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The Sequential Analysis of Collaborative Writing and Editing Processes in Wikis

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THE SEQUENTIAL ANALYSIS OF COLLABORATIVE WRITING AND EDITING PROCESSES IN WIKIS

By

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ABSTRACT

The purpose of this study was to sequentially analyze and identify collaborative writing processes used to increase or decrease the quality of students’ written arguments. The study’s participants were 16 graduate students enrolled in an online course on inquiry and measurement. Every student worked on one team to analyze the arguments for using surveys and worked on one team to analyze arguments for using interview. A total of seven teams worked on the survey arguments; seven teams worked on the interview arguments. Each student worked with their team members using their team’s own wiki to analyze and develop each argument for using surveys and interviews. The arguments produced by the students were scored by the researcher and a second coder to determine which processes performed by the consenting students produced the highest- and lowest-quality arguments. Results indicated that the collaborative writing process used by students working in teams to develop a high-quality argument in a wiki consisted of six action sequence patterns while teams producing a low-quality argument consisted of only two action sequence patterns. Given that the low-quality argument action sequences were also not observed in the processes used to produce the high-quality arguments, it is possible that these two action sequences have hindered or obstructed the processes needed to produce high-quality arguments. The findings indicate that specific action sequences and more structured collaborative writing processes may help to produce high-quality arguments. As a result, interventions should be directed at increasing the frequency of the action sequences found in this study to produce high-quality arguments which may assist students in writing higher quality arguments.
CHAPTER 1

INTRODUCTION

Computer-supported collaborative writing (CSCW) has gained popularity in higher education as it is increasingly used in classrooms and online courses. In order for a CSCW project to succeed, however, a “collaborative environment that deals with learning” must be provided (Kumar, 1996, p. 1). Wikis can provide the ideal collaborative environment by enabling visitors on the Internet to jointly edit content on a web page (Parker & Chao, 2007). Wikis were originally developed in 1995 by Ward Cunningham to use as shared repositories of knowledge (Lund, 2008). Today, students in higher education use wikis to work online with other students in collaborative writing projects (Lamb, 2004). Since the content within a wiki can be revised and expanded at any time by any student, the flexible structure provides students with a highly effective way to work collaboratively on projects (Duffy & Bruns, 2006).

A wiki is a Web 2.0 technology that has helped to extend the World Wide Web beyond the traditional use of websites as a content delivery tool. Wikis and other Web 2.0 technologies such as blogs, Facebook, YouTube, LinkedIn, and Twitter support activities that are characterized by a high degree of interactivity between users. Wikis also support “bottom-up production and transformation of content” by enabling users to work collaboratively to develop and share content (Dohn, 2010 p. 143). The popularity of social media such as blogs, Twitter, Facebook, and wikis clearly demonstrates how this technology has empowered the individual with the ability to connect and build ideas with other people (Alexander, 2006).

In terms of its instructional applications, wikis are well suited for learning activities involving knowledge construction and information sharing (Dohn, 2010). For example, students can use wikis as a collaborative learning environment to develop what Lund (2008, p. 35) refers
to as “collective products”. Furthermore, students can use wikis as a “collaborative work space or digital commons to meet, read, and write” with other students (West & West, 2009, p. 1). In addition, wikis enable students to participate in practices such as “peer assessment, formative evaluation of student work, and, individual and group reflective learning” (Duffy & Bruns, 2006, p. 1).

**Problems with Computer-Supported Collaborative Writing**

Although many students today may be active Web 2.0 users, students do not necessarily have experience using wikis or an understanding of the underlying rationale for using a wiki in an academic setting (Dohn, 2010). For example, Judd, Kennedy, and Cropper (2010) found that a group of undergraduate psychology students exhibited little evidence of collaboration in a wiki writing assignment. Despite using a discussion forum to discuss the project prior to the activity, students did not contribute significant or substantive changes to their group’s wiki. They also did not insert and share comments on other students’ contributions, as required. Based on the amount and timing of edits and comments, students’ contributions also revealed low levels of collaboration between students. The study results indicated that students were more concerned with meeting the minimum requirements instead of engaging in collaborative interactions which would have led to the development of a “comprehensive and coherent group submission” (Judd et al., 2010, p. 350).

At the same time, students may come into a collaborative writing assignment with very different expectations and/or assumptions about how a project will work and how group members should or should not participate in a joint writing process. For example, students may not be aware that writing collaboratively involves the process of writing, revising and editing, and that a better final product can be achieved by working collaboratively than working
individually (Posner & Baecker, 1992). Students may also not understand that collaborative efforts can slow down the writing process, although the process will result in a high-quality, final product (Webb, 1997). As a result, students may not believe in the value of committing additional time to a group project to ensure that all group members learn and achieve an equal understanding of the task and the content under study.

Furthermore, the fact that a wiki can be easily edited by any member of a group may pose a problem for some students, particularly when a student is accustomed to writing papers as an individual. Lund and Smordal (2006, p.41) found that students who used wikis to complete group projects were “reluctant to interfere with somebody else’s materials”. Students who did edit generally made changes to correct grammar and spelling errors rather than content errors. In particular, students expressed concerns about “abuse or inexpert editing” resulting in other students changing content “even when they know that what you have written is correct” (Lund & Smordal, 2006, p 41). Students were also displeased when their texts were deleted by other students. Although the authors did not focus on the quality of the final product, they did observe that students’ reluctance to edit or rewrite their own or other students’ contributions can lead students to add content indefinitely and excessively (Lund & Smordal, 2006).

Identifying Editing Processes and Impact on Learning

In early research on collaborative writing processes, Ede and Lunsford (1990) found collaborative writing groups used a variety of strategies to coordinate the collaborative writing process once groups outlined their paper and held an initial group meeting. One of the collaborative writing strategies often observed in collaborative groups is the “parallel writing approach” where each individual works on his/her own part of the assignment. At the end, the individual parts created by each group member are pieced together into a single document.
Another strategy is the “sequential approach” in which one group member is given the task to create the initial draft. The draft is then passed on to the next group member for additional edits and revisions. This process is then repeated until the paper has been routed through all members in the group. A third strategy is the “reciprocal process” where group members work together simultaneously on each portion of the group paper. Although wikis can be used to support all three of the writing strategies, wikis are particularly useful when used to support the reciprocal writing process. During the reciprocal writing process, using a wiki enables group members to access and edit any portion of the group document at any time. Although the writing strategies identified by Ede and Lunsford present a high-level description of the collaborative writing process, their research did not examine nor identify precise sequences of lower-level actions students perform while using the reciprocal writing strategy. Furthermore, Ede and Lunsford did not examine how students’ hesitancy to edit other students’ work affects the writing process and how the resulting changes in the writing process affect the quality of a group’s final product.

To fully understand how and to what extent these problems affect the quality of students’ final written documents, researchers in the field of computer supported collaborative learning (CSCL) began to use a more micro-level analytic approach to identify and examine the collaborative learning process (Dillenbourg, 1996). For example, Soller’s (2004) study and findings demonstrated how a process-oriented analysis can lead to findings that help explain differences in the quality of students’ written documents. In Soller’s study, differences in discourse processes used by high- and low-performing groups were identified by sequentially analyzing the knowledge sharing conversations observed within each group. A Hidden Markov Modeling (HMM) approach revealed both effective and ineffective student knowledge sharing interactions. The HMM is a tool for modeling sequences generated by an observable sequence.
The findings demonstrated that “online knowledge sharing behavior can be assessed by analyzing sequences of conversational acts and student actions on a shared workplace” (Soller, 2004, p. 26). Furthermore, the findings suggested that similar studies can be conducted to sequentially analyze the sequences of actions students perform when using wikis to write a collaborative paper. This approach can also be used to quantitatively measure and determine to what extent students truly engage in collaborative processes; which of these processes help students produce higher quality papers; and ultimately, to test what interventions or event/action triggers are most effective in fostering the desired collaborative writing processes.

Prior research on students’ editing behaviors in wikis has yet to fully examine and determine the precise processes used by students. Olson, Olson, Storrosten, and Carter (1992) conducted a study that examined and mapped out the transitions between fifteen different tasks that students performed in face-to-face meetings. Student performance, while producing a design plan document, was based on a comparison of the supported groups who used a group editor called ShrEdit to the unsupported control groups who used a shared whiteboard, paper and pencil. The study compared time spent performing a particular task, the number of times students performed each task, and how these numbers differed between the two groups. The study found that using ShrEdit to support the design process raised the quality of the groups’ product design, in part, because the ShrEdit support enabled the groups to focus on core topics and come up with “better ideas” (Olson et al., 1992, p. 95). Although the study produced transitional state diagrams to visually capture and convey the writing process, the study focused exclusively on reporting differences in the time spent on specific activities to explain the differences in group performance. Unfortunately, no in-depth analysis was conducted to determine if there were
structural differences in the activity sequences, and whether such differences explained the differences between the groups’ final product.

Subsequently, to conduct a more in-depth analysis of sequential patterns in the collaborative writing processes between the groups, Olson, Herbsleb and Rueter (1994) researched whether structural patterns were present in the observed transitions between tasks. The authors used log-linear modeling (LLM) and lag sequential analysis (LSA) to conduct the research. LLM is a technique for “constructing and evaluating contingency-table data”. LSA is used as both “an exploratory and confirmatory technique” for finding which particular events found that sequential patterns did exist among the 15 highest frequency categories exhibited by students in the supported (ShrEdit) and unsupported (whiteboard, paper and pencil) groups (Olson, et al., 1994, p. 436). Additional tests also found that the two groups had significantly different working styles which explained observed differences in the quality of the final product. The ShrEdit supported group, for example, took notes while performing the tasks and revised the notes to produce a high-quality, final product. On the other hand, the unsupported group (whiteboard, paper and pencil) made notes on paper and developed the final product in a separate document near the end of the writing process.

The limitations of Olson’s study included labor intensive coding, which required extensive interpretation and revision of the categories when coding both discourse and writing behaviors exhibited by students. While participants were responsible for making notes about the actions they were performing, the categories were generic and failed to capture students’ conversational turns during the group meetings. In addition, the results produced from LLM and LSA were not conclusive because the findings were produced from sparse matrices that contained unacceptably low cell frequencies. As a result, Olson used transitional state diagrams
to reveal differences in sequential patterns between groups and compared standardized residuals to determine if observed patterns were significantly different. A better alternative may have been to use frequencies that measured precisely how often one particular action follows another given action. In addition, using another measure would have enabled the authors to sequentially analyze behavioral patterns of the groups by determining if the observed frequencies were significantly higher or lower than expected frequencies.

Since Olson’s study was conducted with face-to-face groups, the results could not be generalized to students working collaboratively online. Olson’s study also did not use online technologies such as a wiki as a collaborative writing tool. With the exception of Olson’s study, no other studies have been identified that have used sequential analysis to identify differences in writing processes. Furthermore, no studies used sequential analysis to test how the differences in writing processes lead to low- or high-quality group products. Given some of the noted limitations in Olson’s studies, it was determined that the methods for identifying collaborative writing processes requires more precision and further refinements to fully understand how instructional methods and tools affect the writing process.

**Problem Statement**

The collaborative writing process facilitates student learning by enabling students to participate in a team environment to receive as well as to give feedback (Erkens, Jaspers, Prangsma, & Kanselaar, 2004). As students develop collaborative writing projects, they also engage in discussions and negotiate plans for completing the task (Stein, Bernas, & Calicchia, 1997). In the process of discussing and negotiating plans, students learn to become more aware of and learn to internalize the writing process (Giroud, 1999).
Wikis are increasingly used in online learning as a platform for supporting collaborative writing assignments. Although wikis enable students to add and edit text, studies have found that students are reluctant to edit other students’ writing. It is important to understand how students’ reluctance to edit other students’ writing affects the quality of the arguments produced during the collaborative writing process. Furthermore, examining the collaborative writing processes used by teams may lead instructors to develop new and more refined instructional interventions to use in collaborative writing projects.

The purpose of this study was to sequentially analyze and identify collaborative writing processes used to increase and decrease the quality of students’ written arguments. Using this methodology, the researcher investigated the following questions:

1. What sequential patterns are observed in students’ collaborative writing behaviors when students produce high-quality writing?
2. What sequential patterns are observed in students’ collaborative writing behaviors when students produce low-quality writing?
3. Are there differences in the sequential patterns produced by groups that produce high vs. low-quality writing, and if so, how are they different?

Significance of this Study

Jeong’s (2012) study was conducted to examine wiki editing behavior which resulted in the development of a preliminary method for measuring and identifying patterns in action sequences exhibited by students while engaged in a collaborative writing process in a wiki. The study also revealed a clear need to establish a method to operationally define and measure to what extent students engage in specific forms of collaborative editing within wikis.
Building on Jeong’s (2012) findings, the researcher examined how instructional interventions (and other variables) affected the collaborative writing processes. Collaborative writing processes were identified which may support action sequences, increase group performance, or address problems that inhibit group performance. More importantly, processes that facilitate and/or inhibit students from producing high-quality writing were identified. As a consequence, a methodology was developed and tested which may help researchers and instructors identify targeted strategies to help students collaborate more effectively at a higher level.

In terms of long-term implications, the study established the groundwork needed to develop CSCW tools that may one day automatically monitor and guide students through the editing process based on empirically-based and tested process models. Furthermore, establishing methods to measure action sequences may enable future research to address such issues as whether the number of edits increases as students become more familiar with wikis.

**Theoretical Framework**

Two theoretical frameworks influenced the behavioral processes that were specifically selected for observation in this study. While examining the collaborative writing processes, the researcher concentrated on behaviors such as deleting and revising another student’s text where students may disagree and where conflicts may arise. These conflicts call for students to communicate and negotiate with fellow team members to produce a final group document that conveys the thoughts and ideas of the team as a whole. This form of dialog or interaction that occurs between students in a team is based on Bakhtin’s “dialogic theory of learning” which states that narrative is formed by social interaction where negotiation takes place to determine meaning (Koschmann, 1999, p. 310). In particular, the transactions students perform while
editing and revising another student’s text were the collaborative writing processes that were specifically examined in this study. Additional support for this theory was found in research that demonstrates the need for individuals to explain, justify, and understand conflicts as well as act on conflicts (Johnson & Johnson, 1992; Wiley & Voss, 1999; Baker, 1999). Based on these assumptions, the study examined how often: a) one student added text to a document and another student deleted the text (or replaced the text with his/her own text) as a result of differences in opinion and/or viewpoints; and, b) one student added text and another student added additional text and/or elaborations to the text when the students were in agreement.

The second theoretical framework for this study was provided by shared and situation cognition which also provided justification for using sequential analysis. Shared and situated cognition is based on Dillenbourg’s (1996) identification of three major social learning theories that have influenced evolutionary changes in the methods, approaches, and types of outcomes used in collaborative learning research (Dillenbourg, Baker, Blaye & O’Malley, 1996).

Table 1 provides a brief summary of the theoretical frameworks along with associated approaches and limitations. The table also illustrates the evolutionary shift from examining global variables to micro-analytic examination of the processes of learner-learner interactions. Analysis of the theory and methods presented in the table suggest that a more complete and coherent understanding of how global and structural issues affect collaborative writing (e.g., type of tool, instructional strategies that promote collaboration) may be achieved. It was determined that a better understanding of the collaborative writing processes and outcomes that emerge from these processes must be viewed within the context of using a particular tool or instructional strategy.
Table 1

*Dillenbourg’s Social Learning Theories (1996)*

<table>
<thead>
<tr>
<th>Theoretical Framework</th>
<th>Methodology</th>
<th>Limitations &amp; Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socio-cognitive &amp; Piagetian Perspective</td>
<td>Set up conditions hypothesized to facilitate collaborative learning. Compare outcomes of the intervention with a control group.</td>
<td>Collaborative discourse is treated as a black box. Focus is on individual learning outcomes.</td>
</tr>
<tr>
<td>Socio-cultural &amp; Vygotskian Perspective</td>
<td>Employ micro-genetic analyses of the learner-learner interaction. Focus on the processes involved in learner-learner interaction.</td>
<td>Focus on message frequencies independent of relationships between messages. Social interactions are studied as if they occur outside a social context or structure. Fails to recognize that causality of social and cognitive processes is circular and complex. Findings are descriptive.</td>
</tr>
<tr>
<td>Shared &amp; Situated Cognition</td>
<td>Employ micro-genetic analysis of social interaction to determine how meaning is jointly constructed within specific social context and conditions. Identify which interactions occur under which conditions and what effects they have on learning outcomes.</td>
<td>Difficult to determine if some interactions produce better outcomes or only high achievers produce the interactions. Computer-based tools are required to control and measure interactions. Must develop coding within conversational models or tasks (e.g., negotiation, argumentation).</td>
</tr>
</tbody>
</table>
CHAPTER 2

REVIEW OF LITERATURE

The chapter begins with a review of the type of research conducted within the field of computer-supported collaborative writing (CSCW) and an examination of the importance of wikis as collaborative writing tools. Then, collaboration is discussed as it relates to learner-learner interaction in the process of developing a collaborative writing project using a wiki. Given that this study focused on the behaviors exhibited by students working on a collaborative paper, the strategies that students used when writing individually and in collaborative groups are reviewed. Furthermore, the researcher reviews the types of editing behaviors students typically exhibit during the collaborative process. In conclusion, the researcher addresses the methods used to analyze student’s collaborative writing behaviors as well as assessing the quality of group papers.

Computer-Supported Collaborative Writing Research

Early CSCW research focused primarily on reviewing software applications designed to support collaborative writing. Applications that have been studied included Quilt, a collaborative tool which provided annotation, messaging, and computer conferencing; and, the English Natural Form Instruction (ENFI) used by collaborators to share messages on a computer screen (Duin, 1991, p. 132). Lastly, Kumar (1996) reviewed a variety of collaborative learning systems including two CSCW systems: the Work in PREParation writing tool (PREP), and the collaborative text editor, ShrEdit.

Research on CSCW was extended to online applications during the period when Neuwirth, Kaufer, Chandhok and Morris (2000) studied distributed collaborative writing. Distributed collaborative writing is defined as writing which takes place when participants do not
work on a project at the same time or place. Neuwirth studied the processes of distributed collaborative writing using the prototype PREP editor to determine how the tool would increase success of the writing process. Although Neuwirth’s findings revealed that the PREP editor did support planning, drafts and comment processes, it was determined that additional research was needed to find out if the tool allowed “writers to create new forms of interaction” (Neuwirth, et al., 2000, p. 15).

In 2003, Pargman reviewed the impact of a computer-supported writing tool on a group’s ability to write a report in face-to-face and distance environments. Pargman found that understanding how co-authors organize their writing can also help identify solutions to problems students experience when using collaborative writing computer systems. Furthermore, the study found that co-authors tend to work independently in spite of using a tool to support the collaborative function. As a consequence, it was determined that computer-supported collaboration tools must be designed to support both mediation and interaction.

Erkens, Jaspers, Prangsma, and Kanselaar (2005) conducted additional CSCW research to determine whether planning activities affect the quality of the final product. The authors used the T3 groupware system (shared word processor and chats) to observe, record, and analyze discussions between group members. Finally, the processes of planning and gathering information, composing an essay, scheduling individual contributions, and managing time were analyzed. The study concluded that planning activities and writing the content were the primary actions that influenced or determined the quality of the groups’ final product (Erkens, et al., 2005).
Wikis as Collaborative Writing Tools

In contrast to text editors like PREP and ShrEdit, wikis provided an ideal platform for collaborative work since they enabled participants to contribute text and at the same time, edit other students’ work within a shared document (West & West, 2009). Since wiki pages can be interconnected via hyperlinks, they also provided a flexible structure. The wiki structure also gave students a knowledge management space which helped groups to establish “collective cognition” defined as “a process whereby two or more people reach insights that neither could have reached alone” (Lund and Smordal, 2006, p. 37).

In addition, using wikis for collaborative work has been shown to promote a sense of responsibility and ownership for students (Raitman, Augar, Zhou, 2005). By having one central wiki page, students were able to monitor the transformation of the wiki into a collaborative product. Students are also aware that group members rely on them to make contributions to the wiki and as a consequence, students developed a sense of ownership of their wiki entries. Using a computer system to support communication and collaboration also impacts the collaborative process (Dillenbourg, Baker, Blaye, & O’Malley, 1996). As a consequence, wikis provided the ideal interface to allow collaborative partners to take on learning roles which fostered social interaction.

On the other hand, while wiki features facilitated collaboration, research has found that students’ use of wikis does not necessarily facilitate collaborative behaviors when developing content, performing edits, and replying to responses (Judd, Kenney & Cropper, 2010). Judd studied a collaborative writing activity using 772 undergraduate psychology students divided into 30 groups. Each group began the study by participating in an online discussion designed to introduce students to wikis. After the discussion and two lectures, each group was asked to create
a group collaborative writing project which included “descriptions, reflections, quotes, images, web links and diagrams” (Judd, et al, 2010, p. 344). Although the activity was collaborative, students were graded on individual contributions but not on the quality of the group’s collective contributions. Individual contributions were graded based on the following categories of comments: reply, collaboration, content, editing, individual, and group.

Out of the students who took part, 81% contributed two substantial content changes; however, approximately 18% of the edits were cosmetic. Students’ content contributions were also below expectations because the contributions came late in the activity. In addition, students focused primarily on meeting minimum requirements rather than, “establishing a cooperative or collaborative relationship with the other members of their group” (Judd, et al, 2010, p. 350).

Based on the students’ contributions, the authors concluded that using collaborative technologies such as wikis does not guarantee that students will work collaboratively. Study limitations included a coding scheme which used categories that were too general in nature such as reply, content and editing. Moreover, the context of each student’s contribution was not examined in relation to the previous actions performed by others in the group.

**Learner-Learner Interaction in Collaboration**

Collaborative writing or authoring also involves learners in the process of producing a wiki document by more than one author. As a result, learners are not only engaged in the writing process but also in the processes of managing group dynamics as they work to determine how best to communicate between group members. While group members in a face-to-face environment can easily communicate immediately with one another, online group members working in a virtual environment require facilitation and encouragement to communicate with one another (Walther & Bunz, 2005). Furthermore, studies found that virtual group members
who do not share physical space or local context experience problems developing trust between group members, which in turn can impede group effectiveness (Walther & Bunz, 2005). The lack of trust between group members can ultimately impact the quality of the group’s work. Furthermore, Lunsford and Ede (1991) found that “openness and mutual respect” are important for writers to be satisfied with the collaborative writing experience (Lunsford & Ede, 1991, p. 118).

**Individual Writing Processes**

While this study focused on collaborative writing, it was also important to review prior research on the *individual* writing processes and the processes that have been shown to improve students’ writings. In the 1970s, writing research focused primarily on evaluating the learner’s final written product. As the complexity of good writing was recognized, the focus shifted to concerns about the writing process and how a well written piece of writing evolved. The “process movement” was based on “cognitively oriented research” which focused on the “interconnections among thinking, learning and writing” (Hayes & Flower, 1986, p. 1106). Hayes and Flower (1986) argued that instructors should understand “the cognitive processes associated with the three processes of writing: planning, sentence generation and revision” (Hayes & Flower, 1986, p. 1106). These three writing processes have in fact been shown to improve students’ writing.

**Planning.** During the planning process, students develop ideas and organize a writing plan. Goals are set, content is generated, and text is organized based on those goals. For example, a 2006 study of 10th grade high school students in the Netherlands found that using planning strategies versus using revising strategies did not lead to “significant differences in learning” (Kieft, Rijlaarsdam, & van den Bergh, 2006, p. 29). On the other hand, the authors did find that
using a planning writing strategy can lead to improvement in literary interpretation writing. While early research emphasized the importance of planning for producing quality writing projects, more recent research (Hayes & Nash, 1996) concluded that time spent on planning is not as important as time spent on the task of writing.

**Sentence generation.** During the sentence generation process, writers begin to produce formal sentences to form a draft. At the same time, sentences are structured as part of an outline. During this process, writers may think aloud and structure sentences in sequences such as “The best thing about it is – what?” (Hayes & Flower, 1986, p. 1109). According to Kaufer, Hayes and Flower (1986), both experts and average writers create sentences in the same manner. For example, both groups assemble sentences in a “left to right fashion” with parts of the sentence “added to the right of the last sentence part” or as a replacement for a sentence part (Hayes & Flower, 1986, p. 1109).

**Revision.** Fitzgerald defined revision as, “making changes at any point in the writing process” (Fitzgerald, 1987, p. 484). Prior to making changes, students identify discrepancies and make decisions as to what needs to be changed in the document (Fitzgerald, 1987, p. 484). Making these types of decisions often involves cognitive operations used in problem solving and, as a result, research has focused on identifying reasons for breakdowns in the problem solving process. For example, a breakdown can occur when a writer has not clearly established content goals and is unable to decide how to revise the document (Fitzgerald, 1987, p. 489). Furthermore, the writer may have trouble keeping the reader’s perspective in mind. Fitzgerald also found that revisions play an important part in the quality of the produced document. While it is generally thought that revisions lead to a higher quality product, the quality of the product may be dependent on the age and skill of the writer. For a less-experienced college student, revision
may not influence the quality of the final product but an experienced, skilled writer may find revisions improve the quality of the final document (Fitzgerald, 1987, p. 493). Moreover, research suggests that “instructional support or feedback” may contribute to the “link between revision and quality” (Fitzgerald, 1987, p. 493).

**Effects of contextual variables on writing process.** In the 1980s, the focus of writing research shifted to examining writing context and the places where writing took place such as the classroom or workplace. Also, the focus shifted to the social contexts of writer’s interactions with teachers and peers (Freedman, Dyson & Flower, 1987). Researchers also began to build a social-cognitive theory of writing based on process, product and context (Freedman et al, 1987). As a result, a generalized writing process theory evolved which included the following: “Writing consists of planning, transcribing text, and reviewing, although these processes may not occur in a fixed order; the writing process is a hierarchically organized, goal-oriented, problem-solving process; expert and novice writers may solve task writing problems differently; and, a writer’s strategy depends on the nature of the writing task” (Freedman, et al., 1987, p. 17).

**Current research perspectives/initiatives.** Today, research continues to improve our “understanding of the cognitive and social processes involved in writing” as researchers focus on three research initiatives (Hayes, 2008, p. 28). These three initiatives focus on 1) working memory, 2) freewriting, and 3) activity theory (Hayes, 2008).

Our working memory is only able to hold a certain amount of material for a certain amount of time. As a result, working memory may influence complex writing processes beyond content development, revision, and editing (Hayes, 2008). For example, Chenoweth and Hayes (2001) “found that second-language learners were more skillful at editing texts after they had composed them than while they were composing them” (Hayes, 2008, p.29).
The second research initiative, freewriting, involves the process of writing continuously without making edits and revisions. Advocates of freewriting, including Elbow (1973) in his book, *Writing without Teachers*, recommended it as an alternative to using an outline at the beginning of the writing process (Hayes, 2008). Supporters have also argued that the process increases the flow of ideas and leads to the discovery of better ideas. Unfortunately, research to back these claims has been inconclusive and additional research is needed (Hayes, 2008).

The third initiative of activity theory describes how the actions of an individual or group relate to the environment where those actions take place (Hayes, 2008). For example, students completing a collaborative writing project in an online course may be influenced by the environment where the action takes place: Action (writing) + environment (online course) = activity system (framework). Examples of influences include subjects or the people involved in the activity system such as students and the instructor; and, the object/motive or goals of the students involved in the activity system. These influences have been documented in a study conducted by Russell and Yanez (2003) while examining students writing in an Irish history course at a large Midwestern university (Russell & Yanez, 2003).

**Collaborative Writing Process**

While research continues to focus on individual writing processes, students involved in collaborative writing projects have been found to use processes similar to those used by students when writing individually. According to Southavilay, Yacef and Calvo (2010), the collaborative writing process begins with adding text and editing text to develop a document. Writing activities include brainstorming ideas, creating an outline, and developing a draft before moving on to revising or editing the document.
To better understand the collaborative writing process, Southavilay et al. conducted a macro-level analysis of the writing process across five different tasks: brainstorming, outlining, drafting, revising and editing. The authors derived semantic sequences of data and created a Hidden Markov model (HMM) to identify key processes. Student writing behaviors were analyzed across 27 groups of engineering students who developed a collaborative document as a class assignment. In addition, two documents were analyzed for each of the high- and low-performing groups (based on the final grade). Results of the study indicated that overall the writing process models between the groups were similar. The main difference between the models was that high-performing groups were able to produce better documents by choosing the document topic early in the writing process. The low-performing group, on the other hand, spent more time changing topics. Most of all, the study found that the high-performance group exhibited the action sequence outline → draft → revise, while the low-performing group exhibited the action sequence outline → draft → edit → revise.

The above findings suggest that performing surface-level edits before making content-level revisions can inhibit group performance. In other words, the sequence in which students perform different writing tasks might explain differences in quality between groups. However, no other studies at this time have examined these and other differences in: a) the temporal sequencing of writing tasks between high- and low- performing groups; and b) how the tasks are assigned and performed across different members within a group (e.g., drafted by student A → edited by student B → revised by student A).

In collaborative writing, learners must also develop content as well as edit other student’s content. The process of editing other students’ content can involve both constructive and unconstructive behaviors (West and West, 2009). Constructive behaviors improve the wiki and
contribute to group collaboration; unconstructive edits are counterproductive and may lead to a breakdown in group collaboration (see Table 2).

Table 2

**Constructive and Unconstructive Editing Behaviors (West & West, 2009, p.53)**

<table>
<thead>
<tr>
<th>Constructive Editing Behaviors</th>
<th>Unconstructive Editing Behaviors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adding text</td>
<td>Protecting text or pages</td>
</tr>
<tr>
<td>Expanding text</td>
<td>Deleting text without comment</td>
</tr>
<tr>
<td>Improving text</td>
<td>Adding bias to text</td>
</tr>
<tr>
<td>Clarifying text</td>
<td>Claiming ownership over a page or passage of text</td>
</tr>
<tr>
<td>Organizing text</td>
<td>Adding changes to text anonymously</td>
</tr>
<tr>
<td>Integrating text</td>
<td>Waiting for others to make contributions before adding text</td>
</tr>
<tr>
<td>Confirming accuracy of text</td>
<td>Adding poorly researched or inaccurate text</td>
</tr>
<tr>
<td>Adding references to text</td>
<td></td>
</tr>
<tr>
<td>Improving language consistency</td>
<td></td>
</tr>
<tr>
<td>Improving formatting consistency</td>
<td></td>
</tr>
</tbody>
</table>

**Strategies for Coordinating Collaborative Writing**

How writing tasks are sequentially ordered and completed within a group can be fully or partially determined by how a group decides (either consciously or not) to coordinate the writing process. Ede and Lunsford (1990) identified seven coordinating strategies of collaborative writing groups (see table 3). Across these seven different coordination strategies, groups work together on a continuum that involves high to low levels of collaboration between group members.

Table 3

**Ede & Lunsford (1990, p. 118) Coordination Strategies**

<table>
<thead>
<tr>
<th>Writing Coordination Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>The group plans and outlines the task, then the writer prepares his/her part. The group compiles the individual parts and revises the whole document, as needed.</td>
</tr>
<tr>
<td>The groups plans and outlines the writing task, then one member prepares a draft. The group edits and revises the draft.</td>
</tr>
<tr>
<td>One member of the group plans and writes a draft; the group revises the draft.</td>
</tr>
</tbody>
</table>
Table 3 Continued

<table>
<thead>
<tr>
<th>Writing Coordination Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>One person plans and writes the draft; one or more members revise the draft without consulting the original authors.</td>
</tr>
<tr>
<td>The group plans and writes the draft; one or more members revise the draft without consulting the original authors.</td>
</tr>
<tr>
<td>One person assigns the tasks, each member completes the individual task, and, one person compiles and revises the document.</td>
</tr>
<tr>
<td>One dictates, another transcribes and edits.</td>
</tr>
</tbody>
</table>

**Analyzing and Modeling Collaborative Writing Processes**

To achieve a deeper and more precise understanding of the collaborative writing process, various approaches have been used to measure, visualize, and model collaborative writing processes. Similar to Southavilay, Yacef and Calvo’s (2010) use of HMM (as described in the collaborative writing process section above), Olson, Olson, Storrosten, and Carter (1992) mapped out the sequence of behavioral events that occurred as students worked face-to-face to produce a group document on paper versus using a computer. Some groups used a computer-based group editor (ShrEdit) to view and edit a shared document viewed across multiple computer screens. In contrast, the non-supported groups used only a whiteboard, pencil and paper. The two groups were compared primarily on time spent performing a particular task, the number of times students performed each task, and how these numbers differed between the groups. In addition, transitional state diagrams were produced in this study to convey the flow between tasks performed by the groups within each experimental condition (Figure 1).

In the diagrams, different tasks and/or behaviors that occurred during the meetings are represented as circles (such as Issues, Alternatives, Criteria, Project Management, Meeting Management, Digression, Goal, Walkthrough, Clarification, and Other). The size of the circles conveys the total time spent on the activities. The white surface area within each circle represents the introduction of the idea; black wedges within the circle represent time clarifying the topic.
For example, the size of the black wedges on the diagrams indicates that the unsupported group (left) spent more time clarifying the criteria topic than the supported group (right). The number of times a transition was observed between one task to another within each condition is shown by directional arrows that point from one task to the following task. The density/weight of each arrow conveys the relative frequency of each task-to-task transition observed within each condition (high density = high frequency, low density = low frequency).

Figure 1. Unsupported (left) vs. supported (right) groups (Olson, et al., 1992, p. 95)

The study found that using the ShrEdit raised the quality of the supported groups’ product design by enabling the group to spend more time working on core topics so they were able to come up with “better ideas” (Olson et al., 1992, p. 95). The researchers also found that the supported groups spent more time focusing on fewer, but better, alternatives (Olson et al., 1992). While examining the structural patterns present in the observed task sequences, Olson, Herbsleb and Rueter (1994) revised the coding scheme, recoded the data, and employed log-linear modeling (LLM) and lag sequential analysis (LSA) to produce transitional state diagrams to
study and model the collaborative writing process. Categories were revised based on theoretical interest and domain or objectivity (validity and reliability) to fully represent the design activity. For example, the authors were interested in the social management and interplay of the group activity. As a result, the category “clarification” (which occurred 33% of the time) and “issues” were added to the coding scheme (Olson, et al., 1994, p. 432).

The LLM analysis revealed significant differences in the frequency of specific task sequences between the supported (ShrEdit) and unsupported (whiteboard, pencil and paper) groups. The comparison between the supported and unsupported groups (Figure 2) indicated that the two groups worked differently in certain ways. For example, students in the unsupported groups tended to follow the presentation of an issue with any other action (Issue → any action) and follow an alternative with any other action (Alternative → any action). On the other hand, the supported group was far more likely to follow an issue with alternative (Issue → Alternative) as well as follow an alternative with clarification of alternatives (Alternative → Clarification). These findings altogether suggest that the Issue → Alternative → Clarification sequence may be one key process that leads to superior group performance.

In addition to the differences in task sequences, the study found that the supported group took notes while using the ShrEdit early on in the writing process. In the end, these notes evolved into the group’s final product. In contrast, the unsupported group made notes on paper or the whiteboard and constructed the final product near the end of the writing process. These observed differences in the way the groups sequenced their tasks might help to explain the observed differences in the quality of the final product. As a result, the findings suggest that the process of considering alternatives throughout the collaborative process can lead or assist groups to produce higher-quality projects.
Some limitations in Olson’s study included: 1) coding the observed group behaviors required extensive revisions to the coding scheme; 2) the coding scheme was not exhaustive and did not include sufficient categories which resulted in some group behaviors (including dialog) being omitted from the analysis; 3) the use of LLM to identify significant structures in the
process was inappropriate due to the presence of sparse matrices containing low-frequency cells which generated low results; 4) the study did not produce transitional state diagrams (derived from the lag sequential analysis) for each of the two groups (supported and unsupported); 5) the transitional state diagrams did not include observed probabilities, did not vary the weights or thickness of the arrows linking the actions to graphically convey the strength of each observed probability (Jeong, 2005a), and therefore, did not provide a clear visual illustration of the behavioral patterns (and differences in behavioral patterns) exhibited between the two groups; and finally 6) the LLM and LSA methods could not be used to identify patterns in longer sequences than two events/actions or unique action sequences used across different high-performing groups and low-performing groups.

One technique for identifying longer and unique action sequences performed among low- and high-performing groups is to apply multidimensional scaling to the sequential data recorded in adjacency matrices or matrices that consist of cells that report the number of times each event is followed by another given event. For example, Soller (2004) conducted a study to identify differences in discourse processes exhibited by students in small group discussions. The study, however, did not focus on collaborative writing processes. Soller sequentially analyzed knowledge-sharing conversations of high- and low-performing groups. Multidimensional scaling was then applied to subsets of the data to identify clusters within the high- and low-performing groups. The results of the analysis revealed three unique clusters within the high-performing group, each with its unique action sequences (request → explain → agree; request info → explain → clarify → clarify; explain → encourage) that likely contributed to the groups’ success. Moreover, the results also revealed four unique clusters within the low-performing groups, each with their unique sequences of actions that may not have contributed or contributed little to the
Assessing Quality of Group Papers

The type of paper (narratives, descriptive, expository, and persuasive) to be assessed determines the criteria to be used to evaluate its quality. Across all of these types of papers, however, rubrics that include criteria such as organization, content, usage and mechanics are often used to assess the quality (Smith, 1998). To evaluate the quality of persuasive papers (which requires one to build a case based on facts, arguments, counter-arguments, logic and sound reasoning), particular criteria can be used to evaluate how well students are able to integrate arguments and counterarguments (Nussbaum, Schraw, 2006). For example, a 4-point scale can be used to evaluate the extent to which students are able to integrate arguments and counter-arguments, ranging from exceptional, well integrated, slightly integrated, and unintegrated (Nussbaum & Schraw, 2006, p. 17). Furthermore, the level of argumentation exhibited with the written paper can be evaluated by coding the text to determine the frequency in which students state final claims, supporting claims, counter claims, rebuttals, supporting reasons, and reservations and/or qualifications. With regard to the predictive validity of these measures, Nussbaum & Schraw (2006) were able to use the 4-point scale and coding scheme to find significant differences in students’ written papers when students received different instructional interventions designed to improve students’ ability to write opinion essays.
CHAPTER 3

METHOD

The goal of this study was to develop and refine the use of sequential analysis (similar to the methods used by Olson, 1992) to measure and analyze the editing process exhibited by students when using wikis to complete a collaborative writing project. To begin the process of developing this method, Jeong’s study (2012) was examined to determine wiki editing behavior. The study was conducted at a major southeastern university and the participants were eight graduate students (three male, five female) in a graduate-level online course on computer-supported collaborative learning (Jeong, 2012).

Jeong’s study (2012) revealed that students rarely engaged in collaborative editing while using the wiki. While examining the forms of collaborative editing observed in the wikis, the study also revealed a clear need to establish a method that can be used to operationally define and measure to what extent students engage in specific forms of collaborative editing within wikis (Jeong, 2012). It was also determined that establishing these methods would enable future research to test how specific instructional methods affect the collaborative writing process. In addition, researchers would be able to determine how changes in the writing processes affect the quality of the group’s written document. Based on the procedures and methods used and tested in Jeong’s study (2012), the following design, procedures, and instruments used in this current study are presented in this chapter.

Study Design

The design employed an exploratory approach to identify how participants’ actions unfolded while taking part in a collaborative assignment which required students to write and present their analysis of arguments for using versus not using surveys and interviews for
conducting research. Students’ actions were recorded in wiki history pages and examined after completion of the writing assignment. As a result, the actions were analyzed post-hoc to determine sequential patterns in collaborative writing behaviors used to produce high- versus low-quality arguments.

**Participants**

The participants in this study were 22 graduate-level (nine male, 13 female) students enrolled in an online course at a major southeastern university. The students were working towards a certificate in distance education and/or a Master’s degree in Instructional Systems. The online course, taught in the spring of 2013, was a required course for the master’s degree and presented an introduction to inquiry and measurement for practitioners.

**Instructional Treatment**

At week 16 of the course, students were presented with the Human Subjects Committee permission form (Appendix A). The form explained to each student that: a) they may participate in the research study voluntarily and retract their consent at any time without penalty; and, b) the study will enable the researcher to gain a more thorough understanding of how wikis can be used to support collaborative writing. Out of 22 students in the class, 16 consented and 6 did not consent to participate in the study. Students received one participation point for submitting the consent form to the researcher regardless of whether they agreed or did not agree to participate in the study. The course instructor at no time over the duration of the course was told by the researcher which students consented and did not consent to participate in the study.

In week 16, students began work on activities focused on evaluating the pros and cons of using surveys and interviews to conduct research. Students began with the 16.1 (Appendix B) reading activity based on the course textbook, *Researching Real-World Problems* (O'Leary,
2005). After the reading activity, each student worked in a team to complete wiki activity 16.2 on the pros and cons of surveys (Appendix B) and worked in a different team to complete wiki activity 16.3 on the pros and cons of interviews (Appendix B).

Prior to the beginning of the activities, the researcher randomly assigned all 22 students to a total of 14 teams. Each student worked in two teams and completed one activity per team. Seven teams worked on the 16.2 survey wiki activity; seven teams worked on the 16.3 interview wiki activity. Team assignments were balanced by gender not only to reflect the class makeup of the nine males and 13 females, but also to control for the possible effects of gender differences on the processes used by the groups to produce high and low quality arguments. For example, males have a tendency to express their opinions as factual, whereas females show a tendency to hedge and qualify their remarks (Savicki, Lingenfelter, & Kelley, 1996; Vrooman). Teams also varied across the two assignments with 12 teams made up of three students each and the remaining two teams consisting of four students.

Once the teams were established, the students began work on the two assigned activities. The first activity 16.2 (Appendix B) required the students to develop six coherent and well-reasoned arguments to support the claim that using surveys is an effective means of collecting research data based on the six pros and seven cons of using surveys. The second activity 16.3 (Appendix B) required students to develop five coherent and well-reasoned arguments to support the claim that interviews are an effective means of collecting research data based on five pros and six cons of using interviews presented in the textbook readings.

In each activity, students were given access to their own private team wiki (see Figure 3) that contained a template listing the pros and cons for supporting the given claim. Also, students were provided with headings for each argument based on each of the pros of using surveys and
each of the pros of using interviews. Students were also instructed to work collaboratively and to write one and only one single paragraph to develop each listed argument. Students were also instructed to integrate some or all of the opposing arguments into their presentation and development of each supporting arguments.

![Screen shot of a wiki entry](image)

**Figure 3.** Example of wiki produced for week 16 activities

After the week 16 activities were completed, a non-consenting student survey (Appendix C) and a consenting student survey (Appendix D) were distributed to students to gather general anonymous feedback on the collaborative writing process. In addition, the surveys were used to provide data to cross check and validate the actions revealed from the coding of the wiki history data as well as the patterns in the coded action sequences revealed in the sequential analysis.

Non-consenting students received a short survey (Appendix C) to gather general feedback and reactions to the class activity. Consenting students received a comprehensive survey (Appendix D) containing questions asking students if they edited the content in other
students’ work, edited the grammar and/or spelling errors in other students’ work, deleted any sentences posted by other students, added new sentences to build on sentences posted by other students and so forth. To help provide incentive for responding to the surveys, all students received one participation point for completing the online survey.

**Scoring the Survey and Interview Arguments**

To help ensure that the quality of each argument was measured accurately and reliably, a combination of methods was used to score each written argument. First, a concept map was created by the researcher to visually represent the relationships between the pros and cons of using surveys and interviews (Shute, Jeong, Spector, Seel & Johnson, 2009). The concept map for surveys (Appendix E) and the concept map for interviews (Appendix F) were used as a supplement to the rubric (Table 4). Concept maps (also known as “argument diagrams”) are often used as a tool for evaluating arguments (Reed & Rowe, 2004) and have been found to significantly improve students’ critical thinking skills in courses on argumentation and philosophy (Ortiz, 2007). In particular, the concept maps enabled the researcher and second coder to identify the components of each argument and the relationships between the pros and cons so each argument could be assessed. In addition, the researcher and second coder used the concept maps to determine if each argument correctly identified and explicitly stated the relationship between a major and minor premise, such as Pro 1 qualified or enables Pro 2 (P1>P2) as depicted in the left side of the concept map in Figure 4. A correct premise is the pro or con that a team correctly identifies as a pro or con (minor premises) that supports or opposes the pro (major premise) under examination in the argument.
To further illustrate the scoring of correct and incorrect premises, the concept map for surveys (Figure 4 and Appendix E) shows the connection between the pros and cons of using surveys. The map shows three branches which directly connect to the concept that surveys are effective tools for collecting research data. For example, the concept map shows that pro# 6 directly enables the researcher to achieve the benefits of pro# 1. When scoring the wiki arguments, references to pro# 1, 2, 6 and cons 3 and 5, in the left branch, would earn one point based on the fact that the team had selected the correct premise. The team had selected the correct premise that supported or opposed the major premise #2 pro under examination. In addition, pro# 5 and con# 2, in the middle branch; and, pro #3, 4 and con# 1, 4, and 6, in the right branch, would also earn one point. On the other hand, if a student used a premise such as pro# 1 and related it to the incorrect con (#4), the team would receive a zero.

Scores would be entered in the wiki team argument spreadsheet for surveys (Appendix H). The spreadsheet lists scores of one or zero for identifying the correct pro or con; for
identifying the correct relationship between pro and pro or pro and con in the correct branch of the concept map; and, for the addition of a closing argument

![Interview concept map](image_url)

**Figure 5.** Interview concept map

In the interview concept map (Figure 5 and Appendix I), there are two branches. For example, beginning at the bottom left, three cons (#1, 2, 3, 4, and 6) directly relate to the three pros above (#1, 2, 3, and 4). When scoring the wiki arguments, references to these pros and cons would earn one point; and, references to pro# 5 and con# 5, in the second branch, would also earn one point. On the other hand, if the student entered a pro from the first branch and connected it to the con in the second branch, the team would receive a zero.

Scores would be entered in the wiki team argument spreadsheet for interviews (Appendix I). The spreadsheet lists scores of one or zero for identifying the correct pro or con; for identifying the correct relationship between pro and pro or pro and con in the correct branch of the concept map; and, for the addition of a closing argument

Next, the quality rubric (Table 4) based on a modified rubric by Nussbaum & Schraw (2006, p. 45) was revised to align with the concept maps. The rubric provided guidance on how
to code arguments based on the definition of what words are included and used to present an argument; the points each argument should receive; and, keywords to analyze the argument. For example, keywords such as “As a result” and “however” were used by students to identify of state the relationship between a minor premise and a major premise. On the other hand, keywords such as “for example”, “in summary”, or “overall” indicated the beginning of a closing argument. Together, the rubric and concept maps provided the researcher and second coder with a guide for rating the quality of each argument. To train the second coder to score the team’s survey and interview arguments, a scoring guideline for wiki arguments (Appendix G) was also developed.

Table 4

**Argument Quality Rubric based on Nussbaum & Schraw’s (2006, p. 45) modified rubric**

<table>
<thead>
<tr>
<th>DEFINITION</th>
<th>POINTS</th>
<th>KEYWORDS</th>
</tr>
</thead>
</table>
| Main argument is clearly stated and consistently supported with supporting arguments, examples and elaborated with qualifying statements, limitations, and reservations. Veracity of arguments’ claim is addressed with empirical evidence. Alignment begins with main argument. Relevance of ideas to the main argument is made explicit with use of transitions. Final conclusion on the accuracy, veracity, and/or relevance of the argument is provided. | Cumulative score based on one point being awarded to a given argument for each element that is integrated into the given argument. **Pro (Supporting Argument)**
+1 For each correct pro presented to support the main argument. 0 For each pro that is incorrect or not relevant to the main argument or line of argument. +1 Direction of relationship is correct (qualify/enable or consequence). For example, if the student mentions the A  B relationship as A qualifying or enabling B or B as a consequence of A, the student receives one and only 1 point (not two points). For example, “reaching a large number of respondents” is a correct pro that enables, “representing a larger population”. | “one reason why”, “because”, “for example” “however”, “if”, “but” |
Table 4 Continued

<table>
<thead>
<tr>
<th>DEFINITION</th>
<th>POINTS</th>
<th>KEYWORDS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cons (Opposing Argument)</strong></td>
<td>+1</td>
<td>“Author found that”, “observed”, numbers or percentages reported, “found more than”, “found less than”</td>
</tr>
<tr>
<td>+1 For each correct con presented to qualify and/or weaken the stated supporting argument.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Supporting Evidence for Relationships</strong></td>
<td>+1</td>
<td>“As a result”, “however”, “for example”, “in summary”, “overall”</td>
</tr>
<tr>
<td>+1 For each empirical evidence presented to establish the truth value of a pro and/or con (data or numbers).</td>
<td></td>
<td>P1 = researcher X got 3,000 responses P4-P3 Identical statistics; conducted t-test</td>
</tr>
<tr>
<td><strong>Closing Argument</strong></td>
<td>+1</td>
<td></td>
</tr>
<tr>
<td>+1 Conclusion is presented to provide an overall summary and evaluation of the importance, accuracy, veracity, and/or relevance of the supporting argument under analysis (e.g., identifies a pro as a major premise or as only a minor premise to major premise)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Following the training, the second coder scored all survey and interview wiki arguments for each of the teams and recorded the scores in a survey scoring spreadsheet (Appendix H) and interview scoring spreadsheet (Appendix I). At the same time, the researcher scored all survey and interview arguments for each of the teams. Total scores for each argument were computed as a ratio score by dividing the numerator (the total number of points earned for the pro under analysis) by the denominator (the total number of points earned + the total number of incorrect entries identified in the cells containing an X’s in the scoring spreadsheet in Appendix H or Appendix I).
After the scoring was completed, the researcher and second coder met to discuss the scores and to arrive at a consensus on the final scores. At the conclusion of the scoring process, a Pearson's coefficient correlation was calculated to assess the relationship between the researcher’s scores and the second coder’s scores for both the survey and interview arguments. There was a positive correlation between the survey scores, \( r = 0.987, n = 32, p = .0001 \), and the interview scores, \( r = 0.988, n = 25, p = .0001 \).

**High- and Low-Quality Argument Results**

After determining the final survey and the interview argument scores, the results were sorted from largest to smallest. Next, the 32 survey scores were plotted on a scattergram to determine the natural distribution of scores. The sudden bends or elbows in the curve of the scattergram revealed that ten survey scores ranging from 60 to 20 points were at the top and represented high-scoring arguments; ten survey scores ranging from 13 to 7 points were at the bottom and represented low-scoring arguments.

Likewise, 25 interview argument scores were plotted on a scattergram and the results revealed that eight interview argument scores ranging from 50 to 21 were at the top (high-scoring arguments) and eight interview argument scores, all with a score of five, were at the bottom (low-scoring arguments). Both the high- and low-quality survey and interview arguments were then selected to be analyzed to identify differences in behavioral patterns in the processes used to produce high- vs. low-quality arguments. A total of 10 (\( n=10 \)) high and 10 (\( n=10 \)) low scoring arguments were analyzed.

**Coding the Wiki History Data**

The writing and editing behaviors analyzed in this study was collected from each group’s wiki history page. The history page (Figure 6) provided the researcher with access to students’
entries listed by date (including time), author, and author’s comments. Using each paragraph within a wiki as the unit of analysis, a code was assigned to any change made to a given sentence within the paragraph. Changes were identified by specific patterns observed in the color-coded texts presented within the paragraph (Figure 7). For example, wiki entries in green indicated text had been added and entries in red indicated that text had been deleted.

![Figure 6. Wiki history page](image)

![Figure 7. Inserted and deleted text highlighted in green and red](image)

Data were coded using the rules for assigning codes presented in Table 5. For example, pADD indicated that a new paragraph was added below a heading and included multiple sentences. The addition of pADD addressed the problem where multiple sentences were simultaneously posted when a student cut and pasted text directly into the wiki, making it impossible to determine the order in which sentences were added. ADDe indicated a new
sentence had been added to elaborate and provide further details on a previously-stated idea. To identify a students’ action on text written by another student, EDITo for example indicated that a student made a change to another student’s paragraph.

Table 5

Rules for Assigning Codes

<table>
<thead>
<tr>
<th>LABEL</th>
<th>RULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>pADD</td>
<td>Add new paragraph below a heading. Text includes multiple sentences that may have been cut and pasted into the wiki.</td>
</tr>
<tr>
<td>ADDo</td>
<td>Insertion of text into existing paragraph by different student.</td>
</tr>
<tr>
<td>ADDq</td>
<td>Sentence has been added to a paragraph to qualify or note a limitation of the idea presented in the previous sentence.</td>
</tr>
<tr>
<td>ADDe</td>
<td>Sentence has been added to provide further details or elaborate on an idea.</td>
</tr>
<tr>
<td>DEL</td>
<td>Text with only RED blocks deleted by same student.</td>
</tr>
<tr>
<td>DELo</td>
<td>Text with only RED blocks deleted by different student.</td>
</tr>
<tr>
<td>EDIT</td>
<td>Text with RED blocks displayed adjacent to GREEN blocks or both non-adjacent RED and GREEN blocks entered by same student.</td>
</tr>
<tr>
<td>EDITo</td>
<td>Text with RED blocks displayed adjacent to GREEN blocks or both non-adjacent RED and GREEN blocks entered by different student.</td>
</tr>
<tr>
<td>mEDIT</td>
<td>Text with GREEN blocks, or a few RED and GREEN blocks, indicating only a few changes such as minor formatting, addition of names, minor spelling corrections, or minor grammar and punctuation changes, inserted by different student.</td>
</tr>
</tbody>
</table>

ADDITIONAL TAGS

- Correct Premise (cp) is the use of a premise which supports the pro under examination.
- Incorrect Premise (ip) is the use of a premise which does not support the pro under examination.
- Correct Relationship (cr) is the use of a premise which connects to another premise that qualifies or enables the pro under examination.
- Incorrect Relationship (ir) is the use of a premise which does not qualify or enable the pro under examination.
Building on the coding scheme developed in Jeong’s study (2012), the coding scheme used in this study included codes that identified both syntactical and semantic types of revisions. Syntactical codes included mechanical revisions such as spelling, grammar, or rephrasing. Semantic revisions included adding a sentence to build on the previous idea and qualifying or noting limitations of the previous ideas. For example, a sentence containing the words “consequently”, “as a result”, “therefore”, “for example”, and “in other words” were interpreted as an action that builds on the previous idea. Sentences containing words like “however”, “if…then”, and, “on the other hand” were interpreted as expressing new and possibly contradicting ideas that served to qualify and/or address the accuracy and/or veracity of a previously stated idea.

When a student deleted another students’ sentence and replaced it with another sentence, the semantic coding process enabled the researcher to identify whether or not the new sentence was in agreement to the ideas presented in the original sentence or contradicted and/or qualified the views/ideas presented in the original sentence. Codes such as ADDq and ADDe were added to the coding scheme to capture semantic revisions. For example, ADDq indicated a sentence had been added to a paragraph to qualify or note a limitation of the idea presented in the previous sentence. ADDe indicated a sentence had been added to provide further details or elaborate on an idea.

To identify writing behaviors that addressed the relationships between pros and cons, additional tags were added to the coding scheme. For example, tags such as correct premise (cp) and incorrect premise (ip) were added to actions where correct and incorrect premises are stated in support or opposition to the pro under examination. In addition, correct relationship (cr) and incorrect relationship (ir) tags were added to denote whether the stated direct relationship
between two particular pros and/or cons was correct or incorrect. All four new tags, cp, ip, cr and ir were added as a suffix to ADD, DEL, or EDIT to code these particular actions performed on the wikis.

**Inter-coder Reliability for Coded Wiki History Data**

A second coder was trained to code one interview argument and one survey argument selected from the team wikis using the coding scheme and rules for assigning codes (Table 5). Following the training, both the researcher and second coder individually coded the remaining survey and interview arguments presented in each of the team wikis. After the coding was completed, the researcher and second coder met to discuss and resolve any discrepancies in codes. Using the confusion matrices (Appendix J) which indicates that 12 codes were used by the two scorers, an inter-coder reliability test was run for surveys and interviews using the Cohen’s Kappa Coefficient (Gwet, 2012). The survey coding results of the researcher and second coder was 80.9% in agreement with Cohen’s Kappa = .765. The interview coding scores between the researcher and second coder was 74% in agreement with Cohen’s Kappa = .682.

The Cohen’s Kappa values reflect some of the difficulties of arriving at an agreement for the various codes assigned to each edit recorded in the wiki histories. Although there were other coding differences, the researcher and second coder had particular difficulty reaching agreement when using the ADDq and ADDcp codes across all survey and interview arguments. For example, the researcher and second coder disagreed 46 times on the use of ADDq to indicate an added sentence that qualifies or makes note of a limitation of an idea presented in the previous sentence. In addition, there were 26 disagreements on the use of ADDcp for adding a correct premise. It was also evident that the differences were based on the second coder’s inexperience
in recognizing the use of correct premises (ADDcp). In all cases, the researcher and second coder discussed the differences and arrived at a consensus.

Analyzing the Code Sequences

After the actions performed on each argument/paragraph were coded, the codes were sequentially and chronologically entered into an Excel worksheet for each paragraph. For example, the codes from rows 1 through 12 in column A in Figure 8 reveals the sequence of twelve codes that describe all the actions that were performed by students for a given argument. A sequence number was entered for each code in column B ranging from 1 to 12 to verify the chronological order. By using this particular coding procedure and data collection process, the sequential analysis reveals not only how often students entered sentences or edited a previous students’ contribution, but also reveals insights into the writing process in terms of how likely one particular action is followed immediately by another particular action as opposed to another alternative action. The goal is to determine which action sequences are associated with high versus low quality arguments in order to find the action sequences that might help or hinder students’ ability to write and better analyze arguments.

Figure 8. Codes and sequence numbers copied into discussion analysis tool
The Discussion Analysis Tool (DAT), developed by Jeong (2005b) was used to sequentially analyze the codes to identify patterns in action sequences performed by students to create the high-quality and the low-quality arguments. The sequential analysis techniques and statistical z-scores tests, first developed by Bakeman and Quera (1995), were used to operationally identify patterns within the sequences of actions exhibited by students that produced high- versus low-quality arguments. In particular, the DAT software was used to identify which action sequences (e.g., ADDe → EDIT, and ADDq → EDITo) occurred at frequencies that are significantly higher than expected frequencies (based on the use of z-score tests). Action sequences that occurred at frequencies that were significantly higher than expected were identified as a “pattern” in the students’ collaborative writing behaviors. However, event pairs with probabilities found to be significantly higher than expected but with cell values less than three were omitted because the z-score test cannot be used when a cell frequency is less than three. All of the codes and sequence numbers for both the high-quality survey arguments and high-quality interview arguments were copied into the DAT tool to generate a frequency matrix for high-quality arguments (Figure 9). Likewise, all of the codes and sequence numbers for both the low-quality survey arguments and the low-quality interview arguments were copied into the DAT tool to generate a frequency matrix for low-quality arguments (Figure 10). All cell frequency values that originally were bold green and were more than three are presented in boxes in Figure 9 and 10.

Each cell in the frequency matrix reveals the number of times one particular action was immediately followed by another particular action. For example, the high-quality arguments frequency matrix (Figure 9) shows that when a student added a new paragraph, the most common action that followed was ADDcp (n=6). The high-quality argument matrix also reveals
frequencies in bold green that indicate values found to be significantly higher than the expected frequency such as the ADDcp \( (n=16) \).

**Figure 9.** High-quality argument frequency matrix generated with DAT

The low-quality argument frequency matrix (Figure 10) indicates that when a student added a new paragraph, the most common action that followed was ADDcp \( (n=2) \) followed by ADDe \( (n=2) \). In addition, the low-quality argument matrix also reveals frequencies in bold green that indicate values found to be significantly higher than the expected frequency such as the ADDe \( (n=11) \).

**Figure 10.** Low-quality argument frequency matrix generated with DAT
For both high- and low-quality argument frequency matrices, frequencies in bold red reveal values found to be significantly lower than expected based on critical \( z \)-score of 1.65 and below at \( p < .10 \) for this exploratory study. To establish the significance of the \( z \)-score for a particular pair of actions, its cell frequency (as mentioned previously) must be three or greater to determine if a pattern exists. Each \( z \)-score was computed using Bakeman and Quera’s formula (1995, p.109) that takes into account the observed frequencies of both given and target events.

The \( z \)-scores presented in the \( z \)-score matrices for the high-quality arguments (Figure 11) and low-quality arguments (Figure 12) were used to determine whether or not each transitional probability was significantly higher or lower than the expected probability (based on chance alone) using a liberal and exploratory critical \( z \)-score value of 1.64, \( p < .10 \). Transitional probabilities found to be higher than expected (\( z \)-score > 1.64) are highlighted in green/bold type to help identify behavioral sequences that can be considered a behavioral pattern. Transitional probabilities found to be lower than expected (\( z \)-score < -1.64) are highlighted in red/bold type to identify behavioral sequences (or behavioral patterns) that were not common or typical for the given team.

![Z-Scores identify the probabilities that are higher/lower than expected](image)

**Figure 11.** Z-Scores for high-quality arguments
Z-Scores identify the probabilities that are higher/lower than expected

<table>
<thead>
<tr>
<th></th>
<th>pADD</th>
<th>ADDcp</th>
<th>ADDip</th>
<th>ADDcr</th>
<th>ADDDr</th>
<th>ADDq</th>
<th>ADDDe</th>
<th>ADDDo</th>
<th>DEL</th>
<th>DELo</th>
<th>EDIT</th>
<th>EDITo</th>
</tr>
</thead>
<tbody>
<tr>
<td>pADD</td>
<td>-0.23</td>
<td>2.49</td>
<td>-0.72</td>
<td>-0.33</td>
<td>0.00</td>
<td>0.32</td>
<td>-0.05</td>
<td>-0.33</td>
<td>-0.33</td>
<td>-0.81</td>
<td>-0.58</td>
<td>5</td>
</tr>
<tr>
<td>ADDcp</td>
<td>-0.42</td>
<td>-1.32</td>
<td>-0.34</td>
<td>-0.60</td>
<td>0.00</td>
<td>-0.98</td>
<td>2.76</td>
<td>-0.60</td>
<td>-0.60</td>
<td>0.31</td>
<td>-1.06</td>
<td>15</td>
</tr>
<tr>
<td>ADDip</td>
<td>-0.30</td>
<td>-0.93</td>
<td>2.94</td>
<td>2.21</td>
<td>0.00</td>
<td>-1.24</td>
<td>-2.46</td>
<td>-0.42</td>
<td>-0.42</td>
<td>-0.42</td>
<td>-0.42</td>
<td>-0.14</td>
</tr>
<tr>
<td>ADDcr</td>
<td>-0.10</td>
<td>-0.32</td>
<td>3.20</td>
<td>-0.14</td>
<td>0.00</td>
<td>-0.42</td>
<td>-0.84</td>
<td>-0.14</td>
<td>-0.14</td>
<td>-0.14</td>
<td>-0.35</td>
<td>-0.25</td>
</tr>
<tr>
<td>ADDDr</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>-0.01</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0</td>
</tr>
<tr>
<td>ADDq</td>
<td>-0.42</td>
<td>-0.34</td>
<td>-1.32</td>
<td>1.40</td>
<td>0.00</td>
<td>-0.98</td>
<td>1.05</td>
<td>-0.60</td>
<td>1.40</td>
<td>1.40</td>
<td>-0.58</td>
<td>0.12</td>
</tr>
<tr>
<td>ADDDe</td>
<td>-0.69</td>
<td>-0.66</td>
<td>-1.41</td>
<td>-0.98</td>
<td>-0.01</td>
<td>3.72</td>
<td>1.26</td>
<td>0.55</td>
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<td>-0.98</td>
<td>-1.73</td>
<td>-1.73</td>
</tr>
<tr>
<td>ADDDo</td>
<td>-0.10</td>
<td>-0.32</td>
<td>-0.32</td>
<td>-0.14</td>
<td>0.00</td>
<td>-0.42</td>
<td>-0.84</td>
<td>-0.14</td>
<td>-0.14</td>
<td>-0.14</td>
<td>2.86</td>
<td>-0.25</td>
</tr>
<tr>
<td>DEL</td>
<td>-0.10</td>
<td>-0.32</td>
<td>-0.32</td>
<td>-0.14</td>
<td>0.00</td>
<td>-0.42</td>
<td>-0.84</td>
<td>-0.14</td>
<td>-0.14</td>
<td>-0.14</td>
<td>-0.35</td>
<td>3.98</td>
</tr>
<tr>
<td>DELo</td>
<td>-0.10</td>
<td>-0.32</td>
<td>-0.32</td>
<td>-0.14</td>
<td>0.00</td>
<td>-0.42</td>
<td>-0.84</td>
<td>-0.14</td>
<td>-0.14</td>
<td>-0.14</td>
<td>-0.35</td>
<td>3.98</td>
</tr>
<tr>
<td>EDIT</td>
<td>2.30</td>
<td>2.44</td>
<td>-0.42</td>
<td>-0.62</td>
<td>0.00</td>
<td>-1.83</td>
<td>1.42</td>
<td>-0.62</td>
<td>1.32</td>
<td>1.32</td>
<td>1.95</td>
<td>-1.10</td>
</tr>
<tr>
<td>EDITo</td>
<td>-0.23</td>
<td>-0.72</td>
<td>2.49</td>
<td>-0.33</td>
<td>0.00</td>
<td>0.32</td>
<td>-1.91</td>
<td>-0.33</td>
<td>-0.33</td>
<td>-0.33</td>
<td>0.66</td>
<td>1.35</td>
</tr>
</tbody>
</table>

1 9 9 2 0 15 41 2 2 2 11 6 100

Figure 12. Z-Scores for low-quality arguments

Converting Transitional Probabilities into State Diagrams

The behavioral patterns identified in the matrices were converted into transitional state diagrams (one diagram for each group) to graphically and concisely convey similarities and differences in behavioral patterns between the high- and low-quality arguments. For example, the state diagrams from the study (Figure 13) illustrate the sequences of actions taken by an author on his/her own topic heading or paragraph (Jeong, 2012). The diagram on the right conveys the sequences of actions that other peers perform on the topic heading or paragraph originally authored by another student.
Figure 13. Individual and collaborative writing process patterns (Jeong, 2012)

In each state diagram, each node represents a specific action. The frequency in which the specific action was observed is reported in the first numerical value in the node. The frequency of each action is also conveyed by the relative size of the circular glow emanating from each node. The second numerical value reported in each node presents the number of actions that immediately followed and/or were triggered by the given action. Of most importance is that the weights or width of each link are directly proportional to the observed transitional probability observed between two given actions. As a consequence, varying the density of the links provides a graphical representation that conveys which actions were most versus least likely to follow another action. Black or gray links identify transitional probabilities that were significantly higher or lower than expected, respectively.

In this study, state diagrams produced from the sequential analysis of the actions used to create the high-quality arguments and the low-quality arguments were examined, interpreted, and most of all, compared in order to address the following three research questions:
1. What sequential patterns are observed in students’ collaborative writing behaviors when students produce high-quality writing?

2. What sequential patterns are observed in students’ collaborative writing behaviors when students produce low-quality writing?

3. Are there differences in the sequential patterns produced by groups that produce high- vs. low-quality writing, and if so, how are they different?

To address question one, the state diagram for the high-quality argument are examined to determine: a) how many patterns are found overall in the writing process; and b) if any of the individual patterns (e.g., A→B) when strung together reveal or produce longer and perhaps more linear sequences of actions (e.g., A→B→C→D→E), or reveal what might appear to be a collection of more haphazard processes (e.g., A→B→E, C→D→A). To address question two, the same process is used, but using the state diagram generated from the sequential analysis of the low-quality arguments. To address question 3, the two state diagrams are compared and examined together to determine: a) how many total patterns are found across both state diagrams; b) how many and which of the patterns in the high-quality state diagram are unique; and c) how many and which of the patterns in the low-quality state diagram are unique.

Analysis of Survey Data

After the week 16 activities were completed, an anonymous survey for non-consenting students (Appendix C) and an anonymous survey for consenting students (Appendix D) were distributed to students to gather general feedback on the collaborative writing process. Non-consenting students received a four-question survey (Appendix C) to gather general feedback and reactions to the class activity. On the other hand, consenting students received a 17-question survey (Appendix D) which included questions asking students to describe the procedures teams
used to coordinate the writing process; to identify types of contributions made to the team’s wikis; if they edited the content in other students’ work; edited the grammar and/or spelling errors in other students’ work, deleted any sentences posted by other students, added new sentences to build on sentences posted by other students, and so forth.

Consenting student survey results (Appendix K) were based on the comprehensive survey 17-question survey (Appendix D) which included questions that asked students to describe the procedures their teams used to coordinate the writing process; to identify the types of contributions they made to their team’s wikis; if they edited other students’ work; edited the grammar and/or spelling errors in other students’ work; deleted any sentences posted by other students; added new sentences to build on sentences posted by other students, and so forth.

The consenting student survey results were examined in order to identify any information that might provide possible explanations or insights on any of the unique patterns found within the high-quality and low-quality arguments. Furthermore, the survey data was used to determine to what extent students performed the presented task as it was intended to be performed. For example, out of the 16 students who consented to participate in the study, 15 students completed the survey. The student survey results were divided into sections based on activity 16.2, using surveys for research; and, activity 16.3, using interviews for research. In activity 16.2, 40% of the students reported that they referred to the criteria and example argument in the wiki activity instructions while making contributions to wikis on using surveys for research. On the other hand, 50% of students referred to the criteria and example argument for activity 16.3 while making contributions to wikis on using interviews for research.
CHAPTER 4

RESULTS

Introduction

The purpose of this study was to develop a method to code, sequentially analyze, and identify collaborative writing processes that can increase or decrease the quality of students’ written arguments. Initially, the study’s participants were 22 graduate students (nine male, 13 female) enrolled in an online course on inquiry and measurement. In the end, a total of 16 students consented to participate and six chose not to participate in the study. Every student worked on one team to analyze the arguments for using surveys and worked on one team to analyze arguments for using interview. A total of seven teams worked on the survey arguments and seven teams worked on the interview arguments. Each student worked with their team members using their team’s own wiki to develop arguments for using surveys and interviews. The arguments produced only by the consenting students were scored by the researcher and a second coder to determine which processes performed by the consenting students produced the highest- and lowest-quality arguments.

Research Question 1- Processes Producing High Quality Arguments

What sequential patterns are observed in students’ collaborative writing behaviors when students produce high-quality arguments? To answer this question, codes and sequence numbers were aggregated across high-quality arguments for using surveys and interviews and copied into the DAT tool to generate the frequency matrix (Figure 14). The cells in the frequency matrix report the number of times one action was immediately followed by another action. For example, when a student added a new paragraph (pADD), the most common action that followed was the addition of a correct premise (ADDcp, n=6).
Figure 14. High-quality argument frequency matrix generated with DAT

The transitional probability matrix for high-quality arguments was also generated (Figure 15) based on the observed frequencies in the frequency matrix. The cells reveal the probabilities that an action will follow another action. For example, 86% of actions that immediately followed pADD were ADDcp. The remaining 14% of the actions that followed pADD were ADDq.

Figure 15. High-quality argument transitional probability matrix generated with DAT
To examine in more detail the behavioral patterns observed in the collaborative writing process, a 6 x 6 matrix for high-quality arguments (Figure 16) was recomputed using only the codes (or actions) that produced pair action sequences that occurred at higher than expected frequencies and at frequencies three or greater (frequencies presented in boxes). The order in which these six codes/actions are listed in the matrix in Figure 16 was based not on any given empirical model established in prior studies/research, but based on a logical interpretation of what would be a common or natural sequence of actions used to write and edit a written argument. The 6 x 6 frequency matrix for high-quality arguments consists of 107 paired actions. Of these 107 paired actions, six of these paired actions were found to occur at higher than expected frequencies (values presented in boxes) based on a $z$-score of 1.65 and below at $p < .10$ for this exploratory study. In contrast, the cells with a value in bold red (underlined) indicate frequencies found to be significantly lower than expected frequency based on a $z$-score of 1.65 and below at $p < .10$.

**Figure 16.** 6 x 6 frequency matrix for high-quality arguments for 107 actions

The collaborative writing behaviors identified in the 6 x 6 matrix for high-quality arguments (Figure 16) reveal the following patterns in action sequences: 1) when a student added
a new paragraph (pADD), the most common action that followed was the addition of a correct premise (ADDcp, n=6); 2) ADDcp was likely to be followed by ADDcp (n=16); 3) after a student added a sentence to a paragraph to qualify or note a limitation of the idea presented in the previous sentence (ADDq), the action was followed by adding details to elaborate on an idea (ADDe, n=9); 4) ADDe was likely to be followed by ADDe (n=13); 5) the insertion of text into an existing paragraph by a different student (ADDo) was generally followed by ADDo (n=4); and 6) a student’s edits on another student’s text (EDITOR) was likely to be followed by more edits by the student EDITor (n=3).

**High-Quality State Diagram**

The behavioral patterns identified in the high-quality argument 6 x 6 matrix were converted into a transitional state diagram (Figure 17) to graphically and concisely convey the patterns of action sequences used to produce the high-quality arguments. As described previously, the weight or width of each arrow are directly proportional to the transitional probability observed between two given actions in order to provide a graphical representation that conveys which actions were most likely versus least likely to follow another action. Black or gray links identify transitional probabilities that were significantly higher or lower than expected, respectively. Furthermore, the frequency in which the specific action was observed is reported in the first numerical value in the node which represents the givens. The frequency of each action is also conveyed by the relative size of the circular glow emanating from each node. The second numerical value reported in each node, denoted in the replies column in Figure 16, represents the number of actions that immediately followed and/or were triggered by the given action.
Six patterns in action sequences are revealed in the state diagram out of the 89 total action sequences (the marginal total under the Replies column in Figure 16) used to produce the high-quality arguments. These six patterns identify what may be the key processes used by students to produce high-quality arguments. For each of the six events, the first numerical value in the node represents the frequency in which the given action was observed; the second numerical value is the number of actions that immediately followed the given action. Therefore, the seven pADD actions were followed by seven actions; the 47 ADDcp actions were followed by 33 actions; the 15 ADDq actions were followed by 16 actions; the 17 ADDe actions were followed by 26 actions; the one ADDo action was followed by 4 actions; and, the 20 EDITo actions were followed by three actions.
Starting at the top left node and working in a clockwise order, the six patterns reveal that when students first added a paragraph (pADD), the same student was most likely (86%) to follow that action by adding a correct premise to the paragraph (ADDcp). Once a student added a correct premise (ADDcp), the action was most likely (48%) to be followed by the addition of another correct premise (ADDcp). The next observed pattern was the addition of a sentence to a paragraph to qualify or note a limitation of the idea presented in the previous sentence (ADDq), which was then likely (56%) to be followed by the same student adding a sentence to provide more details or elaborate on an idea (ADDe). The next action involved the addition of a sentence to provide more details or elaborate on an idea (ADDe) which was likely (50%) to be followed by the addition of a sentence to provide more details or elaborate on an idea (ADDe). The insertion of text into an existing paragraph written by a different student (ADDo) was very likely (100%) to be followed by a different student inserting text into the existing paragraph (ADDo). Finally, a student adding details to elaborate on an idea presented by another student (EDITo) was very likely (100%) to be followed by a student adding details to elaborate on the ideas of another student (EDITo).

Research Question 2 – Processes Used to Produce Low-Quality Arguments

What sequential patterns are observed in students’ collaborative writing behaviors when students produce low-quality arguments? To answer this question, the combined codes and sequence numbers from the low-quality arguments for using surveys and interviews were copied into the DAT tool to generate the frequency matrix presented in Figure 18. Based on this frequency matrix, the transitional probability matrix for low-quality arguments was also generated (Figure 19) to reveal the probabilities that an action will follow another action.
Figure 18. Low-quality argument frequency matrix generated with DAT

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<tr>
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</tr>
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<td></td>
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</table>
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Figure 19. Low-quality argument transitional frequency matrix generated with DAT

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<th>Transiational probability matrix</th>
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<td>--------</td>
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A 6 x 6 matrix for low-quality arguments (Figure 20) was created using only the paired action sequences with frequencies significantly higher than expected, with frequencies of three or greater, and with the codes used in the high-quality state diagram (so that comparisons can be
made between the processes used to write high- and low-quality arguments). Of the 118 paired actions observed and recorded in the 6 x 6 matrix, two of these paired actions were found at higher than expected probabilities (values presented in boxes) based on a \( z \)-score of 1.65 and below at \( p < .10 \) for this exploratory study. Values less than three such as pADD to ADDcp (\( n=2 \)) could not be tested for significance using the \( z \)-score tests and as a result are omitted from further analysis. The frequencies presented in bold red (underlined) indicate frequencies found to be significantly lower than expected based on a \( z \)-score of 1.65 and below at \( p < .10 \).

<table>
<thead>
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<th>Frequency matrix</th>
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<td>pADD</td>
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<td>pADD</td>
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<td></td>
<td>0</td>
<td>5</td>
<td>15</td>
<td>37</td>
<td>2</td>
<td>2</td>
<td>61</td>
<td>18</td>
<td>118</td>
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Figure 20. 6 x 6 frequency matrix for low-quality arguments for 118 actions

A total of 61 action sequences (marginal total under the Replies column) were observed in the processes students used to produce the low-quality arguments. Two patterns in action sequences were identified in the matrix for low-quality arguments (Figure 20): 1) when a student added a correct premise to a paragraph (ADDcp), the most common actions that followed were the insertion of additional details to elaborate on an idea performed by the same student (ADDe,
and 2) one student’s addition of details to elaborate on an idea (ADDe) was most likely to be followed by the same student’s addition of a sentence to qualify or note a limitation of the idea presented in the previous sentence (ADDq, n=11).

**Low-Quality State Diagram**

The action sequences identified in the low-quality argument 6 x 6 frequency matrix was converted into a transitional state diagram (Figure 21) to graphically and concisely convey similarities and differences in behavioral patterns between teams. For each of the six nodes in the state diagram, the first numerical value in the node represents the observations; the second numerical value is the number of actions that followed or were triggered by the actions.

![State diagram for low-quality arguments](image)

*Figure 21. State diagram for low-quality arguments*
Therefore, the five pADD actions were followed by five actions; the 16 ADDcp actions were followed by 12 actions; the nine ADDq actions were followed by 11 actions; the two ADDe actions were followed by 30 actions; the zero ADDo actions were followed by 1 action; and, the 15 EDITo actions were followed by two actions.

As revealed previously in the transitional probability matrix, two patterns in action sequences are revealed in the state diagram out of a total of 61 action sequences that identifies the collaborative writing processes used by students to produce low-quality arguments. Starting at the top left node and working in a clockwise order, the two patterns reveal that when a student added a correct premise (ADDcp), the student was most likely (92%) to insert additional details to elaborate on an idea (ADDe). The student would then insert additional details to elaborate on an idea (ADDe) which was most likely (37%) to be followed by a student adding a sentence to a paragraph to qualify or note a limitation of the idea presented in the previous sentence (ADDq).

**Research Question 3 – Differences in Processes Used to Produce High- vs. Low- Quality Arguments**

Are there differences in the sequential patterns produced by groups that produce high-versus low-quality writing, and if so, how are they different? The two state diagrams for the high- and low-quality arguments are presented in Figure 22. A visual comparison of the two state diagrams reveals the differences in the sequential patterns produced by teams that produced high-quality arguments versus low-quality arguments.
Figure 22. High-quality arguments (top) vs. low-quality arguments (bottom)
High- and Low-Quality Collaborative Writing Processes. The diagram for high-quality arguments (Figure 22 top) shows a total of six sequential patterns performed during the collaborative writing process. Students that produced high-quality arguments 1) added a paragraph followed by adding the correct premise (pADD →ADDcp); 2) added a correct premise followed by adding another correct premise (ADDcp →ADDcp); 3) added a sentence to a paragraph to qualify or note a limitation of the idea presented in the previous sentence followed by adding a sentence to provide more details or elaborate on an idea (ADDq →ADDe); 4) added another sentence to provide further details or elaborate on an idea followed by adding another sentence to provide further details or elaborate on an idea (ADDe →ADDe); 5) had different students add new text to a text added previously by another student, followed immediately with the addition of more text performed by yet another student (ADDo → ADDo); and, 6) had different students edit the text of another student, and then once again, had yet another different student edit the text of another student (EDITo → EDITo). None of these six patterns were found in the processes used to produce the low-quality arguments.

The diagram for low-quality arguments (Figure 22 bottom) reveals only two sequential patterns in the actions used to produce low-quality arguments. Students that produced low-quality arguments 1) added a correct premise followed by the addition of another sentence to provide further details or to elaborate on a previous idea (ADDcp →ADDe); and, 2) added a sentence to provide more details or elaborate on a previous idea followed by adding a sentence to a paragraph to qualify or note a limitation of the idea presented in the previous sentence (ADDe → ADDq). Neither of these two patterns was found in the processes used to produce the high-quality arguments.
**Unique Patterns for High- and Low-Quality Arguments.** When the two state diagrams are compared, the state diagram for the high-quality argument shows six patterns in action sequences that were not found in the processes used to produce low-quality arguments. In addition, a more holistic view of the patterns when examined collectively reveals to some extent a more linear progression from one action to the next, particularly when moving from one action to the next in a clockwise direction. In the processes used to produce high-quality arguments, students started the process by first adding to the paragraph (pADD) before moving on to add the first correct premise (ADDcp). After adding a correct premise, a student added another correct premise (ADDcp→ADDcp), therefore, building on the foundation of the first correct premise and moving forward to develop a high-quality argument. In addition, the last two actions provide evidence of a truly “collaborative” process. In the first action, a different student adds text in a paragraph followed by having a different student add text in a paragraph (ADDo → ADDo). While, the last action involves a different student adding text followed by having a different student add text (EDITo→ EDITo). Again, none of these collaborative action sequences were found to be a pattern in the processes used to produce low-quality arguments.

In contrast, the state diagram for the low-quality arguments reveals only two patterns in the action sequences with no sufficient number of patterns to indicate that any systematic process was used by the students who produced the low-quality arguments. In the processes that produced the low-quality arguments, students 1) added a correct premise, and then followed by adding another sentence to provide further details or elaborate on an idea (ADDcp→ADDe), and 2) added a sentence to provide more details or elaborate on an idea, followed by adding a sentence to a paragraph to qualify or note a limitation of the idea presented in the previous sentence (ADDe→ADDq). Given that these two action sequences were *not* observed in the
processes used to produce high quality arguments, it is possible that these two action sequences may hinder or obstruct the processes needed to produce high-quality arguments.

**Student Study Survey Results**

Student surveys were used to cross check and validate actions revealed from coding the wiki history data and the observed patterns in action sequence patterns shown in the sequential analysis of the coding actions. Two types of surveys were used to collect data from the study participants. An anonymous non-consenting student survey (Appendix C) and an anonymous consenting-student survey (Appendix D) were distributed with the survey link sent to participants via e-mail.

*Consenting student survey results* (Appendix K) are based on the comprehensive survey 17-question survey (Appendix D) which included questions asking students to describe the procedures teams used to coordinate the writing process; to identify types of contributions made to the team’s wikis; if they edited the content in other students’ work; edited the grammar and/or spelling errors in other students’ work, deleted any sentences posted by other students, added new sentences to build on sentences posted by other students, and so on. Out of 16 students who consented to participate in the study, 15 students completed the survey. The student survey results were divided into sections based on activity 16.2, using surveys for research, and activity 16.3, using interviews for research. Although the survey results were anonymous, the results did provide contextual information which explained why there was so little team collaboration and why some of the codes that were observed in zero frequencies were not included in the analysis and state diagrams.

During activity 16.2, 40% of the students reported that they referred to the criteria and example argument in the wiki activity instructions while making contributions to wikis on using
surveys for research. On the other hand, 50% of students referred to the criteria and example argument for activity 16.3 while making contributions to wikis on using interviews for research.

The survey results for consenting students also revealed the type of contributions made to another student’s work in the group’s wiki. During activity 16.2, 73% of the student’s added sentence(s) to build on another students’ work already posted to the wiki; and, 73% made minor edits to grammar or spelling on another student’s work. In addition, 64% edited the content of sentences posted by another student; and, 64% moved and/or changed the sequencing of sentences posted by another student in the group. Lastly, 45% of the students deleted sentences from another student’s analysis/evaluation of a given argument. At the same time, 78% of the students completing activity 16.3 added sentence(s) to build on another students’ work already posted to the wiki; 67% made minor edits to grammar or spelling on another student’s work; and, 67% of the students moved and/or changed the sequencing of sentences posted by another student in the group.

The survey also addressed students’ comfort level during the editing process. Students were asked if they were comfortable with other students editing their contributions, and if they were comfortable editing other students’ contributions to the wiki. During activity 16.2, 60% of students agreed they were comfortable with other students editing their own contributions. In contrast, 40% of students agreed they were comfortable editing other students’ contributions to the wiki. During activity 16.3, 60% agreed they were comfortable with other students editing their contributions; and, 60% agreed that they were comfortable editing other students’ contributions to the wiki.

Furthermore, the survey results addressed the procedures used by the groups to coordinate the writing process. Fifty-six percent of students completing activity 16.2 said that their group
plans and outlines the task, then each writer prepares his/her part. The group also said they compiled the individual parts and revises the whole document, as needed. At the same time, 38% of students completing activity 16.3 said their group plans and outlines the task, then each writer prepares his/her part. The group also compiled the individual parts and revises the whole document, as needed. In addition, 38% of students completing activity 16.3 said that one person plans and writes the draft, and one or more members revise the draft without consulting the original authors.

Summary

The purpose of this study was to sequentially analyze and identify collaborative writing processes used to increase or decrease the quality of students’ written arguments. The study’s participants were 16 graduate students enrolled in an online course on inquiry and measurement. The following is a summary of the main findings for each of the three main research questions.

**Research Question 1.** What sequential patterns are observed in students’ collaborative writing behaviors when students produce high-quality arguments? The research results revealed that six patterns in action sequences out of the 89 total action sequences were used to produce the high-quality arguments. These six patterns identified what may be the key processes used by students to produce high-quality arguments given that none of these six patterns were found in the processes used to produce the poor-quality arguments. Four of the six patterns are iterative processes where a given action is repeated a second time, however, the other two transitions are from one given action to another action. The six patterns revealed that when students first added a paragraph (pADD), the same student was most likely to follow that action by adding a correct premise to the paragraph (ADDcp). Once a student added a correct premise (ADDcp), the action was most likely to be followed by the addition of another correct premise (ADDcp). The third
observed pattern was the addition of a sentence to a paragraph to qualify or note a limitation of the idea presented in the previous sentence (ADDq), which was then likely to be followed by the same student adding a sentence to provide more details or elaborate on an idea (ADDe). The fourth action involved the addition of a sentence to provide more details or elaborate on an idea (ADDe) which was likely to be followed by the addition of a sentence to provide more details or elaborate on an idea (ADDe). The insertion of text into an existing paragraph written by a different student (ADDo) was very likely to be followed by a different student inserting text into the existing paragraph (ADDo). Finally, a student adding details to elaborate on an idea presented by another student (EDITo) was very likely to be followed by a student adding details to elaborate on the ideas of another student (EDITo).

**Research Question 2.** What sequential patterns are observed in students’ collaborative writing behaviors when students produce low-quality arguments? Two patterns in action sequences are revealed out of a total of 61 action sequences that identifies the collaborative writing processes used by students to produce low-quality arguments. The two patterns revealed that when a student added a correct premise (ADDcp), the student was most likely to insert additional details to elaborate on an idea (ADDe). The student would then insert additional details to elaborate on an idea (ADDe) which was most likely to be followed by a student adding a sentence to a paragraph to qualify or note a limitation of the idea presented in the previous sentence (ADDq). Both transitions are from one action to another different action and none of the two were iterative types of processes.

**Research Question 3.** Are there differences in the sequential patterns produced by groups that produce high- versus low-quality writing, and if so, how are they different? When the two state diagrams were compared, high-quality argument results showed six patterns unique action
sequences that were not found in the processes used to produce low-quality arguments. Also, the writing process used by students to produce high-quality arguments revealed that students started by first adding to the paragraph before moving on to add the first correct premise. After adding a correct premise, a student added another correct premise, therefore, building on the foundation of the first correct premise and moving forward to develop a high-quality argument. The last two actions provided evidence of a truly “collaborative” process with different students involved in adding text to a paragraph written by another student, followed again by adding additional text to the paragraph written by another student. Again, none of these collaborative action sequences were found to be a pattern in the processes used to produce low-quality arguments.

In contrast, the state diagram for the low-quality arguments revealed two unique patterns in the action sequences with no sufficient number of patterns to indicate that any systematic process was used by the students who produced the low-quality arguments. Students produced low-quality arguments by adding a correct premise, followed by adding another sentence to provide further details or elaborate on an idea; and, adding a sentence to provide more details or elaborate on an idea, followed by adding a sentence to a paragraph to qualify or note a limitation of the idea presented in the previous sentence. Given that these two action sequences were not observed in the processes used to produce high quality arguments, it is possible that these two action sequences may hinder or obstruct the processes needed to produce high-quality arguments.
CHAPTER 5

DISCUSSION

Overview

The collaborative writing process enables students to learn the processes of writing by participating in a team environment where they can provide and receive feedback while discussing and negotiating how to complete the task (Erkens et al., 2004). The purpose of this study was to identify the collaborative writing processes used to increase and decrease the quality of students’ written arguments. A process-oriented approach was used to develop a method to code, sequentially analyze, and identify collaborative writing processes that can increase or decrease the quality of students’ written arguments. State diagrams were produced from the sequential analysis of the actions observed as students created high- and low-quality arguments in a wiki. The diagrams were then examined, interpreted, and compared to address the following three research questions:

1. What sequential patterns are observed in students’ collaborative writing behaviors when students produce high-quality writing?

2. What sequential patterns are observed in students’ collaborative writing behaviors when students produce low-quality writing?

3. Are there differences in the sequential patterns produced by groups that produce high- vs. low-quality writing, and if so, how are they different?

Discussion of the Results

The study’s participants were 16 graduate students enrolled in an online course on inquiry and measurement. The researcher randomly assigned students to 14 teams based on gender and whether students consented or did not consent to participate in the study. Seven
teams worked on a survey argument activity using a wiki; seven teams worked on an interview argument activity. Each student worked with team members to develop arguments supporting the use of surveys and interviews.

After completing the activities, non-consenting and consenting students received surveys designed to gather general feedback on the collaborative writing process. Non-consenting students received a short survey to gather general feedback and reactions to the class activity, however, the non-consenting student survey responses were not used in this study. Survey results provided information about the team’s processes while developing the survey and interview arguments. Since the surveys were anonymous and could not be directly connected to action sequences, only results relevant to the main findings are presented.

The arguments examined in this study were produced by all students. However, only arguments developed by students who consented to participate in the study were scored by the researcher and a second coder to determine which processes produced the highest- and lowest-quality arguments. Codes and sequence numbers were aggregated across both high- and low-quality arguments to answer the question of what sequential patterns were observed in students’ collaborative writing behaviors. Transitional probability matrices and state diagrams were also generated for both high- and low-quality arguments. The following paragraphs describe the study findings as they relate the three research questions.

**Sequential patterns observed in students’ collaborative writing behaviors when students produce high-quality writing.** The findings revealed six unique patterns in action sequences identifying the key processes used by students to produce high-quality arguments. For example, study results indicated that students began with two actions which included adding a
sentence to a paragraph and adding a correct premise; and, followed with four iterative actions which included adding additional details or editing a sentence.

These iterative processes also seem to suggest that students worked more in phases where one specific action is performed repeatedly before moving on to a different phase or action. This type of process also seems to indicate that the students used a more methodical phase-like writing process. During the iterative processes, there is also evidence that the teams used the reciprocal collaborative writing process which involves team members accessing the wiki and editing the argument at any time (Ede & Lunsford, 1990). Unfortunately, while Ede and Lunsford (1990) examined the collaborative writing process, they did not distinguish processes used to produce high- versus low-quality arguments.

In addition, these six patterns combined suggest that students who produced high-quality arguments tended to follow a more structured process. The study results are also consistent with the research findings of Southavilay, Yacef and Calvo (2010) who found that the collaborative writing process begins with adding text and editing text to develop a document.

There also appeared to be some level of collaboration between team members based on the two action sequences which involved different students adding new text in succession and different students editing the text of another student in succession. Since these processes were not found in those used to produce low-quality arguments, this finding suggests that these two collaborative action sequences are unique to those used to produce high-quality arguments. In addition, the level of collaboration between team members where different students edit the text of another student provides some indication that the narrative (argument) developed by students was produced through social interaction and dialogic processes (Koschmann, 1999).
Sequential patterns observed in students’ collaborative writing behaviors when students produce low-quality arguments. By contrast, an analysis of the processes used to produce low-quality arguments revealed only two patterns in action sequences. These two sequences included adding a correct premise followed by adding another sentence to provide further details or elaborate on an idea; and, adding a sentence to provide more details or elaborate on an idea followed by adding a sentence to a paragraph to qualify or note a limitation of the idea presented in the previous sentence. The lack of sequential patterns in the processes indicates that the writing process was not very structured which may be evidence of a lack of coordination in the collaborative writing process (Ede & Lunsford, 1990). Moreover, none of the collaborative actions (DELo, EDITo) were observed in either of the two observed patterns. This finding indicates that there was a lack of collaboration between the students developing low-quality arguments.

Survey responses also addressed the procedures used by the groups to coordinate the writing process. Fifty-six percent of students completing the first activity and 38% completing the second said that their group planned and outlined the task, then each writer prepared his/her part which explains the lack of any patterns between the individual writing actions and the collaborative writing actions (different students editing text or different students deleting). The group also said they compiled the individual parts and revised the whole document, as needed, which explains the number of observed insertion of texts into an existing paragraph, but may hide the true number of added incorrect or correct premises, and correct or incorrect relationships that occurred in the collaborative writing process. Overall, the lack of sequential patterns in the actions exhibited by students who developed low-quality arguments indicates that team members may have not coordinated the collaborative writing process. In the future, instructors may want
to discuss the collaborative processes (particularly the ones found in this study to be those that were used to produce high quality arguments) before the activity and have students conduct team meetings to plan the collaborative writing process.

Differences in the sequential patterns produced by groups that produced high-versus low-quality writing. The study findings revealed several key differences in action sequences used to produce high- and low-quality arguments. For example, there were six unique patterns in action sequences used to produce the high-quality arguments and two unique patterns in action sequences used to produce the low-quality arguments. The six unique patterns for high-quality arguments may reflect that students focused on more core tasks such as adding one correct premise and following that action by adding another correct premise. The action sequence appears to suggest that these students were mentally stepping through a particular branch within the concept map by identifying a correct premise and relationship and then moving on down the branch by identifying and adding another correct premise in the course of developing the arguments for a given major premise. According to research, focusing on more core topics leads to the development of a better final product (Olson, Olson, Storrosten & Carter, 1992). The two unique patterns in teams who produced low-quality arguments, on the other hand, may be based on the lack of contributions by students or a focus on meeting only the minimum requirements for the assignment (Judd, Kennedy & Cropper, 2010).

The high number of iterative sequences in high-quality arguments, on the other hand, reveals that students worked within particular phases or modes. As a result, the frequency in which these iterative processes occurred may have eclipsed any notable patterns in the transitions between different actions. This may help to explain why patterns did not show a move from adding a correct premise to adding a sentence to qualify or note a limitation of the idea presented
Students that produced low-quality arguments added a correct premise followed by adding another sentence to provide further details or elaborate on an idea, and added a sentence to provide more details or elaborate on an idea followed by adding a sentence to a paragraph to qualify or note a limitation of the idea presented in the previous sentence. Given that these two action sequences were also not observed in the processes used to produce high-quality arguments, it is possible that these two action sequences hindered or obstructed the processes needed to produce higher quality arguments. The exact reason for why these action sequences would hinder quality is not apparent. Future studies, on the other hand, may be able to determine exactly why these action sequences were observed in the low- versus high-quality arguments.

The use of wikis as a platform for collaborative writing may also have had an impact on the quality of high- and low-arguments by inhibiting collaboration. One of the drawbacks of working in a wiki is the inability of two students to edit a wiki at the same time and this may influence students’ reluctance to edit other students’ writing. Lund and Smordal (2006) found that students may be reluctant to edit or rewrite, particularly when they were displeased when text had been edited by other students. Low-quality argument results should alert instructors to question the use of wikis as the ideal platform for collaborative work (West & West, 2009).

While Southavilay, Yacef and Calvo’s (2010) research found that the writing process models between high- and low-performing groups were similar, the results of this study were not. In this study, differences included greater activity by teams who produced high-quality arguments as demonstrated by the six action sequences versus the two action sequences of
students who developed low-quality arguments. In the teams producing high-quality arguments, collaboration was in evidence during the iterative sequences where additional edits were made by different students. On the contrary, there was a lack of collaboration between the students developing low-quality arguments. Results are different than Southavilay, Yacef and Calvo’s (2010) findings because this study examined the processes of editing and revising only, and did not examine the overall global processes of collaborative writing.

Survey responses also addressed students’ perception of the collaborative writing process, in part, with the type of contributions made to another student’s work in the group’s wiki activities. Students were confident that they added sentence(s) to build on another student’s work already posted to the wiki, made minor edits to grammar or spelling on another student’s work, edited the content of sentences posted by another student and, moved and/or changed the sequencing of sentences posted by another student in the group.

Overall, the study’s findings for high- and low-quality arguments indicate a distinct difference in actions and coordination of the collaborative writing process with high-quality argument results showing more student involvement. As a consequence, instructors should plan to involve students in the collaborative writing process prior to the activity by enabling team members to meet and get to know each other. Team members should also be urged to use these meetings to plan the collaborative writing process and most of all, to make it clear to students that editing the text of other students is both encouraged and expected.

It is important to also point out that survey responses indicate that the students may not have been entirely comfortable with the editing process used during the collaborative writing activities. For example, 60% of students for both activities said they were comfortable with other students editing their contributions and they were comfortable editing other students’
contributions to the wiki. The student’s reported discomfort with editing other students’ contributions was shown in the lack of collaboration in high- and low-quality arguments.

**Limitations of the Study**

The first limitation of this process-oriented, exploratory study is the fact that there were only 16 graduate students who participated in the study. More students are needed to produce sufficient data that generates sufficient cell frequencies in the frequency matrices to examine other action sequences. Expanding the study to a larger population may result in more accurate action sequences for high- and low-quality arguments.

Another limitation involved the coding used to analyze the team arguments which had previously been revised and expanded based on Jeong’s study (2012). The code pADD (which by necessity was used to code multiple sentences that students cut and pasted into the wiki) was a code that likely covered up instances where students were posting ADDcp and ADDip and other behaviors of greater significance. Codes such as ADDo, indicating the insertion of text into an existing paragraph by a different student, were seldom used. Furthermore, the correct premise (cp), incorrect premise (ip), correct relationship (cr), and incorrect relationship suffixes for codes were not used for editing functions such as DEL and EDIT. As a result, this study did not examine how often students edited other students’ work to correct for errors in other students’ contributions to the arguments. The large number of codes also contributed to the small cell frequencies in matrices which in turn led to the inclusion of fewer nodes in the state diagrams for high- and low-quality arguments. The procedures for coding and using the tags need further refinement to make it clearer, less redundant, and more in line with the collaborative writing processes identified in this study. Revised coding may also lead to less labor-intensive coding for a researcher and second coder.
While activity instructions were detailed, clear, and contained an example argument, this study’s findings indicate that the teams involved in developing both high- and low-quality arguments may have not followed directions or used the examples provided. While there was a distinct difference in the action sequences used for high- and low-quality arguments, the arguments produced lacked flow and structure.

The scoring was labor intensive; however, it was effective in producing an accurate score. Although the concept maps and rubric also provided support in assessing the quality of the arguments, the scoring needs to be analyzed and simplified in order to make it possible for future researchers to replicate this study.

Student surveys were originally designed to cross check and validate actions revealed from coding the wiki history data and the observed patterns in action sequence patterns shown in the sequential analysis of the coding actions. However, since the survey was anonymous, the researcher was not able to identify which responses related to teams who produced high- or low-quality arguments. Future research studies should consider options for overcoming this barrier such as having surveys identified by teams.

No controlled experiments were conducted in this study to establish causality between process and quality. As a consequence, study findings were purely correlational.

Finally, a $p$ value of .10 was used throughout the exploratory study. The value was chosen to flush out possible patterns – patterns that can be verified with greater rigor and precision in future studies. Therefore, the study findings are not as conclusive.

**Future Research**

Based on the fact that this study was exploratory and primarily qualitative, more in-depth research should be conducted. The study was primarily based on Jeong’s study (2012) and went
beyond the study to successfully develop a method to score the quality of arguments written by students working in a team and using a wiki. In addition, coding was expanded and the results were sequentially analyzed. The collaborative writing process was identified in the high- and low-quality argument action sequences and, as a consequence, this study can be used as a foundation to move on to address additional research questions.

The findings of both high- and low-quality argument action sequences found that while the high-quality argument action sequences provide evidence of a collaborative process, primarily in the iterative action sequences, the low-quality argument action sequences do not. Lack of collaboration is also revealed in survey results which revealed that students tended to divide up the argument and work individually. Questions that remain include: what type of instructional interventions can help to promote collaboration? For example, using discussions before the activity could be beneficial so groups can discuss collaboration and meet fellow team members before they began to work together. In addition, how do we increase the likelihood that students working in teams will collaboratively work together to develop high-quality writing projects? The collaborative writing process has still not been completely identified and researchers such as Pargman (2003) found that identifying problems students have writing collaboratively can result in determining the best tools to support the collaborative function. As mentioned previously, one suggestion is to reconsider the use of a wiki as the ideal platform for collaboration. While there is no concrete evidence that students disliked the structured wiki provided for this study’s activities, instructors and researchers should consider alternatives such as blogs, journals, Google docs or other tools which may be more familiar to students and easier to use. In addition, students should be urged to utilize the wiki discussions to plan and document the collaborative writing process.
Researchers should also look into solutions for increasing the likelihood that students working in teams will work collaboratively to develop high-quality writing projects. While students work in groups in both the face-to-face and online environments and instructors encourage team activities, both Jeong’s research findings (2012) and this study produced results that provide little evidence of collaboration between students. Research findings from Walther and Bunz (2005) highlighted the unique challenges of working in a virtual team and the need to build trust so members can work together effectively. The findings from this study and the research dealing with virtual group dynamics can provide the foundation for further research and for the development of new tools that can automatically measure and monitor the collaborative writing processes within wiki tools that specifically promote target processes.

The methods developed by this study also provide a foundation for studies dealing with the collaborative writing processes. In particular, sequential analysis provided valuable data in this study based on the use of 6 x 6 matrices which further defined the sequential patterns and provided a more focused state diagram. With the exception of Olson’s study (Olson, Olson, Storrosten, and Carter, 1992), sequential analysis had not previously been used to identify differences in the writing processes.

Future research should also be expanded beyond the 16 graduate students who participated in the study. One way to increase the number of students is to expand the study to include two or more classes which would use the established procedures used in this study. For example, one class could be focused on a collaborative writing activity on one topic such as reasons for using surveys to gather data for research and the other class could focus on the reasons for using interviews to gather data for research.
Future research should expand the type of collaborative writing assignments beyond arguments to include persuasive writing, reports, expository writing, and so on. While there appeared to be difficulty for students developing high-quality arguments, expanding the type of writing assignments may lead to more revealing results. In addition, instructors and researchers should also make sure assignment instructions are detailed, clear, and contain an example of the writing assignment. Instructors should also encourage more collaboration by team members by doing the following:

- Establish a discussion group prior to the activity where the instructor facilitates a discussion on how a collaborative project may be structured.
- Set up practice collaborative writing activities where students receive feedback so students can gain experience completing a collaborative writing activity.
- Involve students in team activities prior to the collaborative writing assignment so students can discuss the collaborative writing process, meet team members in order to develop trust (Walther & Bunz, 2005), and more thoroughly plan the collaborative writing process.
- Use concept maps as a visual guide for students to increase their familiarity with the topic and include the maps in the assignment instructions.
- Use collaborative exercises prior to the assignment to enable the students to become familiar with the collaborative process.

In conclusion, future research should use the methods developed in this study to continue to develop and refine methods for determining the difference between high- and low-quality writing assignments. Additional experimental techniques and qualitative research methods should be considered.
Conclusions

This study was based in part on a prior study by Olsen (1994) and a study by Jeong (2012) conducted to examine wiki editing behavior which resulted in the development of a preliminary method for measuring and identifying patterns in action sequences exhibited by students while engaged in a collaborative writing process in a wiki. In this study, the researcher identified collaborative writing processes used by students working in a team to develop high- and low-quality arguments in a wiki. Collaborative writing processes were identified and processes that may increase as well as decrease group performance.

Study findings concluded that students developing high-quality arguments performed a total of six action sequences performed during the collaborative writing process. None of these six patterns found for students who develop high-quality arguments were found in the processes used to produce the low-quality arguments. By contrast, students developing low-quality arguments used only two action sequences. In both the high- and low-quality argument results, there was a lack of collaboration in teams. The high-quality argument teams tended to exhibit a more structured process, and engaged in iterative processes such as collaborative processes where different students edited and deleted one another’s work. Given that the two low-quality argument action sequences were not observed in the processes used to produce the high quality arguments, it is possible that these two action sequences hindered or obstructed the processes needed to produce higher quality arguments. In terms of their similarities, the processes used to produce both the high and low quality arguments lacked collaboration particularly the absence of editing activities by different students. The reasons for the findings in this study may include the student’s lack of familiarity with the wiki, lack of experience developing a collaboratively
written argument, and, lack of experience with online collaboration. All of these problems can be addressed in future research.

The study resulted in the development of a methodology that used sequential analysis to identify collaborative writing processes that can increase and decrease the quality of students’ written arguments. This methodology can be further tested and refined to help future researchers and instructors identify target strategies to help students collaborate more effectively. Moreover, tools such as concept maps and rubrics proved to be highly-effective as a precise means of assessing the quality of arguments developed during the collaborative writing process. In terms of long-term implications, the study established the groundwork needed to establish methods to measure action sequences which may enable future research to address such issues as whether the number of collaborative edits increases as students become more familiar with wikis. Overall, this study successfully developed a methodology to operationally define collaborative writing processes to measure the results of a collaborative writing exercise. The study results also contributed to the body of collaborative writing research. Additional research will continue to broaden the ability of the instructional systems community to measure the collaborative writing process.
APPENDIX A

IRB APPROVAL

Office of the Vice President for Research
Human Subjects Committee
Tallahassee, Florida 32306-2742
(850) 644-8673 • FAX (850) 644-4302

APPROVAL MEMORANDUM

Date: 01/11/2013

To: Patricia Heeter

Address:

Dept.: EDUCATIONAL PSYCHOLOGY AND LEARNING SYSTEMS

From: Thomas L. Jacobson, Chair

Re: Use of Human Subjects in Research
The Sequential Analysis of Collaborative Writing and Editing Processes In Wikis

The application that you submitted to this office in regard to the use of human subjects in the proposal referenced above have been reviewed by the Secretary, the Chair, and two members of the Human Subjects Committee. Your project is determined to be Expedited per 45 CFR § 46.110(b) and has been approved by an expedited review process.

The Human Subjects Committee has not evaluated your proposal for scientific merit, except to weigh the risk to the human participants and the aspects of the proposal related to potential risk and benefit. This approval does not replace any departmental or other approvals, which may be required.

If you submitted a proposed consent form with your application, the approved stamped consent form is attached to this approval notice. Only the stamped version of the consent form may be used in recruiting research subjects.

If the project has not been completed by 01/09/2014, you must request a renewal of approval for continuation of the project. As a courtesy, a renewal notice will be sent to you prior to your expiration date; however, it is your responsibility as the Principal Investigator to timely request renewal of your approval from the Committee.

You are advised that any change in protocol for this project must be reviewed and approved by the Committee prior to implementation of the proposed change in the protocol. A protocol change/amendment form is required to be submitted for approval by the Committee. In addition, federal regulations require that the Principal Investigator promptly report, in writing any unanticipated problems or adverse events involving risks to research subjects or others.

By copy of this memorandum, the chairman of your department and/or your major professor is reminded that he/she is responsible for being informed concerning research projects involving human subjects in the department, and should review protocols as often as needed to ensure that the project is being conducted in compliance with our institution and with DHHS regulations.

This institution has an Assurance on file with the Office for Human Research Protection. The Assurance Number is IRB00000446.

Cc: Allan Jeong, Advisor
HSC No. 2012.9235
STUDENT CONSENT FORM

I freely and voluntarily and without element of force or coercion, consent to be a participant in the research project entitled “The Sequential Analysis of Collaborative Writing and Editing Processes in Wikis” for the duration of this course and course semester.

This research is being conducted by Patricia Heeter, Doctoral Candidate, Instructional Systems, Department of Educational Psychology and Learning Systems at Florida State University. I understand the purpose of the research project is to gain a more thorough understanding of how Wikis can be used to support collaborative writing.

I understand that if I participate in the project I will be asked to participate in an online group. Each group will be given access to a Wiki to complete a final online collaborative writing project. I will also be asked to complete a questionnaire during the course of the semester. I understand that it is possible that some of my individual responses in the questionnaire may be reported to provide qualitative descriptions and explanations for given findings. However, I do understand that my identity will be kept confidential (to the extent allowed by law regarding confidentiality in the informed consent) and that any of my reported answers will be identified by a subject code number so that my name will not appear on any of the results.

I understand there are benefits for participating in this research project. I will be able to experience and learn the processes of interacting and learning with fellow students in an online learning environment. Also, I will be providing distance education researchers with valuable insight into students’ feelings and reactions to different instructional activities and strategies used to foster collaborative learning. This knowledge can assist practitioners in distance education in providing more effective distance education courses.

I understand there is no identifiable health or safety risk involved if I agree to participate in this study. Regardless, I understand that I am able to stop my participation and withdraw from participating in the study at any time without penalty.

I understand my participation is totally voluntary, and that I can decide not to participate in the study without prejudice, penalty or loss of benefits to which I am otherwise entitled. If I elect not to participate in the study, I will have the option to complete alternative assignments as a substitute to participating in the group discussions. This alternative will consist of individual writing assignments associated with the weekly topics of discussion, which will require the amount of time and effort equivalent to participating in the weekly discussions.

I also understand that once I begin participating in the study, I may still stop and withdraw from participation at any time. I understand that this consent may be withdrawn at any time without prejudice, penalty or loss of benefits to which I am otherwise entitled. I have been given the right to ask and have answered any inquiry concerning the study. Questions, if any, have been answered to my satisfaction.

I understand that I may contact Patricia Heeter, Doctoral Candidate, Instructional Systems, Department of Educational Psychology and Learning Systems at Florida State University, for answers to my rights and to questions concerning this research study. You may also contact your instructor, Dr. Allan Jeong, Department of Educational Psychology and Learning Systems at Florida State University.

Questions about my rights as subjects in the study can also be addressed


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to the Human Subjects Committee, . The results of this study will be sent to me upon my request.

I have read and understand this consent form.

PLEASE CHECK ONE OF THE FOLLOWING:

___ YES I consent

___ NO I do not consent. I will complete alternative assignments as a substitute to the group activities.

PRINT NAME: ___________________________ DATE ___________________________

SIGNATURE: ___________________________
APPENDIX B

WEEK 16 ACTIVITES

Week 16 - Evaluating Pros & Cons of Surveys & Interviews

This Week's Objectives (and last week of class! Hurray!)

Now that you have completed the survey and interview report assignments, we will take this week to engage in two activities to review and synthesize: a) the various pros and cons of using surveys (activity 16.2); and b) the various pros and cons of using interviews for collecting research data (activity 16.3). The purpose of these two activities is to help you articulate and increase your depth of understanding of the whys, whens, and hows of using these two particular methods for conducting research.

Activity 16.1 Readings

Read:

- Review the pros and cons of using surveys (p.104 O'Leary textbook)
- Review the pros and cons of using interviews (p.114 O'Leary textbook)

Activity 16.2 - Using Surveys to Collect Research Data

Requirements: Contribute a minimum of 10 sentences per student (2 pts)
Bonus Points: 1 bonus point awarded to the group that presents the best written arguments
Deadline: By Sunday

Objective: Develop six coherent and well-reasoned arguments that support the claim that "The use of surveys is an effective means of collecting..."
In this activity, you will be assigned to a group of 3 students to use a shared online Wiki document to collaboratively write six arguments (each argument based on one of the six pros presented by O’Leary in chapter 6 p. 106) to support the claim that “The use of surveys is an effective means of collecting research data”. Note below that O’Leary presented a list of the six pros for using surveys separate from the list of seven cons of using surveys.

However, some of the listed pros and cons are conceptually or causally inter-related. Ideas that are inter-related should be presented in context to one another in order to build a more coherent, thorough, well-balanced, informative, and persuasive argument to support the claim. In addition, O’Leary’s list of pros and cons provides no references to empirical evidence or data to establish the veracity of each pro and con. Finally, no closing statements are given to summarize the argument and to provide an overall evaluation of each argument/reason in terms of accuracy, veracity, and/or relevance.

Your objective is to use your group’s assigned Wiki (using only the Wiki with no communications with group members outside of the Wiki) to collaboratively write one coherent, integrated, and well-reasoned paragraph (one paragraph for each pro) that analyzes and evaluates each of the six listed pros/arguments listed below that are used to support the claim that “the use of surveys is an effective means of collecting research data”. An example paragraph with an analysis and evaluation of an argument (based on one of the seven pros of using observations) is presented below to help you better understand the goals and requirements of this activity.

### Pros of Using Surveys

1. Reach a large number of respondents
2. Represent an even larger population
3. Allow for comparisons
4. Generate standardized, quantifiable, or empirical data
5. Generate qualitative data through the use of open-ended questions
6. Be confidential and even anonymous

### Cons of Using Surveys

1. Capturing the quantifiable data you require
2. Gathering in-depth data
3. Getting a representative sample to respond
4. Getting anyone to respond at all
5. Needing proficiency in statistical analysis
6. Only getting answers to the questions you’ve thought to ask
Example Argument Analysis & Evaluation

The example below provides a coherent, integrated, and well-reasoned analysis and evaluation of one of the pros/arguments used to support the claim that "The use of observation is an effective means of collecting research data." For example, the sentence highlighted in yellow presents one of the seven main reasons or arguments as to why observation is an effective method for collecting research data. That is then followed with more supporting arguments for using observations that are a direct and indirect result of the main argument (being able to see what people actually do). This is then followed with three opposing arguments that qualify and/or limit the truth value of the main argument. The first opposing argument (in red) is supported with empirical evidence ("Cordaro found... "). The paragraph ends with a closing argument that summarizes the argument and provides an overall evaluation of the accuracy, veracity, and/or relevance of the first main pro/argument.

Observation is an effective method for collecting research data because observation enables you to explore or see what people actually do – and not just what they say they do $P^1$. Seeing what people actually do leads to three additional benefits/reasons for using observation: (two directly and one indirectly) you are able to take it in for yourself $P^2$, observe nonverbal as well as verbal data $P^7$, and therefore, collect rich, in-depth qualitative data $P^8$.

However, collecting data based on what you see poses several problems. Personal biases might colour your observations $O^2$ (i.e., Cordaro in 1963 found that observers documenting the movements of an animal whom were given to believe that the animal would move frequently counted 5 times more moves than observers given to believe the animal would move infrequently). Potential flaws in the observation protocol can negatively affect how well you are able to credibly capture the data you require $C^1$ from the wealth of data that can be observed while in the field. The participants in the study are not able to maintain total anonymity $C^5$. And finally, the participants may not act naturally if the participants are aware of your presence and you have not established mutual trust between you and the participants $O^4$ – thus introducing further biases into your observational data.

Overall, the ability to see what people actually do presents a strong argument for using observation because it can lead to three other benefits as long as counter measures are taken to address four potential challenges that arise directly from your presence as you watch and observe the participants.

<table>
<thead>
<tr>
<th>Pros of Using Observation</th>
<th>Cons of Using Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. Designing a protocol that can</td>
</tr>
</tbody>
</table>
Instructions:

1. Create a free account and username at [http://www.wikispaces.com](http://www.wikispaces.com) by clicking the "I'm a teacher" or "I'm a student" button located under the Join Now header. If these two buttons do not appear or do not work, try a different or updated web browser. Please create an account with an identifiable username (first and last name) so that you can be recognized and awarded the participation points for your contributions to the wiki.

2. Click on the "Wiki Teams" link in the Blackboard course site to find your group assignment.

3. Then click on the link "Arguments for using surveys" to access your group's Wiki. Please do not share the link to your group's Wiki with students in other groups in class.

4. MAKE SURE YOU ARE SIGNED INTO Wikispaces BEFORE you perform any actions on your group's Wiki so that your contributions will be counted and so that you receive the participation points for completing this activity. Once signed in, each contribution you make to the Wiki (e.g., adding, deleting, editing, revising your own text or someone else's text) will be recorded in the Wiki history page so that you will be rewarded the participation points for making the minimum required contributions to your group's document. Note: You must meet the minimum requirements to receive all 2 participation points. No partial points are awarded for partial completion of the requirements.
5. To EDIT your group's document, click Edit button. In your group's Wiki, you will see that the six pros of using surveys will already be listed. Do NOT delete or remove the listed pros from the document because each pro will serve to identify one argument or reason as to why surveys are effective. Build your arguments (one paragraph maximum) for and around each of the listed pros. Because you are limited to one paragraph for each listed pro, you will need to pay special attention to both brevity and clarity while developing each argument.

6. Next, write and/or edit any portion of the document to develop and present your group's argument that makes explicit references to and/or addresses any or all of the following:

- Supporting arguments: The pros of using surveys.
- Opposing arguments: The cons of using surveys.
- Evidence: Cite empirical data and findings (along with citations/references to the authors of the research/work) to demonstrate the veracity or accuracy of any one claim presented among the list of pros and cons.
- Closing Arguments: Summation or conclusion of the argument.

Note: It is OK to edit or even delete another students' sentence if necessary because each student's contribution is recorded in the wiki history page. As a result, students will be credited for each posted sentence even if the sentence has been deleted and removed from the final draft.

7. When you complete any one contribution to the document, immediately click the SAVE button to save and log your work.

IMPORTANT! Only one person at a time can edit the document at any one time. If two users happen to be editing the document concurrently and at the same time, the work produced by the last user that hits the Save the document will overwrite all the work produced by the previous user. The system will warn you if you will be overwriting someone else's work and will give you the option to cancel your edits (as well as to view the work/changes just submitted by the concurrent user).

Activity 16.3 - Using Interviews to Collect Research Data
Requirements: Contribute a minimum of 10 sentences per student (2 pts)
Bonus Points: 1 bonus point awarded to the group that presents the best written arguments
Deadline: By Sunday

Objective: Establish five coherent and well-reasoned arguments that support the claim that “interviews are an effective means of collecting research data”.

In this activity, you will be assigned to a group of 3 students to use a shared online Wiki document to collaboratively write five arguments (each argument based on one of the five pros presented by O’Leary in chapter 6 p. 114) to support the claim that “the use of interviews is an effective means of collecting research data”. Note below that O’Leary presented a list of the five pros for using interviews separate from the list of six cons of using interviews. However, some of these pros and cons are conceptually or causally inter-related. Ideas that are inter-related should be presented in context to one another in order to build a more coherent, thorough, well-balanced, informative, and persuasive argument to support the claim. In addition, O’Leary’s list of pros and cons provides no references to empirical evidence or data to establish the veracity of each pro and con. Finally, no closing statements are given to summarize the argument and to provide an overall evaluation of each argument/reason in terms of accuracy, veracity, and/or relevance.

Your objective is to use your group’s assigned Wiki (using only the Wiki with no communications with group members outside of the Wiki) to collaboratively write one coherent, integrated, and well-reasoned paragraph that analyzes and evaluates each of the five pros/arguments listed below that are used to support the claim that “the use of interviews is an effective means of collecting research data”. An example analysis and evaluation of an argument (based on one of the seven pros of using observations) is presented below to help you better understand the goals and requirements of this activity.

<table>
<thead>
<tr>
<th>Pros of Using Interviews</th>
<th>Cons of Using Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Allows you to develop rapport and trust</td>
<td>1. Resisting the urge to lead your respondents</td>
</tr>
<tr>
<td>2. Provides you with rich, in-depth qualitative data</td>
<td>2. Facilitating honest and open responses even though you interviewees may want to “impress”</td>
</tr>
<tr>
<td>3. Allows for non-verbal as well as verbal data</td>
<td></td>
</tr>
</tbody>
</table>

90
4. Be flexible enough to allow you to explore tangents
5. Be structured enough to generate standardized, quantifiable data

3. Figuring out how attributes such as race, gender, ethnicity, class and age of interviewer and interviewee alike might affect the interview process – an employing effective strategies for ensuring credibility
4. The potential for communication miscues
5. Difficulties of working with a large or geographically-dispersed sample
6. A lack of anonymity

Example Argument Analysis & Evaluation (as presented earlier in activity 16.2)

The example below provides a coherent, integrated, and well-reasoned analysis and evaluation of one of the pro/arguments used to support the claim that “The use of observation is an effective means of collecting research data”. For example, the sentence highlighted in yellow presents one of the seven main reasons or arguments as to why observation is an effective method for collecting research data. That is then followed with more supporting arguments for using observations that are a direct and indirect result of the main argument (being able to see what people actually do). This is then followed with three opposing arguments that qualify and/or limit the truth value of the main argument. The first opposing argument (in red) is supported with empirical evidence (“Cordaro found...”). The paragraph ends with a closing argument that summarizes the argument and provides an overall evaluation of the accuracy, veracity, and/or relevance of the first main pro/argument.

Observation is an effective method for collecting research data because observation enables you to explore or see what people actually do – and not just what they say they do. Seeing what people actually do leads to three additional benefits/reasons for using observation (two directly and one indirectly): you are able to take it in for yourself, observe nonverbal as well as verbal data, and therefore collect rich, in-depth qualitative data. However, collecting data based on what you see poses several problems. Personal biases might colour your observations (i.e., Cordaro in 1963 found that observers documenting the movements of an animal whom were given to believe that the animal would move frequently counted 5 times more moves than observers given to believe the animal would move infrequently). Potential flaws in the observation protocol can negatively affect how well you are able to credibly capture the data you require from the wealth of data that can be observed while in the field. The participants in the study are not able to maintain total anonymity. And, finally, the participants may not act naturally if the participants are aware of your presence and you have not established mutual trust between you and the participants – thus introducing further biases into your observational data.
4. Be flexible enough to allow you to explore tangents
5. Be structured enough to generate standardized, quantifiable data

3. Figuring out how attributes such as race, gender, ethnicity, class and age of interviewer and interviewee alike might affect the interview process – an employing effective strategies for ensuring credibility
4. The potential for communication miscues
5. Difficulties of working with a large or geographically dispersed sample
6. A lack of anonymity

Example Argument Analysis & Evaluation (as presented earlier in activity 16.2)

The example below provides a coherent, integrated, and well-reasoned analysis and evaluation of one of the proarguments used to support the claim that "The use of observation is an effective means of collecting research data". For example, the sentence highlighted in yellow presents one of the seven main reason or arguments as to why observation is an effective method for collecting research data. That is then followed with more supporting arguments for using observations that are a direct and indirect result of the main argument (being able to see what people actually do). This is then followed with three opposing arguments that qualify and/or limit the truth value of the main argument. The first opposing argument (in red) is supported with empirical evidence ("Cordaro found..."). The paragraph ends with a closing argument that summarizes the argument and provides an overall evaluation of the accuracy, veracity, and/or relevance of the first main pro/argument.

Observation is an effective method for collecting research data because observation enables you to explore or see what people actually do – and not just what they say they do. ⁵¹ Seeing what people actually do leads to three additional benefits/reasons for using observation (two directly and one indirectly): you are able to take it in for yourself, observe nonverbal as well as verbal data,⁵² and therefore collect rich, in-depth qualitative data. ⁵₆ However, collecting data based on what you see poses several problems. ⁵₃ Personal biases might colour your observations (i.e., Cordaro in 1983 found that observers documenting the movements of an animal whom were given the belief that the animal would move frequently counted 5 times more moves than observers given to believe the animal would move infrequently). Potential flaws in the observation protocol can negatively affect how well you are able to credibly capture the data you require. ⁵⁴ From the wealth of data that can be observed while in the field, the participants in the study are not able to maintain total anonymity. ⁵⁵ And finally, the participants may not act naturally if the participants are aware of your presence and you have not established mutual trust between you and the participants, thus introducing further biases into your observational data.
Overall, the ability to see what people actually do presents a strong argument for using observation because it can lead to three other benefits as long as counter measures are taken to address four potential challenges that arise directly from your presence as you watch and observe the participants.

<table>
<thead>
<tr>
<th>Pros of Using Observation</th>
<th>Cons of Using Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Explore what people actually do -- and not just what they say they do</td>
<td></td>
</tr>
<tr>
<td>2. Allow you to take it in for yourself</td>
<td></td>
</tr>
<tr>
<td>3. Get you out there in the field</td>
<td></td>
</tr>
<tr>
<td>4. Allow you to develop rapport and trust</td>
<td></td>
</tr>
<tr>
<td>5. Be flexible enough to let you explore tangents</td>
<td></td>
</tr>
<tr>
<td>6. Provide rich, in-depth qualitative data &amp; standardized, quantifiable data</td>
<td></td>
</tr>
<tr>
<td>7. Allow for nonverbal as well as verbal data</td>
<td></td>
</tr>
<tr>
<td>1. Designing a protocol that can credibly capture the data you require</td>
<td></td>
</tr>
<tr>
<td>2. Making sure your biases do not colour your observations</td>
<td></td>
</tr>
<tr>
<td>3. Avoiding the dilemma of having an impact on the researched</td>
<td></td>
</tr>
<tr>
<td>4. Building trust and getting people to act naturally</td>
<td></td>
</tr>
<tr>
<td>5. Protecting confidentiality and/or anonymity</td>
<td></td>
</tr>
</tbody>
</table>

Instructions:

1. Log into http://www.wikispaces.com using the username you created in the previous activity 16.2.

2. Click on the "Wiki Teams" link in the Blackboard course site to find your group assignment.

3. Then click on the link "Arguments for using interviews" to access your group's Wiki. Please do not share the link to your group's Wiki with students in other groups in class.

4. MAKE SURE YOU ARE SIGNED INTO Wikispaces BEFORE you perform any actions on your group's Wiki so that your contributions will counted and so that you receive the participation points for completing this activity. Once signed in, each contribution you make to the Wiki (e.g., adding, deleting, editing, revising your own text or someone else's text) will be recorded in the Wiki history page so that you will be rewarded the participation points for making the minimum
required contributions to your group’s document.

5. To edit your group’s document, click Edit button. In your group’s Wiki, you will see that the six pros of using surveys will already be listed. Do NOT delete or remove the listed pros from the document because each pro will serve to identify one argument or reason as to why surveys are effective. Build your arguments (one paragraph maximum) for and around each of the listed pros. Because you are limited to one paragraph for each listed pro, you will need to pay special attention to both brevity and clarity while developing each argument.

6. Next, write and/or edit any portion of the document to develop and present your group’s argument that makes explicit references to and/or addresses any or all of the following:
   - Supporting arguments: The pros of using surveys.
   - Opposing arguments: The cons of using surveys.
   - Evidence: Cite empirical data and findings (along with citations/references to the authors of the research/work) to demonstrate the veracity or accuracy of any one claim presented among the list of pros and cons.
   - Closing Arguments: Summation or conclusion of the argument.

   Note: It is OK to edit or even delete another students’ sentence if necessary because each student’s contribution is recorded in the wiki history page and as a result students will be credited for each posted sentence even if the sentence has been deleted and removed from the final draft.

7. When you complete any one contribution to the document, immediately click the SAVE button to save and log your work. **IMPORTANT!** Only one person at a time can edit the document at any one time. If two users happen to be editing the document concurrently and at the same time, the work produced by the last user that hits the Save the document will overwrite all the work produced by the previous user. The system will warn you if you will be overwriting someone else’s work and will give you the option to cancel your edits (as well as to view the work/changes just submitted by the concurrent user).
APPENDIX C

NON-CONSENTING STUDENT SURVEY

INSTRUCTIONS: Please complete the following survey based on your experience as a group member using a Wiki to work on two collaborative writing activities. Comments are also welcome at the end. All students will receive 1 participation point for each completed survey. Thank you!

THE FLORIDA STATE UNIVERSITY

Default Question Block

The collaborative group instructions for activity 16.2 and 16.3 were clear and easy to understand.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Please share your comments and suggestions on activities 16.2 and 16.3. What did you like and dislike about the activity?


Overall, I found the Wiki easy to use in group work.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Overall, the Wiki was an effective tool for completing a collaborative writing activity.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
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</tbody>
</table>

Survey Powered by Qualtrics
CONSENTING STUDENT SURVEY

If you did not edit other students’ work during activity 16.2, please explain why.

Which of the following best describes the procedures your group used to coordinate the writing process in activity 16.2?

- The group plans and outlines the task, then each writer prepares his/her part. The group compiles the individual parts and revises the whole document, as needed.
- The group plans and outlines the writing task, then one member prepares a draft. The group edits and revises the draft.
- One member of the group plans and writes a draft; the group revises the draft.
- One person plans and writes the draft; one or more members revise the draft without consulting the original authors.
- The group plans and writes the draft; one or more members revise the draft without consulting the original authors.
- One person assigns the tasks, each member completes the individual task, and, one person compiles and revises the document.
- One dictates, another transcribes and edits.
- None of the above

If you responded to the previous question with none of the above, please explain the process your group used to coordinate the writing process during the two activities.

ACTIVITY 16.3:
I explicitly referred to the criteria and example argument posted in the Wiki activity instructions while making contributions to the Wikis on using interviews (activity 16.3) for collecting research data.
During activity 16.3, check any or all of the following types of contributions you made to your group’s Wiki and arguments on using interviews.

☐ Added my own sentence(s) to the Wiki to write a new and initial analysis of a given argument
☐ Edited the content of sentences that I personally posted to the Wiki
☐ Made minor edits in grammar and/or spelling on sentences that I personally posted to the Wiki
☐ Moved and/or changed the sequencing of sentences that I personally posted to the Wiki
☐ Deleted sentences that I personally posted to the Wiki

During activity 16.3, check any or all of the following types of contributions you made to ANOTHER student’s work in your group’s Wiki.

☐ Added sentence(s) to build on another student’s work already posted to the Wiki
☐ Edited the content of sentences posted by another student
☐ Made minor edits to grammar or spelling on another student’s work
☐ Moved and/or changed the sequencing of sentences posted by another student in the group
☐ Deleted sentences from another student’s analysis/evaluation of a given argument

During activity 16.3, I was comfortable with other students editing my own contributions.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neither Agree nor</th>
<th>Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

During activity 16.3, I was comfortable editing other students’ contributions to the Wiki.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neither Agree nor</th>
<th>Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If you did not edit other students’ work during activity 16.3, please explain why.
Which of the following best describes the procedures your groups used to coordinate the writing process in activity 16.3?

- The group plans and outlines the task, then each writer prepares his/her part. The group compiles the individual parts and revises the whole document as needed.
- The group plans and outlines the writing task, then one member prepares a draft. The group edits and revises the draft.
- One member of the group plans and writes a draft; the group revises the draft.
- One person plans and writes the draft; one or more members revise the draft without consulting the original authors.
- The group plans and writes the draft; one or more members revise the draft without consulting the original authors.
- One person assigns the tasks, each member completes the individual task, and one person compiles and revises the document.
- One dictates, another transcribes and edits.
- None of the above

If you responded to the previous question with none of the above, please explain the process your group used to coordinate the writing process during the two activities.

OTHER COMMENTS:

Please add additional comments you may have regarding your experience working in a group during the two activities.
APPENDIX E

SURVEYS CONCEPT MAP

Figure 23. Surveys concept map
APPENDIX F

INTERVIEWS CONCEPT MAP

Figure 24. Interviews concept map
# APPENDIX G

## SCORING GUIDELINES FOR WIKI ARGUMENTS

### Table 6

### Scoring Guidelines for Wiki Arguments

| Step 1 | • The spreadsheet includes columns for scoring arguments based on pros and cons, relationships (P6>P1), and, the presence of a closing argument.  
• On the first worksheet, survey arguments 1 through 6 are listed with the teams listed below.  
• On the second worksheet, interview arguments 1 through 5 are listed with the teams listed below.  
• Teams not listed on the worksheet were made up of non-consenting students.  
• All the cells on the worksheets are highlighted green based on the pros and cons in each branch of the concept map.  
• Relationships (P1>P1) are color-coded by concept map branches.  
• The closing argument is also highlighted green. |
| --- | --- |
| Step 2 | • Using both the concept map and rubric, score each sentence of the team’s argument by determining if it contains the correct premise (pros and cons).  
• Determine if the sentence contains relationships such as Pro 1 qualifies or enables Pro 2 (P1>P2).  
• Use the phrases included in the rubric to determine if it fits the criteria and if the argument includes a closing argument. |
| Step 3 | • Once you have completed the review, place a number in each cell to denote correct pros and cons.  
• Place an X in cells used to denote incorrect pros and cons or incorrect relationships.  
• Place a 0 in cells that do not match the premise or relationship shown in the concept map.  
• Score only one point for each relationship except when evidence is provided by the team.  
• Evidence includes statistical data or examples illustrating the relationship.  
• Evidence is denoted with a number plus Evid in the relationship cell.  
• If the argument contains a closing argument, add a 1 to the column.  
• Do not place an X in closing argument column if there is no closing argument. |
| Step 4 | • Total scores are recorded as a fraction.  
• The numerator is the total number of scores in each of the green cells plus the closing argument.  
• The denominator is the total number of scores in the green cells plus the cells containing X (incorrect premises or relationships). |
| Step 5 | • The final score is calculated by dividing the numerator by the denominator.  
• The result is converted to a whole number. |
## APPENDIX H

### SURVEY ARGUMENT SCORING SPREADSHEET

![Survey Argument Scoring Spreadsheet](image)

*Figure 25. Survey argument scoring spreadsheet*
## APPENDIX I

### INTERVIEW ARGUMENT SCORING SPREADSHEET

**Wiki Team Argument - Activity 16.3 Interviews**

<table>
<thead>
<tr>
<th>P1</th>
<th>P2</th>
<th>P3</th>
<th>P4</th>
<th>P5</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>P1 -&gt; P2</th>
<th>P3 -&gt; P2</th>
<th>P4 -&gt; P2</th>
<th>C5 -&gt; P2</th>
<th>C6 -&gt; P2</th>
<th>C1 -&gt; P2</th>
<th>C2 -&gt; P1</th>
<th>C3 -&gt; P3</th>
<th>C4 -&gt; P3</th>
<th>C5 -&gt; P5</th>
<th>P5 -&gt; Main Claim</th>
<th>Closing Arg</th>
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<th>FINAL SCORE</th>
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</tr>
</tbody>
</table>

**Figure 26.** Interview argument scoring spreadsheet
APPENDIX J

CONFUSION MATRICES

Table 7

Surveys Confusion Matrix

<table>
<thead>
<tr>
<th>TOTAL SURVEYS</th>
<th>CODER 2</th>
<th>SUM</th>
</tr>
</thead>
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<td>ADDcp</td>
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<td>pADD</td>
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<td>0</td>
</tr>
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<td>ADDir</td>
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<tr>
<td>DELo</td>
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</tbody>
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Table 8

Interviews Confusion Matrix

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<th>TOTAL INTERVIEWS</th>
<th>CODER 2</th>
<th>SUM</th>
</tr>
</thead>
<tbody>
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<td>12 Observed Categories - Lowest Scoring Interviews</td>
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<td>ADDcp</td>
</tr>
<tr>
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<td>6</td>
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<td>ADDcp</td>
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<td>23</td>
</tr>
<tr>
<td>ADDcr</td>
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<tr>
<td>ADDe</td>
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<td>0</td>
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<td>0</td>
</tr>
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<tr>
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<td>0</td>
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<tr>
<td>TOTAL INTERVIEWS</td>
<td>7</td>
<td>23</td>
</tr>
</tbody>
</table>
APPENDIX K

CONSENTING STUDENT SURVEY RESULTS

1. ACTIVITY 16.2: I explicitly referred to the criteria and example argument in the Wiki activity instructions while making contributions to the Wikis on using surveys (activity 16.2) for collecting research data.

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<th>Answer</th>
<th>Response</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Strongly agree</td>
<td>5</td>
<td>33%</td>
</tr>
<tr>
<td>2</td>
<td>Agree</td>
<td>6</td>
<td>40%</td>
</tr>
<tr>
<td>3</td>
<td>Neither Agree nor Disagree</td>
<td>2</td>
<td>13%</td>
</tr>
<tr>
<td>4</td>
<td>Disagree</td>
<td>2</td>
<td>13%</td>
</tr>
<tr>
<td>5</td>
<td>Strongly Disagree</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>15</td>
<td>100%</td>
</tr>
</tbody>
</table>

Statistic | Value  
Min Value | 1  
Max Value | 4  
Mean      | 2.07  
Variance  | 1.07  
Standard Deviation | 1.03  
Total Responses | 15  

2. During activity 16.2, check any or all of the following types of contributions you made to your group’s Wiki and arguments on using surveys.

Text Response

nothing to check here
Yes to each of the following: Added my own sentence(s) to the Wiki to write a new and initial analysis of a given argument  Edited the content of sentences that I personally posted to the Wiki  Made minor edits in grammar and/or spelling on sentences that I personally posted to the Wiki  Moved and/or changed the sequencing of sentences that I personally posted to the Wiki  Deleted sentences that I personally posted to the Wiki  Added sentence(s) to build on another students’ work already posted to the Wiki  Made minor edits to grammar or spelling on another student’s work  
I basically wrote sections and edited my teammates work.
I added text underneath a heading in the wiki.
Nothing to "check" however, it is the same information as the 16.3 items, i did the following:  Added my own sentence(s) to the Wiki to write a new and initial analysis of a given argument  Edited the content of sentences that I personally posted to the Wiki  Made minor edits in grammar and/or spelling on sentences that I personally posted to the Wiki  Deleted sentences that I personally posted to the Wiki  Is this a question?

Statistic | Value  
Total Responses | 8  

3. During activity 16.2, check any or all of the following types of contributions you made to ANOTHER student’s work in your group’s Wiki

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<th>Answer</th>
<th>Response</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Added sentence(s) to build on another students’ work already posted to the Wiki</td>
<td>8</td>
<td>73%</td>
</tr>
<tr>
<td>2</td>
<td>Edited the content of sentences posted by another student</td>
<td>7</td>
<td>64%</td>
</tr>
<tr>
<td>3</td>
<td>Made minor edits to grammar or spelling on another student’s work.</td>
<td>8</td>
<td>73%</td>
</tr>
<tr>
<td>4</td>
<td>Moved and/or changed the sequencing of sentences posted by another student in the group</td>
<td>7</td>
<td>64%</td>
</tr>
<tr>
<td>5</td>
<td>Deleted sentences from another student’s analysis/evaluation of a given argument</td>
<td>5</td>
<td>45%</td>
</tr>
</tbody>
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Statistic | Value
--- | ---
Min Value | 1
Max Value | 5
Total Responses | 11
4. During activity 16.2, I was comfortable with other students editing my own contributions.

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<th>%</th>
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<td>13%</td>
</tr>
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<td>2</td>
<td>Agree</td>
<td>9</td>
<td>60%</td>
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<td>3</td>
<td>Neither Agree nor Disagree</td>
<td>2</td>
<td>13%</td>
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<td>2</td>
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<td>0%</td>
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<td>Total</td>
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5. During activity 16.2, I was comfortable editing other students’ contributions to the Wiki.

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<th>Answer</th>
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<td>13%</td>
</tr>
<tr>
<td>2</td>
<td>Agree</td>
<td>6</td>
<td>40%</td>
</tr>
<tr>
<td>3</td>
<td>Neither Agree nor Disagree</td>
<td>5</td>
<td>33%</td>
</tr>
<tr>
<td>4</td>
<td>Disagree</td>
<td>2</td>
<td>13%</td>
</tr>
<tr>
<td>5</td>
<td>Strongly Disagree</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>15</td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min Value</td>
<td>1</td>
</tr>
<tr>
<td>Max Value</td>
<td>4</td>
</tr>
<tr>
<td>Mean</td>
<td>2.47</td>
</tr>
<tr>
<td>Variance</td>
<td>0.84</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>0.92</td>
</tr>
<tr>
<td>Total Responses</td>
<td>15</td>
</tr>
</tbody>
</table>
6. If you did not edit other students’ work during activity 16.2, please explain why.

<table>
<thead>
<tr>
<th>Text Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>There was no work posted by the designated time to review.</td>
</tr>
<tr>
<td>I did not feel that it would allow for their true opinion to be presented.</td>
</tr>
<tr>
<td>By Sunday afternoon, no one else had contributed. I was unable to check the Wiki Sunday night.</td>
</tr>
<tr>
<td>The content satisfied the requirements for the assignment. I deemed it unnecessary to make any additional changes.</td>
</tr>
<tr>
<td>I prefer providing comments and recommendations rather than alter another student's writing.</td>
</tr>
<tr>
<td>One's logic and flow of the sentences made sense to me. The other provided content too late for me to edit.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Responses</td>
<td>7</td>
</tr>
</tbody>
</table>
7. Which of the following best describes the procedures your groups used to coordinate the writing process in activity 16.2?

<table>
<thead>
<tr>
<th>#</th>
<th>Answer</th>
<th>Response</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The group plans and outlines the task, then each writer prepares his/her part. The group compiles the individual parts and revises the whole document, as needed.</td>
<td>5</td>
<td>56%</td>
</tr>
<tr>
<td>2</td>
<td>The group plans and outlines the writing task, then one member prepares a draft. The group edits and revises the draft.</td>
<td>1</td>
<td>11%</td>
</tr>
<tr>
<td>3</td>
<td>One member of the group plans and writes a draft; the group revises the draft.</td>
<td>1</td>
<td>11%</td>
</tr>
<tr>
<td>4</td>
<td>One person plans and writes the draft; one or more members revise the draft without consulting the original authors.</td>
<td>1</td>
<td>11%</td>
</tr>
<tr>
<td>5</td>
<td>The group plans and writes the draft; one or more members revise the draft without</td>
<td>1</td>
<td>11%</td>
</tr>
</tbody>
</table>
consulting the original authors.

6 | One person assigns the tasks, each member completes the individual task, and, one person compiles and revises the document. | 2 | 22%

7 | One dictates, another transcribes and edits. | 2 | 22%

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min Value</td>
<td>1</td>
</tr>
<tr>
<td>Max Value</td>
<td>7</td>
</tr>
<tr>
<td>Total Responses</td>
<td>9</td>
</tr>
</tbody>
</table>

8. If you responded to the previous question with none of the above, please explain the process your group used to coordinate the writing process during the two activities.

**Text Response**

I reached out early in the week to propose breaking the assignment into parts. However, there was little feedback. Therefore, no communication to establish a plan.

We split the tasks up and added our responses to the wiki. As other members checked in they edited each other's work.

One member plans/ outlines the task, then each writer prepares his/her part. The group revises the document, as needed.

We did not really communicate for this task. All of us simply added sentences in a coherent manner to each of the arguments.

There was no collaboration on that project, as no one else had responded by the last time I checked it.

In group A, one person told the group to have a contribution by Saturday.

We divided up the assignment and provided suggested edits.

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Responses</td>
<td>8</td>
</tr>
</tbody>
</table>
ACTIVITY 16.3: I explicitly referred to the criteria and example argument posted in the Wiki activity instructions while making contributions to the Wikis on using interviews (activity 16.3) for collecting research data.

<table>
<thead>
<tr>
<th>#</th>
<th>Answer</th>
<th>Response</th>
<th>%</th>
</tr>
</thead>
</table>
| 1  | Strongly Agree          | 3        | 21%
| 2  | Agree                   | 7        | 50%
| 3  | Neither Agree nor Disagree | 2    | 14%
| 4  | Disagree                | 2        | 14%
| 5  | Strongly Disagree       | 0        | 0%
|    | Total                   | 14       | 100%

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min Value</td>
<td>1</td>
</tr>
<tr>
<td>Max Value</td>
<td>4</td>
</tr>
<tr>
<td>Mean</td>
<td>2.21</td>
</tr>
<tr>
<td>Variance</td>
<td>0.95</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>0.97</td>
</tr>
<tr>
<td>Total Responses</td>
<td>14</td>
</tr>
</tbody>
</table>
10. During activity 16.3, check any or all of the following types of contributions you made to your group’s Wiki and arguments on using interviews.

<table>
<thead>
<tr>
<th>#</th>
<th>Answer</th>
<th>Response</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Added my own sentence(s) to the Wiki to write a new and initial analysis of a given argument</td>
<td>15</td>
<td>100%</td>
</tr>
<tr>
<td>2</td>
<td>Edited the content of sentences that I personally posted to the Wiki</td>
<td>7</td>
<td>47%</td>
</tr>
<tr>
<td>3</td>
<td>Made minor edits in grammar and/or spelling on sentences that I personally posted to the Wiki</td>
<td>9</td>
<td>60%</td>
</tr>
<tr>
<td>4</td>
<td>Moved and/or changed the sequencing of sentences that I personally posted to the Wiki</td>
<td>6</td>
<td>40%</td>
</tr>
<tr>
<td>5</td>
<td>Deleted sentences that I personally posted to the Wiki</td>
<td>6</td>
<td>40%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min Value</td>
<td>1</td>
</tr>
<tr>
<td>Max Value</td>
<td>5</td>
</tr>
<tr>
<td>Total Responses</td>
<td>15</td>
</tr>
</tbody>
</table>
11. During activity 16.3, check any or all of the following types of contributions you made to ANOTHER student’s work in your group’s Wiki.

<table>
<thead>
<tr>
<th>#</th>
<th>Answer</th>
<th>Response</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Added sentence(s) to build on another students’ work already posted to the Wiki</td>
<td>7</td>
<td>78%</td>
</tr>
<tr>
<td>2</td>
<td>Edited the content of sentences posted by another student</td>
<td>4</td>
<td>44%</td>
</tr>
<tr>
<td>3</td>
<td>Made minor edits to grammar or spelling on another student’s work.</td>
<td>6</td>
<td>67%</td>
</tr>
<tr>
<td>4</td>
<td>Moved and/or changed the sequencing of sentences posted by another student in the group</td>
<td>6</td>
<td>67%</td>
</tr>
<tr>
<td>5</td>
<td>Deleted sentences from another student’s analysis/evaluation of a given argument</td>
<td>3</td>
<td>33%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min Value</td>
<td>1</td>
</tr>
<tr>
<td>Max Value</td>
<td>5</td>
</tr>
<tr>
<td>Total Responses</td>
<td>9</td>
</tr>
</tbody>
</table>

12. During activity 16.3, I was comfortable with other students editing my own contributions.

<table>
<thead>
<tr>
<th>#</th>
<th>Answer</th>
<th>Response</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Strongly Agree</td>
<td>3</td>
<td>20%</td>
</tr>
<tr>
<td>2</td>
<td>Agree</td>
<td>9</td>
<td>60%</td>
</tr>
<tr>
<td>3</td>
<td>Neither Agree nor Disagree</td>
<td>1</td>
<td>7%</td>
</tr>
<tr>
<td>4</td>
<td>Disagree</td>
<td>2</td>
<td>13%</td>
</tr>
<tr>
<td>5</td>
<td>Strongly Disagree</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>15</td>
<td>100%</td>
</tr>
</tbody>
</table>
13. During activity 16.3, I was comfortable editing other students’ contributions to the Wiki.

<table>
<thead>
<tr>
<th>#</th>
<th>Answer</th>
<th>Response</th>
<th>%</th>
</tr>
</thead>
</table>
| 1  | Strongly Agree                | 2        | 13%
| 2  | Agree                         | 9        | 60%
| 3  | Neither Agree nor Disagree    | 2        | 13%
| 4  | Disagree                      | 2        | 13%
| 5  | Strongly Disagree             | 0        | 0%
| Total|                              | 15       | 100%

14. If you did not edit other students’ work during activity 16.3, please explain why.

- No work to edit.
- I did not feel that it would allow for their true opinion to be presented.
- Nobody posted by Friday, which was the last day I had available to work on this project.
- No one else had contributed at the point when I submitted my additions.
- I prefer providing comments and recommendations rather than alter another student's writing.
15. Which of the following best describes the procedures your groups used to coordinate the writing process in activity 16.3?

<table>
<thead>
<tr>
<th>#</th>
<th>Answer</th>
<th>Response</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The group plans and outlines the task, then each writer prepares his/her part. The group compiles the individual parts and revises the whole document, as needed.</td>
<td>3</td>
<td>38%</td>
</tr>
<tr>
<td>2</td>
<td>The group plans and outlines the writing task, then one member prepares a draft. The group edits and revises the draft.</td>
<td>1</td>
<td>13%</td>
</tr>
<tr>
<td>3</td>
<td>One member of the group plans and writes a draft; the group revises the draft.</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>4</td>
<td>One person plans and writes the draft; one or more members revise the draft without consulting the original authors.</td>
<td>3</td>
<td>38%</td>
</tr>
<tr>
<td>5</td>
<td>The group plans and writes the draft; one or more members revise the draft without</td>
<td>2</td>
<td>25%</td>
</tr>
</tbody>
</table>
16. If you responded to the previous question with none of the above, please explain the process your group used to coordinate the writing process during the two activities.

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min Value</td>
<td>1</td>
</tr>
<tr>
<td>Max Value</td>
<td>6</td>
</tr>
<tr>
<td>Total Responses</td>
<td>8</td>
</tr>
</tbody>
</table>

Text Response

- no communication or participation from other members
- We split up the tasks and posted responses by Saturday. We then read/edited each other's work.
- One member plans/ outlines the task, then each writer prepares his/her part. The group revises the document, as needed.
- We posted sentences to the wiki that allowed for the assigning of specific arguments to each group member.
- There was no collaboration what everyone was going to do. I posted first so I choose to answer two questions (1/3 of them) and wait to just contribute to the rest. The second person answered the rest and added to mine. The third person just added to a few.
- In group B there wasn't any communication between group members and even less participation in contributing to the wiki.
- We divided up the assignment and provided suggested edits.
- One's logic and flow of the sentences made sense to me. The other provided content too late for me to edit.

Statistic

| Total Responses | 9 |
17. OTHER COMMENTS: Please add additional comments you may have regarding your experience working in a group during the two activities.

Text Response
This assignment would have been better served at a time when participation would have been more adequate. It's my conclusion that the participation was minimal due to feasibility, voluntary participation, and ambiguity in instruction (issues with understanding the objections fully).

This was a very frustrating assignment in both of my groups members could not access the wiki. The interview group had a military member who is stationed on base and could not access the wiki as it was restricted for some reason he ultimately had to email my group to clue us in. Eventually the training group he was with was given permission to down the firewall so other members of his team could have recreation time and play video games, and he was able to post to the wiki the 1 time. In my interview group, another team member was unable to access the wiki from work and had to wait until the weekend when he was released to post anything to the wiki, leaving little time to edit the work put up. I really disliked the parameters of this exercise, it is completely unrealistic that we wouldn't be able to communicate via email, and in fact both my survey and interview team members did have to email me so I didn't just think they were leaving it to the weekend to do everything. Additionally without any post check in time there was no way to know when members would ever see a message you may have written on the wiki which was also frustrating.

Two big factors negatively affected this collaborative effort: 1) it was much more work (or at least more difficult) than our usual weekly activities. Normally we read a chapter or two and post at least four times to various class discussion threads. That’s it. The scope of this activity - working w/ two distinct groups of peers who might or might not be motivated to help, w/in a tool we might never have used before, to write a total of eleven paragraphs, including research-- limited the time/effort members spent actually synthesizing one another’s contributions together. Rather, I suspect, most worked independently to add their own pieces to the whole (i.e. divide and conquer). Adding to that challenge, 2) it happened the last week of class - when many of us would rather be working on major projects that have been planned for a long time and are a major part of our course grades (including the final product for this course).

I do not feel that a wiki is a good tool for group collaboration. There is no system for notifying members when edits are made, and the interface is not very pleasing.

This activity would have gotten a better response if it had been done earlier in the semester. It felt like it was suddenly thrown in when we were dealing with final papers/tests in all classes, not just this class.

This whole assignment seemed rushed and underplanned

I feel arrangement of an activity that involves Wiki, a new team, planning and coordination, researching to find empirical data, is not a simple task. It might be better if it's introduced in the middle of the semester, and we might need two weeks just to do that. It could’ve been a great group experience though.

The final project was my main distraction during the same time as this assignment, so I didn't pay much attention to it.

Statistic | Value
---|---
Total Responses | 9
BIBLIOGRAPHY


BIOGRAPHICAL SKETCH

Patricia Heeter

Education

Associate in Science Degree, Business Administration, Northern Virginia Community College
Bachelor of Business Administration, Marymount University
Master of Arts in Human Performance Systems, Marymount University
Graduate Certificate in Instructional Design, Marymount University
Graduate Certificate in Program Evaluation, Florida State University
Doctor of Philosophy, Instructional Systems, Florida State University

Honors

National Scholastic Honor Society
Golden Key International Honour Society
Kappa Delta Pi
U.S. Department of Labor Secretary’s Exceptional Achievement Award
Delta Epsilon Sigma

Professional Experience

Lead Instructional Designer for Quality Assurance
Center for Distance Learning
Tallahassee Community College, Tallahassee, FL
July 2011 to Present

Design and develop online courses in a wide array of disciples. Create and facilitate online and face-to-face workshops for faculty and staff on Blackboard Collaborate, Quality Matters Rubric, distance learning, and the effective use of instructional technologies in teaching and learning.

- Review mature online courses, courses in the development phase, and professional workshops using the Quality Matters™ Rubric.
- Assist faculty to improve courses that have not met all standards.
- Developed and facilitate Distance Learning Faculty Orientation workshop which provides online pedagogy for faculty.
- Serve as a reviewer for the Blackboard Exemplary Course Program

Graduate Research Assistant
Learning Systems Institute
Florida State University, Tallahassee, FL
January 2008 to September 2010
Developed instructor-led and web-based courses for the Seaport Security Curriculum to improve security at our nation’s seaports as part of a project for the Department of Homeland Security, the U.S. Coast Guard, and the Maritime Administration.

- Used Articulate to revise over 500 web-based courses.
- Developed a three-module, nine-lesson Train-the-Trainer course.
- Worked with U.S. Coast Guard subject matter experts to determine appropriate course content.

**Graduate Teaching Assistant**  
Department of Educational Psychology & Learning Systems  
Florida State University, Tallahassee, FL  
January 2006 to April 2010

Taught EME2040, Introduction to Educational Technology, to pre-service teachers entering the College of Education. Course content included the study of how instruction is designed, developed and improved; the types and uses of different media; and, the design of instruction using media. Students learned how to search the web and evaluate web sources; use Web 2.0 technologies such as blogs, wikis and podcasts; and, use applications such as Inspiration and MS Word, PowerPoint and Excel. At the end of the course, students used technology-integration skills to apply for a grant.

**Training Specialist**  
Employment Standards Administration (ESA)  
U.S. Department of Labor (DOL), Washington, D.C.  
July 2001 to June 2005

Developed critical skills training for four major programs within ESA and consulted with program directors on performance and development problems.

- Managed the Skills Training Center which provided ESA employees with self-paced training on a variety of topics and software programs.
- Developed training designs for program management and employee groups to meet specific learning objectives.
- Analyzed performance problems in program areas through document analysis, observation, interviews and surveys to identify possible knowledge and skill deficiencies and propose learning objectives which eliminate priority deficiencies.
- Prepared and validated learning designs by conducting pilot sessions and revising course materials to meet specified performance levels.
- Designed and conducted performance tests and other evaluation studies to measure increase in skills and improved program performance.
- Coordinated departmental Management Development Program (MDP) for ESA. Advised MDP candidates on classes to take and promoted hiring of MDP graduates to managers.
- Managed the Skills Inventory Project which was a major Department of Labor competency initiative. Developed lesson plans for classroom instruction used by several of the Department’s agencies and developed and delivered pilot training for ESA’s Office of Labor-
Management Standards program. Developed web-based training modules including online presentations delivered by ESA’s Assistant Secretary, four program directors and four subject matter experts. Facilitated delivery of training to 500+ supervisors throughout ESA.

Part-Time Instructor
Adult and Community Education, Fairfax County Public Schools, Centreville, VA 1997-2002

Taught technology courses and assisted in developing technology-based curriculum, choosing textbooks and designing a web development certificate program. Designed, developed and delivered a wide variety of technology-related courses to Fairfax County adult community students; Fairfax County Department of Purchasing and Supply Management; Fairfax County Government; City of Fairfax employees; Fairfax County School system teachers; and, delivered the courses to children as part of the K-12, Adult and Community Education (ACE) KIDS and TEENS Summer Program:

Director, ARS Interactive

Technical director of ARS Interactive which specialized in interactive multimedia, e-commerce solutions and innovative website development. Planned strategic direction and supervised the work of a project manager, content director, two website designers and two programmers.

- Successfully developed business by bringing in new accounts totaling over $400,000.
- Managed client relationships from the sales close through the website development lifecycle.
- Prepared proposals for new business including time/cost estimates, technology analysis and work breakdown structure.
- Planned and supervised redesign of corporate and department website.
- Provided content and marketing expertise to ensure more website visitors.
- Supervised creation of an e-commerce infrastructure for acceptance of online registrations for ARS training courses.

Director, Implementation and Customer Services
Affinity Partners.com (also known as RxDrugstore.com), Chantilly, VA 1999

Established and directed implementation process and customer service support for provider of private-label online drugstores focused on the non-profit and association market.

- Managed partners’ expectations and coordinated activities related to the launch of stores carrying over 13,000 products with multiple-product lines (OTC, books, music). Responsible for maintaining post-sales relationship with partners.
- Project manager for implementation of 21 online drugstores. Established timelines for development and delivery of drugstore. Tested store in staging area and coordinated activation and access.
- Defined all customer service policy and procedures including online shopping experience, shipping, fulfillment, coupon processing and product returns.
• Set up customer service and implementation procedures for major expansion of product line. Worked with outside vendors to develop a call center that answered the needs of online shoppers.

President

Specialized in consulting, training, and website development. Developed websites for the National Museum of Women in the Arts; Virginia Association of Female Executives; and, Contacts Count consultants. Developed and delivered training seminars and speeches to professional organizations, schools and colleges. Led online discussion group on technology issues as WebWoman for Women’s Connection Online and was a feature writer for Women in Technology International website.

Assistant Director, Customer Service
PBS ONLINE, Public Broadcasting Service (PBS), Alexandria, VA 1993-1995

Participated in business development of PBS ONLINE which featured PBS Learning Link, a text-based online service targeted to K-12 students, teachers and parents.

• Directed customer service effort and assisted with marketing of PBS Learning Link
• Assisted producers of Sheri Lewis’ Lamb Chop’s Playalong, Mister Rogers Neighborhood, Shining Time Station and Louis Rukeyser’s Wall Street Week to develop discussion groups and content for PBS ONLINE.

Professional Memberships
American Educational Research Association
Association for Educational Communications and Technology
Pi Lambda Theta
The Internet Society

Selected Articles


Selected Presentations

126

Heeter, P. and Jeong, A.C. “Modeling Wiki Editing Behaviors with Sequential Analysis” Presented at the Association for Educational Communications and Technology, 2008.


Heeter, P. “Secrets of Searching the Internet.” Presented workshop as part of Women’s Business Center’s Business Laboratory Program, U.S. Small Business Administration, 1997.