Adapting Social Technology for use in Collaborative Learning and Writing in Higher Education

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Abstract

In this study, the relationship between students' perceived collaborative effort and their academic performance was analyzed, comparing outcomes between students instructed in using Google Drive to accomplish small group writing assignments and students who were not given specific direction with regard to using collaborative tools to complete their work. Additionally, students' and faculty perceptions towards the suitability and use of Google Drive in collaborative writing was also investigated.

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Chapter I: Introduction

Our ability to learn and comprehend increasingly complex ideas is predisposed by the technology and methods at our disposal. Empirical evidence demonstrating more effective learning strategies threaten the traditional lecture format approach in higher education (Prince 2004). As the knowledge communities and workplaces that graduates enter continuously evolve to accommodate increasingly collaborative approaches to produce new information and technology, new methods of improving student collaborative writing and learning need to be explored. This study investigates how achieving learning objectives through small group collaborative writing assignments can be enhanced by using web based collaborative writing tools.

Collaborative learning is defined as a coordinated effort among team members to accomplish a shared task or common goal. Recent studies on collaborative learning in higher education demonstrate the variety of benefits that this learning modality can provide. Learning outcomes as a result of collaborative learning include improved academic achievement, improved self-esteem and increased perceptions of greater societal support and more (Prince 2004; Johnson & Johnson 1998; Springer 1999; Deslauriers et al, 2011). Recent studies have investigated integrating collaborative learning with computer based collaborative writing tools.

Students often perceive group collaborative writing as a tedious process because it involves scheduling meetings and sending documents back and forth. Collaborative learning supported by technology can allow for asynchronous communication and collaborative writing, allowing time for reflection and thought without the constraints of scheduling in person meetings. The low cost, accessibility, and ease of use of web based collaborative tools have prompted educators to invest time and research into the beneficial synergies of using these tools for collaborative group work in higher education. While studies in the computer-supported collaborative learning field began by using early Web 2.0 technology such as blogs and wikis, newer tools such as Google Drive (formerly Google Documents), SharePoint, DropBox, EtherPad, and others contain features directed at group collaborative writing. However, whether these tools are in fact suitable and or enhance collaborative learning and writing remains to be seen.

In this study, the relationship between students' perceived collaborative effort and their academic performance was analyzed, comparing outcomes between students instructed in using Google Drive to accomplish small group writing assignments and students who were not given specific direction with regard to using collaborative tools to complete their work. Additionally, students' and faculty perceptions towards the suitability and use of Google Drive in collaborative writing was also investigated.

Chapter II: Background

Section I: A Case for Incorporating Collaborative, Active, and Cooperative Learning Modalities in Higher Education

This section will examine the theory and empirical literature behind collaborative, cooperative, and active learning modalities. To begin, a summarized recent history of different learning styles will be acknowledged in order to understand how these learning modalities have evolved. Secondly, these learning modalities will be contrasted with each other in order to more clearly understand their differences. Thirdly, empirical studies and meta-analyses on these learning modalities will be discussed to provide a context for the benefits of group learning in higher education. Fourth, the resistance to the adoption of these learning modalities in the classroom will be discussed

The study of learning has interested philosophers and educators of every historical era, while group learning has existed for as long as human beings have inhabited the earth. It was not, however, until the latter half of the 20th century that particular attention was spent on theorizing about and categorizing different approaches to group learning, in an attempt to better understand pedagogy and how to more effectively build knowledge. Several classifications identified include competitive, individualistic, active, cooperative, and collaborative learning modalities. While these modalities share many features, their differentiation from one another primarily depends on the degree of student interdependence (Johnson et al. 1998). Ultimately, the approach used by instructors affects the quality of student-teacher interactions and student learning.

Conventional classrooms in higher education generally have little student-to-student interaction, with students primarily assuming a passive role in absorbing knowledge from an expert (Deslauriers 2011). Competitive learning, which has become standard in American education, involves students competing against each other for ranking within a classroom (Johnson et al. 1998). Competitive learning has particularly impeded the ability for equality in education for women and underrepresented groups (Springer et al. 1999). Individualistic learning is similar to competitive learning in that individuals work on their own towards learning objectives. Yet, individualistic learning recognizes that students may come from different backgrounds and need not be compared to one another through a grading curve. Instead, individualistic learning emphasizes an approach that personalizes evaluation based on criteria unique to each student (Johnson et al. 1998).

A different approach to learning, one based on cognitive and developmental psychology, emphasizing active participation by students, has shown to increase student attendance, engagement, and learning (Deslauriers 2011). Active learning incorporates student to student discussion, small group learning tasks, and targeted in-class instructor feedback. The central tenet behind active learning lies in the simple idea that knowledge is “constructed, discovered, and transformed by students” (Johnson et al. 1991). Active learning asserts that students, upon assimilating knowledge through cognitive structures, continue to reshape the understanding that they created (Panitz 1999). While not all active learning is considered to be cooperative or collaborative, all collaborative and cooperative learning is considered to be active.

Collaborative learning is distinguished by multiple people combining their individual knowledge to synthesize a more refined understanding of the material. In collaborative learning, the student-instructor relationship becomes more dynamic, allowing students to take on the role of both teachers and students (Brufee 1981). Students assume the role of teachers in explaining their knowledge to one another, while coincidentally reevaluating the quality of their own understanding (Brufee 1981). By verbally elaborating their understanding to people like themselves, other peers, students gain insight about their own comfort, or lack thereof, with the material. Collaborative learning shifts the burden of responsibility from the instructor to the student (Panitz 1999). It also assists in personalizing knowledge for an individual by allowing the students to "perceive the organic relation between the mind of the knower and the knowledge itself" (Bruffee 1981). In doing so collaborative learning gives students the sense that knowledge is a social construct and that learning itself is a social phenomenon (Bruffee 1981).

While collaborative learning emphasizes the dynamic role of the student in learning and teaching, cooperative learning utilizes a small group framework in order to accomplish structured learning objectives set by an instructor (Matthews 1995). In some cases the instructor may assign specific roles to group members in order to facilitate group communication in cooperative learning (Matthews 1995). In contrast, collaborative learning groups will create the roles they see fit without outside help from an instructor. Another major dichotomy between these two learning modalities exists in the kinds of knowledge that they seek to instill. Cooperative learning excels at allowing students to explore foundational knowledge such as hard facts and questions that have discrete answers (Brufee 1995). While collaborative learning is more useful for exploring ambiguous questions without "correct" answers; this is known as nonfoundational knowledge (Brufee 1995). According to Brufee, collaborative learning allows students to question the inherent authority of the instructor, to posit novel ideas amongst peers, and to utilize new ways of thinking in order to explain nonfoundational knowledge (Brufee 1995).

A meta-analysis on the empirical evidence of incorporating active learning in higher education classrooms demonstrated substantial improvements in student academic performance on factual and conceptual learning (Prince 2004). Yet, Prince cautions that several factors must be considered when interpreting outcomes related to learning modalities and their transferability to other classrooms. These include the variability in instructional methods used in each specific study, the maturity and willingness to do group work by the students, and in the overarching definitions of the different learning modalities themselves (Prince 2004). In performing the meta-analysis, Prince simplified the overarching definitions of the different learning modalities to ensure that only the core elements of each modality were used to categorize the different studies. For example, in aggregating studies related to active learning, Prince defined active learning as the involvement of introducing activities into the traditional lecture while promoting student engagement. While Prince admits that individual studies do not imply that replicating the methods outlined in other courses will guarantee similar outcomes, the compilation of evidence from many studies supporting active learning provides greater incentive for adopting this approach.

In one study described by Prince involving 72 university students over two courses in each of two semesters, a pause was implemented three times every fifteen minutes during a 45 minutes lecture to allow students to cooperatively discuss their notes with a partner. Short term recall of factual information tested immediately after lecture by measuring the total number of correct facts recorded

during a free recall session was compared to an identical control class without pauses. The lecture with pauses had a total of 108 correct facts compared to 80 correct facts in the class without pauses. Long term recall was assessed by a 65 question multiple-choice exam given one and a half weeks after the last of five lectures used in the study. In the long term recall assessment the class with pauses scored an 89.4 compared to 80.9 without pauses. In the second course the class with pauses scored 80.4 compared to 72.6 without pauses (Prince 2004).

While analyzing the effects of cooperative learning in an intermediate level macroeconomics course at a four year university, Yamarik concluded that student performance on exams improved from four to six points compared to a control group using a traditional lecture based format (Yamarik 2007). Yamarik's methods included dividing a class of 57 students into small groups of three to four, in which members worked together on problem sets inside and study groups outside of class (Yamarik 2007). Yamarik attributed the performance increases on exams to increased student-instructor interaction through asking questions, increased group cohesion through the formation of study groups outside of class, and the novelty of working in small groups sparking student interest in the material (Yamarik 2007).

In studying the empirical evidence for the impacts of collaborative and cooperative learning, Johnson et al. (1998) found that when compared to individualistic learning, collaborative learning had a consistent and broad effect on improving academic achievement, quality of interpersonal relationships, self-esteem, and perceptions of greater societal support among postsecondary students (Johnson et al 1998). In a similar study, Springer et al. (1999) concluded that in 37 studies of students in science, mathematics, engineering, and technology fields, at accredited institution in North America, who engaged in collaborative learning, as defined by small group work inside or outside the classroom, students experienced greater academic achievement, improved attitudes towards learning, and increased retention in academic programs (Springer 1999). Additionally, Berry et al. reported increased retention of minority students when collaborative learning was incorporated in the classroom (Berry 1991). Fredericksen also found that minority students experienced increased retention rates due to the incorporation of active learning (Fredericksen 1998).

While the benefits of collaborative, cooperative, and active learning appear to be vast, there exist several obstacles to the incorporation of these learning styles in higher education classrooms. Instructors worry that incorporating small-group learning activities will detract from being able to cover the entirety of a course's material (Matthews 1995). Additionally, there is a fear that students opposed to the idea of peer-based learning may become disruptive. Lastly, hostile student or peer evaluations may even threaten an instructor's opportunity at securing tenure or promotion (Matthews 1995).

In addition to these aforementioned learning modalities used as an approach to engage students in classrooms, a new idea called the "flipped classroom" has seen a rise in popularity. Flipped classrooms make use of recorded lectures and interactive media that engage and inform students during non-school hours, while class time is used to solve problems related to the content in the lectures. Platforms such as YouTube, Coursera, and Khan Academy allow instructors to upload the content of a lecture to a website for their students to stream at home. Instructors use the tools contained in the platforms to track student behavior and determine if they are caught up with the lecture videos. By enabling students to learn at their own pace, in their own homes, instructors are free to spend more time coaching their students on an individual basis.

The shift to a knowledge based economy has led to increased collaboration within and between institutions (Powell 1998). The increased role of collaborative activities in the workplace prompts the interest in increasing the presence of collaborative, active, and cooperative learning in higher education in order to prepare students for future work environments. Every field which requires the exchange of information and ideas, including scientists and engineers, requires working in small groups that emphasize a collaborative approach between peers. (Springer 1999). Prince (2004) notes that cooperative learning provides a natural environment to practice the necessary interpersonal skills needed to integrate into a workplace environment. As digital media expands into the world of education, it may open up class time for utilization of active, cooperative, and collaborative learning, further increasing the gains students make towards learning outcomes. Adapting these practices into higher education will no doubt help students transition into their knowledge building communities upon graduation and employment.

Section II: Adapting Social Technology for Use in Higher Education

A decade ago the internet was primarily a collection of websites whose owners had the expertise to maintain and manage their web pages for the anonymous users who mainly browsed for information. Today, with the development of Web 2.0 technology, the internet is a much different place. Users post their opinions as comments under articles, edit and create content for encyclopedias of knowledge using wikis, and share their likes and life stories through Facebook. Social interaction through the web medium is the definition of Web 2.0. The question for educators seeking to incorporate this new technology into their classrooms is: can this new web also be useful for promoting collaboration in higher education as well?

Students are increasingly using Web 2.0 in their personal lives to enrich their knowledge and learning (Greenhow et al. 2009). Research into young persons' participation patterns and usage of Web 2.0 technology is paramount to this technology becoming useful for higher education needs. Currently educational institutions remain grounded in the traditional activities and formats such as lecturing (Greenhow et al. 2009). Instructors in both higher education and secondary education worlds must be at the forefront of research observing student engagement in formal and informal learning to facilitate the use of Web 2.0 platforms for educational needs.

An evolving philosophy, called computer supported collaborative learning (CSCL), has emerged as a way to investigate how the use of computers in group work can enhance learning. CSCL involves itself in the study of how collaborative learning supported by technology can enhance group work, facilitate the sharing of ideas, and the distribution of knowledge across members of knowledge communities (Lipponen 2002). Due to the variety of empirical studies and their individual instructional methods and approaches, it is difficult to make broad conclusions about the integration of CSCL in classrooms. However, computers can provide benefits to work done in groups, in many situations the artifacts displayed on-screen can be used as referential anchors for the mediation of understanding and coordination of collaborative actions (Lipponen 2002). On the other hand computer mediated collaboration through a written medium often lacks the richness of referential anchors encountered in real life, such as social cues through faces, gestures and intonations of speech (Lipponen 2002). Clearly

the benefits and disadvantages of using CSCL have not been fully explored. Additionally, while collaborative software continues to expand and accommodate new features, pedagogical studies concerning the use of collaborative tools are lacking in breadth (Brodahl et al 2009).

A variety of Web 2.0 platforms have been created that can serve the purposes of supporting teaching and enhancing student learning. The increasing popularity of "flipped classrooms", discussed earlier, has led educators to find ways of managing the distribution of online curriculum to their students. In addition to the ease of managing content and authenticating user access, low cost, accessibility, and ease of use are all qualities that attract educators to these Web 2.0 platforms (Ajjan & Hartshorne, 2008). Some examples of these platforms include wikis, blogs, Google Drive (formerly Google Documents), DropBox, Microscoft Sharepoint, Skype, EtherPad and more. A key role of these platforms is their ability to asynchronously connect students and content, allowing communication between parties to take place in a reflective manner without the constraints of a set time or space (Lipponen 2002). There exists much debate between researchers on the best practices of implementing these tools in higher education, and whether their use can lead to better student learning outcomes.

One platform which has received a greater audience among researchers compared to others is the wiki. Wikis are sites that allow users to publish content on either a private network, or allow open access to the public. The ease of editing, version tracking, and accessibility from any internet connected browser are features that make wikis ideal for group collaborative work (Chao 2007). Additionally, wikis have been shown to encourage students to reflect on their potential audience and facilitate peer review by allowing students to publish content online (Xiao & Lucking 2008). Lastly, wikis are a popular choice among instructors because they allow version tracking and assessment of individual students' contributions. While wikis are useful in synthesizing collective knowledge into a easily accessible and multimedia form, their role in the creation of new knowledge and generation of meaningful patterns does little to advance the state of knowledge in a field (Anderson & Krathwohl, 2001).

One study, introducing wikis in a large project model software engineering course, encouraged students to create content and openly collaborate with each other. Using an anonymous student survey, the study found that a majority of students in this class strongly agreed that wikis were good tools for project collaboration, for maintaining a group diary, and planned to use wikis for future projects (Chao 2007).

Web based collaborative writing tools such as Google Drive and EtherPad are the next generation of web 2.0 tools, featuring word processing and chat functions to allow synchronous collaboration on documents in real time without the need to be present in the same space. A case study by Brodahl et al. (2009) investigated 201 beginner education students at a four year teacher education university who were assigned a collaborative writing task. Students were required to use the online collaborative tools Google Drive or EtherPad in their group collaborative writing assignments. At the end of the study students participated in a survey to assess their perceptions regarding the tools' use. Although this study cannot be used to generalize beyond the population of education students studied, findings showed that only 13.9% of students were motivated to use the tools for collaboration, and only 15.7% of students reported that the quality of collaboration in the group increased with use of the tools. However, this study was flawed due to the unavailability of the tools during the period of the case study. This likely had an influence on the students' perception of the programs' ability to enhance collaborative work.

The aggregation of studies incorporating Web 2.0 technology such as Google Drive and wikis will contribute to a more coordinated strategy for educational reform. Although many individual methods and software tools may fall short of the goal of increasing progress towards student learning objectives, the diamonds in the rough which will prove useful in the future must be vetted by empirical evidence through quantitative and qualitative means. Educators must be willing to risk experimenting with new technology to be able to provide students with optimal learning environments.

Chapter III: Methods

This project investigated the relationship between students' perceived collaborative efforts and their academic performance, as well as the effects of using Google Drive (formerly known as Google Documents) on these variables. The goal of this project was to use data from two class years to assess the value of using a web based collaborative writing tool in small group writing assignments.

I identified the following objectives needed to achieve the goal of this experiment:

I. Evaluate how perceived individual and group collaborative effort affects student academic performance.

II. Determine whether the use of a web based collaborative tool, such as Google Drive, increases students' collaborative effort or students' academic performance.

III. Investigate how students and faculty perceive the usefulness of integrating web based collaborative writing tools in small group work.

Data used to address the objectives was collected over two years from an introductory level ecology class offered annually in the spring at a four year institute. The course had an enrollment of 40-50 students, with a variety of majors represented. Course curriculum involved three collaborative writing assignments, which altogether made up 30-40% of the students' grade. The writing assignments involved small groups of three to four students participating in an in class computer simulated laboratory experiment and later writing a lab report. Learning objectives for the writing assignments placed emphasis on developing student ability to generate a hypothesis and create relevant experimental models to test them, as well as to interpret and communicate experimental data. Students were graded as a team on the writing assignments.

In addition to the lab report grades, students also had 4-5 multiple choice and short answer questions on each of three exams to assess student progress towards the learning objectives for the writing assignments, mentioned above.

After completing each of the writing assignments, students were given a mandatory post-laboratory survey with questions regarding the individuals' and their groups' collaborative and cooperative effort. The surveys contained working definitions of cooperative and collaborative interactions, distinguishing the two terms. An example of the post lab surveys can be found in the appendix. Completion of surveys was not tracked until the week leading to the end of the course. Students were not tested on their understanding of the differences between cooperative and collaborative interactions.

The post lab surveys contained two ways of measuring students' individual and group collaboration. One method was to ask students to rate themselves on scale from 1-5 where 5 represented the highest rating of collaboration. Another method asked students to determine the

percentage of interactions spent collaboratively relative to cooperatively. The first method allows students to more easily succumb to bias in the rating of themselves. The second method required students to actively think about how their interactions fell within the categories of cooperation and collaboration in which the gain in the rating of one interaction would cause the loss in the rating of the other. One benefit of this approach is that students could not rate themselves as high in collaboration and cooperation in the second method. However, students could also simply report an equal distribution in their relative efforts.

Students from both years were asked to submit logs through a website for every interaction occuring within the group related to the lab reports. Log reports included different options, such as meetings, editing sessions, the length of time of the interaction, comments related to the interaction, and the members included in the interaction. An example of a log report can be found in the appendix.

The 2012 course offering was used as a control in this experiment, with students given no particular instructions to accomplish the collaborative writing assignment. In 2013 students were instructed to make use of the web based collaborative tool Google Drive in order to complete their lab reports. Students were told to submit the lab reports by sharing them with the instructor over the Google Drive web based system.

Objective I: Evaluate how perceived individual and group collaborative effort affects student academic achievement.

To accomplish this objective I used the individual student data from post-lab surveys 2 and 3, the lab report grades for the corresponding surveys, and the lab component of the exam scores of each individual student for exams 2 and 3 over the two years the course was offered. This information was provided to me by the instructor of the course in an Excel spreadsheet. The analysis of these variables is reviewed in Chapter IV of this manuscript. Specifically, responses to questions 1, 2, 5 and 6 from the post-lab surveys were used to determine students' perceptions of their individual and group collaborative efforts, as ratings on an ordinal scale from 1-5 and as percentages of their interactions with their team members relative to cooperative interactions. These responses were used alongside the individuals' lab report grades and the lab component of their exam scores to determine relationships between the variables. The statistical approach used is described in section I of chapter IV

Objective II: Determine whether the use of a web based collaborative tool, such as Google Drive, increases students' collaborative effort or students' academic performance.

To accomplish this objective, I used the same data acquired as in Objective I, except that I analyzed differences in the data between the control class (year 2012) and test class (year 2013), in which Google Drive was deployed. The statistical approach used is described in section I of chapter IV.

Objective III: Investigate how students and faculty perceive the usefulness of integrating web based collaborative writing tools in small group work.

To accomplish this objective I used comments provided by students in response to question 9 on the post-lab survey for lab 3 of the 2013 offering of the course. I selectively chose students' comments which showed unique positive and negative attributes of Google Drive. I also compared the comments to previous studies in the literature whose focal point was the incorporation of Google Documents into higher education writing assignments. Lastly, I conducted several interviews with faculty and students on their perceptions of incorporating web based collaborative tools in group work. I asked questions regarding the interviewee's experience with collaborative learning and collaborative tools and whether they had experience using Google Drive. I transcribed the faculty and student interviews where they can be found in appendix B of this manuscript. I used quotes from the interviews to highlight contrasting opinions of the incorporation of web based collaborative writing tools. I concluded with a general overview of the opinions of students and faculty.

Chapter IV: Results & Discussion

Section I: Quantitative Results

Post-lab surveys 2 and 3 from years 2012 and 2013 were used in this analysis, while post-lab survey 1 was discounted because of the notion that groups and individuals were acclimating to the course and had not fully grasped the differences between collaboration and cooperation; in addition, the course and team rosters underwent fluctuations and changes during the early parts of the course. These post lab surveys were delivered to the students via a university content manager known as Blackboard. Surveys were made mandatory to students, but were not tracked for completion until the end of the course. Students were never tested on their understanding of the difference between collaboration and cooperation as used in this study. The post-lab survey administered to students can be found in appendix C of this manuscript.

A frequency table was made to display the number of responses and associated ratings for four of the questions in the survey. The frequencies of responses for each rating to each question were tabulated in appendix D.

The means ratings of individual or team efforts spent on collaborative interactions for labs 2 and 3 were calculated, along with standard error. Additionally, the mean percentages of individual or team interactions spent collaboratively relative to cooperatively were calculated, along with standard error. In 2012 for lab 2 question 1, the mean was 4.26 and standard deviation was 0.76; for question 2, the mean was 4 and standard deviation was 1.13; for question 5 the mean was 4.26 and standard deviation 0.79; for question 6 the mean was 3.91 and standard deviation 1.15. For lab 3 question 1, the mean was 4.59 and standard deviation 1.31; for question 2 the mean was 3.89 and standard deviation 1.83; for question 5 the mean was 4.39 and standard deviation 1.42; for question 6 the mean was 3.77 and standard deviation 1.93. In 2013 for lab 2 question 1, the mean was 4.3 and standard deviation 1.59; for question 2, the mean was 3.6 and standard deviation 1.62; for question 5 the mean was 4.0 and standard deviation 1.70; for question 6 the mean was 3.4 and standard deviation 1.76. For lab 3 question 1, the mean was 4.2 and standard deviation 1.49; for question 2 the mean was 3.9 and standard deviation 1.62; for question 5 the mean was 4.2 and standard deviation 1.44; for question 5 the mean was 3.8 and standard deviation 1.58.

Students in 2013 rated themselves lower than students in 2012 on their individual and team collaborative ratings on lab 2, but this was reversed on lab 3 with 2013 students rating themselves slightly higher than 2012 students; however, these changes are not considered significant due to the standard error in both cases.

Student ratings of their individual collaborative efforts and percentages of collaborative activity relative to cooperative activity were plotted against the lab component of their exam scores for labs 2 and 3 for both years in figures 1, 2, 5, 6, 13, 14, 17, and 18. Additionally, the mean of individuals' ratings and percentages across both labs was calculated and plotted against the mean of the lab component of their exam scores in figures 9, 10, 21, and 22.

Similarly, the means of teams' student ratings of their groups' collaborative efforts and percentages of collaborative activity relative to cooperative activity were calculated and plotted against the teams' lab report grade for labs 2 and 3 for both years in figures 3, 4, 7, 8, 15, 16, 19, and 20.

Students within the same team were given the same grade for their lab reports. Again, the mean of teams' ratings and percentages across both labs was calculated and plotted against the teams' mean lab report grade in figures 11, 12, 23, and 24.

Correlation analysis was done on each of the relationships showed in figures 1-24 using excel. A table displaying all of the correlation coefficients between these relationships can be found under table 2.

The total number of meetings and editing sessions for each team was calculated and plotted against each individual teams' mean lab report grade for both years in figure 25 and 26. Furthermore, the mean number of meetings and editing sessions per team was calculated and compared between 2012 and 2013.

For each scatter plot in figures 1-26 a regression analysis was done using Microsoft Excel to find a R^2 value. Additionally, a correlation analysis using Microsoft Excel was also conducted on each plot to find the effect sizes of correlations between the variables. As is traditionally used in statistics, an effect size of 0.2 was considered weak, 0.3 moderate, and 0.5 strong.

Lastly, the mean of the lab component of the exam grade for all students in each year was computed and compared in figure 28. Likewise, the mean of the teams' lab report grades for all teams in each year was computed and compared in figure 29.

Section II: Discussion of Quantitative Results

Objective I: Evaluate how perceived individual and group collaborative effort affects student academic achievement.

To accomplish this objective, I used the metrics showing student academic performance, lab report grades and lab component exam scores to create relationships between them and the students' ratings for individual and team collaborative effort using excel. I used a correlation analysis provided in Excel to find the strength of effect sizes between the relationships.

I first analyzed the correlation coefficient between individuals' self rating of their collaboration against individuals' lab component exam scores. In 2012, for lab 2, I found that there was a weak relationship with a coefficient of 0.223; however, for lab 3 the relationship was moderate at a coefficient of 0.305. When individual students were tracked over both labs the correlation coefficient was 0.335. When individuals were tracked over both labs, it was found that not all students had submitted log reports for both labs, or, perhaps, the class roster had undergone changes. It is possible that students who dropped out or did not submit both labs contributed to the increase in the coefficient of correlation. In 2013, for the same relationships I found that for lab 2, higher individual collaborative rating correlated with a lower lab component exam score with a coefficient of -0.340, showing a moderate negative relationship for this correlation. For lab 3 the coefficient changed to 0.174. When individuals were tracked over both labs, a coefficient of -0.174 was observed. Similarly to 2012, in 2013 the course roster had changed between labs, and not all students completed their post-lab surveys. Individuals who were not represented in both lab samples were not included in the combined labs analysis. Overall, the relationship between individual collaborative rating and exam score was not

consistent and no meaningful relationship or statistical significance can be determined in any of the course offerings.

I next analyzed the correlation coefficient between individuals' perceived collaborative efforts relative to cooperative effort percentage with the individuals' lab component exam score. I observed that in 2012, for lab 2, the correlation coefficient was -0.036, indicating no correlation; for lab 3 this changed to 0.351, indicating a moderate positive relationship indicating some degree of correlation. When individuals were tracked over both labs the coefficient changed to 0.384. This incongruence in correlation coefficients over the two labs is likely due to the fact that not all individuals submitted post-lab surveys for both labs, and were not tracked for the combined labs analysis. In 2013, lab 2's coefficient was -0.319 indicating that a higher individual collaborative effort percentage was correlated with a lower lab component exam score. For lab 3 no correlation was observed between the variables with a coefficient of 0.049. In the combined labs analysis, a coefficient of -0.190 was observed.

Next, I looked at relationships between group collaborative rating and the groups' lab report grade over the two labs between the years. Coefficients in all cases but two remained below +/- 0.200 in all relationships over all labs over both years, even when labs were combined. The two cases where the coefficients exceed +/- 0.200 belonged to 2013's data, where a relationship between group collaborative interaction percentage and lab report grade was analyzed; in this case, for lab 2, the coefficient was -0.235, while lab 3's coefficient change to 0.244; when combined labs were tracked, this coefficient changed to -0.065, indicating no relationship.

Lastly, the differences between asking students their collaborative effort rating and percent collaborative interactions relative to cooperative interactions was minimal, according to differences between Pearson's r coefficient for the two questions. In both 2012 and 2013 Pearson's r was remarkably similar between the two methods of asking student collaborative effort. For example, in 2012 the combined labs coefficient for individual collaborative rating and lab component exam scores was 0.335; for the relationship between percent individual collaborative interaction relative to cooperative interaction and lab component exam score the coefficient was 0.384. The difference between these values is only 0.049. Likewise for the difference between the two coefficients regarding group collaborative rating and group collaborative interaction percentage relative to cooperative interaction the difference was minimal as well at 0.115. Similarly in 2013 the differences were 0.026 and 0.148 respectively.

Individual collaborative ratings did not correlate with lab component exam scores. This data does not support the hypothesis that increased student collaboration correlated with student academic performance. However, it is possible that student collaborative ratings collected from the post-lab surveys did not accurately measure student collaboration. Students likely perceived themselves to be collaborating when they were, in fact, either cooperating or not actively collaborating. Because the post-lab surveys were not anonymous, it is possible that students were not honest in their survey responses and gave themselves higher ratings; this is supported by the fact that the majority of student responses on the post lab surveys for individual collaboration fell in the range of 4-5 and was not equally represented in the ranges of 1-3.

Objective II: Determine whether the use of a web based collaborative tool, such as Google Drive, increases students' collaborative effort or students' academic performance.

To achieve this objective, I compared and contrasted the control class in 2012 with the test class that incorporated Google Drive in 2013. First, I looked at general trends between the class years. The mean lab component exam score decreased slightly from 2012 to 2013, shown in figure 28. This difference is not statistically significant due to the standard error of the means. Lab report grades also decreased marginally from 2012 to 2013, as shown in figure 29; this too was not statistically significant.

From 2012 to 2013, Pearson's r coefficient showed a change in the relationship between individuals' collaborative ratings and individuals' lab component exam scores. In 2012 the coefficient was 0.335 for the combined labs while in 2013 this changed to -0.174. This means that in 2012, collaborative ratings correlated moderately with lab component exam scores, but in 2013, this changed to collaborative ratings correlating weakly with lower lab component exam scores. This same pattern is found in the relationship between individuals' collaborative percentage interactions relative to cooperative interactions and lab component exam scores. Individuals' collaborative percentage interactions relative to cooperative interactions in 2012, correlated moderately with individuals' lab component exam scores, but in 2013, the relationship was changed to a weak correlation with lower individuals' lab component exam scores. With regards to group collaborative ratings and group collaborative interactions' percentage relative to cooperative interactions, no change was observed between 2012 and 2013.

Using the logs that students posted of their meeting and editing activity, I analyzed differences between years 2012 and 2013. Compared to 2012, Students who used Google Drive in 2013 participated in fewer face-to-face meetings in 2013 by a significant amount, as shown in figure 27. In contrast, students participated in slightly more editing sessions in 2013; however, this was not by a significant amount based on the standard errors observed. In comparison to students in 2012, students who used Google Drive in 2013 also had stronger correlations between the total numbers of both meetings and editing sessions and mean lab grades, shown in figures 25 and 26.

Overall, I observed that students who used Google Drive in 2013 had a false perception of their individual collaborative efforts relative to students in 2012, due to the change from a moderate positive relationship between ratings and scores in 2012 to a weak negative relationship between ratings and scores in 2013. Students also met together less often in group meetings in 2013; this is likely due to using Google Drive as their main method of communicating and transmitting work between team members. To conclusively make this inference, this data should be triangulated with qualitative data collected from student comments regarding their use of Google Drive.

From this general analysis, there is no meaningful data to support the hypothesis that students who used Google Drive participated in greater collaborative learning interactions in groups, or that students had higher academic achievements.

Section III: Figures and Tables

*Figures not shown below may be found in appendix D

Table 2: Pearson's R coefficient for correlation relationships between both individual and group collaborative ratings and both exam scores and lab report grades for labs 2, 3, and combined labs in 2012 and 2013.

	2012			2013		
Correlation between:	Lab 2	Lab 3	Combined labs	Lab 2	Lab 3	Combined labs
Individual collaborative rating & exam score (lab component)	0.223	0.305	0.335	-0.340	0.174	-0.174
Individual collaborative interaction percentage & exam score (lab component)	-0.036	0.351	0.384	-0.319	0.049	-0.190
Group collaborative rating & lab report grade	0.015	-0.068	-0.001	0.019	0.031	0.083
Group collaborative interaction percentage & lab report grade	0.112	0.037	0.114	-0.235	0.244	-0.065

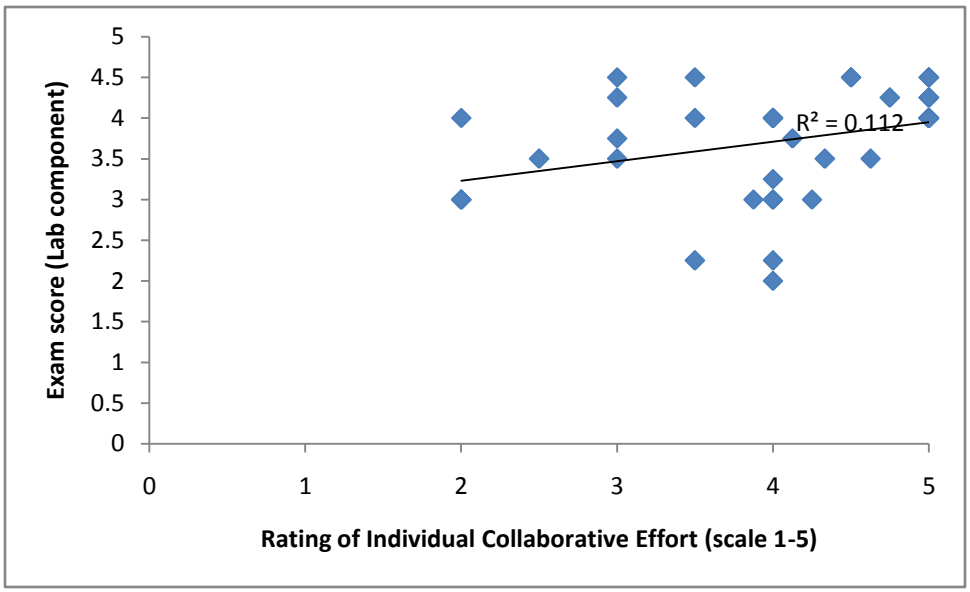

Figure 9: Scatter plot of student responses to question 1 of the post-lab survey for labs 2 and 3 in 2012, showing the mean of an individuals' collaborative effort ratings over two separate labs versus the mean of the individuals' lab component exam scores, by individual student. n = 38

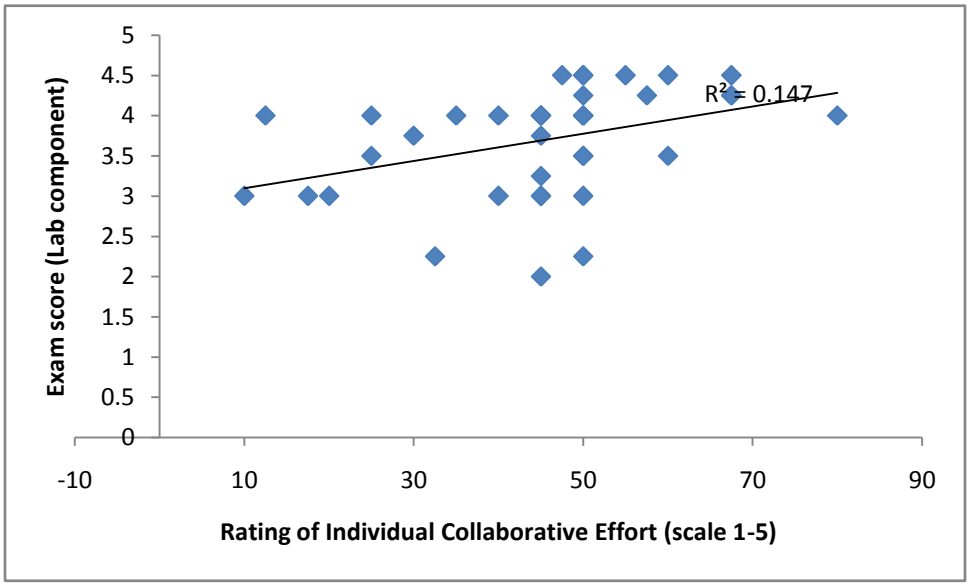

Figure 10: Scatter plot of student responses to question 3 of the post-lab survey for labs 2 and 3 in 2012, showing the mean percentage of individuals' effort spent on collaborative interactions relative to cooperative interactions over two separate labs versus the mean of the individuals' lab component exam score, by individual student. n = 38

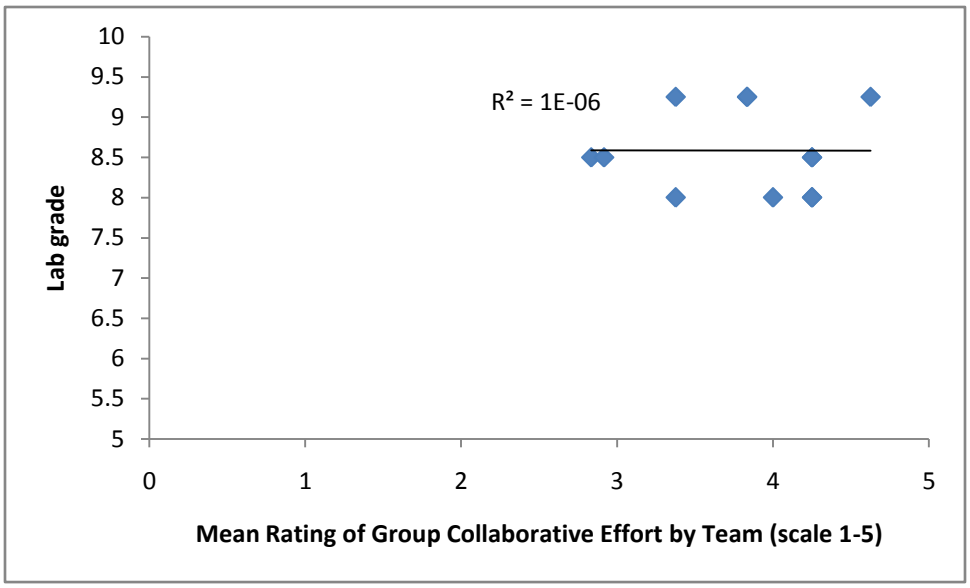

Figure 11: Scatter plot of mean team response to question 5 of the post-lab survey for labs 2 and 3 in 2012, showing the mean rating of collaborative group effort within a team over two separate labs versus the mean lab report grade, by individual team. n = 38

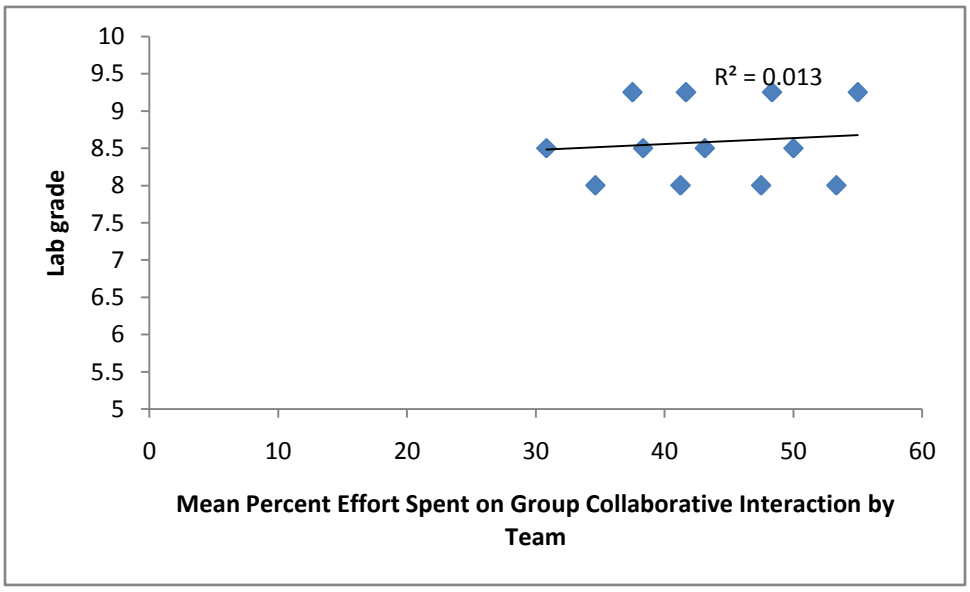

Figure 12: Scatter plot of mean team response to question 6 of the post-lab survey for labs 2 and 3 in 2012, showing the mean percent effort spent on group collaborative interactions relative to cooperative interactions within a team over two separate labs versus the mean lab report grade, by individual team. n = 38

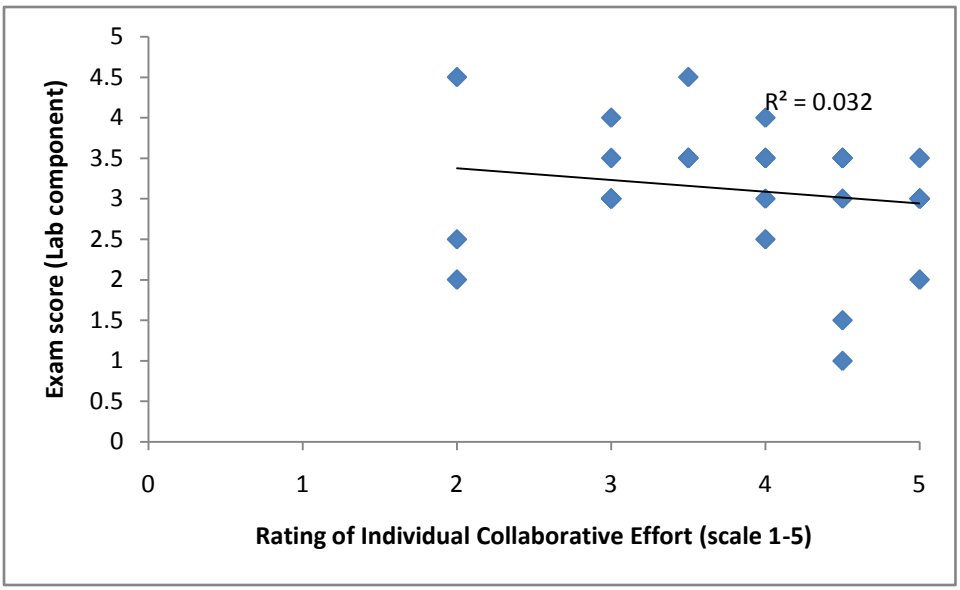

Figure 21: Scatter plot of student responses to question 1 of the post-lab survey for labs 2 and 3 in 2013, showing mean individual collaborative effort rating over two separate labs versus the mean of individuals' lab component exam scores, by individual student. n = 31

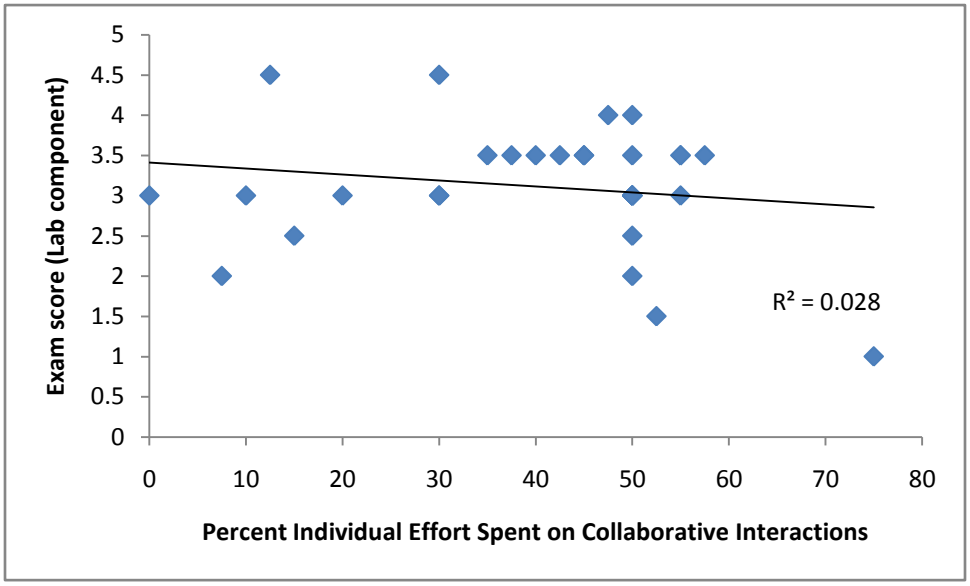

Figure 22: Scatter plot of student responses to question 3 of the post-lab survey for labs 2 and 3 in 2013, showing the mean percentage of individuals' effort spent on collaborative interactions relative to cooperative interactions over two separate labs versus the mean of the individuals' lab component exam score, by individual student. n = 31

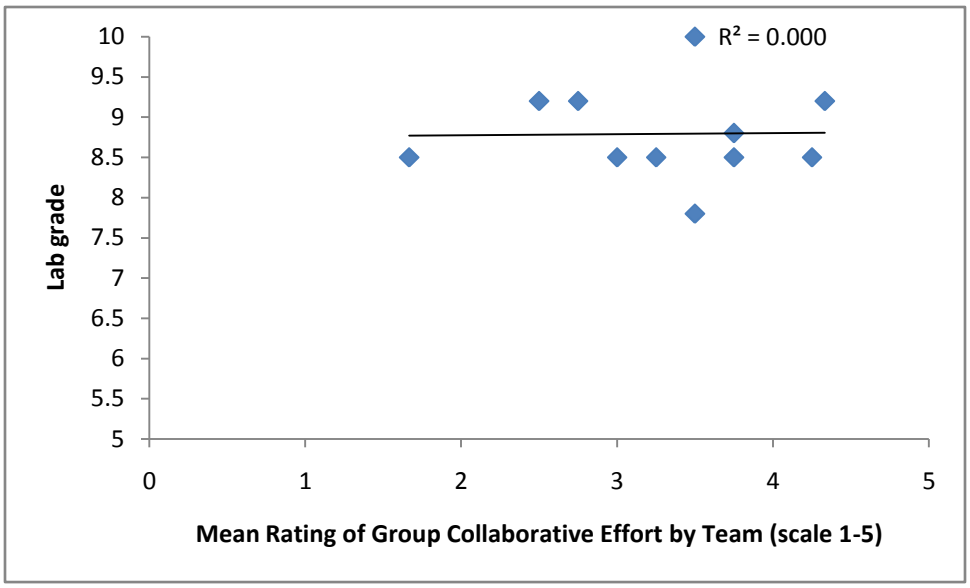

Figure 23: Scatter plot of mean team response to question 5 of the post-lab survey for labs 2 and 3 in 2013, showing the mean rating of collaborative group effort within a team over two separate labs versus the mean lab report grade, by individual team. n = 31

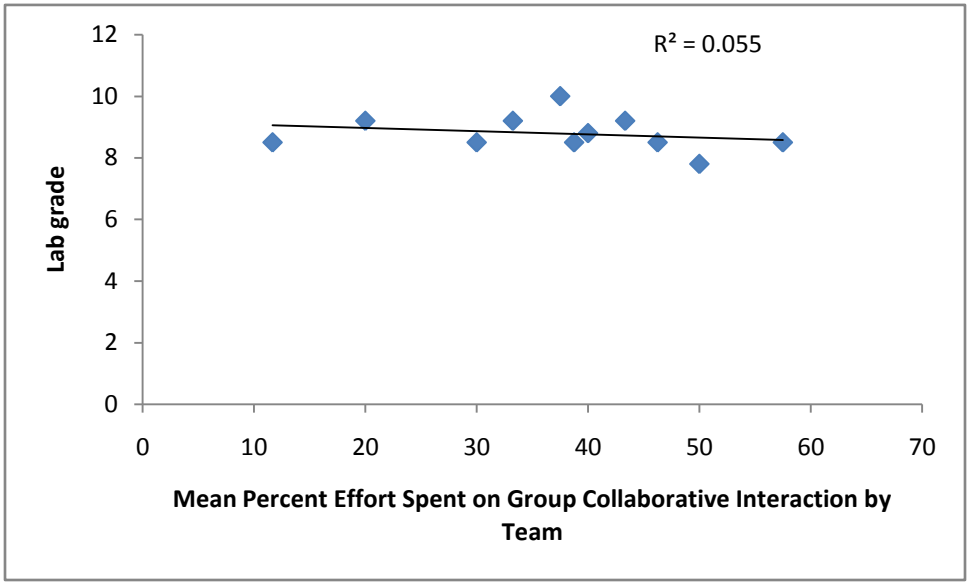

Figure 24: Scatter plot of mean team response to question 6 of the post-lab survey for labs 2 and 3 in 2013, showing the mean percent effort spent on group collaborative interactions relative to cooperative interactions within a team over two separate labs versus the mean lab report grade, by individual team. n = 31

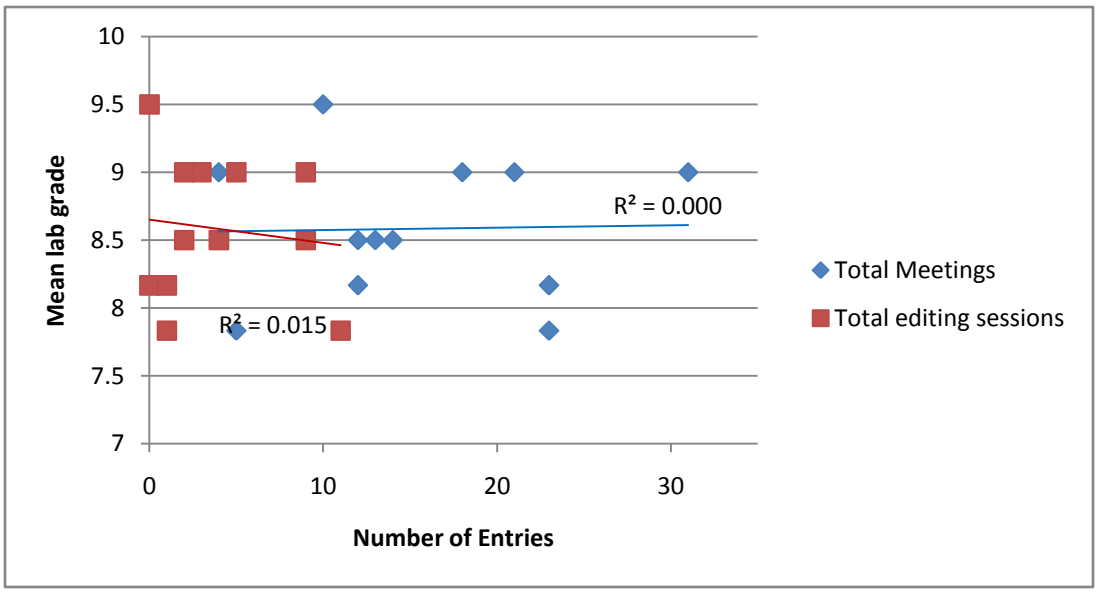

Figure 25: Scatter plot of the number of meetings and editing sessions by individual teams versus their mean lab grades in 2012.

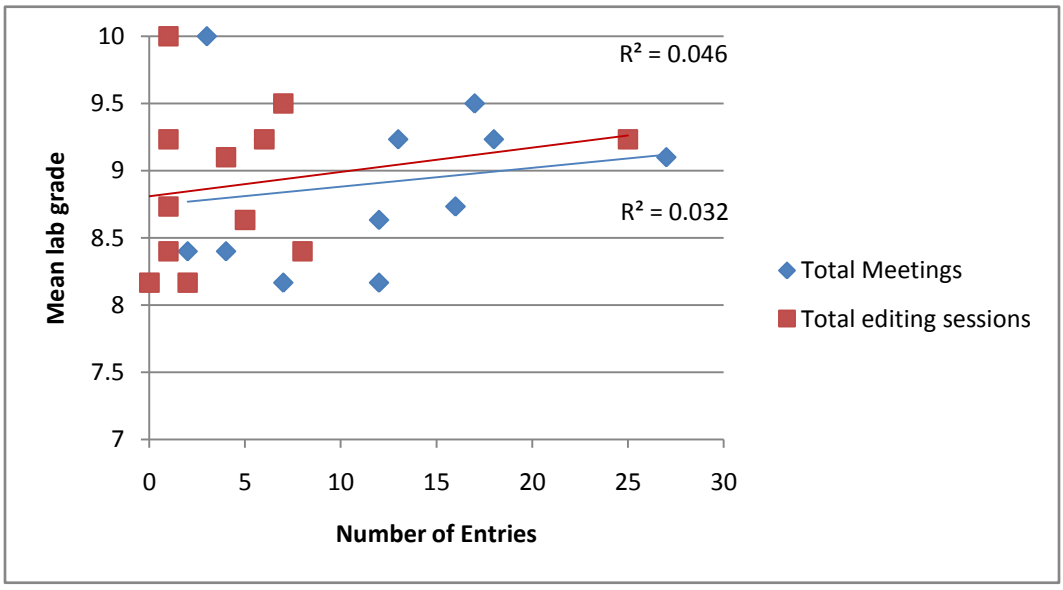

Figure 26: Scatter plot of the number of meetings and editing sessions by individual teams versus their mean lab grades in 2013.

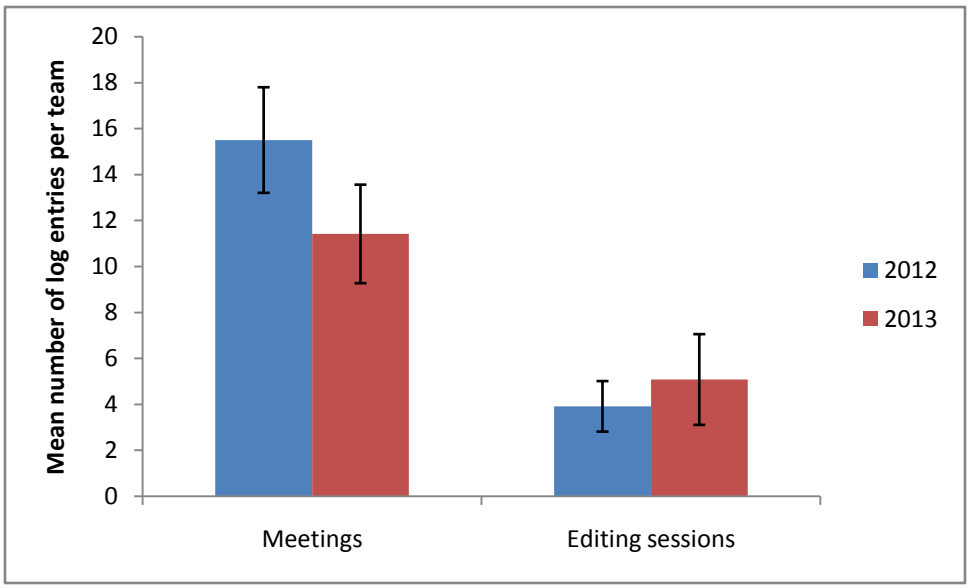

Figure 27: Comparison of the mean number of meetings and editing sessions per team in 2012 and 2013 with standard error. n = 12.

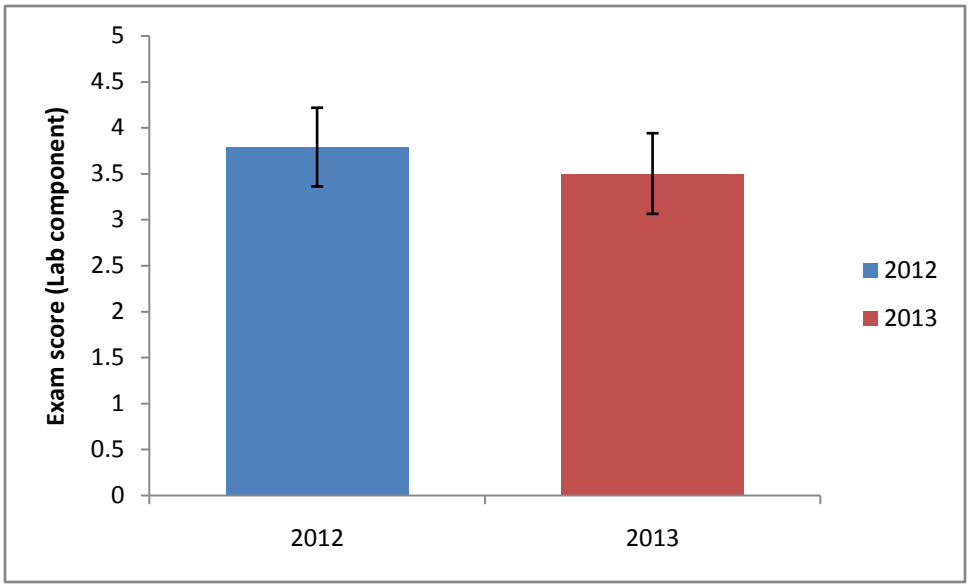

Figure 28: Comparison of the mean exam scores (lab component) over 2012 and 2013.

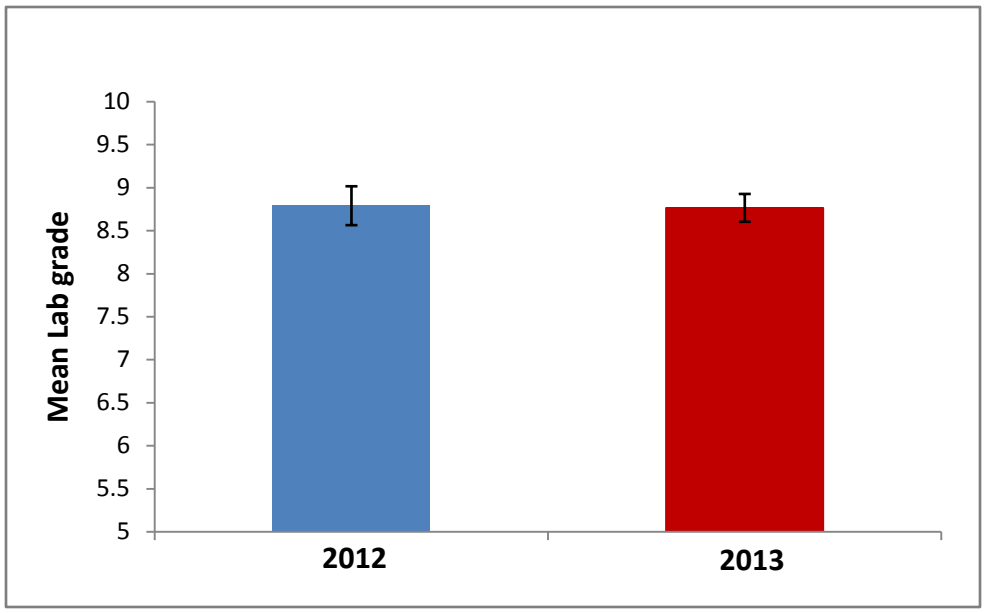

Figure 29: Comparison of the mean lab grades over 2012 and 2013.

Section IV: Qualitative Results

In order to investigate how students and faculty perceive the usefulness of integrating web based collaborative writing tools in small group work, I used the qualitative feedback from students and faculty members who had experience using web based collaborative tools in their courses and group work.

Student feedback

This section will look at qualitative data collected from question 9 of post-lab survey 3 for 2013, which asked students to write about their experiences using Google Drive in the collaborative writing process. All comments are available to be viewed in their non-redacted form in the appendix. Question 9 states:

> Now thinking on your team's work in general on the three lab reports, please comment on your experiences using the collaboration platform Google Drive to complete assignments. In what ways did this platform facilitate collaborative work on these assignments? In what ways did it inhibit collaborative work? In general, what advantages or disadvantages did this platform have over other ways you have collaborated on assignments (be as specific as possible)?

Of the 31 comments made by students, 21 were favorable, 5 were neutral, and 5 were negative regarding the use of Google Drive in the writing process based on my own judgment. Overall students were positive about their experience with the platform. One comment said that "[i]t made collaborative work extremely efficient" [4]. Similar comments were encountered numerous times such as, "[i]t facilitated collaborative work on these assignments because it allowed continuous editing on separate computers at the same time… [and] did not inhibit collaborative work at all" [3], and "we found Google Drive to be extremely helpful for our collaborative work." [26]. This is comparable to a finding made by Chu (2009) which found that student enjoyment using Google Drive positively correlated with collaborative improvement among group members. It is also possible that students confused collaboration for cooperation in the comments praising Google Drive.

Several individuals expressed their dissatisfaction with the formatting options featured in Google Drive because "there were occasional bugs which messed up some formatting…" [9] and "the program itself is flawed and many spend more time working to make it work, than working on the project" [10]. Some other students who were dissatisfied with Google Drive claimed that "people who are not familiar with using Google tools would have a harder time using the software" [11]. One student mentioned that Google Drive had "[n]ot many disadvantages, besides formatting problems...[because] it was difficult to add pictures/figures to the document." [13]. It is possible that users could not easily adapt to a different word processor if they had only used one throughout their entire life. Also, due to the web based nature, and the necessity for accommodating multiple browser types and operating systems, Google Drive may have been difficult to format for students with rare internet browsers or

operating systems. In addition, from the students' comments, Google Drive's word processor may or may not be as fully-featured or easy to use compared to more common word processor programs.

A few negative comments regarding the effect of Google Drive on group collaboration stated that "[i]t took away from really collaborating as a group because it allowed our team to not literally work together, but work together indirectly," [25] and that "most of our actual discussion occurred in person because it is not easy to have everyone on the document at the same time to have the necessary discussions, and often discussions are longer than what can be said on the document" [12]. This echoes research done by Brodahl, Hadjerrouit, & Hansen (2009) who found that only 13.9% of students were motivated to use the web based collaborative writing tools Google Documents and EtherPad for collaboration; in addition, they also found that only 15.7% of students reported the quality of collaboration in the group to increase using Google Documents.

Faculty Interviews

Two interviews were conducted with professors at WPI who had previously been known to incorporate web based collaborative tools in their courses. An additional two interviews were conducted with student project groups who had used web based collaborative tools to facilitate their collaborative writing. All interview transcripts may be found in the appendix of this manuscript.

When asked why she chose to adopt collaborative writing tools in her classrooms, one faculty interviewee responded, "the one thing I was really hopeful about from a pedagogical perspective [was that] there was a lot of literature that said that students have a lot more ownership of what they do… [and are] a lot more engaged and likely to learn more and integrate it" [Jill Rulfs]. Additionally, this faculty member thought that "collaborative learning tools are really important," and claimed that "we're getting there… [but found that whatever] I use, my students are one step ahead of me, [and seem to] have a system that works better." As a result, the faculty member was not sure if she "should drive what they're going to use," and felt that she "should set up the opportunity for collaborative learning, but let [the students] define maybe what they want to do." [Jill Rulfs]. Professors should, perhaps, let students decide on their own what programs to use in order to facilitate collaborative learning

When asked about the detracting qualities of incorporating web based collaborative tools, one faculty member stated that, with regards to navigating through the technology, "I find it too cumbersome having to have this site that you have to go to and having to learn how to use the tools" and did not find it "very user friendly" [Jill Rulfs]. Another faculty member stated that "in the end, the user has to be in mind when you make these things, and even if it can do all that stuff, nobody is going to want to use it because it has to be approachable" [Destin Heilman]. It is apparent that ease of use and intuitive user interfaces are important features for faculty to adopt a technology in the classroom. Future programs should consider the user experience as a main focal point for improvement to optimize the general uses for their technology and encourage users to utilize their program.

A different faculty member, in response to a question about where collaborative tools belong in the classroom said, "I'm not necessarily an advocate of putting technology in the classroom for technology's sake, [so] I have to see the need," continuing to say that "[t]here's a lot of technology out there that is arguably useful" [Destin Heilman]. This faculty member insisted that "[as an instructor] I need to be quick and efficient so that we can move on in the course, so I prefer a lot of technology that

allows us to get to the pedagogy as opposed to things that help us deliver the pedagogy" [Destin Heilman]. It is evident that in order to have a place in the classroom, technology must be introduced and used to mainly focus on optimizing the learning experience for students.

Asked about their use of Google Drive specifically, one faculty member praised the simplicity of the user interface, saying "Google docs seems to work the way I wish sharepoint would, only more easily and the user interface is much more simple and much more intuitive" [Jill Rulfs]. Another faculty member said that, "I've used Google docs for proposal writing with colleagues [because] as a collaborative tool, it was great, especially when two people were in there editing the document, it was really neat" [Destin Heilman]. Among faculty members, their apparent perception is that Google Drive is a user friendly tool useful for doing asynchronous collaborative writing.

Student Interviews

Students who had used Google Drive or other web based collaborative writing tools to complete their senior and junior thesis were interviewed about their experience using the tools. One group consisted of two female students who had used Google Drive for their junior thesis, while the other group consisted of four male students working on their senior thesis.

When asked about features in Google Drive that facilitated working collaboratively, students said that "we chose [Google Drive] it because it's all in one place and it's editable" [Rachel Hickox and Gabby Nunez]. Additionally, they praised the tools' auto-save feature, "[w]hen it comes to data and stuff I forget to save all the time, and there it's saved automatically. [t]hat's like the best" [Rachel Hickox and Gabby Nunez]. Another group praised the chat box feature for group communication saying that, "the chat box and the ability to edit [the same sections] at the same time and add comments was really useful." [Wilson MQP group]. When asked about the ease of sharing documents, the second group said that, "it was extremely easy for any Google user [because] all you needed to do was make a document and add users" [Wilson MQP group].

Alternatively, when asked about the negative aspects of Google Drive, one group said that, "In one of my classes I did a lot of formatting in Powerpoint for animations and such, and then I put it on google drive so my partners could see, [but] it just ruined everything" [Rachel Hickox and Gabby Nunez]. A different group stated, "you can't format say a 50-100 page IQP/MQP, any page that is supposed to have headers and footers and subsections, you can't do that with google" [Wilson MQP group], a different student within the same group stated that "[w]hen we worked on my IQP we used google docs solely for all of our editing and then we would export that to a word document for formatting. The fact that you couldn't do the formatting in google docs wasn't that big of an issue" [Wilson MQP group] This echoes previous comments from students on the post-lab survey which said that formatting and editing with Google Drive was difficult. Another comment discussed the lack of a timestamp feature in the chat box, "The only thing with the chat in the document though is there isn't a timestamp, so you can't tell when someone sent a message." The student commenting continued to give an example, saying that "if I go away and come back two hours later to a message I have no idea how recent it is, so that's inconvenient" [Rachel Hickox and Gabby Nunez].

When asked about concerns of security and privacy of their documents, one respondent said that "I'd still prefer Google just because it's mainstream, [and] I realize Sharepoint drive is protected, but

Google is just so much easier" [Rachel Hickox and Gabby Nunez]. This student group did place emphasis on privacy concerns or issues of document protection over ease of use.

Overall students and faculty found Google Drive easy to use with an intuitive user interface. They found it beneficial to use when working collaboratively in small groups. However, students also had problems with formatting and including multimedia in their reports through Google Drive. It seems that with a few adjustments to the software and instructions for users, Google Drive could easily replace common word processors for group collaborative work.

Chapter V: Conclusion and Future Work

The goal of this work was to assess the impact that a web based collaborative tool such as Google Drive has on student collaborative learning and behavior. More specifically, the aim was to use a control class which was given no instruction on how to accomplish a group writing assignment to create a baseline to compare a test class where students were instructed to use Google Drive in their collaborative work.

The experiment allowed the investigation of research questions, posed as objectives, by means of students' self evaluations of their individual and group collaborative efforts through surveys. Two methods of asking students' their collaborative ratings were used which showed remarkably similar results when used in correlation analysis. Additionally, qualitative results through student and faculty feedback on interviews and a survey of students' opinions on their experience using Google Drive in group work allowed insight into the benefits and detriments of using these tools. The quantitative results have been analyzed using a combination of correlation analysis and frequency distributions. Although correlation analyses and frequency distributions alone cannot tell whether using Google Drive enhances students' collaborative interactions or leads to greater academic achievement outcomes, they help to understand how students perceive their own collaborative effort within a specific educational context.

Firstly, the results refute the hypothesis that increased student collaborative learning measured by students' perceived collaborative effort correlates with higher academic achievement. It is likely that students' ratings of their own collaborative efforts are inflated, or that students did not fully comprehend the definition of collaboration when answering the survey. Another possibility is that students answered dishonestly on the survey due to it not being anonymous. A better way to study student collaboration should be established to more accurately measure this metric for future studies.

Secondly, the results refute the hypothesis that using web based collaborative tools such as Google Drive increase students' collaborative efforts or academic achievement. There was no correlation found between use of Google Drive and increased student ratings of their individual or group collaborative efforts or their academic performance. Students who used Google Drive had lower mean ratings in their individual and team collaborative efforts compared to students who did not use Google Drive. In addition, students who used Google Drive had fewer face-to-face meetings than students who did not use it. Lastly, students who used Google Drive had slightly worse mean academic performances compared to students who did not use the tools. These conclusions should be warily accepted, in light of the fact that the method used to measure student collaboration used students' self-perceived collaborative efforts, which may not be an accurate measure of actual student collaboration.

Overall, this study found that there was no quantitative data to back the use of Google Drive in collaborative group work. Although the use of Google Drive did not seem to help students achieve higher academic performances, students' praised the programs ease of use and only had few negative comments about its incorporation into group work. Both students and faculty who had used it in the past commended it for facilitating collaborative writing for group work. Google Drive was useful for allowing team members to meet when they could not find time for face-to-face interaction. Users of Google Drive found that editing and formatting was more difficult in Google Drive than in other word processors, especially the inclusion of multimedia.

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Appendix A: Comments from post-lab survey #3 for 2013

Table 3: Comments from question 9 of post-lab survey #3 for 2013

1	This tool allowed cooperative work to be much simpler, and it allowed for a much easier way to keep the lab up to date.
2	Google drive helped tremendously on us being able to organize who did what and make most of our labs successful even though we were not able to meet in person. The only disadvantage was that anything uploaded could not be directly edited on the drive but instead downloaded, edited, then reuploaded.
3	I think the Google Drive platform is the most useful platform when completing group work. It facilitated collaborative work on these assignments because it allowed continuous editing on separate computers at the same time. It did not inhibit collaborative work at all. In general, the advantages of this platform over private editing is that work is faster with Google Drive. There are no disadvantages that I noticed.
4	The drive was a useful experience. It made collaborative work extremely efficient. It really didn't have any disadvantages. The only downside to this project was the fault of a group member that failed to pull his weight. Besides that, the use of Drive to finish assignments was very beneficial and should continue to be used for future assignments in this class.
5	As time went on, we grew more used to using the google drive tool and only had to meet to decide what we would be doing for each assignment. I think this tool is great for saving time and helps eliminate any many scheduling conflicts. Google drive is the perfect tool for canned labs like this, because there is less of a need for collaborative brainstorming and more of a need to finish the assignment as quickly and painlessly as possible. While more convenient, it does eliminate the discussions necessary for breakthrough work in detailed investigations. It's the ultimate software for undergraduate class group work, provided each team member is willing to complete assigned tasks on time.
6	This was the first time that I have ever used Google Drive to work on an assignment, and I really enjoyed the experience. It was very easy to keep drafts fluid and constantly better, and it was easy to access everyone's materials. The only thing that I did not like is that google drive does not version like sharepoint does, so it was a little bit more difficult to track who made what changes.
7	I liked using Google Drive and editing the same document simultaneously with others. You can chat while everyone is logged on so you can ask questions and check in with your partners. Google even improved this chat ability in the past week, so that was cool to see. It got complicated when not everyone used the Google documents and made edits in Word, but it wasn't too bad to put the two together. Making comments and editing is MUCH easier in Word though, where you can track changes and make comments easily. While you can comment on the Google drive, you can't track your changes. This makes it harder to see the report changing over time with edits.
8	I personally enjoyed using Google Drive. It substantially streamlined the editing of the labs and everyone could see the whole lab come together. If we had not used Google Drive I feel like our labs would have taken a significant amount more of time.
9	Google Drive made working on the same lab report simultaneously very efficient. There were occasional bugs which messed up some formatting but overall it was very effective.
10	Google drive is the most convenient of the collaborative platforms out there however I still do not like it. The program itself is flawed and many spend more time working to make it work, than working on the project. It did allow us to keep an up-to-date document in a place easily accessible to the whole team which reduced the need to email it back and forth. It allowed us to work on the project on our own time as well, which was good for our very busy group.

11	I enjoyed using Google Drive, but I can see that people who are not familiar with using Google tools would have a harder time using the software.
12	Google drive was helpful in the sense that we could work in different places on the same document and use the chat and comment features to say important things. However, most of our actual discussion occurred in person because it is not easy to have everyone on the document at the same time to have the necessary discussions, and often discussions are longer than what can be said on the document.
13	Google Drive was great. When we met we were able to see what each other had written and all edit at once. Not many disadvantages, besides formatting problems. It was difficult to add pictures/figures to the document.
14	It's really hard to edit in Google Drive.
15	We used the Google Drive site mainly to share completed sections or drafts. If we had edits to make, we downloaded the document and then uploaded a new version when finished. This platform replaced us sending emails to each other with latest drafts as attachments. For ID2050, I used a similar platform but it was on my.wpi.edu. This was convenient to use because everything was in one place, all course materials, assignments, and work that we were doing.
16	It's ok, just not for pictures, tables, and figures which are all needed for these assignments. There are also no citation tools built in to drive.
17	The google docs was definitively helpful for editing each other's work simultaneously. It was not good for using the excel features.
18	Our group really liked the Google docs drive for a couple of reasons. When we got together to work on the labs, you could physically see what they were typing. This made it easier to edit what they were typing and add to it as well. We could also do stuff on our own and then a team member could edit what you did without having to email back and forth or what not. There were a few glitches with the Google Drive though. The spacing on the actually document was different on each laptop, making it harder to fit our lab on the mandatory three pages. Other than that we really like it and I think you should continue it. This was my first time using it and I think it worked well.
19	Google drive is probably better than blackboard submission, but we are not using it all the times. We often exchange first draft using email, and we won't put anything in the drive until we feel comfortable with what we have.
20	This made it very easy to work on everything together. Because you can see who is doing what and when they did it and what edits they made, it is easy to keep eachother on task and complete the assignment. It creates tension when you realize that only 3 people are really contributing by looking at the edit history.
21	I liked it, made it easier to work on things without always having to schedule. Asking questions was hard at times but the comments feature helped it that. I would recommend it to all.
22	Google Drive platform was an easy way to work on reports simultaneously and made sharing information much easier as well. I have used the Google drive for past courses and it is the easiest way to share group work and material.
23	It was convenient to use google drive but the fact that the files had to be downloaded to see the comments was a little confusing. Other than that, google drive was very useful.
24	This facilitated synchronous collaboration with a single screen—as in the Tech Suites. It also kept individual motivation up as other team members could check on our individual progress as we worked cooperatively.
25	The advantages were that people were able to edit things anytime they wanted too, but the negatives outweighed the positives. It took away from really collaborating as a group because it allowed our team to not literally work together, but work together indirectly. Most of the key

	changes to our reports were made when we were all actually sitting together.
26	We found Google Drive to be extremely helpful for our collaborative work. I don't think it inhibited our work at all, it really helped a lot to all be working on one document at the same time.
27	Google docs worked well for us
28	Sometimes using the google drive was annoying. Uploading and downloading the document wans an extra step that felt rather unnecessary. We did not edit the same document at the same time, instead certain sections were delegated to different people, so using the drive made no difference in that respect. You can't copy and paste and the document looks distorted until you actually download it. If the download step wasn't there and you could just work on it live (like sharepoint kinda) then it would be worth it. We just individually sent our sections to someone who compiled the document and uploaded it.
29	It was an advantage because all of us were able to work on it at anytime instead of having to send drafts via email.
30	I think Google Drive was an excellent method to write the report. Allowing the sharing of every document we used helped everyone be on the same page and certainly made editing easier. Even if we weren't together working, we could see the changes that others were making.
31	Google drive is convenient. We could upload our drafts when each of us finished our part of report. We split our work first. Then, we combined draft together and revised.

Appendix B
Interview Transcripts

Faculty Interviews

(i) Interview with Jill Rulfs
(ii) Interview with Destin Heilman

Student Interviews

(iii) Interview with Rachel Hickox and Gabby Nunez
(iv) Interview with Dan Sullivan and Wilson MQP group members

*Note that Sasha is a nickname for the author Alexander Pankratov

Faculty Interviews

(i) Interview with Jill Rulfs

Jill Rulfs (J)
Sasha (S)

S: Hi Jill, just for clarification we do have your permission to record your speech?
J: You do have my permission to record.
S: Okay thank you.
S: So I've kind of overviewed a little bit about what we're going to be doing in the mean time [That Stephen was absent]. And so Jill have a little experience with Wikipedia
J: The one that's blackboard. Wiki.
S: [To Stephen]Oh do you have the list of interview questions by chance? Sorry we're kind of unorganized right now.
J: That's okay… it's kind of last minute
S: And when do you want us to stop by?
J: I have the rest of the day free…
S: okay so just to get this for the record what experience do you have with Web 2.0?
J: So what experience do I have with Web 2.0 other than Wikis? Other than using this in my class? Or what do you want to know?
St: I guess just including wikis how have you used them in your classroom?
J: Okay so last… last year. in my cell biology class I wanted to do some collaborative learning project. And it's kind of a big class I mean I think we had around 75 80 people.
S: And this is the GPS class?
J: No this is cell biology.. so I wasn't sure how to organize that but Erin Desilva suggested that Wikis could be a good collaborative tool and part of the reason I liked them was that I could see who did what and who posted what and see what kind of edits were made so that I could really make sure that there was really collaboration going on. And so there were small group projects. And the one thing I was really hopeful about from a pedagogical perspective there was a lot of literature that said that students have a lot more ownership of what they do. They're a lot more engaged and likely to learn more stuff and integrate it. And so I thought if we're going to create a real honest to god Wiki about cell biology. And if we think its good we will put some of it up on Wikipedia because its going to be good information by knowledgeable people who are going to be doing real scientific research. It's sort of the dream. And so students took on different topics. And they were working in groups as you say and you know in two or three four people and sort of on average I was happy with under five. And usually more than that it gets awkward and difficult. The students were okay with it. But my problems were mostly the technical ones.
S: So learning how to use the software?
J: No, kids on macs that I couldn't read on my PC. I could read them but they scrolled all the way across. For every line I had to scroll across.
S: And this is a powerpoint or something?
J: This is the wiki tool on blackboard. And so the students who were using PC's I had a better experience with. But we also had the whole problem with and I think blackboard had fixed it this year. But chrome didn't work well, firefox didn't work well. And I don't remember there were certain browsers that you just couldn't use and students were very frustrated because they had set them selves up for use firefox but now you can't do that
S: Very inconvenient

J: SO the technology was getting in the way from my point of view and their satisfaction and my satisfaction were in the process. The content of what was done was good. And from what I could see of the collaborations it was good. Since I could very clearly that I had eyes on everyone effort. Like I could see who did what, who edited what. Then I think that provides people with something they can really engage with and be graded on. And so from that point of view it went very well. And I'm always frustrated when technology gets in the way of the concept.
S: Detracts from it kind of.
J: I have used sharepoint with students and I personally view sharepoint… I find it… So the first thing that attracted me was this business that you could come out and take a document and put it back there and different people could edit the same document but you were all looking at edits in real time. And so I really like that but I find it too cumbersome. Having to have this site that you have to go to and having to learn how to use the tools. And I don't think its very user friendly.
S: It's not very intuitive
J: It's not very intuitive right there you go. And you know im an old dog I need things to be fairly simple. So there are good things about sharepoint and there are bad things about sharepoint. And so I was really excited about the wiki because I thought it was going to be easier but somehow because it was part of blackboard I thought it was going to be more user friendly. But somehow the technology of that was difficult. Now I havne't tried it since then because I was frustrated by it and I threw up my hands. And so the other thing I discovered was that there are a lot of collaborative or discussion type things set up in blackboard.
S: Forums and discussion boards too
J: Yes and theres forums and discussion boards and I would set those all up and the students would go off and use Facebook or whatever. And one of the ones we had success with was. And although I haven't heard much recently though but I do know some students have been using Google Docs. You know google docs seems to work the way I wish sharepoint would. Only more easily and the user interface is much more simple and much more intuitive. And I now understand that google has somehow changed google docs.
S: Well they have changed it but they really just renamed it and brought it under the umbrella of other things too, so google docs became part of the this thing called drive and drive encompasses all these collaborative features. But the main focus of it is the Docs. It's… they've really improved it but they should have done a better job of explaining what they did.
J: Ah okay so they've renamed it. So I don't actually I don't think right now… Well I might have an MQP whos using google docs. But I find that one easier than sharepoint more intuitive
S: because the interface?
J: Yes because the interface. It's just easier for me to understand.
S: Yeah we both looked at sharepoint..
J: Sharepoint looks like computer code to me
S: Yeah… I know.
St: Yeah weve heard a lot of that
J: And when I see things that are computer code my eyes sort of just glaze over.
St: Yeah its easy to.
J: So with google docs its just easier theres instructions written in English you don't have to put double brackets on each side of everything you know its just stuff like that
S: So with the Wiki kind of codex.
J: Yeah it drives you to distraction. So I think collaborative learning tools are really important. I think were getting there. But what I find is that when I use my students are one step ahead of me. And they have a system that works better. So Im not really sure I should drive what they're going to use. I should set up the opportunity for collaborative learning but let them define maybe what they want to do. I

have moments in my cell biology class that now I set up discussion groups for my students for them to find groups and put ideas out there. A couple of people use it. Not all that many but a couple people use it you know. And I'm not going to say that you have to use this right. And no one has used anything else on blackboard to work on their project but I know a bunch of them have used Facebook and Google drive.
S: But that's all kind of hidden from you its tough to tell…
J: Its all hidden from me that's right. And I don't have to engage them in it. Don't you think?
S: Right
J: I think I don't really have to engage in it. The only thing that the wiki did was allow me to have eyes on the collaborative process which I can't so if you're working in Google docs I can only really see the final project. And so the collaborative part really escapes my eyes.
S: Would you wish that that was something that you could kind of engage in? Like the… viewing the collaborative part. Viewing the edits made. I mean it's a big part of why you chose Wiki I think.
J: That is a big part of why I chose Wiki, and.. yes I guess in my ideal work yes. I would really like to have everyday comments. You know every day be able to say that yes you guys are doing a great job. Hey I haven't heard in a while from billy bob today. Hey whats going on I see that one person has been doing all the work so far. But it.. the technology made that really hard for me to do. I would pull up these projects and they would scroll off the screen. And half the people were using macbooks and half the people were using PCs. I would have the females saying I can't do this because I use chrome. And okay I can't be your technical guru because I'm incapable. I will tell you that the joy of working at WPI is the academic technology center. If I was somewhere else I wouldn't have tried these things.
S: You have to be the one responsible for helping everyone out sort of.
J: yes. You have to.. So the fact that I had Erin DeSilva holding my hand showing me how to set up the wiki and show me how to use it is what made it possible. This past fall in my great problems seminar we used a content management system that was designed by the people at Boston College it's called Mediachron and its not publicly available because you have to be a test site for it. And they haven't rolled it out. And it was an interesting experience for me because at BC they had used this for I mean two years for teaching. It s a content management system that allows you to put up text, video, audio, maps, all kinds of stuff on this single site for your course. And they had use it but they only allowed faculty access to it and I said well I need my students to have access to it and they need to be able to put content up on it on the content management site. The people at BC were hesitant to let me do that. And I promised them that WPI students could manage it. I mean I can manage that. It's a pretty nice interface, they designed it for old faculty I believe. And so we let students use it and essentially they did what they did with the wiki and in small groups they designed content. They put it up there and they allowed lots of things that the wiki doesn't do well they put pins on maps they put tags on different places on the site you know they put links to tags on different places. You know it was a really nice interface and I really did see the advantage that.. and the reason im telling you about mediachron is because what I saw there was and again these are all freshman I saw there was this ownership thing they were proud of what they did and they wanted to polish it because BC is going to run the site publicly and have it by the end of the year. So they wanted it to look really great. And I told them that they were the first student content management people. All of the rest of the stuff was faculty and so it set the bar higher for them. Right you don't want to be embarrassed. You want your stuff to look professional and they really seemed to enjoy it and take ownership and pride in what they did. Which is what you want collaborative learning to be.
S: Going off that, how would you define collaborative learning?
J: Well you know groups of people working together outside of my classroom and learning things that are beyond what were doing in the classroom. And so they're collaborating with one another and they're working in groups and they're doing things that we are not specifically doing in class. And they're

engaging and enhancing their understanding by learning outside the box. To me that's what this is all about. For them it gives them a format or platform to do that
S: Versus having them do that in class?
J: Well you can have them do it in class but you know if we're going to call it how it really is then you know so if you give them in class time to do work and so these three people in our group didn't come to class today and so then what? You're going to workwithout them? And so if I give them collaborative learning space outside the classroom then theres no excuse for them not to show up there. Right you can show up there whenever it works for you. And you can edit stuff that others put up there or… You know its asynchronous material right? You don't have to be there with the people there. And in my opinion that's the advantage that technology can afford us. No matter how hard you try they're not there. You know some for legitimate reasons some for non legitimate reasons. But I don't care I don't want to be the classroom police right? I want learning to happen that what I want. I don't care what the venue for that is. And so this should work beautifully and over time these tools will get better and better. Students will at least always have time.
S: So when you were working with the wiki toolset, how did you assess that collaboration was occurring?
J: Well you can see who did what as its running you can see who posted what to it. This person edited on this day. You can see at least on the face of it that different people are logging and doing something to it. And that is one of the problems with google docs is that I only see the final product.
S: It could be all on one person. You need the evidence that everyone puts into it.
J: You cant force that kind of stuff, they might be weirded out. And from the pedagogical side you get out what you put in. you learn what you want to put effort into. I put effort in giving opportunity but its up to the student.
S: This isn't high school anymore
J: This isn't high school anymore, you don't pay 50k/year for nothing. It's your loss if you don't. Collaborative tools make learning available but its about personal responsibility. So those are my experiences with collaboration. Wait I don't think I let you read your questions
St: Well were mostly using these as a guideline and you've covered all the bases.
J: okay if theres specific things that you want me to answer.
S: Do you think other faculty should use these tools? Is it too early for that?
J: I think that part of the job of faculty is to do all that you can to make the learning environment as rich as it can be. So do I think everyone should use these tools? I think everyone should try stuff and see. I mean not everyone will be comfortable with it. Not everyone will find it fits well. But what you should be saying is that we have technology that can change the learning environment in ways that's more conducive towards student learning. And if I just stand up here and lecture at you I am not doing my job. So do I think every faculty member is gonna want to jump up and love the wiki? No. Will other people find it easier using the Wiki? Yeah. I mean I think other people are more facile with technology than I am. But that doesn't mean I can just say im not good at this stuff. I mean that people at the ATC laugh because I have them on speed dial. Help turning point isn't working today. But it's our job. Our job is to teach students not content. My job is to find ways for students to engage with the material.
S: I think that's one of the best parts of WPI, faculty are really engaged.
J: and we should be and not everyone is. And I like to say this all the time but if I can do this you can do this. Because you know.. So the piece that I always tell my students is that my dissertation was typed on a typewriter. There were no word processing programs we just typed on a typewriter. I learned to program in FORTRAN so I have a lot to overcome theres a big learning curve for me and it didn't start for me when I was in 3rd grade or something but that doesn't absolve me of all responsibility to try to use these things. Theres a guy named Glen Krensky that says you guys are digital natives and have grown up with it. So digital natives are people that have grown up with it and have had access to digital

information and I did not. So I have to learn all this stuff that you guys just own because your natives and Im just not. So yes I do think everyone should at least try something. And I don't really think im in any position to dictate what that something should be and especially here since we have such amazing support. Its not hard to try you know when I said you know I have students here who are trying to edit video Jim Monacco shows up and teaches us all like that. When my students wanted to do stuff for their content sites Jim said okay I'll do that. When I wanted to set up sharepoint sites Tom came up and set up and taught us how to use them. You know I don't have any excuse not to give this a go. I do understand that people come from different places and they might not have that kind of tech support or are less excited about trying it. And students are helpful, during class they are very forgiving and theyre helpful because theyre digital natives. I don't think you will do any harm by trying this stuff.
St: How much time was actually spent trying to actually teach students how to use the stuff?
J: From my point of view? None.. The ATC put up wonderful instructions and if students had trouble with it I sent them to the ATC. And that's what they're there for. It's not me being rude. Its what they like to do. So no time. All I did was explain the project and explain how we were gonna use the wiki and then I said here are the instructions and if you have trouble with these instructions then go see people in the ATC its very convenient. And it also means that im not spending class time trying to make technology work. So that's one of the things that technology affords us. Is the ability to do things outside of class time that we would normally have to have class time to do. Because now you know you can say well lets make this work outside. Always at the beginning people from the seminars ask me how to use technology and I cant answer that question. They have the collaborator. That's the ATC teaching and learning. Technology for teaching and learning the TTL group in the ATC and you see TTL. They have this site called the collaborator and they have tips and instructions for how to use almost anything you would want to use written for the idiot I can usually follow me. But that's all there, tutorials, screenshots, textual. You should look at it. And it has all kinds of stuff. And if they don't have one they'll make you one.
S: You know how WPI has all these group projects; they're kind of especially conducive to these platforms. And In my opinion its kind of the way of the future, how it's going to be organized but – any thoughts on how that's different? Using these platforms in a course compared to in a project?
J: Not so much, one you learn it you can adapt it to what you want to do. Its versatile. And part of the reason we do projects in classes is by the time you get to the MQP and IQP you already know how to do it. And so project students who use this some designed by students. How can we make this technology work for us better in different kinds of ways? And you know really its group work and just the nature of the. And frankly I do some of this stuff with people that don't work here. For me collaborative learning is the way of the future. Collaborative interactions and interdisciplinary interactions with different kinds of people. And so it's a tool, just like how you learn how to word process. You learn how to collaborate. So I do have projected groups that use this type of stuff.
S: Do you have anyone else in mind that we could talk to?
J: What do you want to know any Web 2.0?
S: I guess that is kind of broad but yes with Web 2.0
J: Mike buckholt has used a lot of different kinds of stuff in laboratory he uses google drive. Mike is about to teach in D term a big class environmental biology class I think hes going to use some of these collaborative tools and I know he was talking about blogs and wikis all of them through blackboard. But he uses google drive. And you know people say biology students don't know how to use tech but our students are one of the biggest users of these tools.
S: Thank you very much!

(i) Interview with Destin Heilman

Destin Heilman (D)
Sasha (S)

S: Hey Destin, we're interviewing you for our IQP. Do we have your consent to record you?
D: Yes.
S: Ok so our IQP is focused on like seeing how Web 2.0 tools and platforms can be incorporated into classrooms for like a group assignment. So really we're just interviewing faculty members and students about any experience they have using these platforms. You in particular had some experience using, well initially sharepoint which you kind of disliked, and a little with wikis.
D: So I guess I'll start off by asking you a question because I'm not savvy enough with this. Is there a particular group of things that fall within the category of web 2.0? Like is that a thing or a colloquialism that we use generally?
S: It's basically the way the web is today, interactive. Instead of having like a static web page where you just view the content as a user, you interact with the content and make new stuff. Like a wiki page, you edit and add to it. It's kind of a new term that has popped up.
D: So it's very general. So yeah I've had experiences with sharepoint and wiki pages for courses and here and there some different apps that we've designed. Animations, tutorials, stuff like that, kind of a smattering of different things. My sense for in general is that it's good. I mean when you have a need for something like that, you have the ability to really solve problems with it. One of the examples I was giving before is for our biochemistry course we have to do a very simple thing. We have a list of enzymes for the students and they get together in their groups and they pick an enzyme. We just have to make sure that when they pick an enzyme nobody else picks that enzyme. So it's a very simple exercise but in practice with a course with 120 students, every attempt that we've had with different methods was a trainwreck unless we used a physical piece of paper which in retrospect would have been a good thing to do. They would just have to sign their name on the paper next to an enzyme and we were looking for a digital version of that. So in a web 1.0 system they actually designed a webpage that simply had a field where students would just type in an enzyme name and it would just regenerate the webpage, it wasn't even interactive, with the text next to the thing. What kept happening was the students would enter something wrong in the field and I would literally have to go back and have IT reset the webpage and they'd have to do it all over again. So I got tired of dealing with that and that's when I built the wiki. Which was better in that it's a group editable webpage, but the caveat there was that everyone had editing privileges and so somebody could go in and we'd have problems where somebody would just use an odd font and it would blow the table apart. Or they'd just put whatever they wanted on there. First names instead of last names or something like that, it wasn't refined enough. So it was a very simple problem but a more logistically difficult one to solve and I still don't have a great one.
S: Have you tried something like google docs or forms?
D: Yeah I've used google docs for proposal writing with colleagues. And this was maybe a year ago when I used it. As a collaborative tool it was great, especially when two people were in there editing the document, it was really neat. It likened me back to like when instant messaging was first invented or ICQ when you could actually see someone typing while you were messaging. It was neat and I thought it was good. The problem we faced with this enzyme picking thing was you have to impose rules on a simple procedure like that. I couldn't just have the students just enter their names or something simple like that, it would go awry. So I thought wouldn't it be great if something could be integrated with banner or something like that and they could just click a checkbox next to the enzyme and then they would click the checkbox next to their group. All of it's there, we just don't have the connectivity. So there's the potential to do that. And that way there would be no other way to input things, it would literally just be

here's my group, here's my enzyme, and link them together. That's what I want. With regard to sharepoint it's mostly an issue of design of the software and compatibility issues. I don't particularly think that it is a well designed piece of software.
S: We were talking to Jill Rulfs and she said it was like cumbersome to deal with.
D: Non-intuitive. It is cumbersome. It is also not polished. It is a very utilitarian piece of software. It is not user friendly and doesn't look user friendly. Like generation 1 website stuff, like it looks like it was built in 1993.
S: Gets the job done but you have to go through so many hoops to get there?
D: Exactly. And in that respect it's utilitarian approach to it, they're not concerned with how it looks, ease of use, it was built to be a comprehensive tool for doing that. I see it more as a kind of throwback mentality where if you looked in the early days of microsoft or even now, there is a lot of complexity to the software. It's got a learning curve to it. It's very very comprehensive, you can do a lot with it, it's deep functionality, but as an approachable piece of software it's intimidating. It's almost like the first time you use Photoshop, it's like oh there's buttons everywhere! It's just intimidating. It can get the job done but my point of view for this stuff is that the end user has to be in mind when you make these things. Even if it can do all that stuff, nobody is going to want to use it because it has to be approachable. If it's that difficult to learn to use it or glitchy/buggy, I mean I'm a mac user and I don't know if the latest version works with mac but there were a lot of functions that didn't work when I used it. Not a fan.
S: You do know about the WPI affiliation with sharepoint? How we want to encourage its use?
D: Oh yeah, from the perspective of a faculty member I see that it's being pushed a lot. And I know a lot of the point people that are in charge of that sort of thing. And it's not to say that a tool like this shouldn't be pushed out. I mean I think we can use a tool that has that much functionality and it does have a need. Perhaps there will be an iteration of sharepoint that achieves that level of polish. Or perhaps there will be a front end that has a clean interface that is user friendly and it has a minimal amount of functionality on the front end so that you carve off something where you know 60% of the users are only going to be using these functions. If somebody really wants to dig deeper, the functionality is there but not thrown in your face.
S: Like an expert mode?
D: Exactly. That's a common approach these days in regards to deep functionality. You either break it off as a separate thing and say like well this only does this stuff but if you're interested in the deep functionality you can get to the mode that requires you read the 300 page manual to use. I don't know what the newest iteration of sharepoint looks like. I just remember it was arduous. And it reminded me a lot of, I mean there was a lot of stuff in there that I thought I don't need this, why do it this way. The database aspect of sharepoint can be very powerful, you can do a lot of data gathering and mining. But like with any other tool, if it's too complex on the uptake you're not going to use it you'll grab the other tool.
S: Would you say that you found wikis a lot easier to deal with?
D: Mhm. I mean a lot of it, and here comes my lack of CS parlance, but it uses that umm, universally adopted applet thingee that has the buttons in it for changing font and selecting fonts and making things bold and introducing a text box, whatever that thing is that can be thrown into any web page. You can tell with the wiki stuff there was some attention paid to well what people are more familiar with. So the end user was in mind a bit more? I wouldn't say it's completely user friendly, but I remember when I was first introduced to a wiki. I just threw myself to the water and it took maybe 10 minutes and I had a wiki page that did what I wanted it to do. It was pretty simple. And I saw immediately the boundaries of what it could do and what it couldn't do. And that transparency to the piece of software was what made it so approachable. Within minutes of getting started with it I immediately identified what it was for and what I can do with it and obviously what I couldn't do with it. It was obvious there was more attention

paid to the user experience. I even look at google docs now, gmail, all that stuff. And it's reaching that tipping point where it's becoming too busy, too large. I have a gmail account and I use it, but now when I go to gmail online, which is obviously a web 2.0 example, it's busy. When gmail came out it was simple, it was just gmail. And now I can't imagine taking one of my relatives who aren't computer savvy and giving them a gmail account and using the web based email. You have to search around for even the compose thing or the inbox, they changed it so it's busy.
S: Yeah there are so many apps now that you have to sift through what you want.
D: Some software is really keeping the user experience at the forefront. Realizing that if the app is not approachable, I don't care what functionality we give to people they're not going to use it. They'll favor things that have the functionality and are approachable. We don't have time to be learning new things. You think back to 20 years ago when you bought a piece of software or a machine to do something, it always had a manual. It always had a paper manual and it was "this" thick. There was always a learning curve. The concept of it being user friendly wasn't even...
S: It was almost an insult back then.
D: Exactly. I mean I bought a printer a little while back and there was nothing. Maybe a one page quick start guide. Even on the CD if you pop it open there's nothing comprehensive anymore. It's just well, it's on our web page if you need it. They all kind of work this way now. Part of it is building up the common knowledge aspect of it but that's at the expense of the people who aren't in the mainstream. It can be difficult.
S: So you seem to be pretty for incorporating these like tools in a classroom?
D: Where there's a need.
S: So where do you see these tools helping out most?
D: Where it will allow me to more efficiently conduct my classes. For the pedagogy. I'll give you a couple examples. Most of the times I'll see the use for a tool like this is where you'd see the use for any tools like this. If you're faced with a situation where you're trying to get a nail into a board and you didn't have a hammer or any notion of a hammer. You'd pick up a shoe or try to use your fist, you could be presented with a variety of tools that could do that. They could present you with something amazingly complex with all these moving parts and everything... it's like no just give me something blunt and heavy. Again, ease of use. But ultimately we have to think about why you wanted the tool in the first place. For me it boils down to efficiency. Work smarter not harder. I'm trying to accomplish a task and the tool needs to help me do that. I'm not necessarily an advocate of putting technology in the classroom for technology's sake. I have to see the need. There's a lot of technology out there that is arguably useful. Even something as simple as a web app or powerpoint or something like that. Is this pedagogically sound or not, is it helping the student or not. Those things that are arguable I tend to debate over a lot longer and tend not to adopt. But those things where there is a definitive need and it's less arguable... I need to be quick and efficient so that we can move on in the course. So I prefer a lot of technology that allows us to get to the pedagogy as opposed to things that help us deliver the pedagogy. So I like the course websites, mywpi, stuff like that. It's a lot more efficient to but the syllabus up there and make revisions, and allowing people to tap into that.
S: So organizing your files and sharing them?
D: Yeah, logistically it's much better. Having to deal with the age old problem of a student coming up to me and saying I lost my syllabus can I have another? And then I have to give them a copy...that's what we used to have to do. Now it's a non issue. But that doesn't have to do with the pedagogy. It doesn't have to do with them learning equilibrium constants and stuff like that in a course I'm teaching. So I like adopting the tools where it helps me to allow the class to progress in a very efficient and well oiled manner. When it comes to incorporating technology for pedagogy I see that as a different issue because it becomes more debatable. For as much as I'm surrounded by tech gadgets, I am probably one of the more old school faculty members in the classroom. I do chalkboard stuff and I rarely use stuff like

powerpoint but only for pictures. It's much easier to show everyone at once as opposed to making copies and dole them out. I tend to be very hesitant when it comes to incorporating things like this for the pedagogical. It's oftentimes a hard sell to convince me that this will definitely help the students learn better. And those examples that I have used in classes are ones that it's been a really good sell. It has to be a very obvious and adopted technology for students to learn the stuff better. Like we're using a piece of software right now called ALEKS that is a chemistry tutoring tool, they offer it for things other than chemistry, but it's a web app, it's java based unfortunately. But it's a java applet the students use and we're seeing marked improvements. It took a couple of years of convincing before adopting that because we wanted to make sure that it would help not hinder or at the worst be a waste of time and money.

S: Do you know who lead that initiative in incorporating ALEKS?

D: It was something we'd heard of for a while, and our department head had used it before and had given it a small plug. But eventually I decided to call up and negotiate for a free trial of it to run and Professor Broder and I right now are both trying it out. We've got very hefty amount of data from the students and their performance. We're going to go into a data analysis phase in the department to decide if it's helping or not and we're going to be very critical. I don't want my students to be guinea pigs, I want to take things into the classroom that have a very good chance of improving my success. Which is not to say that we don't try things and they fail but I want to give it the best chance of success. We try them ourselves first before we implement them into the larger group. A lot of this stuff is just my personal philosophy.

S: Do you think that other faculty members should work to incorporate these platforms into...again like we were saying, where this an actual need or argument for it?

D: No, I don't think I would expect faculty members, even if there is a very definitive need and even if there is a piece of technology proven to fill that need, I don't expect a faculty member to adopt the tech. Another example I can give you is that we have clickers. Lots of faculty members use the clickers and it can solve a good need, you can get active response data, you can get instantaneous feedback, you can take quizzes and have them instantly graded. It also takes time to implement, and like any piece of technology it can be wrought with problems. Whereas there are faculty members that use different survey methods like different colored pieces of paper. The clickers can give you bar graphs that you can store. But with the paper you can get an instantaneous read on the class without the tech. So I think the question we need to ask ourselves is, this is a good solution, but is there an easier way? Can we just use a piece of paper? If I'm trying to get a feel for if the class understand the concept, I can ask "How many of you feel comfortable with this?" And it's nice with just raising hands because I can get an automatic gradient, a human gradient, that somebody who raises their hand all the way up is automatically very confident, halfway up is less confident. It's certainly not quantifiable. I'm very critical of tech. I wouldn't expect faculty members to throw the tech in their classrooms willy nilly, nor would I expect them to completely avoid it altogether. I think most of them will fall somewhere in between. I make the separation between is this tech for pedagogy or is this tech for efficiency.

S: Alright I think we've extracted all the information we can out of you. Thank you for sitting down with us.

Student Interviews

(i) Interview with Rachel Hickox and Gabby Nunez

(S) Sasha

(C) Rachel Hickox and Gabby Nunez

S: Hey guys. I'm here with Rachel Hickox and Gabby Nunez. Do I have your permission to record this interview?

C: Yeah.

S: So let me talk a little bit about the project itself. We've been looking at all these web 2.0 platforms, and we talked a little bit about in [BB4150]. We're looking at these interactive platforms where you can add and share content - like google drive, which you're familiar with. We're trying to see how you can use the version history to track the individuals contributions to a final work. We're trying to come up with recommendations of different platforms such as dropbox, drive, sharepoint. These recommendations will be to teachers looking to incorporate these into their classrooms. So I know you guys have some experience with google drive so I don't know if you want to talk a little bit about your positives and negatives experiences with it.

C: Sure. We use google drive for our MQP work so any writing that we do is always on drive. For example we have all of our data on google drive so when we first started, when we created crayfish we put it all in a spreadsheet. From there we wrote our intro and methodology from the docs. And then now we have a huge giant spreadsheet of all of our data in graphs and charts and stuff. And we chose it because it's all in one place and it's editable and [unintelligible].

S: Yeah it's like easy to share it and send it to other people.

C: Multiple people can be on it at the same time and we can talk to each other when we're on it. I like that better than dropbox because like, for example I was trying to edit a dropbox thing and someone else opened it and I couldn't save it.

S: Right it gives you the corrupt version or something.

C: Exactly. We ran into that problem but this way we can all make changes at once.

S: Did you find it easy to use?

C: I mean it's easy to use and there were things about it that were nice. When it comes to data and stuff I forget to save all the time, and there it's saved automatically. That's like the best.

C: The only to improve I think is the user interface. Everyone is so used to using Word.

S: Like the toolbox and having the fonts and stuff.

C: Exactly. Like word and Excel. [Docs] keep some of the buttons and stuff but not all of them. I

C: I like to write in word first, I hate writing in docs. You can't like put your cursor out in the margins to highlight lines, which I do all the time in Word.

S: Oh, I didn't know you could do that. I learn like one new thing every time I talk about it.

C: Yeah I was doing my IQP presentation this year and I learned how to use like the format paintbrush thing. To copy formatting of one section and put it in another.

C: I think it's really weird that it doesn't work well in powerpoint, like they have the option in word but it's hard in powerpoint.

C: In one of my classes I did a lot of formatting in powerpoint for animations and such, and then I put it on google drive so my partners could see. It just ruined everything.

S: Oh, opening in google drive messed up the background and stuff?

C: Yeah that's definitely something that works in powerpoint but not in drive.

S: Have you guys ever used like skype? Like when you guys are on google drive are you all in the same area or...?

C: Sometimes we use Facebook chat. Like facebook skype. Does google drive have a skype thing?

S: Yeah it has Google hangout.

C: Sometime we just type into the document.
S: Isn't there a chat bar on the side?
C: Yeah we use that a lot actually.
S: Do you use a voice communication thing? Or?
C: No, we don't. We just meet in person.
S: Is it the whole group or just a couple individuals usually?
C: It's usually just a couple individuals. Sometimes one of us gets lazy like me yesterday, I just worked from [my dorm room].
S: So drive is nice for like a virtual meeting?
C: Yeah. The only thing with the chat in the document though is there isn't a timestamp, so you can't tell when someone sent a message. If I go away and come back two hours later to a message I have no idea how recent it is. So that's inconvenient.
S: They should get with that, most other chats have timestamps. Have you guys used any other programs? Like dropbox or something?
C: We tried to use dropbox. I used it for research and stuff, I'm collaborating with another university for which it's been great. For example some powerpoints are so large you can't email them, but on dropbox it's just there for them. And there's no thumb drive or anything, you just need internet.
S: Have you guys had any other classes that use wikis or tools? Like Professor Mathews has a wiki project at the end?
C: I had one class that had a wiki, but it was very basic. I don't actually remember much about it. This class's is a lot more in depth.
S: Does it take a while to learn how to use?
C: Yeah it actually took me a while to even figure out how to open it, and then I had to try to explain it to my partner who had no idea. And even the user interfaces are pretty difficult to figure out.
S: Especially the syntax I find to be pretty difficult. It's like you're coding to just make a document.
C: I like to type it up in a word document and then paste it in.
S: Where do you see these tools fitting in a classroom? Like projects, or...
C: I think projects. Anything where you're sharing information. So like in my labs we've used docs to put in data. [unintelligible] Even between professors and students I think it would be beneficial.
S: So like somewhere to have an archive, so that you can go back to it.
C: Exactly.
S: What if for MQPs and IQPs what if students were automatically assigned one of these tools, how would you feel about that?
C: I guess a lot of times we end up choosing them even if we weren't assigned them. Drive is good in some cases and dropbox for others so it depends on the situation. I think if it becomes more popular people will use them.
C: I was required to use sharepoint for a class and I hated it.
S: Sharepoint is another program that we've been looking at. We really don't like its...like it's layout looks like a program made in 2000 or something. It looks so outdated. What class did you have to use it for?
C: My seminar. We had to comment on other students work. I never understood it, I just kind of...managed. We had to download from sharepoint which I had trouble with for a while. Then we had to make our corrections or whatever then put it back as the updated version. I've used it for other things and it's better. But it's not good for collaborating or any of that stuff. It's just good for having documents in one place - a library.
S: How come you didn't like sharepoint so much? If you could elaborate. Was it just difficult to learn?
C: I still don't understand it. It just gives you so many options. Like create a new version or append or a new version limited, I just don't even know what they mean.

S: What if it were a barebones version of sharepoint? Like, it only had basic options instead of flooding you like you said?
C: I'd still prefer google just because it's mainstream. I realize sharepoint drive is protected, but google is just so much easier.
S: So I'm out of questions, do you guys have any final thoughts?
C: No I don't think so.
S: Well, thanks for doing this.

(i) Interview with Dan Sullivan and Wilson MQP group

(S) Sasha
(W) Wilson MQP group

S: Uh, hey guys, so do we have your permission to record this?
W: Yeah. Who's going to hear it?
S: Well it's going to be transcribed for our IQP.
W: So you just need the recording for like proof or..?
S: Yeah yeah. Ok, so, let's talk a little bit about like what we're actually trying to do. So we're trying to see how web 2.0 platforms and tools can be applied to like a classroom learning environment. To kinda support collaborative learning. I don't know, Stephen, do you want to elaborate on it a little bit?
W: Wait, what is web 2.0?
S: So by Web 2.0 we mean a dynamic web where the user can interact with the website. And not just consume information but actually like you know, actually make edits and changes.
S: Basically like interactive instead of static. And by web 2.0 tools we mean like sharepoint, google drive, dropbox, basically online tool that users are able to interact with.
S: So have you guys used any of the other tools other than sharepoint?
W: Well google drive. For my IQP I used google docs a lot. That was very helpful for working on documents at the same time. Well, I don't really know google drive.
W: It's google docs.
S: They didn't really make it clear that it's the same thing, they just kind of shifted over and like didn't tell anyone.
W: I think my dad uses google drive to like send me random photos of this dog.
S: Um cool. But you guys have like mainly experience with sharepoint I guess.
W: Yeah we've been able to like explore all the options that sharepoint has before us. Maybe not like all of them but a lot of them. Like we tried playing with the uhhh... Like it will make all of the gant charts for you, like you set up tasks and the duration of the task. And it will auto generate a gant chart for you.
S: What's a gant chart?
W: It's like a chart that shows certain tasks and when each task needs to be started and finished.
S: So sharepoint was pretty good with that?
W: Yeah it's not necessarily the main feature that we use it for, but it was an awesome side feature of it that we didn't really realize until we started working with it.
W: It's like a built in very very mini version of Microsoft Project.
S: So going onto like the main functionality that you guys like got out of it. So having like sharing your documents and like editing it in realtime. Did you use sharepoint for that?
W: Umm, so I haven't found anyone who's found that there's a better way for making word documents than using Microsoft word.
W:Sharepoint allows you to have a shared microsoft word document. So like how you can use google docs and share your text and stuff, you can't format say a 50-100 page IQP/MQP, any page that is supposed to have headers and footers and subsections, you can't do that with google.
W: But sharepoint allows you to do that in a browser, or check out the document to yourself and then make your changes in word and then sync it back in sharepoint. Another cool thing, it has revision history, so anytime someone makes a save to the document it counts as a revision.
S: Do you know if the revision system works differently from say, Google Drive's?
W: I don't know google drive's. But say if Jibin makes a bunch of changes, and then I delete it, you can go "ah you're an idiot, why did you do that" and then go back to a previous revision.
S: And you can see exactly who did what to the document at what time?

W: Just by revisions. Like you can't see that so and so made this change to this section. I mean it's blocked off when you're editing. If he's editing a paragraph I can't work on that paragraph.
S: But when he's done with that paragraph can you see what changes he's made?
W: I think the only way you can do that is looking at revision comparisons in Word. We use track changes in word as well. Another benefit of the versioning system: we have it set up right now so that our advisor can see any major versions. For example if we make 1.0, then make a bunch of changes but they're terrible in 1.5, he can only see 1.0. We can publish major versions to control what he sees (1.0, 2.0).
S: Did you guys have trouble learning sharepoint off the bat or did it come pretty naturally?
W: It was kinda natural. There was definitely some weird stuff about it. I have a sneaking suspicion that a lot of the problems come from it not being set up correctly at WPI, because it's not set up to be an integrated system with the whole campus - it's set up to be like, you could use sharepoint which doesn't interact with anything or you could use mywpi which doesn't interact with anything.
S: Can you go over the things you had to go through with setting up sharepoint?
W: Alright. So you request to have a sharepoint made with some online form or something so I did that. Then I got an email that said do you want a tutorial so I said sure.
S: So Erin emailed you?
W: Yeah I think the librarians are excited about people trying to use it. I went to meet with her, she showed me some of the cool features. Then I was having some problems with user management so she just ended up elevating my user privelages to like site owner or something like that.
W: I guess Dan was trustworthy enough to give super admin powers. Or annoying.
[Shows up their sharepoint]
W: So this is the home page, and here is our group image (Wilson). And like all of the white space here is customizable. So like the getting started section we could delete or move or whatever you want to do.
S: So where do you see the main functionality? Just sharing documents or what?
W: Yeah documents. We also do all of our note in a Virtual notebook, OneNote. Each notebook has like multiple binder tabs, and then each tab has multiple pages. So we have a page for each of our advisor meetings. And it's integrated with sharepoint.
W: The onenote meeting notebook has been one of the most useful features I think. We've developed a format that we can copy and paste this template into each of our meetings, and then sometimes we take notes at our team meetings and we have an archive of our past meetings. So we have like a lot of changes throughout the whole project that we can reference when we're writing our final paper from throughout the whole thing. That might just be good planning but OneNote and Sharepoint have helped us do that.
[rambling about our project]
W: So I can give you another angle. When we worked on my IQP we used google docs solely for all of our editing and then we would export that to a word document for formatting. The fact that you couldn't do the formatting in google docs wasn't that big of an issue, but the chat box and the ability to edit at the same time and add comments was really useful . Also you could edit the same section at the same time. That kind of sucked but as long as you talked about who would work on what section it was easy to coordinate. In the end we got an A so I guess it worked out.
S: Did you make use of the revision history in Google Docs?
W: Not really, once we made edits the old revisions became obsolete. I'm not even sure we would have known how to roll back changes.
S: Was it easy to use?
W: Yes it was extremely easy for any Google user. All you needed to do was make a document and add users.
S: All right thank you.

Appendix C
Example Post-Lab Survey from 2013
BB2040: Principles of Ecology

Self & team evaluation of team assignments

Name:

Team number:

I am reporting on the following lab:

Please complete the following assessment for team assignments. This assessment is intended to gather information on the relative contributions of cooperative versus collaborative effort in team assignments. It is NOT intended to assess the relative contributions of individual team members to assignments.

For the purpose of this assessment, **cooperation** is defined as a division of labor among team members to accomplish some task, including all or part of an assignment. Partners cooperate when they **divide any component of an assignment**, including writing, formatting, and background research, with team members pursuing work towards their assigned components **individually**.

Collaboration is defined as a coordinated effort to accomplish some task together, using mechanisms that may be synchronous (i.e., multiple individuals work together at the same time) or asynchronous (i.e., multiple individuals work together, but at different times).

- Partners collaborate synchronously when they engage in **face-to-face or electronic meetings** to accomplish all or part of a task, including discussion and brainstorming, background research, writing, editing, and formatting.

- Partners collaborate asynchronously in such activities as **electronic discussion threads** (e.g., by email or wikis) and in **shared critique and editing** of others' work (including both written and non-written components).

- NOTE that collaborative work may also involve the division of labor, but this division of labor involves strong overlap through discussion, team editing, etc.

Self assessment:

1. The extent to which I personally engaged in **cooperative**

Interactions with my team to accomplish the assignment was: 1 (low) – 5 (high)

2. The extent to which I personally engaged in **collaborative**
Interactions with my team to accomplish the assignment was: 1 (low) – 5 (high)

3. The relative distribution of my effort between **cooperative** and **collaborative** interactions was:

Cooperative: % of my effort
Collaborative: % of my effort (should total to 100%)

4. Please list below any comments you have about the way you managed this assignment.

Team assessment:

5. The extent to which my team as a whole engaged in **cooperative**
Interactions with my team to accomplish the assignment was: 1 (low) – 5 (high)

6. The extent to which my team as a whole engaged in **collaborative**
Interactions with my team to accomplish the assignment was: 1 (low) – 5 (high)

7. The relative distribution of my team's effort between **cooperative** and **collaborative** interactions was:

Cooperative: % of my team's effort

Collaborative: **%of my team's effort (should total to 100%)**

8. Please list below any comments you have about the way your team managed this assignment.

9. Now thinking on your team's work in general on the three lab reports, please comment on your experiences using the collaboration platform Google Drive to complete assignments. In what ways did this platform facilitate collaborative work on these assignments? In what ways did it inhibit collaborative work? In general, what advantages or disadvantages did this platform have over other ways you have collaborated on assignments (be as specific as possible)?

That's it. Once again, your feedback is much appreciated!

Appendix D: Miscellaneous Tables & Figures

Table 1: Frequency tables showing total number of respondents and their responses on a 1-5 scale (1 being the lowest, 5 beings the highest) to questions regarding individual and group collaborative and cooperative efforts from post-laboratory surveys 2 and 3 from 2012 and 2013 class offerings.

Response	Frequencies	Lab 2		2012
n = 43		Question		
Rating	1	2	5	6
1	0	1	1	2
2	1	5	0	3
3	5	6	3	9
4	19	12	22	12
5	18	19	17	17
Response	Frequencies	Lab 3		2012
n = 44		Question		
Rating	1	2	5	6
1	0	3	0	4
2	0	4	1	5
3	3	6	4	7
4	12	13	16	9
5	29	18	23	19
Response	Frequencies	Lab 2		2013
n = 38		Question		
Rating	1	2	5	6
1	0	1	1	4
2	3	4	3	3
3	2	12	6	12
4	12	11	13	11
5	21	10	15	8
Response	Frequencies	Lab 3		2013
n = 41		Question		
Rating	1	2	5	6
1	0	0	0	0
2	1	4	1	5
3	6	8	6	8
4	16	15	19	17
5	18	14	14	10

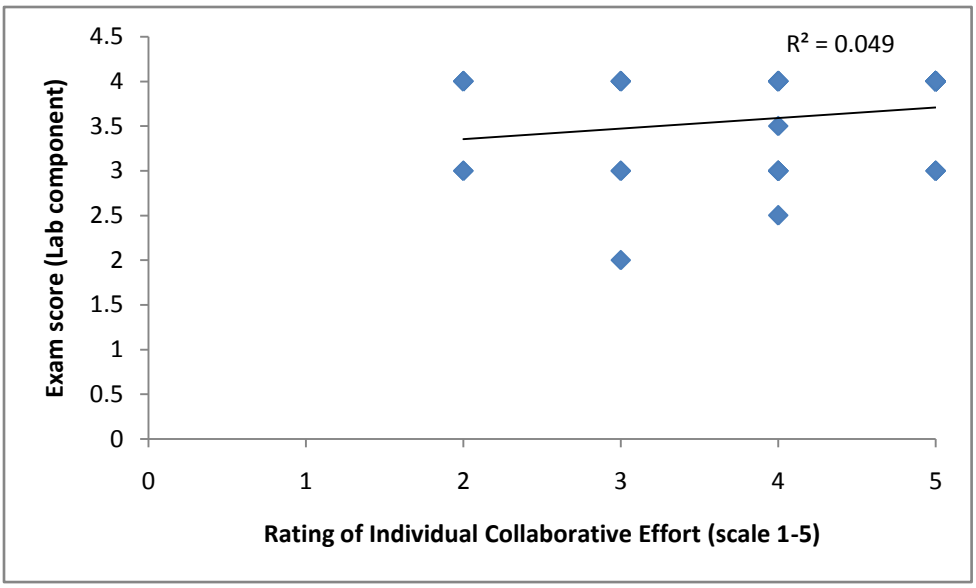

Figure 1: Scatter plot of student responses to question 1 of the post-lab survey for lab 2 in 2012, showing individual collaborative effort rating versus the lab component of students' exam scores, by individual student. n = 43

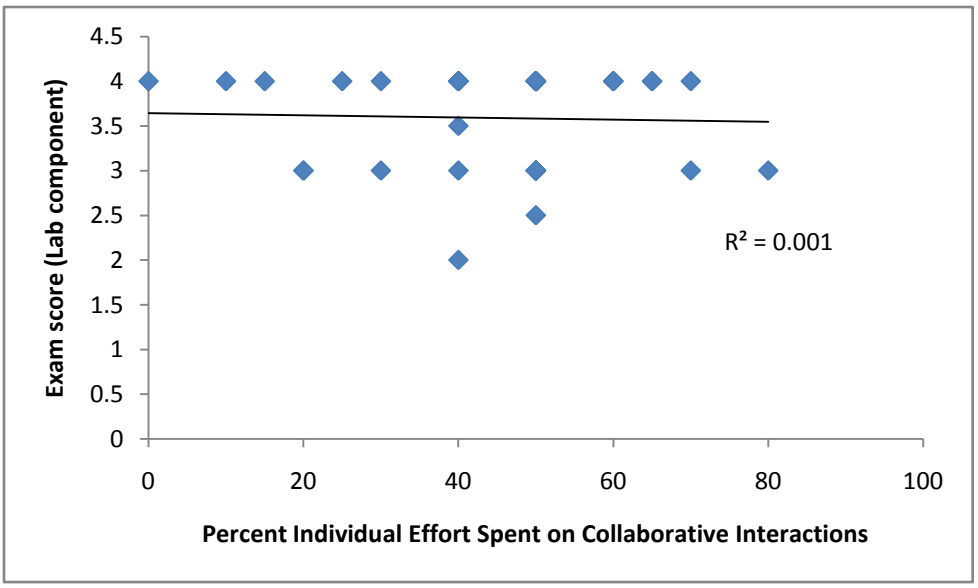

Figure 2: Scatter plot of student responses to question 3 of the post-lab survey for lab 2 in 2012, showing percentage of individual effort spent on collaborative interactions relative to cooperative interactions versus the lab component of students' exam score, by individual student. n = 43

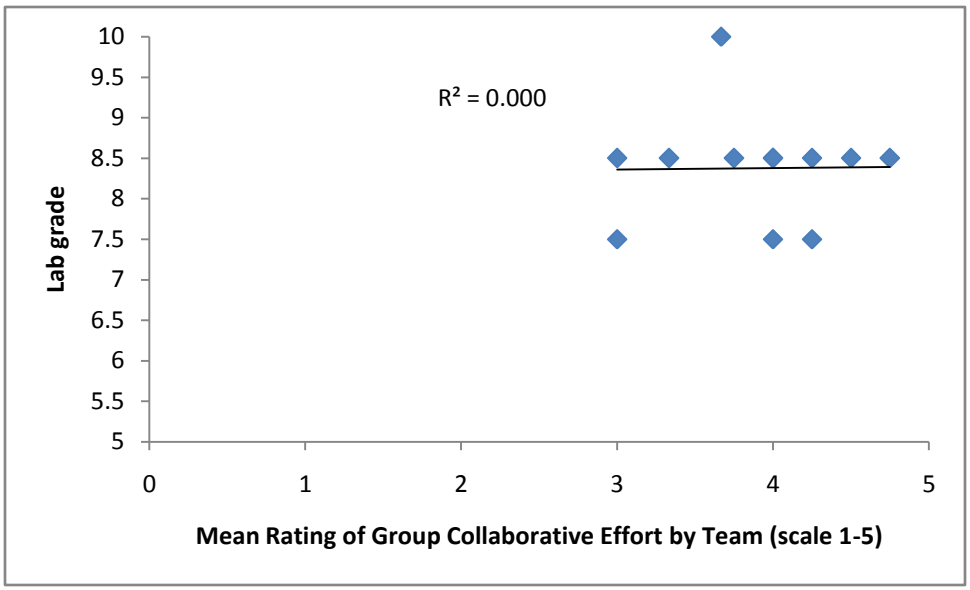

Figure 3: Scatter plot of mean team response to question 5 of the post-lab survey for lab 2 in 2012, showing the mean rating of collaborative group effort within a team versus the lab report grade, by individual team. n = 43

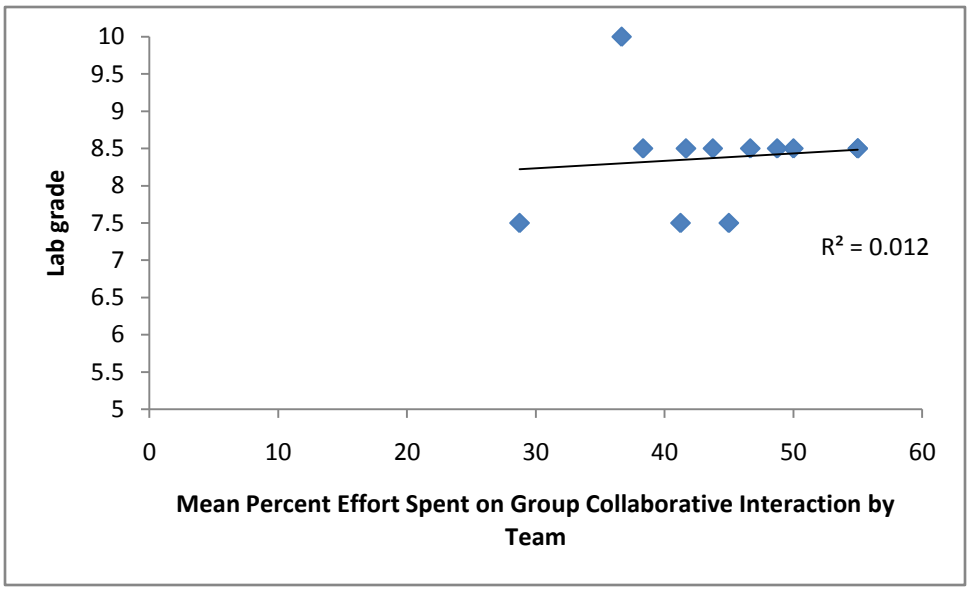

Figure 4: Scatter plot of mean team response to question 6 of the post-lab survey for lab 2 in 2012, showing the mean percent effort spent on group collaborative interactions relative to cooperative interactions within a team versus the lab report grade, by individual team. n = 43

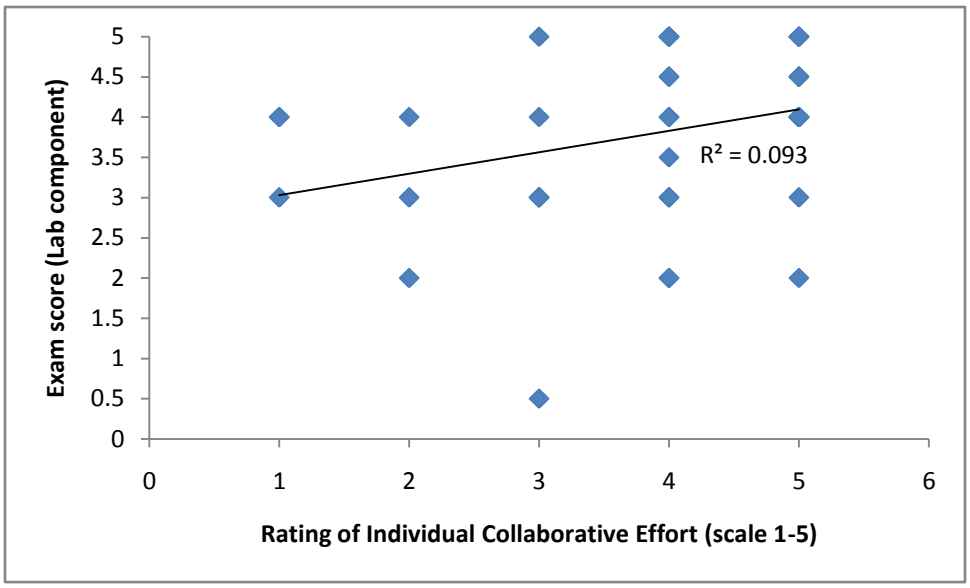

Figure 5: Scatter plot of student responses to question 1 of the post-lab survey for lab 3 in 2012, showing individual collaborative effort rating versus the lab component of students' exam scores, by individual student. n= 44

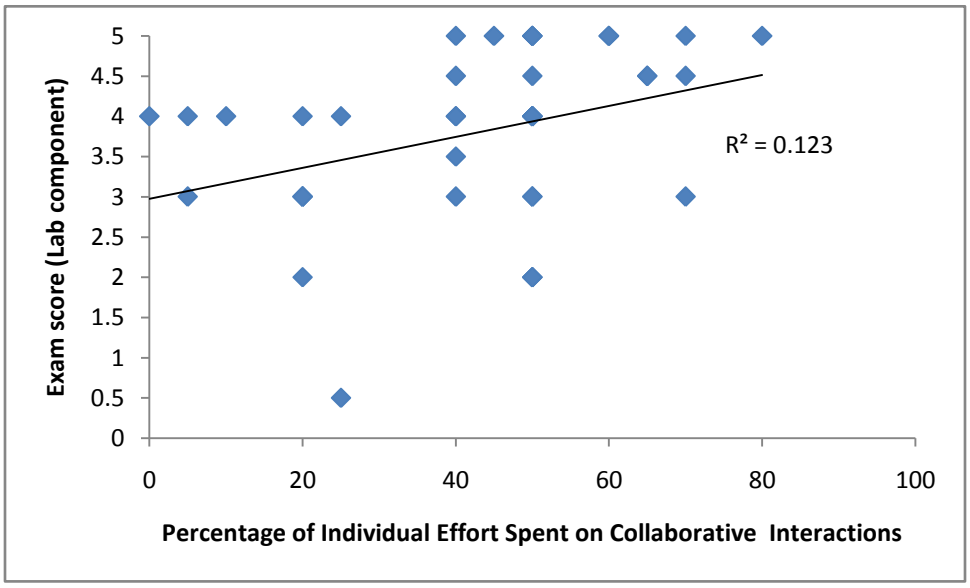

Figure 6: Scatter plot of student responses to question 3 of the post-lab survey for lab 3 in 2012, showing percentage of individual effort spent on collaborative interactions relative to cooperative interactions versus the lab component of students' exam score, by individual student. n = 44

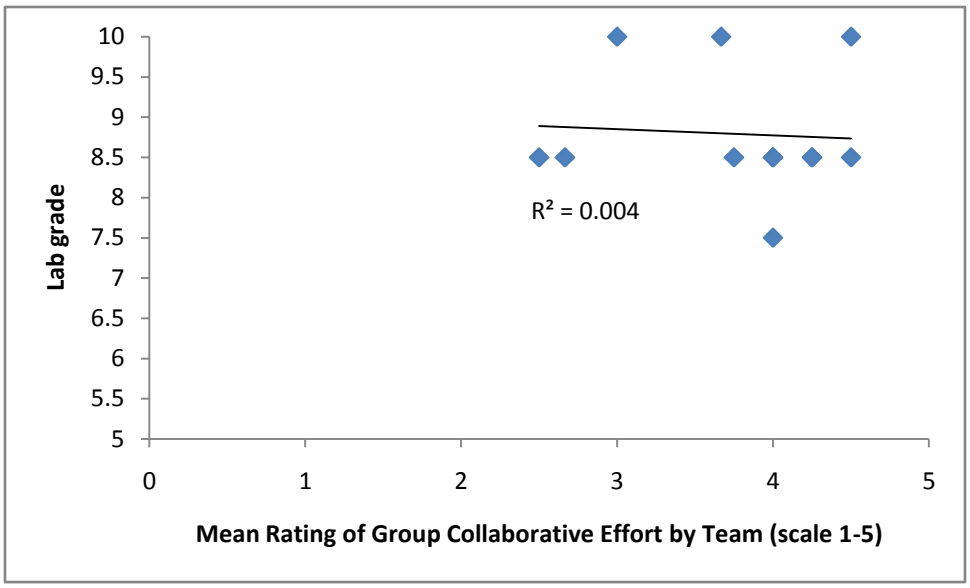

Figure 7: Scatter plot of mean team response to question 5 of the post-lab survey for lab 3 in 2012, showing the mean rating of collaborative group effort within a team versus the lab report grade, by individual team. n = 44

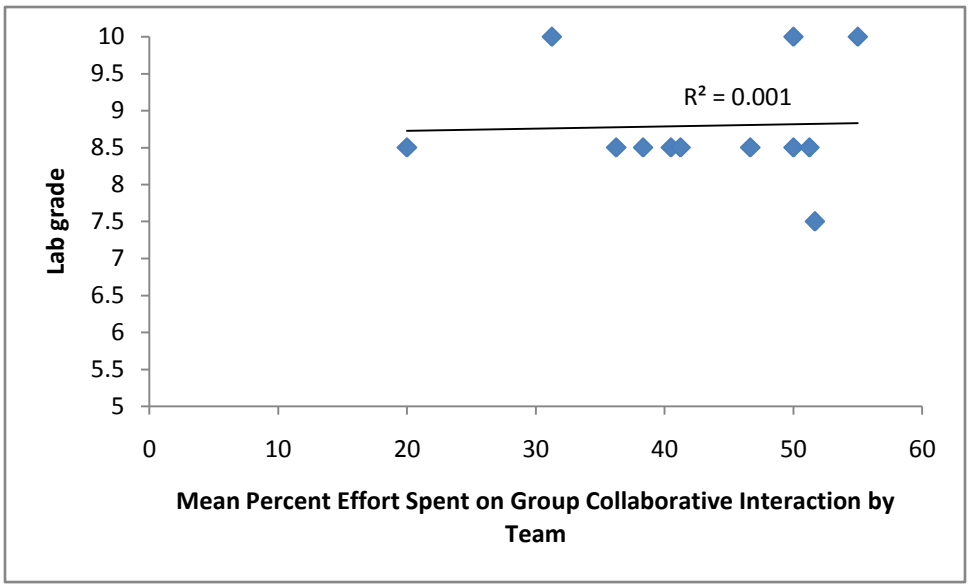

Figure 8: Scatter plot of mean team response to question 6 of the post-lab survey for lab 3 in 2012, showing the mean percent effort spent on group collaborative interactions relative to cooperative interactions within a team versus the lab report grade, by individual team. n = 44

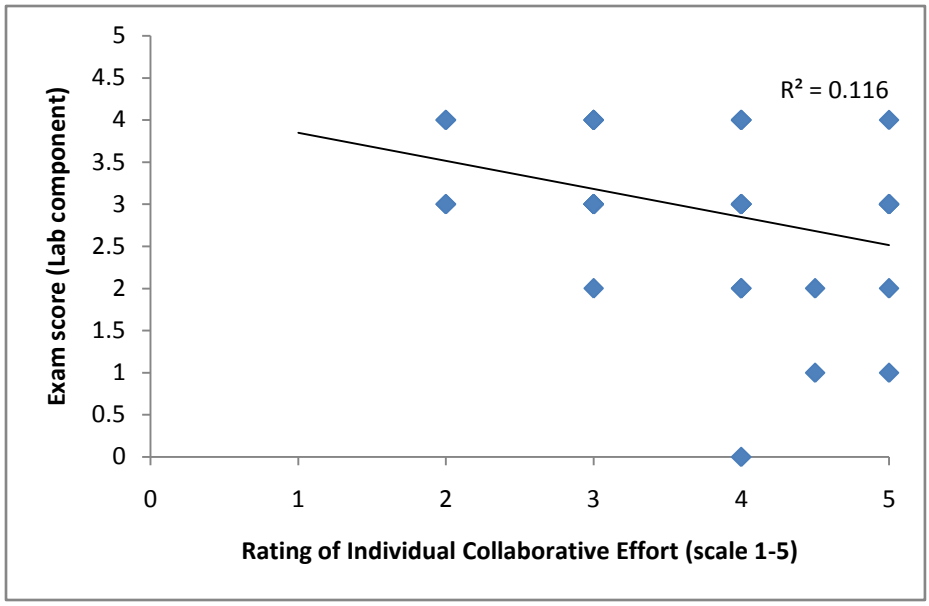

Figure 13: Scatter plot of student responses to question 1 of the post-lab survey for lab 2 in 2013, showing individual collaborative effort rating versus the lab component of students' exam scores, by individual student. n = 38

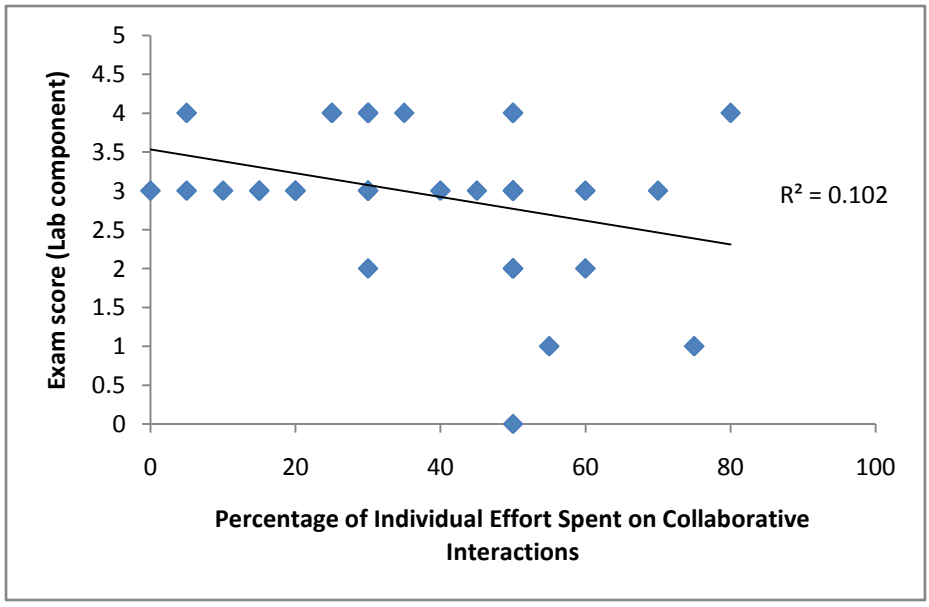

Figure 14: Scatter plot of student responses to question 3 of the post-lab survey for lab 2 in 2013, showing percentage of individual effort spent on collaborative interactions relative to cooperative interactions versus the lab component of students' exam score, by individual student. n = 38

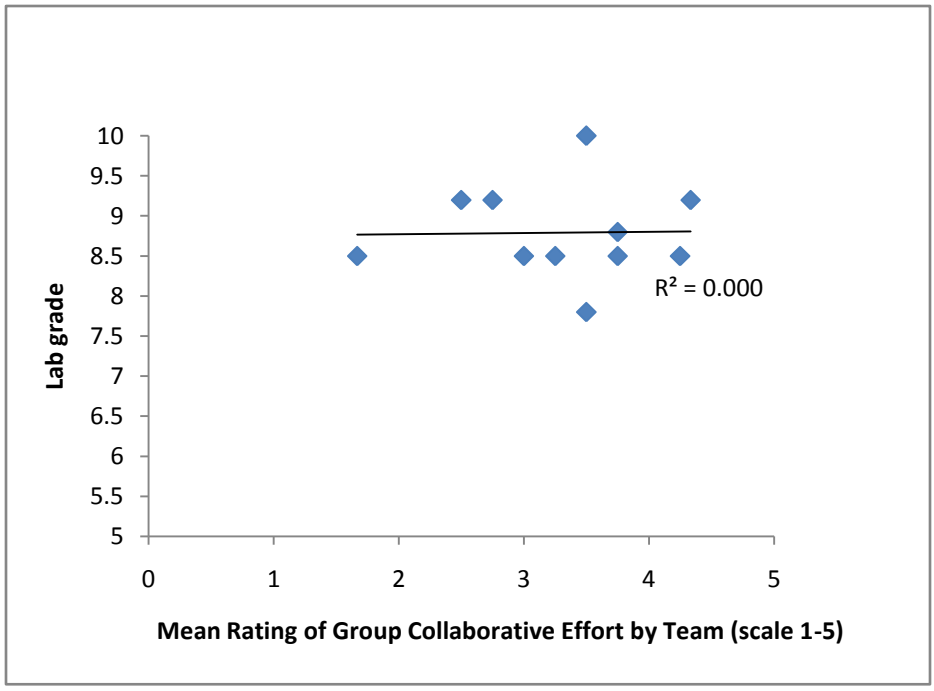

Figure 15: Scatter plot of mean team response to question 5 of the post-lab survey for lab 2 in 2013, showing the mean rating of collaborative group effort within a team versus the lab report grade, by individual team. n = 38

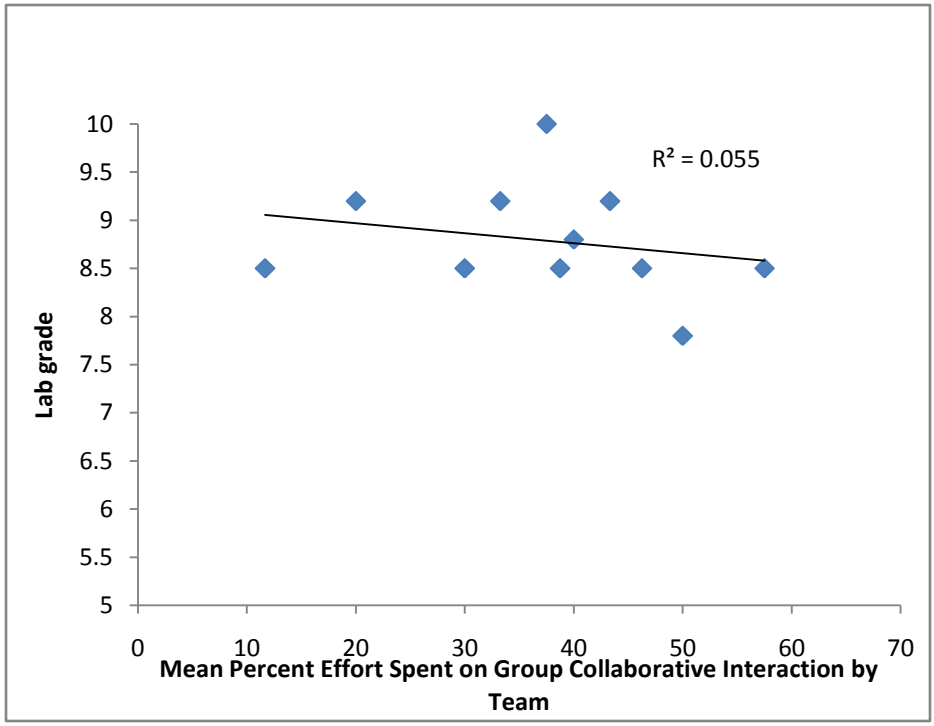

Figure 16: Scatter plot of mean team response to question 6 of the post-lab survey for lab 2 in 2013, showing the mean percent effort spent on group collaborative interactions relative to cooperative interactions within a team versus the lab report grade, by individual team. n = 38

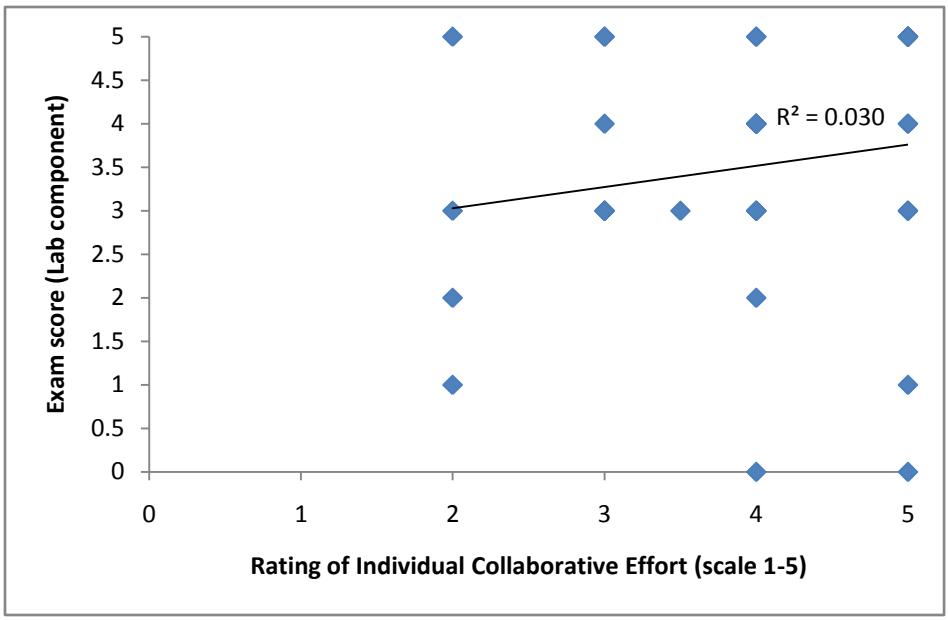

Figure 17: Scatter plot of student responses to question 1 of the post-lab survey for lab 3 in 2013, showing individual collaborative effort rating versus the lab component of students' exam scores, by individual student. n= 41

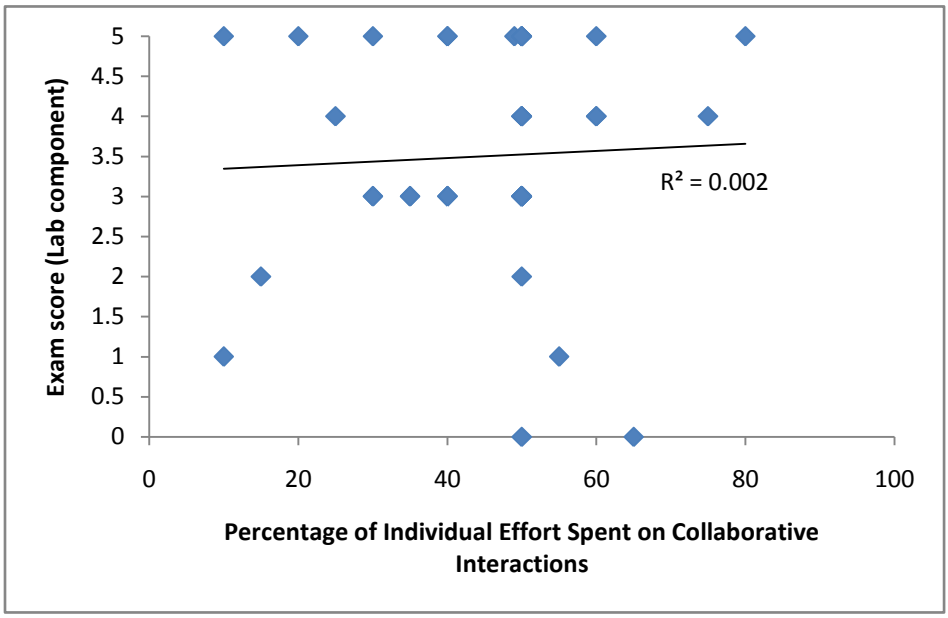

Figure 18: Scatter plot of student responses to question 3 of the post-lab survey for lab 3 in 2013, showing percentage of individual effort spent on collaborative interactions relative to cooperative interactions versus the lab component of students' exam score, by individual student. n= 41

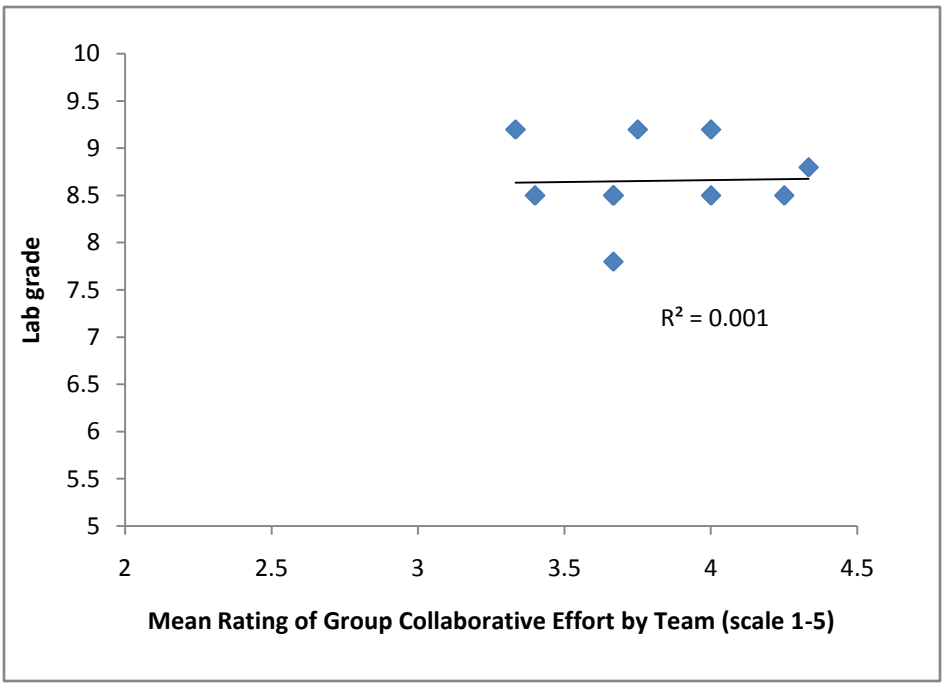

Figure 19: Scatter plot of mean team response to question 5 of the post-lab survey for lab 3 in 2013, showing the mean rating of collaborative group effort within a team versus the lab report grade, by individual team. n = 41

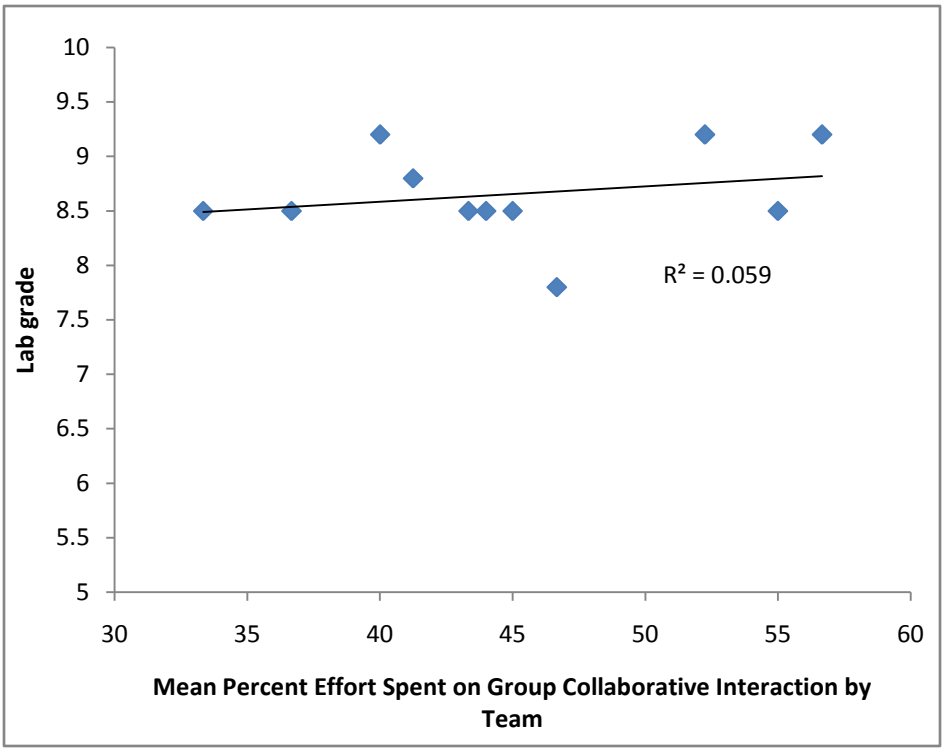

Figure 20: Scatter plot of mean team response to question 6 of the post-lab survey for lab 3 in 2013, showing the mean percent effort spent on group collaborative interactions relative to cooperative interactions within a team versus the lab report grade, by individual team. n = 41