

Co-Authoring in Online Problem-based Learning: Collaborative Approaches and Challenges

Brenda I López Ortiz

Assistant Professor of Educational Technology
St. John's University
Queens, NY 11439 USA
lopezorb@stjohns.edu

Lin Lin

Assistant Professor of Learning Technologies
University of North Texas
Denton, TX USA
Lin.Lin@unt.edu

Mary Tipton

Director of Distance Education and Support Services
Kent State University
Kent, OH USA
mtipton@kent.edu

Abstract

This paper examines students' efforts working together to solve problems and to document their solutions to those problems through online problem-based learning (PBL) projects. In particular, this paper focuses on studying patterns that students adopted in co-authoring project documents that their PBL experience required. This focus will help better understand and contribute to the literature on student paper co-authoring approaches in PBL.

Keywords: collaborative document authoring; problem-based learning; shared cognition; off-load-cognition; cooperative; collaboration; asynchronous; synchronous

Introduction

Collaboration for learning has been studied by a multitude of scholars and researchers throughout the years. Some researchers have established requisites for collaboration to be an effective learning approach including interdependent goals and individual accountability (Johnson & Johnson, 2003). Other researchers have also explored the ways in which division of labor occurs when students work together in a learning task (Salomon, 1993) and their approaches to assemble their individual contributions (Sclater & Bolander, 2004).

Salomon (1993) distinguished between two kinds of distributed cognitions in collaboration: off-load and shared. Off-load cognition is characterized by a division of labor. Individuals pass on their responsibilities to peers or mediating agents such as learning modules. Shared cognition, on the contrary, is characterized by a shared and interactive labor. Here, individuals are engaged in the same idea collaboratively, with the same or different outcomes. Each action or interaction can change the nature of the joint effort. Salomon (1993) argues that shared cognitions are more likely to yield advances in individual competencies, while off-load reduces individuals' opportunities to learn. He points out that a basic condition for real collaboration is the genuine interdependence of the participants. This means that in shared cognition, the interdependencies emerged because the participants have complementary competences from which the whole group can benefit, not because the participants are forced to

collaborate. The individual learner's awareness in the learning activity, in particular, in the collaborative part of it, will be an important precondition (Sorensen & Takle, 1999).

Online collaboration may pose challenges and thus reduce the potential benefits of this educational approach. Inherent to the development of an online learning experience are the assumptions that people will be engaging in the process at the convenience of their own time and location. While this does not automatically preclude shared cognition, it certainly introduces delays in the communication process and lack of physical and communicational immediacy that students sometimes seek as they proceed through its stages. Students may then resort to off-loaded cognition to cope with the demands of the course within the anytime, anywhere context. In light of these circumstances, it is important to study the strategies students implement when co-authoring the documents that represent the cumulative knowledge of the group as a result of an online collaborative problem-based learning (PBL) experience.

Literature Review

Positive interdependence is one of the basic elements of cooperation (Johnson & Johnson, 2003). Its dimensions include outcomes interdependence (goals and rewards) and means interdependence (resource, role and task). Having students work collaboratively to resolve a problem and document the cumulative knowledge of the group in solving the problem is an example of both means and outcomes interdependence. Students use a single interface to co-author the document and submit a single document that amalgamates the contributions of all group members.

Students, however, can interpret and/or translate interdependence into practice in a number of different ways. While students may still achieve outcome interdependence in many different ways, most variations seem to revolve around the assignment of individual tasks (the breakdown of labor and responsibility) and the method of integration to present a coherent end product. Basically, they can "divide and conquer" within re-assemblage, or they can work together in every phase on every aspect.

Bennett (2004) studied the experiences of groups of three or four students as they worked together to develop an educational multimedia product for a real-world client. She adopted a case study methodology that examined student assignments, discussion board transcripts, class observations, student interviews, instructor comments and researcher's notes during the process. Her findings highlighted two modes of collaborative authoring of project documents. On the one hand, one mode characterized one person collating the ideas of all team members. On the other hand, some groups worked having every person in charge of a part of the multimedia product and one person consolidating the efforts of all.

Sclater & Bolander (2004) studied the factors influencing students' orientation to collaboration. They focused on an 18-week long learning module on technology and lifelong learning that explored how the Internet may facilitate learning. Students were asked to select a relevant topic of interest and write a joint paper about it. Their collaborative process clearly delineated individual and collaborative activities. The individual activities were meant to feed the collaborative activities. These researchers studied student collaboration by analyzing transcripts of online communication exchanges and interviews. They identified three modes of collaborative authoring of the joint paper. Sclater & Bolander's (2004) first mode, core amalgamation, described a process in which the final submission was mostly the result of the work of one member. The second mode, negotiated collaboration, consisted of one person in charge of weaving individual group members' contributions to the paper giving it one voice. The final mode, cutting down and stitching together, mostly resulted in a cutting and pasting exercise that yielded a paper that was lacking cohesion. Authors acknowledge that the individual/collaborative process design may have influenced students' tendencies towards this last mode.

In an effort to help strengthen the characterization of student paper co-authoring approaches, this paper focuses on studying patterns of adoption of individual and collaborative contributions in collaboratively authoring the project documents that the PBL experience in this course required.

Methodology

Participants

This study looked at the work of twenty-five (25) students who agreed to participate: 3 male and 22 female students. They belonged to degree programs in the teacher education and school library media specialist fields. These students were both undergraduate and graduate students attending a mid-western state university.

The Context

The data for this study was collected during a 4-month semester course that focused on computer applications in education. The course covered topics such as desktop publishing and presentations, computer use in classrooms, telecommunications and distance education, computer hardware and software, networking, lab administration, multimedia presentations, and publishing. The course implemented a problem-based learning process that guided students to explore these topics as they designed a learning experience facilitated by relevant computer applications. Instructors requested that this learning experience take the form of a web-based project. They suggested the project could be a combination of blog, wiki, and other types of web pages created with FrontPage, Dreamweaver, or other web authoring tools. Along with this, course instructors required a marketing piece publicizing the project to the target audience and a presentation piece that highlighted and summarized its main parts (i.e. introduction, the theoretical framework, the design and the conclusion).

The online collaborative problem-based learning experience lasted the entire semester and developed through a series of stages that are outlined below.

- *Group formation (first 3 weeks of classes)*. Students shared their experiences with group work online or otherwise, and ideas for projects and worked on forming groups based on common interests.
- *Problem Definition (1 week)*. The fourth week was dedicated to prepare a project proposal that encompassed student-generated problems to be solved within the parameters of course content and assignment requirements.
- *Consultation of Information Resources and Application of Knowledge towards a Solution (6 weeks)*. Students conducted class readings and discussions and explored the application of their ideas into the solution of their problems. During this process, groups submitted their work to the course instructors twice for feedback and suggestions for improvements.

Data Collection and Analysis

The researchers investigated students' patterns of collaborative authoring of project documents during the online collaborative PBL experience through a variety of data sources that included the analysis of class and small group discussion boards, analysis of blog postings, chat transcripts, individual and group wikis, responses to an online self and peer assessment survey, and responses to an online PBL and technology experience survey. Two researchers independently analyzed the documents to identify emerging themes of this research. They examined data for possible evidence of individual student co-authoring, group members' authoring of discrete project documents parts, and/or group members' co-authoring of all project parts asynchronously or synchronously. Researchers then arrayed findings in a matrix against a predetermined set of criteria so that the lack of data in a particular area would manifest itself.

Findings

Discussions of the findings are situated in the three major phases of the problem-based learning process, namely, group formation, problem definition, and consultation of information resources and application of knowledge towards a solution. Within each phase, the authors discuss how group members approach the process of co-authoring required documents in order to complete their projects.

Students contributed to the authoring of the group project documents in a variety of ways. The researchers assigned labels to four main approaches: subordinate, cooperative, collaborative-asynchronous, and collaborative-synchronous. Other approaches that were identified were mostly variations of the subordinate approach. The first category labeled "subordinate" describes student co-authoring patterns when the work was mainly done by one or two individuals (a minority of the group

members) and the rest merely provided feedback (if at all). Remaining group members seemed subordinated to the work of the authoring peers. The “cooperative” approach describes the efforts of students when they divided and conquered. Students cooperated with each other to accomplish their goals. Each person was in charge of and solely responsible for a separate part of the project document. Peers provided feedback (if at all) to the portions their classmates had written. Two other categories represented more collaborative approaches. “Collaborative – asynchronous” characterizes work during which all students provided input for all the portions of the document and then integrated the best of the work into the final version. “Collaborative – synchronous” describes students co-creating the group documents as they engaged in synchronous communications (e.g., chat, face-to-face meetings, or phone).

Group Formation

The online collaborative PBL experience began with an initial stage that was dedicated to explore potential ideas for group projects. Students discussed the subject matter and grade levels they were interested in focusing on as they learned the content of the course. As part of the exploration activities, students were also asked to share positive and negative experiences that they had had during group collaboration in past academic experiences. This stage did not necessarily require that students produced co-authored documents. Therefore, this section does not include an analysis of the approaches students adopted in co-authoring project documents. However, the analysis of their communication exchanges revealed interesting insights about their personal preferences in working in groups which may have impacted their behavior in leaning towards either shared or off-loaded cognition.

Some students expressed a personal preference for doing things by themselves instead of relying on others to do part of the work: “The hardest thing about group work, for me, is not working on my own. I’m a do-it-yourselfer and I have a hard time leaving others to do something that I could be doing.” Furthermore, students expressed preference to work on their own because they recognized that their personal work patterns may be troublesome in the context of a group: “I am not the most organized person and I do not want to burden others. In order for groups to be successful, the members need to be organized. I don’t like to feel that I am holding others back.” As stated by one student, “groups are only as good as the people in them”. By extension, groups may be as prone to shared or off-loaded cognition as the people in them.

Some students indicated adopting approaches to ensure individual accountability that may be counterproductive to shared cognition: “My group experiences are quite limited. In undergraduate work, group activities were usually split individually to make sure that the workloads were even.” This may present an interesting question for research if educators are to follow Johnson and Johnson’s (2003) suggestion of ensuring individual accountability and Schrage’s (1993) suggestion of encouraging shared cognition to ensure the success in the learning experience.

Students did recognize the value of participating in collaborative learning experiences in which all group members participate:

I really fell [sic] that in the right group everyone can benefit. As the saying goes, “Two heads are better than one” while that’s true if they are both on the same team. Everyone has a unique outlook on various topics by completing group work I feel that we are able to explore these perspectives a little further.

However, they shared concerns with leadership patterns or lack of participation of group members. The fear of non-participating peers stems from the fact that they may get credit for work they did not do. These situations may infringe upon true shared cognition:

My bad experiences were mostly a result of certain group members not understanding what working together as a group entails. Sometimes there were people who didn’t participate as an active member of the group, doing only the bare minimum (if that). Other times there were people who wanted to dominate the group, taking over certain aspects of the project without even discussing it with the rest of us.

These comments suggest that even with instructors’ best intentions to encourage shared cognition, personal work patterns and preferences when unaddressed may interfere with students’ approaches to

group work and even biases towards more off-loaded approaches. The instructor's approaches to group formation may also impact the development of trust which is basic before groups can work in a healthy fashion.

I have always had good experiences with group work when I was able to pick my own group. The times when I didn't have such a positive experience were when the teacher chose the members of each group. When the teacher chose the members, I always found myself doing most of the work because I didn't know if I could trust the other members of the group to complete their part of the project.

Trust was also mentioned beyond the context of group formation but throughout the entire learning experience as an issue that impacts group work. Other students commented on ingredients of group work that may be key for shared cognition to blossom:

I have discovered that the greatest thing needed in order for a group to have success is COMMUNICATION. It's even harder when people are miles apart, but technology has greatly facilitated this. Another thing needed is FOLLOW-UP. For example if I send a group member something to review and need feedback they need to follow through with letting me know.

For cognition to be shared, the exchange of ideas needs to happen in a consistent fashion. If feedback messages are never exchanged or are exchanged with significant delays as may be the case in online learning, groups may resort to off-loaded cognition. The following claim for shared responsibility and desire to bounce ideas off group members are also key ingredients for cognition that is shared as opposed to off-loaded:

Shared responsibility has to be established to avoid bitter feelings during collaborative efforts. I enjoy working with a group and alone. In a group setting I enjoy bouncing ideas off of each other and seeing how everyone contributes their special talent in creating a wonderful masterpiece of a project.

Ten out of the twenty-five students expressed concerns over doing a group project at a distance as they had not had experience with this kind of process before. However, despite the concern, they expressed an interest in contributing to making the experience a successful one.

Group wikis, the spaces designed to be adopted as the collaborative authoring environments to be used synchronously or asynchronously as each group's "shared mental space" (Schrage, 1990 as cited in Hannafin, Oliver, Hill, & Glazer, 2003, p. 252), were set up towards the end of the group formation process. Only one group actually used this technology during this period. There were 13 revisions to the wiki but only one student made all of them. Two of these revisions evidence brainstorming activities which are necessary steps in the process of collaborative authoring of an educational design document. However, they illustrate the adoption of the wiki as a communication tool more so than a first level co-authoring tool: "With the very lively and rich discussion about the Internet and personal privacy, I think a great topic would be: discovering the issues with personal privacy, safety, and security when using the Internet."

Problem Definition

During the stage of problem definition, the dominant mode of paper co-authoring was the cooperative mode. The individual approaches, where not all members of the group contributed to the writing efforts, followed. The least mode to be used was the collaborative mode in both the asynchronous and synchronous modalities. Below are qualitative analyses of co-authoring that took place during this stage.

Subordinate approaches. Course instructors had set up a discussion forum entitled "Projects and Group Members" to have students finalize the process of group formation. Some conversations in this forum began before that stage and continued into the problem definition stage. One comment in this forum demonstrated that one student had a major role in writing the project proposal which was an exercise of problem definition:

I posted the wiki and did the pbl proposal. Mary (pseudonym) has given me some ideas to add. I don't think we are cemented in what we post for that, just so we have a general idea of what our focus will be. If you have more ideas, please e-mail me. I'll get back on around 8:00pm and finalize the proposal and make sure it is there. It might be a better idea for you to just add comments on the wiki and I'll check it and incorporate them. Either way, I'll check both around 7:45 or so before I finish up the proposal.

Students then had another forum entitled "PBL Project Proposals" to post their project proposals. Another comment from a student acknowledged the previous student doing the work for the project proposal: "Thanks, Joanne for getting this done for us."

An analysis of the wiki revealed patterns of collaborative authoring of the project documents at this stage. Groups made an average of six revisions to their wikis during this stage. The analysis of its statistics showed that one person created all revisions for this stage in two out of the seven groups. Three or four different authors were co-authoring the project proposal in two other groups. However, in at least one of those groups, the analysis demonstrated that one student was mainly in charge of writing most of the proposal with the revisions of other students mostly showing editing commentary. The student inserted comments in the wiki to let her peers know that she had written as much as she could for the proposal and requested suggestions: "Ladies, I filled in everything I felt comfortable with. Please fill free to edit or add your suggestions. I hope this [is] what we had in mind. Let me know what you think." Peers acknowledged her role in writing the document: "Jane, Michelle did the porposal [sic]... she deserves the credit! I just set up the format. :-) Dana."

A posting and a response in one of the individual blogs during this stage characterizes group use of the wiki in a way that is similar to what was captured by researchers.

Hi All! I am really getting accustomed to using the wiki that my group created! We are using it to communicate and create and make changes to projects. It is so cool how they work. Dana

Dana, I agree completely that Wiki is working well for the group to communicate. I have also become accustomed to wiki and I am becoming more comfortable with using the site.

Collaborative – asynchronous approaches. A comment posted in one of the individual blogs suggests student interest in working collaboratively in authoring project documents since the supporting technology allows for that.

I think the neatest thing so far was the wiki site our group posted. It's really neat how we can all get on and edit changes to our project. We protected the site so that only our group members could make edits. It's a really useful tool for collaborations especially in this class setting where we don't meet face to face.

More than one comment in individual blogs suggested an intention to engage in collaborative authoring of project documents while not necessarily evidencing actual engagement on doing it: "I am really glad that we are in a group together and have been able to merge some of our very fabulous ideas. I can't wait to meet on Sunday to get a head start on things!"

Figure 1 shows students' opinions about their patterns of collaboration in the co-authoring of project documents during the stage of problem definition.

As demonstrated by the graph, more students reported having resorted to dividing proposal sections and working individually to put together the document. Following this, an equal number of students reported that either one or two students took charge in writing the project documents in some cases distributing them for feedback among the rest of the group-mates or worked together writing them during synchronous exchanges. Nevertheless, the analysis of transcripts of use of the various technologies that supported this online collaborative PBL process does not necessarily support this last approach during this stage.

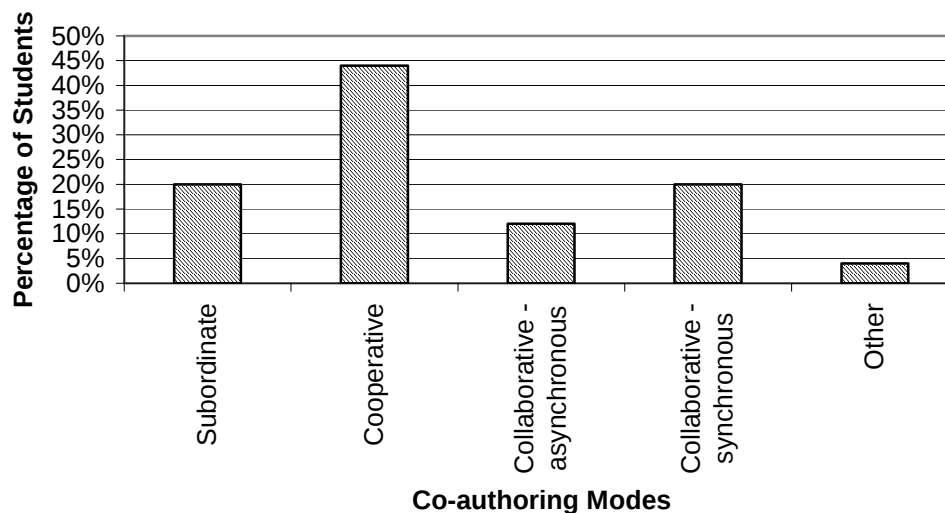


Figure 1: Co-authoring Modes Reported by Students

Consultation of Information Resources and Application of Knowledge towards a Solution

At this point in the process, students had received feedback about their proposed approaches to go about designing learning experiences that were supported by computer applications. This stage is now about learning and applying knowledge in search for their design solutions. The analysis of transcripts of the various technologies students used during the process evidenced how they approached the task of co-authoring the documents that would evidence their solutions.

Subordinate approaches. The analysis of communication exchanges through the wiki revealed approaches to co-authoring that subordinated the work of most group members to the initiative of one. "10-4-2006 I hope you are all having a great week! Who is going to submit the progress report? I am more than willing to do it. Dana." A group-mate replied about having done it and sent it for feedback: "10-4-06 Girls, I e-mailed you a progress report I typed up. Check it out and let me know what you think. Michelle."

In other contexts, more students comments seem to reveal subordinate patterns of document co-authoring: "07:15:27 PM Tracy: A picture w/ our project OR the project proposal? I did pictures @ the beginning. 07:15:38 PM Tracy: When I submitted [sic] the proposal" This particular student had worked and submitted the proposal and is confirming this at a later stage when other students inquired about pictures to be posted along with their work.

The course design required that students worked with a desktop publishing program in the creation of a flyer to advertise the educational design they had put together as a solution to the problem that was presented to them. The use of this type of software is instrumental as students become exposed to this kind of technology and thus are able to consider its benefits and advantages for learning. However, this type of course requirement may also guide students towards subordinate approaches to co-author documents: "Another group member will be posting the Publisher piece, as she is the only one with Publisher." The university did not necessarily have the technologies to support online collaborative authoring of this type of file. More collaborative approaches could have been adopted with the web-based component of the project as students had access to group FTP web server spaces.

Cooperative approaches. Most of the examples of co-authoring of project documents during this stage, however, exhibited a more cooperative approach. The following excerpt from communication exchanges in the wiki illustrates how one student focuses on working on the web portion of the project while another one works on the electronic presentation portion.

Good evening girls. I was able to get the links created and added them to the BookBlog tonight. When you click on the Grade 5-6 book list link it takes you directly to the webpage. I had to make a couple of adjustments to make the file open but I think it works.

Girls, You would be so proud of me!!! I thought since I need to learn the most about powerpoint [sic], I'd attempt to do the edits for our final presentation. I'm all finished except the transitions. I'll send you both a copy before Monday so you can look it over before we talk.

Excerpts of synchronous chat transcripts illustrate how students made decisions about dividing the workload to accomplish their interdependent goals. In this case, students suggested preparing different sections of the same document.

02:57:35 PM Mike: Somebody needs to write up a brief paragraph relating our project to a learning theory and/or group of theories. Showing why we're taking the approach we are to solve our problem.

02:57:53 PM Mike: Anybody up to this task?

02:57:58 PM Carla: i [sic] can come up with something

02:58:19 PM Mike: Cool .. I can incorporate it in the PPT and proposal once you're done.

02:58:20 PM Carla: angie and i [sic] can work together

02:58:31 PM Mike: Great

In another instance, each student subdivided the work by selecting a subject matter to focus on when working on their design problem.

10:16:29 PM Lilly: Should we start by announcing what topic we're each doing

10:16:36 PM Barbara: Yes.

10:16:50 PM Rhonda: home page

10:16:57 PM Lauren: math/science

10:17:11 PM Jennifer: Did anyone look at the assignments submitted by other groups?

10:17:44 PM Christine: ... [URL omitted]

10:17:50 PM Jennifer: One is fairly involved and the others were just summaries.

10:17:58 PM Jennifer: Art and music

10:18:08 PM Christine: student resources here

10:18:22 PM Lilly: English and research skills if we want those too

The "divide and conquer" approach is visible throughout groups and discussion environments. Their postings in the group discussion forums have suggestions to work that entail this division of labor: "Hey Guys, Everyone grabbed a piece of the final PBL. I'll do anything to help too."

Evaluative comments at the end of the experience also validate the notion that a preferred approach was the cooperative one.

Girls, I think we have put so much effort into this. We have great finished products which we have all contributed to in some way or another. We just each took one piece of the final and put all of our group ideas/work/research into that piece.

The cooperative method requires that students coordinate their efforts: "I think it is just an organizational meeting...who's doing what and when and so forth and so on." It also requires assembly of individually authored sections into a single document. "Jennifer and I talked and we kind of thought that I would put all the pages of our web together at the end. You can create your pages in MSWord (I can Christine) or frontpage. [sic]" The cooperative may also yield uneven results:

Ophelia, Thanks for your help on our project. I think the reason our pages looked so different from one another is the fact that some of us worked on our pages in WORD. For the finished product we will put it all together in FRONTPAGE [sic] and I am certain it will then look uniform.

While the approach that was mainly adopted during this stage was the cooperative approach, some students in more than one group recognized the value of having a unified effort and even exhorted their

peers to engage in more collaborative approaches even if only in the discussion of the content to be included in each section.

Group- I'm unwilling to post the draft powerpoint [sic] that was posted last Thursday; it represents individual effort, not a group collaborative effort.

I will read over what you posted, but hopefully I've completed that leg of this project and we won't need to revisit it. Nonetheless, I strongly encourage all of our group members to actually have some 'real' discussion on what's been (and will be) posted here.

This shows a glimpse of hope in the possibility that more collaborative approaches could be designed while still maintaining a level of convenience in terms of time and place to engage in academic work for the students who register in online courses precisely searching for that. One group decided to use the discussion board in a fashion that could be seen as a building block for a collaborative authoring environment by creating distinct threads for different project areas and using them as containers for content generated for each.

Since our collaboration needs to happen in Vista, let me suggest we create 1 topic thread for each standard we'd like to tackle. Underneath the thread we can start to post resources and tools. Between now and Oct 25th we can generate all the content for our project.

The same group defined an internal timeline for the group efforts in which the cooperative approach was clearly suggested: "Week 4 Oct 16 – Define individual responsibilities for content creation of project elements. Oct 16–20 peer-review and posting of content." The group, however, did not transcend the initial individual efforts to be in charge of just one part by moving into suggesting content for each part and then providing feedback for the contributions of others and refining their work.

Collaborative – asynchronous approaches. With regards to the ways to go about working together in the resolution of an educational problem, students recognized that there are tools available for them to collaboratively author project documents: "06:45:36 PM Stephanie: okay, how should we divide that up? 06:45:47 PM Stephanie: should we all just try to make changes to it? 06:46:09 PM Stephanie: I guess that IS how a wiki works..."

As previously stated, these students had limited prior knowledge of the affordances and constraints of technologies like the wiki in supporting truly collaborative authoring efforts. Therefore, as part of the process, they also explored ways in which they could all have access to the same document for updates.

06:48:34 PM Stephanie: Is it possible to post it in our group file so we all can work on it?

06:48:55 PM Rob: yes that's a great idea

06:49:04 PM Barbara: I can try to put something together

06:49:26 PM Stephanie: that would be great. if you get the initial file up there, we can all work on it

06:49:38 PM Barbara: You mean the group file that Lynne has set up for us in Vista?

06:49:48 PM Rob: if we put it on our first wiki page so everybody can work on it

06:50:06 PM Stephanie: okay

06:50:08 PM Barbara: I know how to do that - I think :)

06:50:16 PM Rob: sounds good

06:50:21 PM Stephanie: yeah, thanks

Even when more evidence was found that students were considering collaborative approaches to co-author their documents, the co-authoring in the wiki was still mostly done by the minority of group members. The average number of revisions during this stage was 8 and the average number of group members making revisions was 1.

Technical barriers may force students out of more collaborative authoring environments: "I know there are technical [sic] barriers to accessing wiki from school environments, so to what degree are we willing to use wiki for our project?" This is an important consideration when designing environments in which facilitators would like to encourage more shared as opposed to off-loaded cognition.

Collaborative – synchronous approaches. This type of collaboration in the authoring of group project documents can happen in a number of ways. One person can write up ideas while group members chat. All group members could connect to the same co-authoring environment and make changes at the same time. For this educational experience, only one group seemed to have attempted to adopt this approach.

10:06:42 PM Barbara: When I was looking at the things other groups sent in, they were very simple. I can type on one computer while communicating with the other like we did last time. I just need a minute to change locations in my house.

This group worked on this mode at least twice during the semester. While this instance illustrates the collaborative – synchronous approach, the group also switched to more cooperative approaches at other points in time during the process.

Besides the analysis of transcript of group work through the variety of technologies, students also had the opportunity to share their opinions with regards to their approaches to collaborative authoring of their project documents through a question in the survey. Figure 2 illustrates these findings.

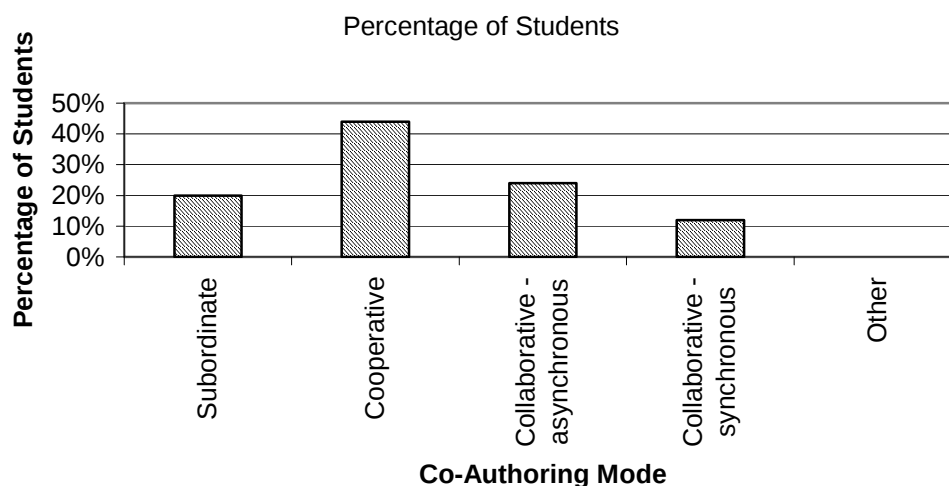


Figure 2: Co-Authoring Modes during the Final Stage of PBL

Students once again highlighted the cooperative mode as their approach for co-authoring. This was substantiated by the analysis of online documents as well. The other modes were also suggested as descriptive of their work during this stage to a lesser degree. The researchers found compatible evidence of all of them in their analysis of online documents.

Discussion and Conclusion

The stage of problem definition is really the first stage when groups start working together, adopt ideas for the project that might have been suggested by one group member and develop a shared understanding of the project requirements. As students grapple with meeting the project requirements, it is possible that the best strategy to get the work done is off-loaded cognition (Salomon, 1993). Fleshing out an idea among a group of peers is a process that entails a conversation exchange online students may not be able to afford. Reliance on synchronous exchanges may defeat the very purpose why students register in online courses: the flexibility of anytime education.

The authors invoke the metaphor of the long distance relay race and the use of baton. When individuals work asynchronously like the baton carriers, they exhibit a high degree of control and responsibility for their portion of the work. While each individual carries the baton, there is a great sense of responsibility for his or her own contribution. The asynchronous mode of working helps to protect one's ability to work in an uninterrupted fashion. Yet, working in this manner does not necessarily encourage responsibility for co-authoring or synergy in a shared cognition.

Asynchronous exchanges could potentially take students to a comfortable place where they all understand what they want to do given the assignment requirements. However, the consequent delay in responses provoked by the convenience of anytime education may make it counterproductive when students are also trying to achieve milestones. Subordinate approaches may be the result of attempts to meet early deadlines when a single member originally generated ideas adopted by the group and therefore has a better understanding in order to write them up for the project document. Students who defer to collaborative authoring during synchronous exchanges may have been adopting more traditional patterns of work that rely on face-to-face encounters rather than online ones.

The findings of this research study should be adopted with caution because of the size of the sample. They are nevertheless consistent with Sclater & Bolander's (2004) results. The present study invites reflection from the community of scholars interested in promoting online collaborative PBL. It was clear that students seem to favor the cooperative approach when co-authoring group documents. On the one hand, future research can help develop instructional designs that guide students to be collaborative without sacrificing their convenience during the learning process. Johnson & Johnson (2003) favored individual accountability. This can be established when students adopt the cooperative approach or engage in off-loaded activities. Sclater & Bolander's (2004) pathways to establish individual accountability may have impacted students' approaches to co-author project documents in deterring them from engaging in shared cognition. Such instructional design would have to strike a balance in which both individual accountability and shared cognition coexist in the online PBL environment. On the other hand, future work of scholars can help determine whether the combination of audience and online collaborative PBL context makes it necessary to give up shared cognition in favor of more cooperative or off-loaded approaches if they prove to be more beneficial for accomplishing learning goals. After all, student learning is what researchers are always striving to achieve.

References

- Bennett, S. (2004). Supporting collaborative project teams using computer-based technologies. In T. S. Roberts (Ed.), *Online collaborative learning: Theory and practice* (pp. 1-27). Hershey, PA: Information Science Pub.
- Hannafin, M., Oliver, K., Hill, J. R., & Glazer, E. (2003). Cognitive and learning factors in web-based distance learning environments. In M. G. Moore & W. G. Anderson (Eds.), *Handbook of Distance Education* (pp. 245-260). Mahwah, New Jersey: Lawrence Erlbaum Associates, Publishers.
- Johnson, D. W., & Johnson, R. T. (2003). Cooperation and the use of technology. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology: A project of the association for educational communications and technology* (2nd ed., pp. 785-811). Mahwah, NJ: Lawrence Erlbaum Associates.
- Sclater, M., & Bolander, K. (2004). Factors influencing students' orientations to collaboration in networked learning. In P. Goodyear, S. Banks, H. V & D. McConnell (Eds.), *Advances in research on networked learning* (pp. 175-203). Boston: Kluwer Academic Publishers.
- Salomon, G. (1993). No distribution without individual's cognition: A dynamic interactional view. In G. Salomon (Ed.), *Distributed cognitions: Psychological and educational considerations* (pp. 111-138). Cambridge, UK: Cambridge University Press.
- Sorenson, E. K., & Takle, E. S. (1999). Distributed collaborative learning across disciplines and national borders. In C. M. Hoadley & J. Roschelle (Eds.), *Proceedings of the Computer Support for Collaborative Learning (CSCL) 1999 Conference* (pp. 600-610). Palo Alto, CA: Stanford University.

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