PARALLEL-PATTERN VERSUS LINEAR-PATTERN DISCUSSION ONLINE COLLABORATIONS

A Thesis in
Instructional Systems
by
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ABSTRACT

While online learning can enable synchronous and asynchronous collaboration among distance learners, a lack of clarity exists regarding the nature of online collaboration for interaction effective patterns, and for methods for engaging in collaboration. A more effective learning environment could excite learners’ motivations, and, for instructors, could enhance the evaluation of the learning process while enabling faster conveyance of information. This investigation proposes the online interactional pattern “Parallel-pattern Collaboration (PPC),” which differs from the traditional “Linear-pattern Collaboration (LPC)” discussion. This investigation, which compares Google docs (PPC) discussion to ANGEL discussion boards (LPC), considers the effects of peers’ collaborative asynchronous interactions to explore the avenues by which students interact online in two different interactional environments. Henri (1992) and Cakir et al. (2005) described “desirable” and “less desirable” patterns, and this study uses these methods to characterize PPC and LPC from data obtained from participants (N=44), randomly divided into two groups. Based on the study’s results, Google Docs is more effective at increasing certain desirable learning interactions compared to ANGEL discussion boards. Understanding patterns of collaborative interactions that improves effective learning serves as a guide for designing instructional interventions.
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Chapter 1
INTRODUCTION

Online learning as a trend in education

Many researchers believe that online learning can develop students' motivations for learning (Lathrop, & Ruma, 2010) and increase learning’s depth (Mandernach, 2009). Online social network space provides engaging options for traditional classroom discussions, since students can explore lesson-topics at any time. Also, text-based responses recorded during online learning allow for later review. Online discussion systems add convenience to students’ tasks by enabling collaborative study from a distance and providing flexible scheduling. Furthermore, cooperation among teams may foster students’ abilities to solve problems encountered during study (Lathrop, & Ruma, 2010), and consequently, allow improved understanding of difficult concepts.

“Online discussion” in this study refers to a collaboration approach for students’ learning in online environments, in which students cooperate through sharing information and experiences to accomplish a common learning goal (Jonassen, Davidson, Collins, Campbell, & Haag, 1995; Palloff & Pratt, 2007). From a constructivist perspective, collaborative learning can stimulate students’ to discuss information from different perspectives, simplifying complex problems; furthermore, collaborative learning as a learning method can make learning more realistic and so stimulates students’ motivations (Veerman & Veldhuis-Diermanse, 2001, p. 625). Thus, this process may develop students’ higher order thinking skills to leading to a generation of richer knowledge (Brookfield, 1995).

Compared to synchronous counterparts, asynchronous text-based online discussion boards provide students with opportunities to interact with each other and provide more time to reflect and think. When students reply to others’ responses, they can stop and search for additional information before contributing to the discussion (De Wever, Schellens, Valcke & Van Keer, 2006). Comments are usually more thoughtful; however, during offline periods, students tend to perpetuate and even strengthen convictions arising from initial knowledge at the expense of attaining a “fuller” understanding from the unique contributions from others (Stasser & Titus, 1985). Moreover, text-based online discussion renders the collaborative process more transparent; that is, students read the initial posts and reply with posts to other students. In
addition, the instructor can read and evaluate the group’s collaborative process and balance individual contributions to that process. The online transcripts become useful as a basis for future analysis of data (Meyer, 2004) and for reflection by both students and instructors (Macdonald, 2003, p. 378).

The purpose of studying online learning

Although researchers seem to agree that online learners can gain from others’ interactions (Capdeferro & Romero, 2012), no clear theory exists to guide research of computer-mediated interactions (Stahl, 2003). Identification of, and agreeing to, the empirical indicators to form the basis of a coding instrument as a standard to evaluate whether or not effective learning occurs during online discussions are difficult (Gunawardena, Carabajal, & Lowe, 2001). To a certain degree, results of collaborative learning depend on learners’ contributions, and demanding students to gain certain perceptions and actually contribute is nearly impossible.

Currently online collaborative learning primarily uses text and asynchronous messages. A delay of interactions and feedback often leads to specific frustrations with online Computer Supported Collaborative Learning (CSCL) (Capdeferro & Romero, 2012). Perhaps improvements to layouts of traditional discussion boards could improve scanning of the initial topic and others’ comments simultaneously, since rereading entire threads (especially long ones) each time the student wants to post is inconvenient. A partial solution could be informed structuring of the conversation by the participants, for example copying and pasting a portion of the initial post into an added comment. But typically when a student replies to an initial on-topic post, connecting with the previous post becomes problematic, since the student replying to the initial post may forget some of the important, original, substantive aspects mentioned earlier. Consequently a second comment to the first is even further from the initial on topic post.

This typical pattern described above represents “linear-pattern” activity, with the initial post above and comments following below; in contrast to a “parallel-pattern” where initial posts and comments to that post are side-by-side on the screen. A parallel pattern would allow the student to easily view specific parts of the initial post and so their comments to that post should be relevant to the post. In contrast, linear-pattern conversations may weaken the impact of connections to the specific initial post topic. Thus, this investigation explores the characteristics of patterns of online responses to increase students’ desired learning performance with a “linear-
pattern” compared to a “parallel-pattern” response approach. The goal is a more effective collaborative pattern to overcome the negatives of reducing missing, relevant information.

**Statement of the problem**

Participation in discussions depends on the context and situational description. Some online classes only state that students need to finish discussion activities, while others have carefully constructed and clear rules for participants’ interactions in the discussion (e.g., Dennen, 2000; Jeong & Joung, 2004; Jonassen & Remidez, 2005). Generally, many methods exist for establishing an undergraduate online discussion, but most have three aspects: (a) individually read specific course content (usually a textbook chapter), (b) check for an individual’s understanding (usually a short quiz or summary paragraph), and then (c) interact within a group task (such as answering high-order questions, creating a diagram of a process, a concept map of content, or critique of others’ writing). Instructors have their own preferences.

In online classes, students often receive points and grades for the messages that they post to class’ forums. General experience indicates that instructors tend to assess learners’ performance holistically, taking into consideration overall contribution in terms of quantity, quality, and participation within the class’ community. In this approach, clearly communicating expectations to students is challenging, but proper directions or grading rubrics may encourage learners to invoke personally useful metacognitive strategies to engage in dialogue rather than thoughtless postings.

Based on different contexts and assignments’ requirements, various rubrics can be used to measure the online discussions. No consensus exists for the best measurements for online discussions. According to the asynchronous discussion instrument of Gunawardena, Lowe, and Anderson (1997), the amount of knowledge constructed within a discussion is an important measure of learning. In addition, Pena-Shaff and Nicholls (2004) developed an instrument to evaluate the process of constructing knowledge from online discussions. We chose to follow the instruments of Gunawardena et al. (1997) and Pena-Shaff and Nicholls (2004), because those techniques seem sensible for this research. From quantitative analysis of participation and interaction rates, discussions with peers have acceptance for fostering learning (Pena-Shaff & Nicholls, 2004). For this instrument, social-constructivist learning theory supported the
theoretical framework. Moreover, students should be actively involved in a social, conversational process of construction in knowledge environments (Pena-Shaff & Nicholls, 2004).

Barron (2003) said that the “quality of interaction had implications for learning” (p. 307). Students learning effectively in groups encourage each other to ask questions, explain and justify their opinions from different perspectives, articulate their reasoning, and elaborate and reflect upon their knowledge (Soller, 2001).

In exploring collaborative learning discussions, as far as we can determine, these experts have not considered the notion of a parallel-pattern collaboration (PPC). PPC is any design that encourages students’ responses to be directly connected with the initial post topic content. An example is a Google docs discussion, that can keep the initial topic always present as students highlight an aspect by commenting in a sidebar (see Figure 1-1). In contrast, an ANGEL discussion, perhaps due to the linear layout (i.e., comments appear below initial posts rather than alongside) tends to encourage students to respond generally to others’ posts, therefore, ANGEL discussion boards in this study represent “Linear-pattern collaboration” (LPC), which means that the initial posts and the responses are shown in the linear view (see Figure 1-2). On the other hand, in Google docs discussions, due to most students’ responses “surrounding” and pointing to the specific topic. To comment, a student can “highlight” a specific sentence in the post and comment on that sentence. Thus, students may gain more specific and perhaps effective on-topic information from collaborative learning and thereby foster motivation for learning.
Figure 1-1: Group AA: ANGEL Discussion
Figure 1-2: Group BB: Google docs Discussion

Subsequent to this introduction is a literature review in Chapter 2. The literature review considers the factors influencing online learning processes from theories, frameworks on collaborative learning, and convergence of social constructivist theories and knowledge. Moreover, this study characterizes “desirable” and “less desirable” patterns of discussion using Henri (1992) and Cakir et al. (2005) as guidelines.


Chapter 2

LITERATURE REVIEW

Participation’s effect on online learning process

In online learning activities, group work is a commonly used method. Based on a collaborative learning framework, group work can contribute to the development of a collaborative and participatory learning environment. In addition, from a social-constructivist perspective, learners’ participation and interaction are most critical for learning performance and outcomes.

In online discussion, learners can read a topic’s materials and each other’s messages, share thoughts and experiences, ask questions, and provide feedback. What an individual learns in an online discussion activity depends then to some degree on that individual’s approach for communicating with others. Holliman and Scanlon (2006) found that active and passive participants provide comments to each other and produce better team reports (on media coverage of a controversial topic) compared to non-participants. In this context, interactions with others’ responses or even just reading others’ comments (i.e., passive participants) affect and improves learners’ knowledge. Thus, collaborative learning processes are highly dependent on the shared conversations’ content and patterns of interactions established among the participants. Students can gain more information from an effective learning group or a knowledgeable student in the discussion group.

How patterns of interaction affect the online learning process

Researchers have attempted to identify which patterns of interaction can affect construction of knowledge (Jeong & Hmelo-Silver, 2008; Puntambekar, 2006). First, learning occurs in “two or more students sharing information through online interactions” and the accepted notion is that this reflects the process of constructing knowledge. In addition, transmission of knowledge can occur among participants when students with less information gain from a knowledgeable partner. In contrast, less shared knowledge lowers the efficiency of collaboration. In this context, measurement and presence of learning appears from the quality of conversation and the rate of group interactions. Consequently, this current investigation’s interest is the degree of influence of PPC and LPC on the amounts and quality of interactions. Therefore,
emphasis is on use of collaborative learning and participants’ interactions in order to optimize learning (Matusov, Bell, & Roger, 2002).

Learners reconstruct existing knowledge and establish new structures of knowledge by reflecting on their own and other group members’ perspectives (De Lisi & Goldbeck, 1999; Fischer, Kollar, Mandl, & Haake, 2007; Hogan & Tudge, 1999). Based on Piaget’s learning theory, socio-cognitive conflicts elicit reflective behavior. Within this cognitive-developmental approach, learners need to explore methods of recognizing and confronting the knowledgeable conflicts (Asterhan & Schwarz, 2009; Sacco & Bucciarelli, 2008). The issues becomes whether or not PPC and LPC influence the amount of conflict, and whether or not a design like Google docs (PPC) that only allows highlighting and commenting on specific ideas in others’ posts supports socio-cognitive conflict better than a design like ANGEL (LPC).

More recently, researchers turned attention to the approach of cognitive elaboration, which highlights the importance of cognitive processing during interaction and attempts to explore the reasons for promoting learning of academic content (e.g., Barron, 2003; Staarman, Krol, & van der Meijden, 2005; Webb & Palincsar, 1996). The main idea of the approach of cognitive elaboration is that explicit expansion of knowledge leads to processes of cognitive elaboration that, arguably, cause changes in the structures of knowledge (Cohen, 1994; Van Boxtel, van der Linden, & Kanselaar, 2000). How will Google docs (PPC) and ANGEL (LPC) influence the amount of elaboration?

The presence of cognitive elaboration has several indications including the number of on-topic conversations indicated by measuring the content of responses, the length of responses and number of on-task contributions. Research findings have shown the positive influence these indicators have for individuals; acquisition of knowledge (Barab & Duffy, 2000; Cohen, 1994). By analyzing these indicators, researchers found that increased and effective elaboration requires more participation (Weinberger & Fischer, 2006).

Besides these indicators, the quality of elaboration is another important factor for evaluating interrelated conversations that foster the construction of knowledge in more detail (Strijbos & Stahl, 2007). Henri (1992) classified discussion responses with five dimensions: (1) students’ participation rates, (2) patterns of electronic interactions, (3) social cues within students’ messages, (4) cognitive and metacognitive components of students’ messages, and (5) depth of processing-surface or deep-within messages posting. These models serve as a useful method to
analyze asynchronous discussions, but they are “not very specific on how to evaluate the process of knowledge construction that occurs through social negotiation in computer-mediated communication (CMC)” (Gunawardena et al., 1997, p. 402).

So the interactional sequences’ patterns likely play a particularly pivotal role in searching and receiving information (King, 1999; Mäkitalo, Weinberger, Häkkinen, Järvelä, & Fischer, 2005). Thus, some researchers have engaged in identifying different patterns of interactions that have positive relations to learning.

**Others’ patterns of online discussion**

By exploring different patterns of interactions, some researchers found that response-length and social interaction can provide a useful, initial orientation for analyzing collaborative learning processes in online learning environments. Counting messages is a measure of students’ participation and the mean number of words is a rough indicator of message quality. Counting reply times, direct responses, and indirect responses garner further details for understanding the underlying mechanisms of group interactions regarding students’ communications, interactions, and collaborations (Strijbos & Stahl, 2007). Also, researchers’ reconstruction of the structures of responses (as patterns) provides important evidence for development of a coding procedure of online communications.

Cakir et al. (2005) noted that the frequently observed interactive patterns of dyads and triads are two conversational structures in online collaborative learning (see Figure 2-1 and Figure 2-2). Informal conversation is turn-taking: a given posting normally responds to the previous posting. In online discussion, an initial post establishes explicit response relationships. The Cakir et al. (2005) approach makes use of the discussion’s information of the collaborative session to construct a graph that represents the interactional flow, with each node denoting the content, including the complete information from the recorded transcript. Traversing the graph shows the most frequently occurring structures of dyads and triads, and subsequent analysis identifies the patterns of collaboration and sequential organization of interactions under such specific settings (Strijbos & Stahl, 2007). The diagram shows that “B” replies to “A” in a dyad structure. In a triad structure, two situations exist: One is “B” and “C” replying to “A”, the other is “B” responding to “A” and “C” responds to “B” (see Figure 2-1 and Figure 2-2). I will describe the interactions in this current investigation as dyads and triads.
Prior to the current investigation, in the summer of 2012, an online course, IST 110, explored the interaction pattern of an ANGEL discussion board. The discussion approach used in the summer pilot study and in the actual investigation involved (a) individually reading an opinion essay on multitasking, (b) individually researching multitasking and gathering evidence, (c) individually writing a substantial personal opinion of multitasking, supported by evidence, and posting the results on the discussion’s forum (referred to here as the initial post), (d) contributing at least two substantial replies to classmates’ posts (referred to here as responses). Counts of initial posts, 1st responses, and 2nd responses to analyze the ratio revealed that the ANGEL summer pilot discussion board matched Cakir’s et al. (2005) dyadic interaction structure (see Table 2-1 and Figure 2-1). Participants replied to initial posts and did not reply to any sub-posts. This interactional structure is simple. The results showed, however, that the occurrence of integration of others’ responses into posters’ messages did not occur to a great extent.
Table 2-1. Summer 2012 IST 110 Discussion Response Diagram (the number represents word count)

<table>
<thead>
<tr>
<th>Initial Post</th>
<th>1st Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-01 (344)</td>
<td>&gt; S-08 (197)</td>
</tr>
<tr>
<td>S-02 (612)</td>
<td>&gt; S-04 (203)</td>
</tr>
<tr>
<td></td>
<td>&gt; S-09 (128)</td>
</tr>
<tr>
<td>S-03 (314)</td>
<td>&gt; S-07 (184)</td>
</tr>
<tr>
<td></td>
<td>&gt; S-02 (161)</td>
</tr>
<tr>
<td>S-04 (609)</td>
<td>&gt; S-10 (125)</td>
</tr>
<tr>
<td></td>
<td>&gt; S-07 (144)</td>
</tr>
<tr>
<td></td>
<td>&gt; S-11 (167)</td>
</tr>
<tr>
<td>S-05 (338)</td>
<td>&gt; S-01 (198)</td>
</tr>
<tr>
<td></td>
<td>&gt; S-02 (123)</td>
</tr>
<tr>
<td>S-06 (677)</td>
<td>&gt; S-03 (156)</td>
</tr>
<tr>
<td>S-07 (358)</td>
<td>&gt; S-09 (160)</td>
</tr>
<tr>
<td></td>
<td>&gt; S-04 (227)</td>
</tr>
<tr>
<td>S-08 (474)</td>
<td>&gt; S-03 (109)</td>
</tr>
<tr>
<td></td>
<td>&gt; S-06 (272)</td>
</tr>
<tr>
<td>S-09 (439)</td>
<td>&gt; S-10 (108)</td>
</tr>
<tr>
<td></td>
<td>&gt; S-08 (205)</td>
</tr>
<tr>
<td>S-10 (415)</td>
<td>&gt; S-06 (158)</td>
</tr>
<tr>
<td></td>
<td>&gt; S-11 (94)</td>
</tr>
<tr>
<td>S-11 (465)</td>
<td>&gt; (none)</td>
</tr>
</tbody>
</table>

Table 2-2. Summer 2012 IST 110

<table>
<thead>
<tr>
<th></th>
<th>Initial posts</th>
<th>1st response</th>
<th>2nd response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Responses</td>
<td>11</td>
<td>19</td>
<td>0</td>
</tr>
<tr>
<td>Average words per response</td>
<td>470.7</td>
<td>164.2</td>
<td></td>
</tr>
<tr>
<td>St. Dev.</td>
<td>132.6</td>
<td>45.7</td>
<td></td>
</tr>
<tr>
<td>Ratio</td>
<td>19/11 = 1.73</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Research Questions

The data from the summer of 2012 pilot showed a clear dyadic pattern. The dyadic structure of the pilot suggests that students were posting just to complete the minimum requirements of the assignment, but there were no follow-up interactions. I consider that the affordances of Google docs might encourage secondary postings, which implies more collaboration or at least more interaction. The proposed research questions are part of a larger research project, which will investigate different types of collaborative practices in online courses, also using analysis of online interactions in the discussion forums and online posts produced by students’ differing discussion patterns. Therefore, the goal is to continue to consider the patterns of response in discussion forums with particular interest in distinguishing the patterns that characterize more or less effective groups. This investigation focuses on LPC as an ANGEL discussion and PPC as a Google docs discussion.

Research Questions:

1. Does the student participate differently in Google (PPC) docs discussions compared to ANGEL (LPC) discussions?
   a. Do the quantity of responses, including 1<sup>st</sup> responses and 2<sup>nd</sup> responses, that initial posts receive occur more frequently in Google docs compared to ANGEL discussions?
   b. Do Google docs discussions gain more on-topic responses compared to ANGEL discussions?
   c. Does the quality of 1<sup>st</sup> and 2<sup>nd</sup> responses differ with Google docs compared to ANGEL discussions?

2. What are the patterns of discussions in Google docs and ANGEL discussions in online learning environments?

Answering these research questions considers two measures: in my investigation: “participation” and “patterns of discussion.” Specific research procedures appear in Chapter 3.
Chapter 3
RESEARCH PROCEDURES

Participants
This investigation was conducted with an IST110 online course of volunteering undergraduate students (N=44) at the Pennsylvania State University (PSU). The class accessed an asynchronous or delayed computer supported learning environment as partial replacement for traditional classroom discussions. Since asynchronous electronic discussion has time and place independence, it may foster depth and peer responsiveness, compared to synchronous discussions (Bonk, Hansen, Grabner-Hagen, Lazar, & Mirabelli, 1998). This research does not collect data for gender, ethnicity and race for variables, and so excludes those factors.

Consent and IRB
The Office for Research Protections (ORP) at PSU approved a proposal that detailed the procedures for the study, IRB#39016. All of the students’ recorded responses were for Lesson 10 for the ANGEL discussion board and one Google Docs document. This data is confidential, and access to the record of ANGEL discussion boards required security confirmation from the IST110 instructor. Individuals can visit the record for Google Docs via the Google Docs link and can only have permission for “comments.”

Discussion activity distribution and participant rate
During the 2012 fall semester, the discussion activity occurred online, via ANGEL discussion boards (Pennsylvania State University course management system) and the Google Docs discussion tool, docs.google.com. Students in the IST 110 online class received invitations to participate in the discussion activity. The instructor used ANGEL to randomly divide the participants (N=44) into two groups: The activity group for ANGEL discussions, Group AA, had 23 students all with permission to access their ANGEL account to finish the assignment via the discussion boards. The Google Docs discussion activity group, Group BB, had 21 students, who received directions to a URL for the Google document, to complete the assignment in that environment. This assignment provided students in both groups with parallel directions for completing the assignment before November 15, 2012. A differential mortality (e.g., Group AA
final n = 13 and Group BB final n = 18) limits generalizability of results, some students dropped the IST110 class. The reason for the lopsided mortality among the ANGEL group’s members is unknown.

The steps of this assignment for Group AA (ANGEL discussion activity) and Group BB (Google Docs discussion activity) were the same and included four steps: Every student, individually, was required to: (1) **read** the *Crosscurrents* essay on "Multitasking" by Ellen Goodman (see *Digital Planet* Chapter 12), (2) **write** and then post an assessment of Goodman's article and reflections on the long-term consequences of human multitasking for both individuals and society, (3) **find** and **cite** at least three academic references (citations should be in APA style), and (4) **reply** to at least two other posts 24 hours later via ANGEL (Group AA) or Google Docs (Group BB) (see Appendix A and B). In summary, students were responsible for reading Chapter 12 regarding Multitasking and posting a unique and substantial response to the original question, along with at least two substantial responses to classmates’ posts. The instructor provided the discussion activity’s grading rubric to evaluate students’ performances. This rubric guided students when completing discussion activities for the grading criteria (see Appendix C).

**Measures**

This investigation measured participation and patterns of responses’ quantity. The measures of participation included the average number of responses received per initial participant from others, numbers of topical questions posted by students, numbers of responses from second responses, average numbers of responses by category, numbers of on-topic and off-topic responses, word count of responses, and numbers of off-topic responses posted per participant. Measurements included patterns of responses by following PPC and LPC regarding topical comments as compared to comments directed toward other students’ posts.

The results reported 62 total discussion responses and compared the ANGEL discussions with the Google Docs. Calculations from the entire sample provided descriptive statistics for the numbers of students’ responses, allowed creating graphs of the patterns, and computed the standard of word numbers in responses via SPSS statistics software. By computing the mean value of the number of responses that the initial posts received, ANGEL obtained 1.8 comments per student and Google docs, 2.4 comments per student, and the t-test value is $p = 0.43$, which is
not significant at the $p = 0.05$ level. This research used “on-topic,” “off-topic,” “patterns,” “response category,” and “response length” as variables to compare the two discussion patterns.

**Table 3-1. Categories of Students’ Responses**

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>On-topic</strong></td>
<td>The response related to the topic directly or the argument supported to the topic.</td>
</tr>
<tr>
<td><strong>Off-topic</strong></td>
<td>The response is unrelated to the topic directly.</td>
</tr>
<tr>
<td><strong>Question</strong></td>
<td>The response asks a question, which relate to the topic.</td>
</tr>
<tr>
<td><strong>EBS</strong></td>
<td>Experience-Based Support. The response reflects the student’s experiences.</td>
</tr>
<tr>
<td><strong>ARE</strong></td>
<td>Argument, Reason and Evidence. Students’ personal arguments, reasons, or evidence other than the original article and references supports the response.</td>
</tr>
<tr>
<td><strong>RBS</strong></td>
<td>Research-Based Support. The responses referenced the original article and other research.</td>
</tr>
</tbody>
</table>

In summary, the measurements considered two treatments (PCC and LCC), “participation” and “patterns of interaction,” from the quantity and quality of students’ responses. Results appear next in Chapter 4.
Chapter 4

RESULTS AND DISCUSSION

Part I: Results

Participation Measures

During this activity, 13 students dropped the class due to their personal reasons (i.e., 44 total – 13 dropped = 31 participants). Thus, the 31 students’ initial posts consist of 13 with ANGEL (Group AA) and 18 with Google docs (Group BB). Group AA’s initial posts received 24 total reply responses representing an average 1.8 responses per student (note: the grading rubric required 2 responses), 23 students directly replied to the initial posts and only 1 student replied to another student’s response. In contrast, using the same calculations for Group BB, initial students’ posts were 18 and these garnered 44 responses, representing an average of 2.4 responses per student (note: this exceeds the required 2.0 responses). For Group BB, 35 students directly replied to initial posts, and 9 students replied to other students’ responses (see Table 4-1). Further, some students’ initial posts received NO replies. In Group AA, 10 students’ initial posts received replies, and 3 received no replies, averaging 23% (3/13) non-responses. In contrast, in Group BB, 15 initial posts received replies and 3 initial posts did not receive replies. The average of those not receiving a reply is 17% (3/18).

<table>
<thead>
<tr>
<th>Table 4-1. Number of Responses Received</th>
</tr>
</thead>
<tbody>
<tr>
<td># of initial substantive responses</td>
</tr>
<tr>
<td>Group AA</td>
</tr>
<tr>
<td>Group BB</td>
</tr>
</tbody>
</table>

The average length of initial substantive posts for Group AA (ANGEL) was 583.5 words and for Group BB (Google docs) was 604 words (note, the ANGEL summer pilot was 470.7 words). There are only 21 words (3% of total) difference between Group AA and Group BB initial substantive posts. This would be expected since the two treatments were identical up to the point of submitting the initial posts.
In contrast, the average word count for first reply responses for Group AA was 157.5 words and for Group BB was 79.2 words (note, the summer pilot program was 164.2 words). First responses to the initial post in Group BB were about half as long as Group AA and as the summer pilot (see Table 4-2).

Table 4-2. Pilot IST110 Summer 2012: ANGEL, 11 initial posts (1.73)

<table>
<thead>
<tr>
<th>Count</th>
<th>Initial post</th>
<th>1st response</th>
<th>2nd response</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>11</td>
<td>19</td>
<td>none</td>
</tr>
<tr>
<td>Average words</td>
<td>470.7</td>
<td>164.2</td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>132.6</td>
<td>45.7</td>
<td></td>
</tr>
</tbody>
</table>

Table 4-3. Group AA: ANGEL, 13 initial posts (1.85)

<table>
<thead>
<tr>
<th>Count</th>
<th>Initial post</th>
<th>1st response</th>
<th>2nd response</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>13</td>
<td>23</td>
<td>1</td>
</tr>
<tr>
<td>Average words</td>
<td>583.5</td>
<td>157.5</td>
<td>150.0</td>
</tr>
<tr>
<td>SD</td>
<td>171</td>
<td>97.2</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Table 4-4. Group BB: Google Docs, 18 initial posts (2.39)

<table>
<thead>
<tr>
<th>Count</th>
<th>Initial post</th>
<th>1st response</th>
<th>2nd response</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18</td>
<td>35</td>
<td>9</td>
</tr>
<tr>
<td>Average words</td>
<td>604</td>
<td>79.2</td>
<td>85.7</td>
</tr>
<tr>
<td>SD</td>
<td>183.6</td>
<td>46.0</td>
<td>47.3</td>
</tr>
</tbody>
</table>

Results of Analysis of Content and Quality

The summary analysis of content and quality for every student response are shown next. For the purposes of anonymity, the names of the students are reduced to first and last initials. For example, in Group BB, student BG posted an initial post and gave the on-topic responses to JE, DP, WH, and CH (see Table 4-5 and Table 4-6).
Table 4-5. Group AA, 24 Responses, One Off-topic Response.

<table>
<thead>
<tr>
<th>Initial Post</th>
<th>1st Response</th>
<th>2nd Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>CW (600)</td>
<td>&gt;SK: (off-topic, no question, 30)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;DK: (on-topic, question, EBS, 142)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;DB: (on-topic, no question, ARE, 75)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;LA: (on-topic, no question, EBS, 83)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;KD: (on-topic, question, ARE, 140)</td>
<td></td>
</tr>
<tr>
<td>KD (880)</td>
<td>&gt;LA: (on-topic, no question, ARE, 35)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;MA: (on-topic, no question, EBS, 145)</td>
<td></td>
</tr>
<tr>
<td>FD (720)</td>
<td>&gt;KD: (on-topic, no question, ARE, 170)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;MA: (on-topic, no question, EBS, 80)</td>
<td></td>
</tr>
<tr>
<td>MA (683)</td>
<td>&gt;BS: (on-topic, no question, ARE, 125)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;BK: (on-topic, no question, ARE, 260)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;DK: (on-topic, question, ARE, 380)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;DB: (on-topic, question, ARE, 103)</td>
<td></td>
</tr>
<tr>
<td>DK (782)</td>
<td>&gt;(NONE)</td>
<td></td>
</tr>
<tr>
<td>SK (655)</td>
<td>&gt;SB: (on-topic, question, ARE, 300)</td>
<td>&gt;CJ: (on-topic, no question, ARE, 150)</td>
</tr>
<tr>
<td></td>
<td>&gt;LAZ: (on-topic, no question, ARE, 100)</td>
<td></td>
</tr>
<tr>
<td>DB (635)</td>
<td>&gt;(NONE)</td>
<td></td>
</tr>
<tr>
<td>BK (760)</td>
<td>&gt;SB: (on-topic, no question, ARE, 280)</td>
<td></td>
</tr>
<tr>
<td>SB (550)</td>
<td>&gt;LAZ: (on-topic, no question, ARE, 120)</td>
<td></td>
</tr>
<tr>
<td>CJ (420)</td>
<td>&gt;SK: (on-topic, no question, EBS, 80)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;BK: (on-topic, no question, RBS, 360)</td>
<td></td>
</tr>
<tr>
<td>LA (420)</td>
<td>&gt;FD: (on-topic, no question, RBS, 150)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;CJ: (on-topic, no question, RBS, 220)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;BS: (on-topic, no question, ARE, 125)</td>
<td></td>
</tr>
<tr>
<td>LAZ (860)</td>
<td>&gt;(NONE)</td>
<td></td>
</tr>
<tr>
<td>BS (480)</td>
<td>&gt;FD: (on-topic, no question, ARE, 120)</td>
<td></td>
</tr>
</tbody>
</table>
### Table 4-6. Group BB, 44 Responses, One off-topic response.

<table>
<thead>
<tr>
<th>Initial Post</th>
<th>1st Response</th>
<th>2nd Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>EA (735)</td>
<td>&gt;JB: (on-topic, no question, EBS, 90)</td>
<td>&gt;&gt;DG: (on-topic, no question, ARE, 144)</td>
</tr>
<tr>
<td></td>
<td>&gt;RP: (on-topic, question, ARE, 63)</td>
<td>&gt;&gt;LB: (on-topic, no question, EBS, 72)</td>
</tr>
<tr>
<td></td>
<td>&gt;LB: (on-topic, no question, EBS, RBS, 225)</td>
<td>&gt;&gt;MC: (on-topic, no question, ARE, 72)</td>
</tr>
<tr>
<td>RP (435)</td>
<td>&gt;DG: (on-topic, no question, EBS, 36)</td>
<td>&gt;&gt;CS: (on-topic, no question, ARE, 108)</td>
</tr>
<tr>
<td></td>
<td>&gt;MC: (on-topic, no question, RBS, ARE, 126)</td>
<td>&gt;&gt;LB: (on-topic, question, EBS, 144)</td>
</tr>
<tr>
<td></td>
<td>&gt;EA: (on-topic, no question, EBS, 108)</td>
<td>&gt;&gt;NA: (on-topic, no question, ARE, 37)</td>
</tr>
<tr>
<td>JB (390)</td>
<td>&gt;LB: (on-topic, question, ARE, 63)</td>
<td>&gt;&gt;CS: (on-topic, no question, ARE, 90)</td>
</tr>
<tr>
<td></td>
<td>&gt;MM: (on-topic, no question, EBS, 90)</td>
<td>&gt;&gt;LB: (on-topic, no question, ARE, 37)</td>
</tr>
<tr>
<td></td>
<td>&gt;RP: (on-topic, no question, ARE, 45)</td>
<td>&gt;&gt;BG: (on-topic, no question, EBS, 21)</td>
</tr>
<tr>
<td></td>
<td>&gt;TG: (on-topic, no question, EBS, 90)</td>
<td>&gt;&gt;JE: (on-topic, no question, ARE, 21)</td>
</tr>
<tr>
<td>MM (540)</td>
<td>&gt;CH: (on-topic, no question, EBS, 162)</td>
<td>&gt;&gt;CS: (on-topic, no question, EBS, ARE, 90)</td>
</tr>
<tr>
<td></td>
<td>&gt;CM: (on-topic, no question, EBS, 72)</td>
<td>&gt;&gt;LB: (on-topic, no question, ARE, 37)</td>
</tr>
<tr>
<td></td>
<td>&gt;JT: (on-topic, no question, EBS, 90)</td>
<td>&gt;&gt;BG: (on-topic, no question, EBS, 21)</td>
</tr>
<tr>
<td></td>
<td>&gt;MC: (on-topic, question, ARE, 108)</td>
<td>&gt;&gt;JE: (on-topic, no question, ARE, 110)</td>
</tr>
<tr>
<td>LB (555)</td>
<td>&gt;EA: (on-topic, no question, ARE, 72)</td>
<td>&gt;&gt;CS: (on-topic, no question, ARE, 144)</td>
</tr>
<tr>
<td></td>
<td>&gt;CM: (on-topic, no question, ARE, 72)</td>
<td>&gt;&gt;LB: (on-topic, question, EBS, 162)</td>
</tr>
<tr>
<td></td>
<td>&gt;MC: (on-topic, question, EBS, 144)</td>
<td>&gt;&gt;MG: (on-topic, no question, EBS, 108)</td>
</tr>
<tr>
<td></td>
<td>&gt;MM: (on-topic, no question, EBS, 75)</td>
<td>&gt;&gt;BG: (on-topic, no question, EBS, 72)</td>
</tr>
<tr>
<td>CM (810)</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>DG (525)</td>
<td>&gt;JT: (on-topic, no question, ARE, 36)</td>
<td>&gt;&gt;CS: (on-topic, no question, ARE, 108)</td>
</tr>
<tr>
<td></td>
<td>&gt;MG: (on-topic, no question, EBS, 45)</td>
<td>&gt;&gt;BG: (on-topic, no question, ARE, 84)</td>
</tr>
<tr>
<td>CH (360)</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>MC (915)</td>
<td>&gt;JF: (on-topic, no question, ARE, 45)</td>
<td>&gt;&gt;CS: (on-topic, no question, ARE, 108)</td>
</tr>
<tr>
<td></td>
<td>&gt;BG: (on-topic, no question, ARE, 45)</td>
<td>&gt;&gt;BG: (on-topic, no question, ARE, 84)</td>
</tr>
<tr>
<td></td>
<td>&gt;MC: (off-topic, no question, 21)</td>
<td>&gt;&gt;JE: (on-topic, no question, ARE, 37)</td>
</tr>
<tr>
<td>BG (420)</td>
<td>&gt;DP: (on-topic, no question, EBS, 110)</td>
<td>&gt;&gt;CS: (on-topic, no question, EBS, ARE, 108)</td>
</tr>
<tr>
<td></td>
<td>&gt;CH: (on-topic, question, EBS, ARE, 162)</td>
<td>&gt;&gt;BG: (on-topic, no question, ARE, 84)</td>
</tr>
<tr>
<td>JT (255)</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>JE (615)</td>
<td>&gt;BG: (on-topic, no question, ARE, 37)</td>
<td>&gt;&gt;CS: (on-topic, no question, EBS, ARE, 90)</td>
</tr>
<tr>
<td>DP (540)</td>
<td>&gt;MG: (on-topic, no question, EBS, 54)</td>
<td>&gt;&gt;LB: (on-topic, no question, EBS, 72)</td>
</tr>
<tr>
<td></td>
<td>&gt;BG: (on-topic, no question, EBS, 21)</td>
<td>&gt;&gt;NA: (on-topic, no question, ARE, 37)</td>
</tr>
<tr>
<td></td>
<td>&gt;JE: (on-topic, question, ARE, 110)</td>
<td>&gt;&gt;BG: (on-topic, no question, ARE, 84)</td>
</tr>
<tr>
<td>CS (765)</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>TG (690)</td>
<td>&gt;WH: (on-topic, no question, ARE, 37)</td>
<td>&gt;JF: (on-topic, no question, ARE, 33)</td>
</tr>
<tr>
<td>JF (510)</td>
<td>&gt;JE: (on-topic, no question, EBS, 101)</td>
<td></td>
</tr>
<tr>
<td>MG (555)</td>
<td>&gt;WH: (on-topic, no question, EBS, ARE, 99)</td>
<td></td>
</tr>
<tr>
<td>WH (960)</td>
<td>&gt;BG: (on-topic, no question, ARE, 30)</td>
<td></td>
</tr>
</tbody>
</table>

**On-topic and off-topic**

Chapter 3 provides definitions for on-topic and off-topic responses. In this research, an on-topic response directly relates to the initial topic (e.g., a reflection on “multitask”) or supports the topic. Responses that are not very related to “multitask” or are unrelated to “multitask” are off-topic. Example 1 illustrates responses: Student DP in the Google docs group’ initial post was 540 words long. MG gave the on-topic response to DP. Example 2 shows an off-topic response from student MC. Example 3, 4 and 5 illustrate the categories of responses (ARE, EBS and RBS).

**Example 1**

Portion of initial post from DP:

“Not only was I aware the human brain is unable to carry out multiple tasks efficiently but also how erroneous multitasking can be in the workplace. While some companies see multitasking as a way to maximize a human’s capabilities, others consider it counterproductive” (Discovering Multitasking Behavior at Work: A Context-Based Ontology).

An **On-topic** response to DP from MG:

“I agree with your opinion on how multitasking in a work place can be counterproductive. I work in the photo lab at a CVS where I am expected to take care of developing film, customer service, and answering the phone and I find myself stressed and I lagging behind in my tasks.”
In the initial post, student DP gave evidence of counterproductive multitasking’s in a work place. First, student MG indicted agreement. Then, used personal experience as an example to provide evidence for support, rendering the response as on-topic and EBS.

Example 2

An **Off-topic** response to MC from herself:

“Sorry these aren't indented correctly...I was afraid if I messed with it, it would screw up everyone's formatting!”

In this response, student MC added a comment to herself about the reference format and therefore, an indirect response and obviously off-topic.

Example 3

Another portion of the initial post from DP:

“One of my biggest concerns with multitasking is how our younger generation depends on it.”

An **ARE** response to DP from JE:

“I couldn't agree more with that statement. The need to be constantly connected to the Internet and media is strong in the younger generation. They learn how to multitask but they don't learn how to analyze and think critically. I wonder where they learn to multitask? Do they learn it from watching their parents multitask or is it because there are so many avenues of communication now that they feel they need to monitor them all? Whatever the answer is the education system needs to teach kids to focus on one task at a time rather than barely complete a bunch.”

Students’ personal arguments, reasons, and evidence, other than the original article and references represent ARE responses. JE agreed with the initial post that the younger generation is dependent on multitasking, then offered personal arguments and reasons to support the younger generation’s need to learn to multitask.
Example 4

An **EBS** response from MG:

“I agree with your opinion on how multitasking in a work place can be counterproductive. I work in the photo lab at a CVS where I am expected to take care of developing film, customer service, and answering the phone and I find myself stressed and I lagging behind in my tasks.”

Referring to Example 1, MG’s response is EBS according to a personal experience as supporting evidence.

Example 5

An **RBS** response from MC:

“The studies that I read say the opposite. According to "A unified attention bottleneck in the human brain" (full citation in my submission), the human brain physically can't handle multiple stimuli at once. It "bottleneck's" information--takes a bit here and a bit there. Since the brain can't process everything, the message is condensed and our reaction to the message is less focused. The misconception is that because young people tend to multitask more that they're better at it. Not true. If anything, their brains suffer from lack of ability to focus, which makes their brain processes unorganized and unproductive.”

RB references the original article and means that the evidence comes from the original *Multitasking* article, the required reading for the class. MC disagreed with the initial post and used the argument from the multitasking article for support, creating an RBS response.

In Group AA, the majority of students’ responses were ARE (see Table 4-7 response categories), 62.5% of responses. EBS responses represented 20.8% of all responses. The number of EBS and ARE in Group BB were almost the same, about 50%. On-topic responses of Group AA were 23/24=95.8% and of Group BB, 43/44=97.7%. Five students in Group AA posted questions, and seven posted questions arose from Group BB (see Table 4-7). Based on Table 4-6, 4/7=57.1% questions received feedback that produced 2nd responses. But no feedback received
from others in ANGEL group. Off-topic responses are less desired responses in this study, but I did not observe many off-topic responses.

**Table 4-7. Average Number of Responses by Category**

<table>
<thead>
<tr>
<th>Category</th>
<th>Group AA (ANGEL)</th>
<th>Group BB (Google docs)</th>
</tr>
</thead>
<tbody>
<tr>
<td># of initial posts</td>
<td>13</td>
<td>18</td>
</tr>
<tr>
<td># of total responses</td>
<td>24</td>
<td>44</td>
</tr>
<tr>
<td># of on-topic responses</td>
<td>23</td>
<td>43</td>
</tr>
<tr>
<td># of off-topic responses</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>ARE</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td>EBS</td>
<td>5</td>
<td>22</td>
</tr>
<tr>
<td>RBS</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Question</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

Referring to Table 4-7 again, Group BB (Google docs) has seven questions that were posted in discussion activity; five questions were posted in Group AA (ANGEL). Here is an example to show the student posted the question in the response (Example 6).

**Example 6**

Initial post from RP:

“I believe this is because when you learn how to do something instinctively as multitasking at a young age you become more efficient at it. Kind of like how it is easier to learn a language at a younger age than when you are older. Do you agree, or do you believe there is some other factors at play?”

DG posted a question:

“I disagree. The kids probably aren't actually better at multitasking then the older generation is, they just think they are. They can probably navigate newer technology better than the older people, but that doesn't mean that they are retaining or processing the information they are receiving any better. I'd like them both to go head to head on something that both have equal amounts of exposure to, and then study the retention and information processing rates of
Of course a younger person can download iTunes and upload to Facebook "better/faster" than an older person, but can they read and absorb a book while walking on a busy sidewalk? An exposure and familiarity with technology is not needed for the second multitasking test."

A second response answered the question posed by JE:

“I think that the younger generations are better prepared for the newer technology because they grew up with it being common. In my own life, I grew up having a PC in the home and when I went into the workforce our offices did not have PCs and they were just beginning deployment. I took to it very easily and ended up being "tech support" for my fellow employees who were at least 20 years my senior. As each new set of technology came out, I was selected to be the trainer and installer of the equipment, as I was one of the younger people who did understand and was able to convey in plain terms how to utilize it in the most effective manner.” (see Figure 4-1)

Figure 4-1. Example 6 pattern diagram

In Figure 4-1, RP, DG, and JE present students. Both DG and JE as the first response replied to RP. In the initial post, RP indicated that a younger age allows easier learning of new things. Based on RP’s idea, DG argued that younger individuals are not retaining or processing any information. He asked a question to inspire others to consider his reasoning. This approach can attract students to participate in discussions to produce more interactions.
Part II: Discussion

The content of responses: on-topic and off-topic

Analysis of the interactive patterns used the three variables of interactivity from Henri (1992): 1) conversations’ content, 2) first response to this conversation, and 3) second response reply to the first comment. Based on these three variables, this study’s categories for content of discussions became on-topic and off-topic, with emphasis on interactions between the first response and the second response.

This investigation could not control the content of posted responses. Comments and posts are subjective; sometimes related to initial posts and on-topic, while sometimes unrelated responses to initial posts were off-topic. Due to these problems, a visual structure of responses can capture the interactive process in online discussions.

Identification of responses represent one of three categories: "explicit interaction," "implicit interaction," and "independent statement" (Henri, 1992). Explicit interaction is a direct response or comment to a specific response or person, as noted on the graphs of discussion activity with a line with an arrow. In the analysis, explicit interaction is on-topic that a direct response to the initial topic or the argument supported to the topic. For example, A → B means that student A replied to student B by using a direct reference. The responses or arguments are the personal experience, the evidence supported to the topic or reflection from other academic articles. A more implicit interaction involved indirect responses or comments. If the content of another student’s response appeared in the former student’s responses, but did not directly related to the initial topic, the categorization became off-topic.

In our diagram, implicit interactions are linked by a dotted line with an arrow. For example, B← A -----→ IT means that student A gave a direct response to student B, but the response indirectly relates to the initial topic. An independent statement appears as an isolated number since it lacks referential cues to previous responses and does not lead to further statements. Independent statements are also off-topic responses. Thus, the response that A replied to B is on-topic. The response that A gave to initial poster is off-topic. In this study, explicit interactions are on-topic and desired. In contrast, implicit interactions and independent statements are off-topic and less desired.

Based on the approach, solid arrows represent explicit on-topic responses and dotted arrows represent off-topic responses. Counting the solid arrows in ANGEL discussions and
Google docs produced 23 on-topic responses for Group AA (see Figure 4-2) and 43 on-topic responses for Group BB (see Figure 4-3). There is one dotted arrow in ANGEL discussions. In Google docs, MC added a note to herself related to her APA reference format. It is not listed in Figure 4-3.

Figure 4-2: Group AA (LPC, ANGEL) interactive structure

Figure 4-3: Group BB (PPC, Google docs) interactive structure
Comparing the total number of solid arrows shows students’ have more interactions in Google docs than in ANGEL discussion boards.

The learning goal of this discussion activity is to encourage on-topic responses related to the topic “Multitasking” and participation. Recall that with Google Docs, the sidebar discussion box allows the topics to have clear and independent locations; students can track the topic’s information directly when scanning the document to avoid information loss (PPC, “parallel-pattern Collaboration”). In addition, Google docs provides an email response reminder system that is easier to reply to students than ANGEL. Receiving email notification to review all new replies is convenient, is easy to reply to, and likely improves students’ participation.

On the other hand, the ANGEL discussion format linear-pattern and causes “information-distance” since students only can track one message directly. They cannot easily scan the initial topic and others’ responses simultaneously, which alters their response pattern and may reduce students’ motivation to provide feedback or reduce the number of targeted responses.

Also ANGEL typically shows the new posts on top (or bottom), the order is reverse chronological and changes dynamically. This makes it easier to see new posts but also hides old posts. Focusing on the most recent unread part may likely permit earlier discussions to drift off-topic (Hewitt, 2003). Since students tend to review the newest part, key ideas introduced earlier in the response may be forgotten. As a result, ANGEL discussions (LPC) can lead to informational drift.

Based on word counts, the data shows that the average for first responses is similar to the average of second responses in both Groups AA and BB. (Group AA: 157.51=150, Group BB: 79.28=85.7). Thus, word count alone is not adequate to identify the interactive patterns here.

Response interactions

Following the research of Henri’s (1992) study, students’ rates of participation and electronic interactional patterns provide another important guideline for the current study. In ANGEL (LPC) discussions, most first responses did not receive second responses. The interactions in Google Docs (PPC) are more complex. Since each discussion usually involved more than two participants, the interaction’s or response’s intent was not always as linear as the Henri (1992) model might suggest. Certainly, student A could respond to student B and C as well as IT. In Figures 4.4 and 4.5 IT represents initial topic, and A, B, and C represent students; the
two-way arrow represents students’ interaction, and the one-way arrow represents the response’s direction. Apparently, students in ANGEL prefer not to continue with the topic once completing the task. Also, since LPC discussion patterns have limits, the numbers of responses without replies increases.

![Figure 4-4. LPC: one-way responses](image)

In addition, considering the theory of Cakir et al. (2005), a restructuring of the response framework is necessary. In a dyadic structure, the intended recipient is always the other partner in the same group. The connections between chat lines form a chain of responses needing reconstruction. In Group AA, all students only replied to initial posts. Thus, ANGEL represents a dyad structure (see Figure 4-6). In Group BB, most students who posted initial or first responses all received feedback responses. Hence, Google Docs is a triad structure. The initial response is the beginning, IR as initial response, and R as a response from a student. Based on the hierarchical representation of each thread, a bigram results (see Figure 4-7):

![Figure 4-6. Two-level LPC dyad structure](image)
Moreover, Google docs and ANGEL have different methods for notification on discussion boards. In Google docs, the students who initially posts and comments can receive notification via email (Gmail account) when new replies occur. Email notifications allow students to know when collaborators have comments, and with highlighting to know which sentence garnered the comment. In ANGEL discussions, the students and instructor log onto their ANGEL accounts, first, then, see new replies highlighted in the title’s list. Thus, Google Docs has added features for commenting (push technology) by adding notifications and simultaneously shorten the time for replies, this likely allows more participation and so makes the collaborative experience more robust.

Referencing Chapter 2, a comparison of the ANGEL data from the pilot Summer 2012 IST110 and Fall 2012 IST110 shows that the ratio of receiving responses is similar (1.73 comments and 1.8 comments between pilot Summer 2012 IST110 and Fall 2012 IST110). The dyad structure is simple. In contrast, the triad structure for PPC is complex and has more interactions among participations. Building on the analyses, conclusions and reflections related to desired online learning patterns appear in Chapter 5.
Chapter 5
CONCLUSIONS AND RESEARCH REFLECTION

Part I: Conclusion

**PPC can elicit more participation**

Indirect impacts of discussion activities may include motivational or social factors. Keeping students engaged and on-task when learning via a medium that can readily become isolating is not minor or to be overlooked. Indeed, the body of research that considers issues such as retention and participation levels reflects this concern. This study compares response patterns from two online discussion approaches. Analyzing the responses’ quality (on-topic, off-topic and responses categories) and quantity (word counts) reveal that relative to ANGEL (LPC), Google Docs (PPC) gains different kinds and amounts of participation most likely due to its sidebar layout and email notification system. Students and teachers can easily scan and review all responses in an interactive structure of a triad environment.

Inspiring motivations for students' interactions through the design of the interface is advantageous. Active expression is part of a positive cycle of learning: The more students responding and the more complex the interactive structure, the greater the gain for students’ knowledge. In this process, students will want to share experiences and thoughts, reflect on questions from different perspectives, and provide effective evidence and feedback. This approach can help participants build connections between new and old knowledge.

**PPC can inspire students’ knowledge-oriented questioning**

A further indicator essential for learning is knowledge-oriented questioning (Chin, Brown, & Bruce, 2002; Chin & Osborne, 2008; King, 1999). To formulate a knowledge-oriented question, learners must elaborate on content to detect gaps in understanding through interactions. In this present investigation, instructions did not direct students to question each other; however, 15.9% (7/44) of responses in the Google Docs group were questions and 57.1% (4/7) of these questions got the responses from others. In contrast, 20.8% (5/24) of responses in ANGEL posted questions. But none of them received feedback. This seems important and reflects different attitudes in the Google Docs group, compared to the ANGEL group. Finally, providing learners with open and activating questions, such as prompts, has positive effects on individual
understanding (Chi, Siler, Jeong, Yamauchi, & Hausmann, 2001). Explanations, inferences, and speculations help learners reflect on content and elicit further discourse (King, 1999), which fosters individuals’ achievements through ongoing communication that constructs differentiated and overlapping mental representations of knowledge (Hogan, Nastasi, & Pressley, 1999; Ickes & Gonzalez, 1996).

**Part II: Research Reflection**

**Limitation and validity**

Two major limitations of the data presented in the study need consideration. First, the sample is small, limiting the quality and quantity of responses. Apparently some students had temperaments that made them more likely to share different views and provide comments, influencing interactional patterns. Control of this factor occurred by distributing students randomly through the system. Moreover, a requirement of the participants was to provide an initial post on the main topic. In ANGEL, the "Which group am I in? (Group AA or Group BB)" shows that 23 students should have attended Group AA, but only 13 initial posts appeared. Also, 21 students should have attended Group BB, but Google Docs only received 18 initial posts. 11 students dropped the class and they did not participate this activity. Eight students belonged to Group AA (ANGEL) and 3 students were part of Group BB (Google Docs). The course instructor of this class claimed consistency with some of the other assignments, and therefore, arguably, omitted the non-participants from the data analysis.

Second, the requirements of the class also affect the results. Each student needed to produce at least two responses to others as an assignment from the instructor; so these responses were not spontaneous. One consideration is whether or not students’ habits of online learning play a role in the study, such as students’ preference for face-to-face discussions.

**Future Research**

During this study, the students’ responses were nearly twice as long in ANGEL as in Google Docs. The significant difference may be the size of the response boxes for ANGEL and Google Docs. The ANGEL response box has a larger space than the Google Docs response box, since it is the full width of the screen and the length is unlimited, while the Google docs comment space is a narrow band in the right margin. Moreover, based on word count statistics,
the data shows that the average word count of first responses is similar, with the average word count of second responses in both Groups AA and BB. (Group AA: 157.5≈150, Group BB: 79.2≈85.7), leading to consideration of whether or not the discussion box can affect the length of response. Future research may analyze what factors affect the lengths of students’ responses: Students’ motivations to cease typing, a subconscious limit to the number of lines; the size of the response box.

In summary, ANGEL and Google Docs elicit very different interactional responsive patterns, despite the identical directions for the discussion task. The amount, quality, and kind of responses were very different. The differences in designs and constraints in these two asynchronous discussion approaches, especially the different screen layouts for each and the email notification feature for Google doc (ANGEL does not send email notifying of a comment). These findings clearly indicate that Google Docs elicits what are arguably “desirable” response patterns compared to ANGEL. Students have more motivation to attend to discussions. Future research should consider the distinct effects of the email notification system and of the screen layout differences.
**BIBLIOGRAPHY**


Mandernach, B. J. (2009). Effect of instructor-personalized multimedia in the online classroom. *International Review of Research in Open and Distance Learning, 10* (3), 1492-3831.


The purpose of this assignment is threefold: (1) to gain more practice at doing academic library research on IST-related topics, (2) to further improve your ability to carry out creative, critical-thinking, and analysis of topics, (3) to practice summarizing, organizing, and presenting the results of such activities in written form.

First read the handout (found in the Lesson 10 folder) on *Library Research at Penn State and Beyond*, and then carry out the following exercise in academic library research for your post. To get full credit, remember to reply to at least two of your fellow students. A description of the exercise follows:

After reading the *Crosscurrents* essay on "Multitasking" by Ellen Goodman (see *Digital Planet* Chapter 12), do some library research of your own using Penn State's Library system. Don't just Google "multitasking"; one of the main purposes of this assignment is to learn how to do academic library research in IST. Finally, based on your research, discuss your assessment of Goodman's article and what you think will be the long-term consequences of human multitasking for both individuals and society. To get full credit you must refer to and cite at least three academic references (citations should be in APA style), and reply to at least 2 other posts 24 hours later via ANGEL.
APPENDIX B: GROUP BB: GOOGLE DOCS DISCUSSION ACTIVITY DIRECTIONS

The purpose of this assignment is: (1) to gain more practice at doing academic library research on IST-related topics, (2) to further improve your ability to carry out creative, critical-thinking, and analysis tasks, (3) to practice summarizing, organizing, and presenting the results of such activities in written form, and (4) compare ANGEL discussion boards and Google docs.

First read the handout (found in the Lesson 10 folder) on Library Research at Penn State and Beyond, then carry out the following exercise in academic library research for your post. To get full credit, remember to reply to at least two of your fellow students. A description of the exercise follows:

**Step 1:** Reading the Crosscurrents essay on “Multitasking” by Ellen Goodman (see Digital Planet Chapter 12).

**Step 2:** Do some library research of your own using Penn State's Library system. Don't just Google "multitasking"; one of the main purposes of this assignment is to learn how to do academic library research in IST.

**Step 3:** Based on your research, discuss your assessment of Goodman's article and what you think will be the long-term consequences of human multitasking for both individuals and society. Paste your response in the Google doc. To get full credit you must refer to and cite at least three academic references (citations should be in APA style).

Please paste your response for this discussion activity in the Google doc. Make sure you include and bold your full name in the beginning of your paragraph.

**Student’s name**

*In today’s high-tech world, we’re continually bombarded with messages, media, and more. Some of these information bombs are self-imposed—we want to keep up with our friends online and by phone—and some are imposed by jobs and other responsibilities. (Add your academic references with APA style)*
Step 4: Reply to at least 2 other posts within 24 hours via adding comments in the Google docs. Add your full name at the end of your comments. How to add the comments in Google docs? (see screenshot below)

1: Select the sentences or words that you want to reply, right click and select “Comment”, and then type your reply in the comment box.

2: If you want to reply to others’ comments, click the comment box and then select “Reply”.

Then after you click “Reply” it will look like this:

3: Please do not “Resolve” any comments.

4: Make sure to include your name at the end of your comment or reply.
During the lesson 10 (Chapter 12) discussion activities, students are responsible for reading Chapter 12 about Multitasking and posting a unique and substantial response to the original question, along with at least two substantial responses to classmates’ posts. This DA requires original post due 24-hours prior to due date; additional posts and replies due by due date. This Rubric provides guidance for students when completing Discussion Activities so they can remind themselves of the grading criteria.

<table>
<thead>
<tr>
<th>Item Being Graded</th>
<th>What to Look For</th>
<th>Weight</th>
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| Organization       | ● There is a definite introduction and conclusion.  
                   ● Ideas are well organized, clearly, communicated, and connect tightly to central purpose.                                                                                                                   | 15     |
| Strength           | ● Audience is left with a full understanding of the presenter’s position.  
                   ● Personal experience integrated where relevant and appropriate.                                                                                                                                             | 15     |
| Topical/Subject    | ● Student demonstrates full knowledge by answering with explanations and elaboration.  
                   ● Student supports ideas with data, evidence, examples, and facts and from the course content.  
                   ● Student includes an original idea – not a restatement of ideas posted by classmates.  
                   ● Student has demonstrated an understanding of the Topic by using the course content when drawing conclusions.                                                                                           | 30     |
| Completion of Topic| ● Identifies relevant arguments (reasons and claims) pro and con.  
                   ● Offers analyses and evaluations of obvious alternative points of view.  
                   ● Includes at least one correctly cited resource.  
                   ● Engages other students and instructors for follow up (responding to at least two other postings).                                                                                                          | 30     |
| Mechanics and Grammar | ● Response has no misspellings or grammatical errors. Paragraph(s) is well organized and uses complete sentences                                                                                             | 10     |