

Online Collaborative Problem-Based Learning of Computer-Mediated Communication Topics

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Keywords: Problem-Based Learning, Online Learning, Computer-Mediated Communication, Collaborative Learning

Introduction

Computer-mediated communication (CMC) is a 3-credit, semester-long course that has been offered through a graduate program in educational communications and technology for more than five years. The course draws on communication and media theory to guide students in understanding the evolution of CMC, its impact upon society in general and in education in particular, and the tools that support such type of communication.

The course instructor demonstrated interest in adopting a problem-based learning (PBL) methodology in an effort to encourage meaningful learning related to the design of CMC to support educational endeavors. She was a doctoral candidate in the same program as the course under study. She had more than three years of experience in teaching the course online and about 1 year teaching the course in a hybrid mode incorporating a problem-based methodology. The hybrid mode consisted of some students taking the course online with some students taking it F2F. She had never taught the course online using the PBL methodology. The instructor was located in the same city as the institution that offered the course.

The interest in redesigning the course was related to studying online collaborative PBL in a naturalistic setting. Two consecutive semesters of the course were studied. The first stage of the research endeavors consisted of the redesign of the course to incorporate the PBL methodology. Because of this, the researcher thoroughly studied the course's contents, objectives, expected outcomes, and learner characteristics in an effort to determine whether or not the course was suitable for redesign.

Course Suitability for Redesign as a PBL experience

The course had the following goal and objectives (Lin, 2004): "The overall objective of this course is to gain a comprehensive understanding of computer-mediated communication theories and practices through a critical assessment of the field." Some of the objectives included to:

- ❖ explore and try on some computer mediated communication tools and techniques for recursive purposes
- ❖ situate computer-mediated communication tools in educational settings and explore how such digital communication techniques help enhance teaching and learning in a constructive learning environment

Nelson (1999) suggests some characteristics of a learning environment that make it suitable for collaborative problem-solving efforts. She suggests that course designers can select this kind of instructional design when the types of tasks that comprise the learning activity are heuristic instead of strictly procedural. Nelson (1999) advises one to use these types of learning activities when the learning environment makes collaboration, experimentation, inquiry, and reflection feasible. She also notes particular characteristics that learners and teachers must possess to be involved in the activity. Learners should be or have the willingness to become self-directed. Teachers, on the other hand, must be comfortable with having less control of the students and the instructional process (Nelson, 1999).

The review of these objectives helped determine that the course met the first requirement in that the learning tasks were heuristic instead of procedural. The fact that the course did not restrict the specific educational context in which CMC should be situated welcomed the possibility of receiving students with interest in contexts such as of K-12 education, teacher professional development, higher education, and corporate learning. Such different contexts imply different affordances and constraints that students need to consider when situating CMC in them. Thus, a variety of procedures could be implemented by different students in devising CMC implementations for the various educational contexts.

This course met the second requirement in that the environment allowed for collaboration, experimentation, inquiry, and reflection in a twofold way. The main course-management system (CMS) that was used along with complementary tools from other providers supplied the technological support for such activities as co-authoring documents, inquiry and negotiation of understandings, and reflection (because of the asynchronous nature of some of the tools). Furthermore, instructional design decisions heavily leaned towards those activities as valuable in learning.

Conversation with the instructor regarding the students from prior semesters revealed learners' abilities to be self-directed. Finally, the instructor herself had a long tradition of belief in student self-directedness and a strong preference for her role as a co-participant in the learning process as opposed to an authoritative figure. This was evidenced not only in her teaching but also in her scholarship.

These characteristics of course, instructor and students demonstrated the suitability of the course to be redesigned as a PBL experience. As a result, the researcher and the course facilitator engaged in a collaborative redesign process taking into consideration the literature of PBL.

Theoretical Framework

PBL originated out of concerns with learning that resulted in "inert knowledge". In the early sixties, Howard Barrows observed how students he had seen pass basic courses with excellent marks were barely able to apply such knowledge later on in practice (Barrows & Tamblyn, 1980). These observations lead to the development of PBL. Other authors praise the validity of PBL as an educational approach precisely because of its emulation of the experience of professional practice (Varanelli, Baugher, & Hall, 2001). Duffy and Cunningham (1996) refer to PBL as an approach that "exemplifies constructivist theory" (p. 189). Savery and Duffy (1996) visualize it as an approach that seems to "almost ideally capture the principles" of constructivism (p. 140). As such, the problem-based approach centers learning experiences on an authentic situation that presents a problem to be solved within the context of one or several interrelated domains. That authentic situation challenges student higher-order thinking. It places learners in

roles that naturally stem from the situation encouraging an active pursuit of knowledge while searching for the solution. Most of its implementations encourage collaboration and communication among learners during this process. They also recommend continuous reflection and multiple sources and perspectives in assessment. The incorporation of the development and use of meta-cognitive strategies helps support not only current but also future learning endeavors. Drawing from what they learned from those interrelated domains, the result constitutes a well-informed response of students to solve the problem.

Barrows and Tamblyn (1980), provide justification for centering learning in problems. They describe learning from problems as a process that is so basic that it has allowed humans to survive since primitive times. They assert that, because of the nature of human cognition, people naturally retrieve information easier if it was inscribed during confrontation with everyday problems. Since concepts and skills are internalized as components of those problem situations, recall is more spontaneously triggered in subsequent situations by similar conditions.

In order to place the present study in context, a review of the literature written about online collaborative PBL helped this researcher understand what was studied, and how and what was still needed to further the understanding of this instructional design model. Researchers have explored the roles and perspectives of students and teachers in this context, the process of group formation, the subject matter and problems that anchor it, the use of technology and its applications to support cognition, readiness to learn in this environment, communication and collaboration, and student outcomes and assessment.

Research in online collaborative PBL revealed difficulties because of the changes in the roles and responsibilities of both teachers and students (Poon, Reed, & Tang, 1997; Sage, 2000; Taplin, 2000) that suggest the need for efforts to build readiness to participate in the process (Björck, 2002; Ronteltap & Eurelings, 2002). Sage also reported difficulties in the stage of group formation for a course that lasted only six weeks.

In speaking about the problem in which learning is founded in this methodology, McAlpine and Dudley (2001) highlighted the importance of their authenticity. Lehtinen (2002) wrote of the potential of technology to communicate such authenticity. Other authors pointed out the impact of the nature of the problem (identified as theoretical or practical) in the amount and level of the interactions generated to solve it (Cheesman & Heilesen, 1999; Ronteltap & Eurelings, 2002). The design consideration of presenting the problem at the beginning of the learning experience was considered troublesome in the context of Taplin's (2000) study because of the design of learning materials that supported their hybrid process. Sage (2000) also considered the importance of the subject matter in the design of online collaborative PBL.

A number of authors addressed issues related to technology as mediating communication and as providing cognitive support. Some authors stressed the importance of taking into consideration the technology literacy and access of students who participate in online collaborative PBL (McAlpine & Dudley, 2001; Sage, 2000). Sage (2000) in particular also pointed out the limitations of mediating technology in supporting educational communications.

Several authors focused on the design and testing of tools that support this type of learning process. Their study of such tools yielded issues such as the need to further refine their support of cognitive and managerial process underlying PBL and technical considerations (Cameron, Barrows, & Crooks, 1999; Orrill, 2002; Steinkuehler, Derry, Hmelo-Silver, & DelMarcelle, 2002).

Some authors discussed the issues of communication, collaboration, and the development of trust within the context of online collaborative PBL. Sage (2000) stated that, while it is possible to achieve trust online, the variety of activities that can contribute to it is more limited. Taplin's (2000) suggested the combination of individual and collaborative assignments to account for the limitations of online students in engaging in collaboration due to their prior personal and professional commitments. McConnell (2002) points to the development of groups in three overlapping stages and the importance of such achievements as milestones in helping develop the sense of community in group members.

One final area that research literature on online collaborative PBL addressed is that of student outcomes and assessment. Lehtinen (2002) highlighted the lack of evidence to help attribute student achievement to particular considerations in the design of online collaborative PBL. Sage (2000) reported the need to clearly specify expectations and the need to address student considerations of individual accountability in group work. Taplin (2000), on the other hand, suggested the need to encourage the implementation of alternative means of assessment for the online context.

The general theme in concluding research reports related to online collaborative PBL is the recognition that this kind of learning process can constitute a different enterprise than its F2F counterpart because of the mediation of technology. Authors encourage designers to avoid adoption of F2F models without adaptations that consider the mediation of technologies and its impact on students in the process. More research is encouraged. However, authors stress the importance of richly describing the context and kind of experience researchers are implementing together with their methods to engage in such research.

In light of the ideas of these currents of thinking, the intention of fostering collaborative problem-based learning environments at a distance needs the special consideration of the affordances and challenges that the medium of delivery attaches to it. Synchronous communication that could bring the benefits of copresence (Boden & Molotch, 1994) is technology-mediated. Asynchronous communication that brings the advantage of reflective thinking entails delays in the exchange of ideas. When learning necessarily has to occur with a separation of space and/or time, such distributed examples of problem-based learning need to be informed by research that explains how to facilitate such experience with the lack of immediacy between distance learners and teachers.

Course Redesign

Based on this theoretical framework, course designers adopted an ill-structured design problem so that students had the opportunity to fully customize it to their interests. It required students to design CMC to support the communication needs of some people in the particular context in which they were interested. The problem prompts were redesigned between semesters because of the observations from Semester 1. The redesign focused on modifying the problems to communicate more clearly the idea that the problems were about designing CMC and not about designing learning experiences.

Course designers determined that students would group themselves by participating in a series of activities that would enable them get to know their peers and their interests and to identify common ground for collaborative work. Course facilitators also modified the prompts for conversation conducive to group formation so that students focused on the type of context in which they were interested in an effort to avoid focusing on potential solutions.

While PBL methodology suggests that students determine the learning issues and find learning resources by themselves, the literature on online PBL suggested this was a problematic aspect. Thus, course facilitators provided a core of resources and learning issues but encouraged students to acquire in-depth understanding of the particular issues that were relevant to their problems. There was no direct instruction but an exchange of ideas in the group as a whole with regards to those learning resources throughout the duration of both semesters. Small-group members then brought the relevant ideas to the resolution of their particular problems.

Additional external tools complemented those available in the CMS to support communication, collaboration, co-authoring, distribution, management, and reflection. Observations from Semester 1 made design modifications necessary in order to incorporate a tool that would help hold the cumulative knowledge of the small group. Course facilitators also introduced online calendars as a tool to help students coordinate synchronous chats. Students underwent the process in three stages.

During the first stage, students engaged in the refinement of the problem they wanted to address according to their contexts of interest. This refinement consisted of specifying the audience for which they wanted to design CMC, the communication needs of such audience, the technology infrastructure they had, and a rationale for using CMC to support those communication needs. Students submitted a proposal at the end of this stage. This constituted a milestone in their work. Course facilitators provided feedback to these proposals which mainly consisted of requesting the clarification of ideas and considering the scope of the projects. Students underwent a second stage by means of which they learned and applied their learning to the resolution of their problems. Thus, they used communication theory to describe communication in their specific contexts and to justify the selection of tools to satisfy those needs. Furthermore, they described the implementation of tools as part of their designs. Before the end of this stage, students submitted a draft of their ideas. Course facilitators provided feedback once again. As an ending phase, students finalized their solutions and prepared presentations for their peers in other groups. Classmates reviewed other projects and shared comments related to the description of the context, audience, and communication needs, the use of theory to describe communication needs and to justify the selection of tools, and the proposed implementation of those tools to satisfy the communication needs within the context. Group members assessed peers in areas such as knowledge of theory and tools, and their contributions to group work. Finally, students reflected on the experience once during the process and once at the end.

Research Methods

In order to study the evolution of the process of online collaborative PBL in all its stages, the research collected data from 3 sources. The researcher “observed” the development of the process as it was evidenced by postings in the discussion board, intra-group exchanges of communication in their private group spaces within the course-management system, synchronous conversations, and email messages. These were the data sources for the group in the first cycle of data collection. The analysis during the second cycle did not incorporate the use of synchronous communication but it did include the analysis of a wiki per small group. Data was analyzed by conducting several cycles of reading for identify and refining emerging themes. This analysis underscored important themes related to the scheduling of activities, student work strategies, supporting technologies, facilitation strategies and feelings of students throughout the process. These themes constituted the foundation for the development of student survey and instructor interview questions.

The second source of data came from a survey administered to students at the end of the PBL experience.

The third data source consisted of interviews with the instructor at the end of each cycle of implementation.

The researcher had a dual role within this context as researcher and as teacher assistant. Several measures helped ensure the quality of the investigation including long-term engagement with the data, rich, thick description of the experience, a variety of sources of data (i.e. documents, instructor and students' perspectives) and a variety of methods to mine the data (i.e. analysis of such documents, surveys, and interviews).

Results

Differences occurred in the way in which the process developed for the two groups of participants. Students in both groups generally disagreed or strongly disagreed with the statement that the problem was introduced too early in the semester. However, some did express concerns that they lacked sufficient knowledge about the course, their classmates, and the project in regards to making early decisions about it. The instructor's perspective concurred with the need for an early introduction of the problem because of the time constraints the course format imposed. Both semesters had a relatively long process of group formation. Students enrolled in Semester 2 had a longer process than those enrolled in Semester 1. The process of students in Semester 2 transpired in a more private atmosphere and did not include synchronous conversations. The deemphasizing of synchronicity in Semester 2 occurred because of concerns about a perceived impact on future student selection of work mode, synchronicity's demands upon students' schedules, and early concerns that students in Semester 2 voiced regarding their availability to engage in synchronous conversations. Students in Semester 1 relied on a combination of class discussion board, chat, and email to form groups. Students in Semester 2, on the other hand, mainly relied on email and the discussion board. The analysis of documents demonstrated more activity on the Semester 1 student discussion board than for Semester 2. Facilitator roles during this stage consisted of implementing design decisions, monitoring the process, and encouraging communication so students would make progress in exploring ideas for projects and constituting groups. Students appreciated both the design decisions for this stage together with active participation of course facilitators during communication exchanges. Students' feelings were generally positive or neutral in Semester 1 and neutral or negative in Semester 2, congruent with the longer and less public process for Semester 2. Group dynamics accounted for many of the students' feelings during this stage. Students mostly agreed with the time allocated for this process during both semesters. The analysis of documents uncovered only few instances in which students voiced concerns about the amount of time available for work. The instructor's perspective concurred with the sufficiency of time partially due to the time constraints imposed by the course format.

Students underwent the stage of problem understanding and refining with the support of chat and personal email in Semester 1 and email and the wiki in Semester 2. The students in Semester 1 used more synchronous communication for brainstorming and negotiation. The instructor also shared the perception that students in Semester 1 used more synchronous tools while students in Semester 2 used more asynchronous tools. Document writing occurred mostly before or after students' meetings and a few times during students' meetings as one student volunteered to write-up decisions as they were made. The students in Semester 2 mostly conducted their work

through asynchronous approaches. They used email for negotiation and the wiki for synthesis of their efforts. The analysis of documents also uncovered that students in Semester 2 also used the wiki in negotiating their ideas and coordinating their efforts. The documents were mainly authored by some or all group members individually. Through analysis of the documents, the researcher evidenced the limited use of tools in the private group spaces within the CMS. Facilitators actively participated in communication exchanges during this stage. Such participation was highly appreciated by students; they also valued the use of the proposal as a milestone and the provision of feedback after its submission. About half of the students had mostly positive feelings during this stage. The instances in students' communication exchanges interpreted by the researcher as expressions of feelings during this stage were mainly positive. Group dynamics accounted for most of the positive, neutral or negative feelings. Students mostly agreed that the amount of time allotted for this stage was sufficient.

For Semester 1 students, tool-use to support the stage of learning and application was relatively consistent to the previous stage. They continued to utilize email and chat profusely. While Semester 2 students continued to use email and wiki, they had already started voicing the potential need for chat in supporting the process. Only one group conducted a chat in conjunction with the wiki according to the expectations of course designers. Students in Semester 1 continued to engage in brainstorming and synthesizing and the individual development of discrete parts of project documents. Students in Semester 2 continued with their asynchronous work strategies. Some or all members of the group individually co-authored documents before or after communication exchanges. The researcher's document analysis continued to evidence the limited use of tools in the private group spaces within the CMS. The high value of active course participation by course instructors was consistent in this stage. Students also valued the submission of a draft of their projects as a milestone and the provision of feedback. About half of Semester 1 students and three quarters of Semester 2 students had positive feelings about the process during this stage. Group dynamics again accounted for most of those feelings. About half of the students in both iterations agreed that course facilitators allocated a sufficient amount of time for this stage. A few students requested more direction or more explicit guidelines for the process.

For the final stage, email-use increased in Semester 1. Students reported some brainstorming and synthesizing. Individual development of discrete parts of the groups' project documents occurred. In Semester 1, there was a slight decline in requests for course facilitator participation during communication exchanges. However, course facilitator availability was appreciated. Wiki-use declined according to Semester 2 students. During this stage work requirements changed; students prepared presentations, thus making the wiki less useful at this point. However, wiki's technical limitations may have also accounted for this decline in use. The course instructor noted this shift in both semesters. While the work strategies remained somewhat consistent from the previous stage, one group of Semester 2 students resorted to synchronous work to work through differences in ideas that had become evident. Students in Semester 2 used email for both negotiating and synthesizing. Again, some or all group members developed parts of the written document individually. While just under half of Semester 1 students expressed positive feelings, three quarters of Semester 2 students were positive at this point. Group dynamics remained the reason most commonly supplied by students to explain their feelings. Students in Semester 2 expressed more agreement with the amount of time allotted for this stage. They had had more time to work in the previous stage as a result of calendar issues and it is conceivable that that contributed to their opinions at that point.

Implications for Practice

The results of this study invite course designers to consider the length of educational experiences and its suitability to implement online collaborative PBL. The delays that asynchronous pieces of courses impose on the development of such processes without interfering with student readiness to make the necessary decisions to make progress through the process might be pointing to longer rather than shorter time frames as more beneficial within this milieu.

This study suggests that a holistic combination of synchronous and asynchronous activities should be established so that students develop comfort early in the process in joining groups and settling for project ideas.

The use of a range of tools was necessary to satisfy the communication and information needs students had throughout the process. This availability of tools contributed to hold the cumulative knowledge of the group in separate locations as opposed to a single location that supported multiple communication and information needs. Thus, the study advises designers to adopt tools that provide support for such varied needs in terms of time-independence and nature of the tasks involved and to make the use of such tools required so that groups achieve maximum benefit of the knowledge construction experience.

Active facilitators seemed to be beneficial throughout the development of both implementations of the course. This is consistent with literature on online learning. However, it is inconsistent with literature that explains the model of PBL. Designers should consider the previous experience of the target students in order to adjust the level of participation of facilitators in order to satisfy the needs of online students while still honoring the PBL ideal.

Students reported group dynamics as the cause that was most often responsible for the way they felt throughout the stages. As the mediation of technologies impacts students' ability to discuss issues related to group processing, designers should adopt ways in which students will address these issues during the process in a way as assertive as possible given the limitations of technology.

A way to ensure educational quality is to design instruction that benefits from the educational principles that are deemed to yield effective learning. PBL is one of the educational methodologies that have emerged from practice in traditional classroom-based environments as such. However, in order to ensure such quality, such educational methodology needs to be adapted to match the affordances and constraints that this medium imposes on the learning experience. Understanding such limitations and affordances of implementing online problem-based learning will help capitalize on the media attributes and compensate for its limitations in providing meaningful education for students at a distance.

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