4, 679-692.
21. Rutkowski, A-F., D. Vogel, M. Van Genuchten, and, C. Saunders, (2008) "Communication in Virtual Teams: Ten Years of Experience in Education", *IEEE Transactions on Professional Communication, (*51) 3, pp. 302-312.