ONLINE COLLABORATION IMPACT ON STUDENT ENGAGEMENT AND

COMMUNICATION IN ENVIRONMENTAL SCIENCE

By

Laura Jane Patch

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STATEMENT OF PERMISSION TO USE

In presenting this professional paper in partial fulfillment of the requirements for a master's degree at Montana State University, I agree that the MSSE Program shall make it available to others under the specified rules of the MSSE program.

Laura Patch

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ABSTRACT

To enhance student engagement in Environmental Science enlightening articles and applicable case studies were integrated in the science content. For each unit students read articles, responded to essential questions, and participated in an online discussion forum with their peers. This study focused on the benefit of online collaboration to promote independence in learning, engagement in the content, self-direction and communication among ninth grade students.

INTRODUCTION AND BACKGROUND

<u>Purpose</u>

The purpose of my action research was how online collaboration was used to promote engagement, interest, and communication amongst my ninth grade Earth/Environmental Science students. The project was focused on how the use of online techniques could promote student independence in learning, because I was frustrated by how students lean on others for the responsibility of work in my classes. However, since researching and exploring other studies I have realized that a large part of what makes students more self-directed comes from being engaged in the material. The idea behind making material relatable and fostering active learning comes from the theory of constructivism. I integrated real-world situations from our science content, recent discoveries, enlightening articles, and case studies to enhance student engagement.

Through the use of online collaboration, relevant questions and discussion topics can be incorporated that draw from our curriculum. The advantages behind using online discussion forums is that the more introverted students would have opportunities to "speak", students would be able to make personal connections to not only the material but to each others' ideas in the posts, and the lack of disruptions or judgments from their peers that may happen during class discussions.

In my Earth/Environmental Science class I encourage discussion on science topics, and want the students to lead and be involved in these discussions. However, it can turn into competition among the extraverts and doesn't allow for time to listen, absorb, and then reflect on the information.

Using technology in education is not a new idea, but it has adapted to the point that teachers need to take advantage of the various aspects of this resource. Not only are our students very familiar with the use of technology, but enjoy the hybridization of new techniques into the classroom. I hope to find that the use of technology as an addition in a traditional classroom improves student motivation, which ultimately leads to an increase in student performance. In our county we are initiating a program called "one on one", which provides a laptop for every student this school year. I think my action research topic will hold great significance to my colleagues as we develop techniques to use the laptop in our classrooms. For my topic I focused on online collaboration, but there are so many opportunities that technology can be used for and we should be taking advantage of using this tool as an extension to what we are already doing in our classrooms.

Research Questions

My topic is focused on using online discussion forums to promote self-direction and engagement. Therefore, my primary research question is: How does the use of online collaboration impact student engagement and initiate communication in Environmental Science?

From this initial topic I have several secondary questions that can be researched and measured

1) In what ways do online discussions enhance engagement in the topic?

2) How well did students communicate with each other?

3) What are the motivational impacts of using online technology for students?

4) What effect will using online learning have on my teaching and school setting?

CONCEPTUAL FRAMEWORK

<u>Overview</u>

I explored the use of online instruction within an Earth Science high school classroom. My questions focus on the benefit of online learning to student performance and self-direction in comparison to traditional classrooms. The focus for my topic comes from observing the lack of student responsibility for their work and their reliance on teachers versus self-motivation. Based on initial interviews, I found that students became more engaged, motivated, and active learners with the use of technology.

As a result of these interviews, there were several factors, along with the other benefits of online learning, that I wanted to explore during my literature review. The main themes that emerged were that the type of student and how their learning style influences success, how knowledge is understood by the theory of constructivism in promoting relevant and active formats for learning, and the benefits of student-centered control in an online learning environment

Providing a framework for online learning should take advantage of learning opportunities within the classroom. Online techniques enhance the curriculum by providing current resources and allow variation in structure with the content. Ron Oliver pulls from the theories of constructivism and socio-constructivism learning theories to explain why technology-based learning is beneficial for students. However, he only supports online courses if they use critical elements that support constructivism. These critical elements are influenced by how the student relates to the material (Oliver, 1999). Lebow (1993, as cited in Oliver 1999) supports this influence by saying that tasks need to be relevant and authentic, students should have ownership in the learning process, and it

"encourages self-awareness of the knowledge" (p. 242) that is gained through this process.

Socio-constructivism is focused more on students' personal connection to the material. If a student understands the relevance and is able to make a connection to the purpose of the material then they can apply this knowledge inside and out of the classroom. Oliver concludes that if these theories are applied to technology-based learning then students will take responsibility for the work. The teacher could design learning activities using technology that are student-centered.

In a second article, *Constructivism, Technology, and the Future of the Classroom* the authors give an overview of constructivism by saying that "children actively construct their knowledge." (Strommen and Lincoln, 1992 p. 468) Students need to be involved in actively learning the material, having a personal connection, which can be applied to new situations which fits into higher order thinking skills as shown in Bloom's Taxonomy.

Therefore, online learning can add value to the curriculum if implemented according to this framework. Technology allows access to databases, current research, multimedia, virtual labs, games, etc. that should be used to elevate a student's learning experience. In addition *Exploring strategies* also mentions in planning an online component, teachers should be aware that technology shouldn't be used for replacing traditional teaching, but used as an addition to enhance student learning (Oliver, 1999).

<u>Direction</u>

I found that the theory of constructivism combines with understanding our audience, in our situation the students we teach, and based on connecting knowledge with that audience. Constructivism is based on personal connection, where students are

making relevant connections to the material (Oliver, 1999). Recognizing the learning

styles of our students and how they approach the material will be extremely beneficial if

we are to use online learning to enhance the curriculum. Also, assessing the role of

learner control and independent learning will give ideas in the usefulness of online

learning.

Learning Style and Effectiveness of Online and Face-to-Face Instruction

*(*Neuhauser*, 2002)* gave insight on student's learning preferences and style in comparing

two sections of the same course, however, one was taught fully online and the other face-

to-face (FTF). The purpose of the study was to examine a variety of factors, such as

gender, grades, learning styles, and effectiveness of tasks, between the two courses. The

final two factors I had an increased interest in; since how a student learns, as well as how

effective the activities used in the class were to the student, will influence the usefulness

of implementing online instruction into classrooms. Before delving into details of

personalities Keirsey and Bates (1984, as cited in Neuhauser, 2002) distinguish between

introvert and extravert type of people. Introverts typically hesitate to share ideas with the

whole class and excel in individualized activities, whereas extraverts feed off of other's

ideas and excel in group activities. Keirsey and Bates hypothesized that introverts would

be more successful in online courses (p. 102) and based on my own experiences with

these types of students I would agree. As part of the student surveys I asked if students

considered themselves shy or rarely spoke in class discussions, in order to assess

introverted personalities to see if online discussions were more beneficial to these types

of students.

Even though it was hypothesized that learning styles would positively impact the context in which a student learns, the study in the *Learning Style* article found no correlation with learning styles and grades for online courses versus FTF instruction. There was no significant difference in test scores, assignment, and participation grades. However, student attitudes towards the effectiveness of these courses did show a difference. Ninety-six percent (*N*=62) of online students found that the course was as or more effective than FTF courses. Eighty-six percent of online students thought lectures were 'very effective' versus 75% for FTF. Seventy-three percent found discussions 'very effective' online versus 88% FTF. Eight-six percent found chapter reviews 'very effective; online versus 56%. Lastly, 73% found assignments 'very effective' online versus 50% FTF. None of the students rated any of these categories 'not effective' for online while chapter reviews did get 6% of the students saying they are not effective FTF. Overall, the students did find online instruction very effective in several measures and it shows that FTF instruction can be converted to be used online and be just as valuable for students (Neuhauser, 2002).

"The virtual classroom is no less a legitimate place for learning than the actual classroom. It simply calls for a different mode of delivery." (Meroff 2003, p. 12) The mode of delivery he is referring to is promoting student interactivity, in which students connect information in meaningful ways. The use of technology should be taken advantage of to bridge this connection. One of the suggested ways to include interactivity with technology is use of online discussion boards. This article does not go into methods for incorporating online discussions, but does acknowledge its usefulness for introverted types of students; those who are shy or unwilling to participate in front of

the whole class. "Some students who would be among the silent majority in an actual classroom shine in the virtual classroom." (Legon, as cited in Maeroff 2003, p. 13) Online discussion forums give students a place to be self-reflective, so they do not feel pressured and can take time to formulate their thoughts into words.

Online learning holds promise (Maeroff, 2003) also asks two main questions. First, who is online learning meant for? As already mentioned, online learning will probably benefit the introverted types, but also students who are more mature, exhibit greater academic intuitive, have self-motivation and responsibility. Online learning may not be suited for students that do not show these characteristics, including managing time well and being organized. These implications lead into the second question of what are the downfalls to not having students meet FTF. In classrooms these lead to types of learning that promotes character development, socialization, listening and speaking skills (Maeroff, 2003). The author concludes by addressing the idea that different courses may lend themselves better to online learning. Those courses that present facts to memorize and basic concepts will lead to better student achievement than courses that require deep understanding and critical thinking skills. However, I see that a combination of both basic memorization and deeper understanding could be achieved with combining online instruction with traditional FTF.

In another article relating learning styles to building an online format for instruction was more of a review of literature than a research study, however the authors advise developing the course based on who is taking or using the course. For example knowing the demographics of a classroom, learning styles, motivation, and academic

level for a particular subject will influence how to build a successful online component for one's classroom (Perry and Pilati, 2011).

Methods

For online education to be beneficial the success depends on the community, feedback, clear guidelines and expectations (Perry and Pilati, 2011). This article, as well as the majority of other articles I have read, advocate for the use of hybrid instruction. Hybrid instruction is blending online techniques within the traditional classroom. Pulled from the Department of Education's 2010 study, "students who took all or part of their class online performed better, on average, than those taking the same course through traditional face-to-face instruction" and "instruction combining online and face-to-face elements had a larger advantage…whereas 'advantage' refers to the learning effectiveness of the various instructional approaches." (Means and others 2010, as cited in Perry and Pilati, 2011 p. 101) Clear expectations are necessary for this type of course to be successful, though. "Online instruction provides faculty with a chance to be more purposeful in their teaching and to offer students more opportunities to interact with course material." (Perry and Pilati 2011, p. 98)

My interpretation of using online instruction is not having students just doing assignments to fill time, especially if assignments are self-paced for students. The tasks need to be relevant in enhancing student achievement. Both with assignments and discussions, thinking and writing skills need to be expected just as you would expect in the traditional classroom. Lastly, online instruction allows extra time for those who need the additional time, and students who work at a quicker pace can do so. "It removes the confines of the clock," (Perry and Pilati 2011, p. 98) and if structured correctly could be

beneficial for classrooms that have large variations in student achievement levels, such as an introductory science course.

In one research study I came across, *The Changing Nature of Teaching and Learning in Computer-Based Classrooms* (Swan and Mitrani, 1993)*,* the authors were examining changes in learning as a result of computer-assisted instruction. Entitled "The Computer Pilot Program" computers were added in at-risk public high schools, in New York City, and used for instruction with a variety of learning systems. Even though the pilot program added computers into all grade levels this study focused on high school classes.

The goals of the study were to see how integrated learning systems could be effective in increasing academic performance, attendance, and positive attitudes for lower academic students (Swan and Mitrani, 1993). The 15 technology-based systems were mentioned, but not described in detail in the study. The findings, though, suggest positive results in the goals of the study. Students commented that it gave them more control over their learning Teachers found that they gave students more individualized attention and were aware of individual performances (Guerrero, Swan, and Mitrani, 1989, as cited in Swan and Mitrani, 1993). The results were based on measuring teacher versus student interactions and whole group versus individual interactions within the classroom.

These results were more qualitative based on behaviors and who was guiding the lessons. In a more traditional learning style the teacher is the one who guides the lessons and interactions, whereas computer-based lessons the student or individual is the one who acts as the guide. Therefore Swan and Mitrani concluded that with the use of the computers students were more self-centered learners, tasks could be individualized for

students, and the end result was more cooperation amongst students and teachers in the learning process (1993).

Teaching Courses Online: A Review of the Research (Tallent-Runnels, Thomas, Lan, Cooper, Ahearn, Shaw, and Liu, 2006) stated that students reached lower levels of communication of sharing information, but failed to reach the higher levels of construction and agreement. A second study was referenced that found that students reached a 'multi-structural' level in which the learner picks up on relevant material but did not incorporate the content within situations (Thomas, 2002, as cited in Tallent-Runnels et al., 2006). These findings gave reasons on why online communication has not reached the higher level skills. These reasons include: lack of instructor's guidance in communication, not enough structure in discussion forums, and promoting challenging situations/questions that allow for applying and evaluating the student's knowledge. Therefore, the authors suggested developing guided systems to promote the higher communication levels.

Through techniques such as email, listservs and chatting forums students should be actively engaged in learning and discussion the material. (Althaus 1997, as cited in Tallent-Runnels et al., 2006) "concluded that students who were actively involved in the computer-mediated discussions earned higher grades than other students." (p. 102) As a result, as teachers we need to incorporate relevant questions and discussions topics that draw from the material students are learning and enable them to apply to real-world situations. Also, online forums can lead to discussions amongst students with no disruptions or judging from their peers.

Another benefit mentioned in this article related to the personality of students. Those who are more introverted often do not speak up in class discussions, and even though they may have great input, extraverts will overshadow them in a group. Online forums reduce the competition amongst students, give more time to reflect and "listen" to everyone else's ideas.

One final idea that related on a personal level was that online discussions help record interactions which are hard to do in a FTF classroom. I enjoy and encourage class discussions with my environmental science classes and have tried to attach participation grades for students during these discussions. Several teachers suggested using 'cards' to quantatively keep track of participation, but I find myself being too wrapped up in listening and probing student discussion, as well as keeping some on track and respectful of one another, that these did not work well for me. However, in an online forum it is easy to see who has posted, when, how many times, as well as having time to read through responses and questions. I can visualize these forums being useful in not only going over basic concepts, where students can guide other students, but as a place students can be engaged in conversations without the pressure of a classroom setting.

METHODOLOGY

Timeframe

For my action research project I used my ninth grade Earth/Environmental Class. I have been teaching a total of seven years at my high school and have taught this specific class the past five years. The timeframe consists of a total of eleven weeks, running from the beginning of January 2013 to the end of March 2013. The first two weeks of the treatment served as an introduction, enrolling students into the online program called

Moodle2, showing students the formatting of the program and having students start their first online discussion on "frog gender". The following nine weeks were used to implement the treatment using various Environmental Science topics with online collaboration. The final week was spent wrapping up with post-treatment data instruments.

Demographics

This study used one Earth/Environmental Science class, with a total of 16 students. All 16 students were in a grade placement of 9th grade with ages ranging from 14-16 years. All 9th grade students entering our school system must take this class as a graduation requirement, it is offered as "regular" and "honors" sections, and my sampling came from a "regular" performing classroom. There were 11 males and five females in this class. Twelve of the students were of Caucasian decent, two were African-American, and two were multi-racial.

Brevard High School is located in the mountainous town of Brevard in Western North Carolina. Our school was ranked 35th within North Carolina by a recent U.S. News and World Report. Our enrollment for 2012-2013 was 712 students. Eighty-four percent of the students are Caucasian, 7% African-American, 5% two or more races, 3% Hispanic, and 2% Asian. Thirty-one percent of the student body are eligible for free lunch and 9% are part of the reduced-price lunch program, therefore 40% of the student body are considered economically disadvantaged (Best High Schools Rankings, 2013).

Treatment Design

The beginning of my project involved setting up three major components before treatment was started. First, I had to design a pacing guide of case studies that

coordinated with the one for my class originally. Seven topics were decided on: Scientific Method, Ecology, Hydrosphere, Oceanography, Atmosphere, Climate Change, and Plate Tectonics. After deciding on the topics I wanted to cover, next was researching case studies and current events that related to the unit content. In December and January I used the National Case Study database, run through the University of Buffalo as a starting point in my search for relevant case studies. I have chosen this website, in particular, because they provide peer-reviewed case studies that promote problem-based learning. These materials teach scientific concepts through critical thinking, which directly supports the framework of my project. Even though I only used one specifically designed case study, this website gave me ideas on interesting topics and from there I used several science and research based websites for news articles. The sites I explored included, but were not limited to, Science News for Kids and National Geographic Education.

Second, once the articles were selected to use for a particular unit I had to develop questions that students would answer and discuss. I came up with four to six questions to pull from the articles, then went through and ranked each by a critical thinking level by using Bloom's Taxonomy (Appendix A). The reason for the rankings were to engage students in critical thinking skills through a hierarchical ordering, such as the first question I would ask would rank at a lower level in Bloom's while the third or fourth question would be one of the highest levels.

The third feature was setting up the discussion forums using Moodle2. Moodle2 is an online program that our county uses to deliver resources and assignments to students. Teachers within our district are encouraged to create a course for each of their

classes. This aspect took the largest amount of time because even though I was familiar with the workings of the program there were many details I had to learn while uploading documents and setting up forums. Setting up the discussion forum involved creating groups, of which I placed three to four students in each group, for a total of five groups for each case study. These groups randomly changed with each unit to enable communication with new voices since all students have various strengths and ideas to pull from. The next step was setting up the discussion forum. I used a Question and Answer style forum that has other student's responses blocked until that particular student posts a response first. Once the group was created for the unit I had to insert groups separately into the discussion forum and add questions for each group. Thus, each group would have the same questions to respond to, but only be able to see the responses from the members of their specific group. The setup of the article, forum and other related files or websites are shown in Appendix B.

<u>Introductory Case Study</u>

I spent the first week and a half introducing the Moodle2 course. In order to access this program students require logins, need to have their Gmail set up, and agree to the school rules of using the laptops in the classroom. Because the students received their Chromebooks at the beginning of the 2012-2013 school year, most of these introductory items have already been covered. The first day that I introduced Moodle2 to the class I did an informal survey of how many students were familiar with this program and 10 out of 16 had from 8th grade or from the previous semester, out of those 10 four had specifically used a Moodle forum before, leaving six students who had not used Moodle previously.

As part of the introduction case study I set up a sample discussion forum so students can work out technology issues and know how to access the article, post, respond, add links, etc. I uploaded the selected article, "When Frog Gender Flips" under the Scientific Method: Case Study #1 section for students to access and opened the discussion forum. As part of the first day students got enrolled in the course, were shown how to open PDF articles that appeared in a pop-up window, opened forum number one, and learned how to post replies to the original questions and then to each other. Students were then instructed to use 30 minutes in that class period to read the article and begin to post to the three questions. I asked them to have the initial questions posted by the end of the day and to post to their peers within the following two days. I did not give an exact amount of peer posts they needed to make, but just wanted to use this case study as an introduction to the workings of the case studies and discussion forums. This was also an excellent time to answer student questions and work out any foreseeable issues. Several students asked "how long do the posts have to be" and my response was that they should be more concerned with the quality of the posts- the content and thoughtful discussion, not the length. Another question was how "right" they were in relevance to the questions. My response for this was that there are no "right" or "wrong" answers to these discussion questions, just support your response. They seemed to like the idea that there were no specific lengths to answer and that the majority of the initial questions were based on how they perceived the article and related the content.

During this, and each subsequent case study, I set aside time during class periods, typically 30 minutes a few days a week, since students have access to their laptops at any point during the day. The students would also be able to access the discussions out of

class, on their own time, since I think a valuable part of online collaboration is giving time for students to reflect on each other's comments. Some of the responses to the case study one were as follows: several students thought the frog switching genders was "cool" with two in particular really into how this happened and if this gender switching occurs in other species. I felt this article was overall an easy article to read, but questions two and three were challenging. I meant for them to be higher order, but students were not prepared for this level of thinking at this moment. Another issue that came about was that there is a window of editing, so that students cannot see posts others make until 30 minutes of editing time passes, which hinders instant communication. For the next case study I asked our instructional technology person to decrease the editing time and we settled on a 15 minute window. During this introductory week I learned that I needed to spend time going over ways to respond to higher order type questions beforehand because some students were quite lost in how to answer a question where the response wasn't exactly or directly stated in the article. From the beginning the majority of the students had difficulty reading "between the lines" to infer meaning and relate it to previous or current knowledge.

For the subsequent case studies two through seven, displayed in Table 1, students were asked to read the article, or in one case study I posted a supplementary video and another case study I added other links to associated websites. Then they had two-three school days to respond to the initial questions. Following initial posts, students were asked to post at least three times to their peers by the end of that unit, typically having another two to three days to complete the peer posts.

Table 1
Case Studies Outline

Unit	Dates/ Total Days	Article/ Summary	How Many Questions/ Minimum Peer Posts
Introduction: Scientific Method	Jan 7- Jan 15/ 3 days	"When Frog Gender Flips" Frogs switching genders from male to female, perhaps from a chemical atrazine in the water	3/ 3
1: Ecology	Jan 17-Jan 25/ 6 days	"City Planning for Burrowing Owls" Burrowing owl habitat is being overrun by human development in CA	4/3
2: Hydrosphere	Jan 29-Feb 6/ 6 days	"One Glass for Two People: A case of Water Use Rights in the Eastern United States" Who has the water rights to use the Catawba- Wateree River in central NC?	3/3
3: Oceanography	Feb 7- Feb 15/ 7 days	"Great Pacific Garbage Patch" Trash being dumped in the Pacific Ocean is being continuously circled in the Gyre	3/3
4: Atmosphere	Feb 20-Feb 26/ 5 days	"Urban Heat Island" Areas with greater air pollution are also becoming hotter creating the heat island effect	3/3
5: Climate Change	March 1- March12/ 7 days	"Mammals Feel the Heat" Surface temperature is rising leading a re-location of mammals in the Western Hemisphere	3/3
6: Plate Tectonics	March 19- March 26/ 6 days	"Ancient Volcanoes Eruptions Caused Global Mass Extinction" 260 MYA a volcanic eruption in China led to a mass extinction of various life forms	4/3

Research Design

Data Collection Instruments

To answer the primary and secondary research questions I used an assortment of

qualitative and quantative data instruments as shown in Table 2.

Table 2
Data Triangulation Matrix

Research Questions:	Data Sources			
	1 Student Surveys	2 Student Work Samples	3 Discussion Board Rubric	4 Teacher Journal
Primary: Does the use of online collaboration engage students and initiate communication about an Environmental Science topic?	X	X	X	X
Secondary: In what way do online discussions enhance engagement in the topic	X	X	X	X
Secondary: How well did students communicate with each other?	X		X	X
Secondary: What are the motivational impacts of using online technology for students?	X		X	X
Secondary: What effect will using online learning have on my teaching and school setting?	X	X	X	X

The first data instrument that was used is the student survey that was given before

and after the treatment. These surveys would give quantitative and qualitative insight on

how the student views the process of online collaboration including benefits, challenges,

personal accomplishments, and engagement of the material (Appendix C and D). Using

this survey I was then able to compare before and after treatment attitudes (Appendix E).

A second type of qualitative data collection was the use of student work samples from the discussion posts (Appendix F), which related to the participation and communication secondary questions. Creating a rubric of the discussion board posts specifically related to the secondary question of motivational impacts of students using online collaboration because I hypothesized that the more a student posts in the discussion forum the more engaged and motivated they are with the material. Moodle2 easily lets the teacher have control over the discussion by counting the number of posts students make, when they post, as well as alerting you to when new posts are made. This data was arranged in a spreadsheet, and was helpful in tracking the progression of individual students. I then used this data to create graphs showing the progression, or lack thereof, amongst the entire sample of my students, class, and individual development.

Attitude Survey

The student survey was designed more as a self-assessment based on behaviors and attitudes of the student. Hendricks (p. 105) mentioned an attitude scale developed by Lian-Hwang Chiu called the School Achievement Motivation Rating Scale. This scale is used for teachers to rate behavioral observations in relation to course grades, GPAs, self-measuring of motivation, measures of self-esteem and anxiety (Chiu, 1997, pp. 295-296). I found the information on measuring motivation most relevant to my topic and therefore did further research into the Achievement Motivation Scale.

This scale is in a questionnaire format that takes into account not only academic challenge and grades (a factor I am not measuring, but easily could correlate), but relevance of academic content and interest (factors I am interested in measuring). Both of these scales gave ideas on how to design a Likert scale for my questionnaire that I would

deliver pre-treatment and post-treatment to my 9th grade Earth/Environmental Science

Class. I decided on using the Likert scale since it is based on the students' self-

assessment and gives choices based on student attitudes.

Before starting the treatment I used an attitude survey (Appendix C) to measure

my secondary question of "What are the motivational impacts of using online technology

for students?" Before I begin the treatment of having students discuss Earth and

Environmental case studies online, I administered the survey to the whole

Earth/Environmental class. I created the survey using Google Survey, since the students

had direct access to their Google chromebooks and docs. I also found that the online

survey was very effortless to tally scores, show distribution graphs, and summarize

student comments. I also delivered a slightly modified survey to the same students after -

the treatment, for comparison. This post-survey (Appendix D) was also delivered through

Google docs and had the initial nine same questions, with five added questions related to

student's perception of the case studies and discussion forums. The students were

automatically linked to the survey so if needed I could follow up with student interviews,

can compare survey responses with the student's work, plus comparing pre- and post-

treatment attitudes.

The survey responses were assigned a numerical point value for easier

assessment. For example Strongly Agree was a value of four, whereas Strongly Disagree

was a value of one. I decided to only use a four-point scale, without an Undecided or No

Opinion option because I have used several Likert-type scales in past activities and some

students will never make a decision by putting No Opinion. That choice of response

would then have no impact in my data analysis on whether there was change from the

two surveys. In assigning point values I compared before and after self-assessments and note a change for data analysis (Appendix E).

Discussion Board Rubric

From the discussion board I created a rubric to measure student participation and quality of work. I decided on a 12 point rubric to include: up to three points for initial posts of questions by deadline, up to three points for peer responses by deadline, up to three points for the quality of initial posts and up to three points for quality of peer responses (Appendix G). At the end of each unit I read through each group's discussion forums and rated students based on the scale above. For case studies five through seven students received a completion grade based on their score. I ranked the point value earned in discussion to a percentage of completion, for example six points of less earned a 70% score, seven points earned a 75%, eight points earned a 80%, nine points earned a 85%, 10 points earned a 90%, 11 points earned a 95%, and the maximum amount of points of 12 earned a 100% for that unit.

Teacher Journal

Previous to the treatment I kept a journal on case study ideas relating to the concepts taught in the Environmental Science course, for example if I came across and article or during exploration of science websites I would write down article titles or ideas. This helped when it came time to narrow down a selection for each case study. During the treatment I used my journal to brainstorm essential questions from each case study, summarize the articles, record issues with the technology as well as those that arose from the students, informal feedback from students, and my overall thoughts on the

process. I did not keep to a daily or weekly schedule of recording information, but found the journal to be a place to work out ideas and keep track of student quotes and feedback.

<div align="center">Validity</div>

In order to establish validity and reliability for my data collection I used several types of data instruments throughout the project. A variety of data instruments were necessary for comparison of what I was trying to measure versus what was actually measured. The instruments, such as the attitude survey and discussion board rubric, were based on pre existing items that were then structured to fit the purpose of my project. I used the rubric scores for students based on discussion boards, how many times they posted to the forum, as well as individual's comments for comparison. To ensure reliability I used the same discussion board rubric for each unit and same questions (one through nine) in the pre- and post- surveys. The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained (Appendix H).

<div align="center">DATA ANALYSIS AND INTERPRETATION</div>

<div align="center">Overview</div>

There are numerous reasons why students may not be engaged in a topic within Earth/Environmental Science classes. From a student's personal attitude towards school in general, to lack of interest in the topic or not being able to constructively relate to the content. Therefore, I wanted to create a discussion on current events and topics relatable to Environmental Science for ninth grade students. My hope was that through the use of online collaboration students would examine case studies, read applicable scenarios, and have conversations on these in depth topics.

Students seemed excited initially to read case studies in class. Twelve out of 16 agreed or strongly agreed that they were interested in reading case studies or current events that relate to our material. Also, from the pre-survey, five out of 16 students found they already could relate Environmental Science topics to their life, leaving nine out of 16 students disagreeing with being able to relate life experiences to science. Therefore, this pre-survey shows that students were lacking a constructed connection with the material. The majority of students, 13 out of 16, said that learning Earth/Environmental Science is important in their life. One student agreed and commented that "I think science is important because it helps you know how to do more creative things and learn more about the environment." One student strongly disagreed with the importance of this science class by writing, "because I don't need it."
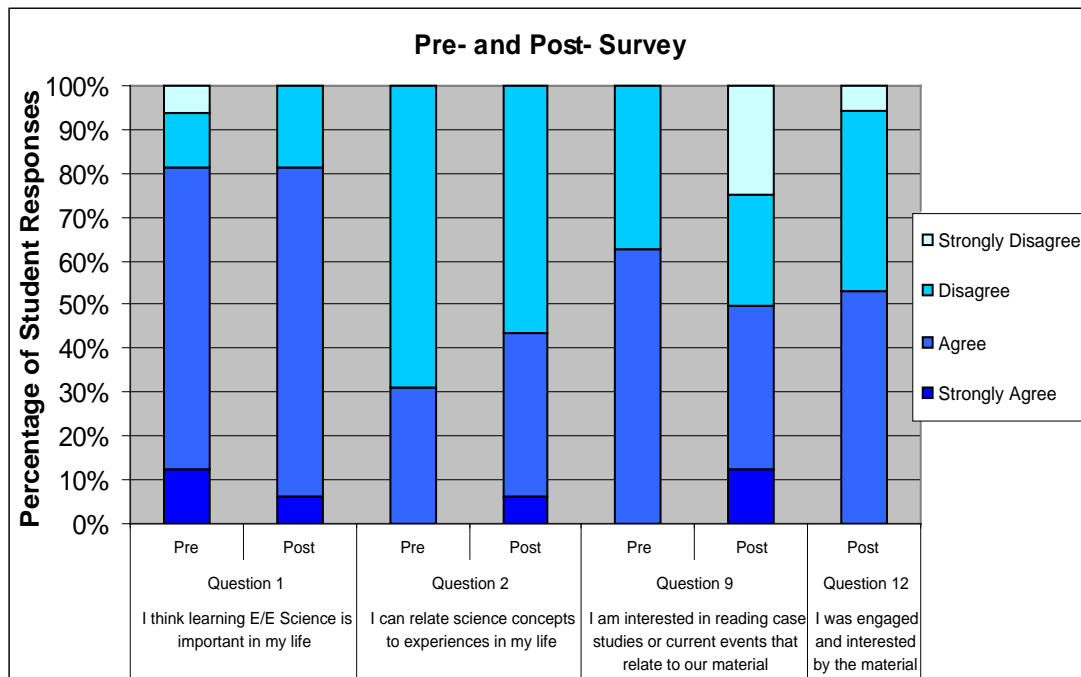

Figure 1: Pre- and Post-Survey Results Questions 1, 2, 9, 12, (*N*=16).

Engagement and Interest with Online Discussion

The first theme extracted from the data concentrates on how effective the online discussions were for engagement in the content. From the pre-survey I learned that 77% of the students recognized that science is important in their life, but only 29% felt they could relate science concepts to experiences in their life. Therefore showing disconnect of linking these topics to things that students may experience everyday. Constructivism, the theory of application of real-life scenarios, is key for student retention and interest in the material. In the post-survey students still had a similar percentage of how important science is to their lives, but had an increase from 29% to 44% when asked if they can relate concepts to their lives.

In order to asses the secondary question of "Did discussions show engagement of the content" I had to first summarize the rubric scores for the class (Appendix I). From the rubric scores I then averaged the point value by each student to see how effective online discussion boards were per case study, shown in Figure 2. Four out of 16 students earned greater than the median amount of six points from averaging the points for case studies two through seven. Student O earned 54% of the points available. Student J earned 65% of the points available. Students G and M earned 92% of the points available. 12/16 students earned less than the median amount of 6 points from averaging the points for case studies two through seven. Students A, B and I earned between 25-30% of the points available. Students E and P earned between 30-35% of the points available. Students C, D and L earned between 35-40% of the points available. Students F, H, K and N earned between 45-50% of the points available.

Case Study 2-7 Average Point Value By Student

Student ID	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Av. Point Values	3.3	3.5	4.8	4.3	4	5.7	11	5.5	3.2	7.8	5.8	4.7	11	5.7	6.5	3.8

Average Point Value Max=12
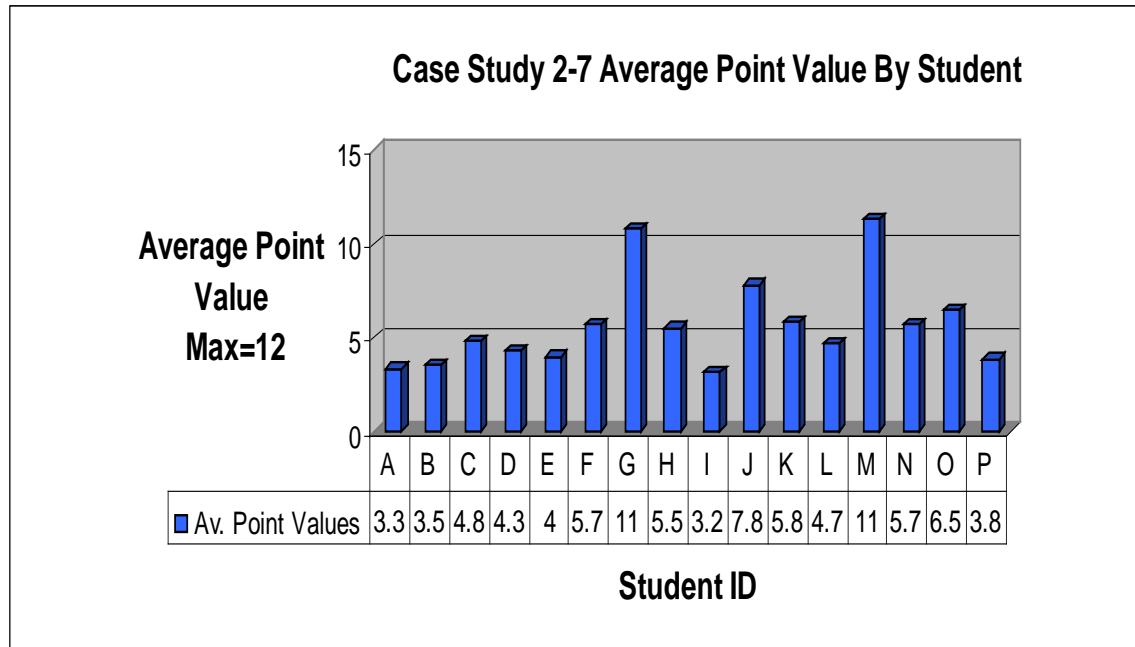
Figure 2: Average point value by student in case studies 2-7, (*N*=16).

The next question posed was how interested were the students in case studies. Were there particular case studies students discussed more or was the approach to using case studies not ideal for getting students engaged in the material? In both the pre- and post- surveys students were asked to rank their attitude towards being interested in reading case studies or current events. Figure 1 shows a drop from 62.5% to 50% of students that were interested after treatment.

Table 3 shows a comparison of student attitude towards the case studies before (column one) and after (column two). The third column represents a change between rankings by student. Overall students showed a negative attitude towards case studies, with 6/16 having a negative change in their disposition, 3/16 having a slightly positive change, and 7/16 showing no change. The average of the student's attitude towards being interested in case studies was a 2.8 average before using case studies in class. This position dropped to a 2.3 average after using case studies. Even though this is not a large

drop, column three shows that four students dropped dramatically, from either agreeing to strongly disagreeing or strongly agreeing to strongly disagreeing in their interest in case studies; from their outlook before and then after completing the treatment. I think the students perception on the case studies changed after the treatment because they were either burnt out on doing the case studies or their negative rankings showed dis-engagement in the material. There were two students that ranked their pre-treatment interest at a two (disagreeing) then increased interest to a three (agreeing) after treatment. I was interested to see if there was a trend for these two students, F and N, in terms of amount of times posted to the forum and their average point values. Student F posted 20 (with 36 maximum amount) times to the forum and earned an average of 5.7 points (with 12 the maximum amount). Student N only posted 10 times and earned 5.7 average point value, as well. Even though these students neither posted the maximum amount of times or earned half of the amount of point values they ranked themselves as having an increased interest in case studies. Student G had an increase from being interested to having a high interest in case studies, posting the second highest amount on the forum (32 times out of 35), and having the highest average point value from the rubric (11 out of 12 points).

Table 3
Question nine survey comparison: "I am interested in reading case studies or current events that relate to our material" (N=16).

Student ID	Student attitude pre-survey	Student attitude post-survey	Change prior and after treatment
	Student Attitude Ranking: 4: Strongly Agree 3: Agree 2: Disagree 1: Strongly Disagree		Pink= Negative Change Green= Positive Change
A	3	1	2
B	3	1	2
C	2	2	0
D	4	1	3
E	3	1	2
F	2	3	1
G	3	4	1
H	2	1	1
I	3	3	0
J	3	2	1
K	3	3	0
L	2	2	0
M	3	3	0
N	2	3	1
O	3	3	0
P	3	3	0
Average Attitude Ranking	2.8	2.3	8

Which case studies captured particular interests for students? Two out of the six case studies students earned just around the median of the amount of points one can earn for a unit case study. These case studies scored both 6.31 points out of 12 points. These case studies were number two: Burrowing Owls and number seven: Volcanoes and Extinction. Conversely, four out of the six case studies students earned below the median amount of points one can earn for a unit case study. These case studies scored as follows:

number three: Water Rights earned 5.69 points, number four: Pacific Trash Gyre earned

5.62 points, number five: Urban Heat Island earned 4.5 points, and number six: Mammals

Feel the Heat earned 5.25 points.
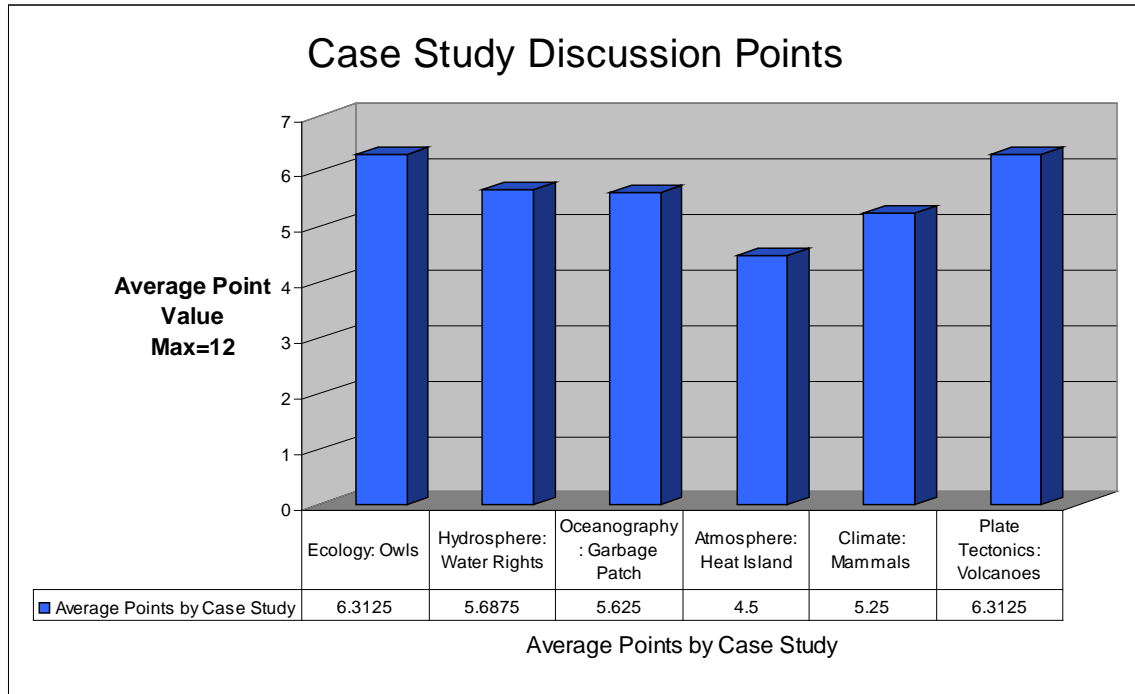
Figure 3: Case Study Discussion Points, (*N*=16).

These point values could have been dependent upon several factors. Interest in

the subject or case study, how difficult or time consuming the article was to read, how

difficult the questions were to answer how much time students spent on the case study

(both in and out of class), if the initial questions were answered, did the student respond

to their peers, and overall how much effort did the student put in the discussions.

In the post-survey question number twelve asked students if they were engaged

and interested by the material presented in the case studies. Fifty-three percent of the

students ranked that question a three, meaning agree, while 47% either disagree or

strongly disagreed that they were engaged or interested in the case study material. On the

positive side students commented, "Just that some of the stories are interesting" and "Learning things I have never read or heard about."

Participation Rate and Communication

Another way to evaluate how students were engaged in the material is to look at the secondary question of "How well did students communicate with each other?" by looking at participation rate. Did students participate in reading the articles and answering initial questions, as well as posting to their peers to create a discussion? Figure 4 illustrates the average number of both initial question and peer posts that students made for each case study.
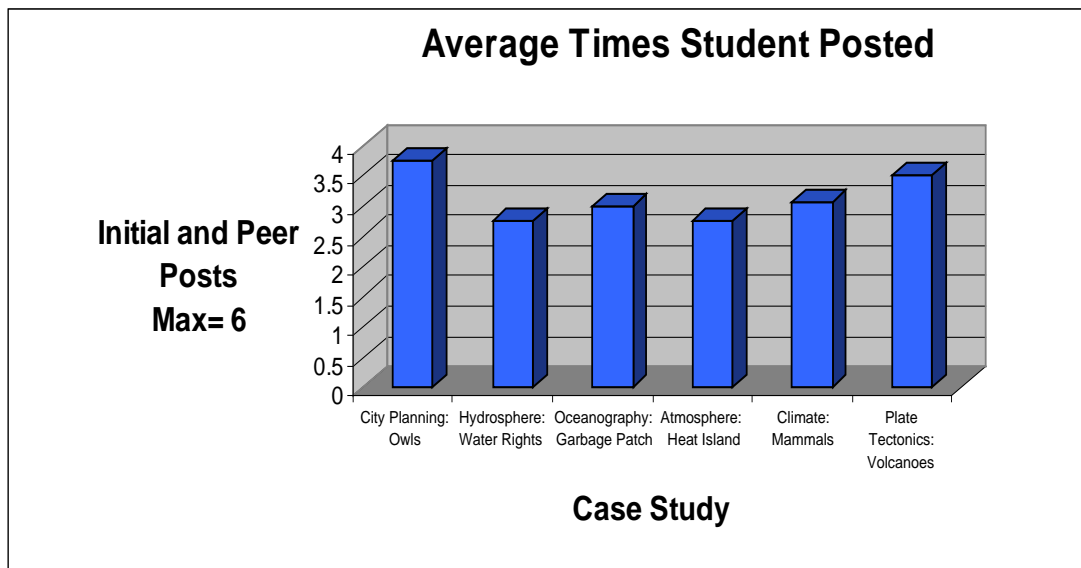
Figure 4: Average number of times students posted by case study, (*N*=16).

Case study number two: Burrowing Owls showed the highest amount of posts, with an average of 3.75 out of 6 and a response rate of 62.5%. Case study number seven: Volcanoes and Extinction had an average of 3.5 posts, with a response rate of 58.33%. Case studies four: Pacific Garbage Gyre and six: Mammals Feel the Heats scored at or slightly above 50% response, with case study three: Water Rights and five: Urban Heat

Islands having slightly less at 45.83%. Based on these response rates it shows that students were engaged in the case studies, but not tremendously. The Burrowing Owls case study may have had the most posts because it was the first official introduction of the case studies that included the amount of times required to post and deadlines, but it may have also intrigued students since I posted a Good Morning America video with the reading, and we had dissected an owl pellet in class during that particular unit on ecology. While setting up the case studies I tried to link the articles with material we were talking about and looking at in class, serving as additions to the traditional material presented in class.

In order to evaluate reasons why several of the case studies earned low response rates I compared the average points earned by initially posting to the questions and by peer responses, shown in Figure 5. Having students post initially to questions starts the conversations. Our class was not to the point where students could facilitate discussions, but the article questions were a way of having students accountable for reading the case study and responding to the main topics or debatable ideas. The peer responses served as additions to the discussion, where students would hopefully have an open discussion on the initial questions.
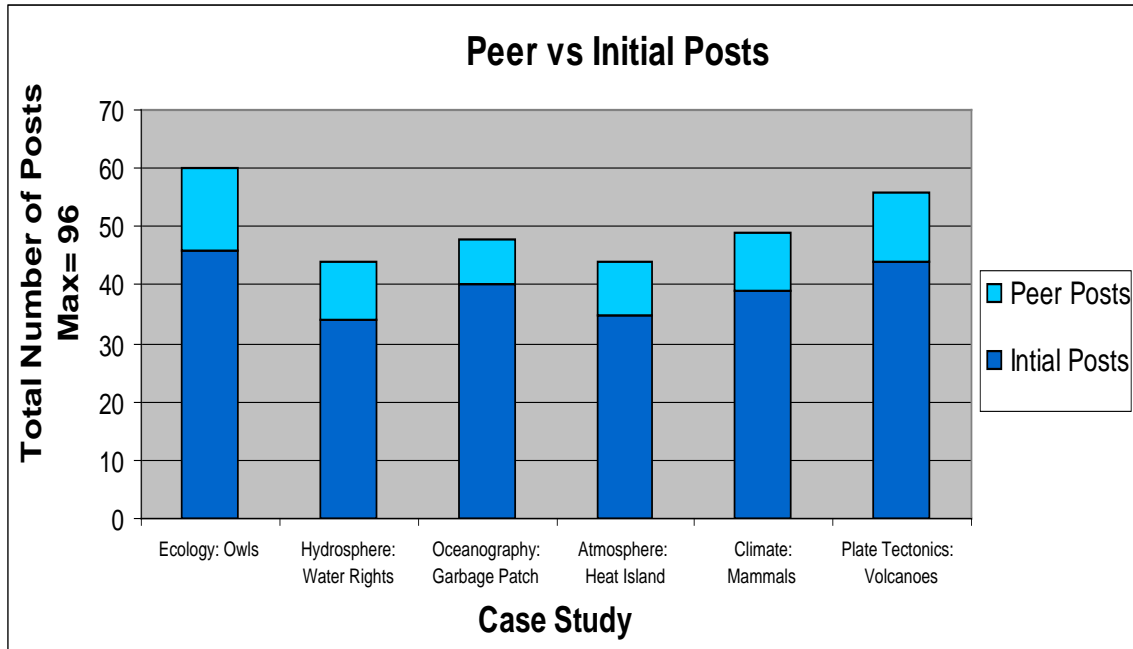
Figure 5: Peer versus Initial Posts, (*N*=16).

Figure 5 shows that students posted more times to the initial questions than posting to their peers. As previously stated the initial questions assessed that students read the case studies. Students are used to reading articles and answering main topic questions from these articles, but are less accustomed to having a back and forth discussion on these questions. From the post-survey, question 10, students were asked to rank themselves if they participated fully in the Moodle online discussion. Seventy-one percent of the students responded that they either agreed or strongly agreed that they fully participate in the forum with 29% disagreeing. Thus, students felt that they were participating in the discussion, but as shown by the amount of times they posted they were actually not posting as much as they were asked, especially their peer responses. Students cited reasons being, "I don't like to reply to my peers" or "sometimes I don't finish them all the way." A script of the discussion forum from case study six: Mammals Feel the Heat is shown in Appendix F.
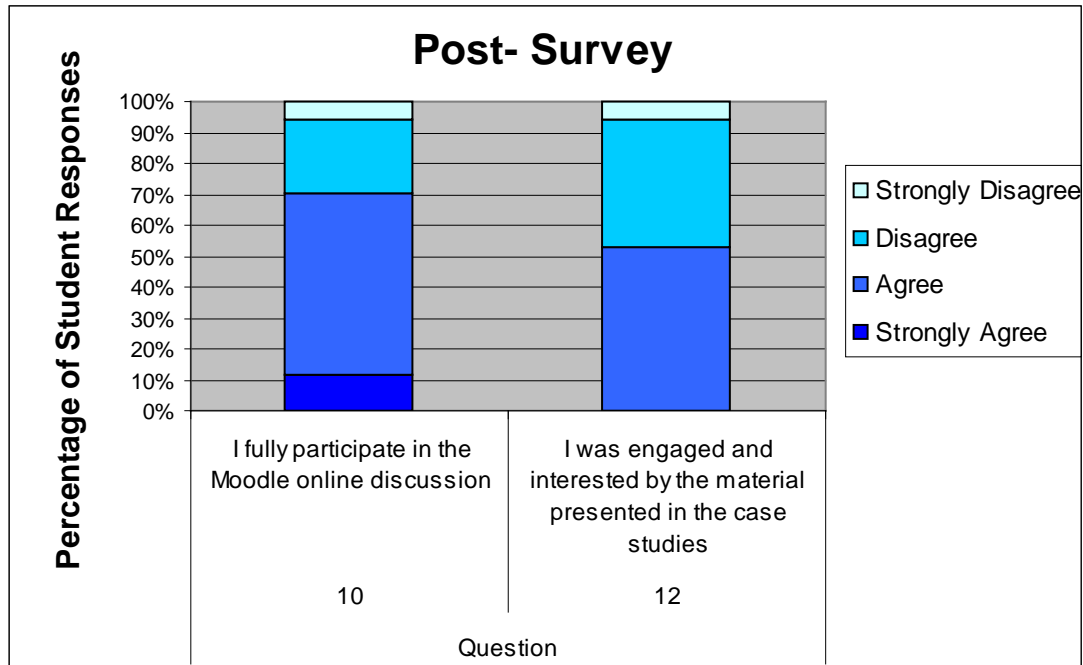
Figure 6: Post- Survey Questions 10, 12, (*N*=16).

A follow-up question to number 12, on being engaged with the case studies, had students commenting on what they enjoyed the least from the case studies. Four of the students specifically cited reading the article as a boring thing or that they have never been good at comprehending what they are reading. However, five students made comments that their least favorite part were the peer responses: "having to reply to other people's answers because I didn't really know what to type," "having to respond to other people and they have the same answer as you," and "when everyone doesn't answer." The last comment rang true throughout the case studies because if everyone in the group, either three or four individuals, didn't respond to a question it was difficult to have a conversation within the group. I had students constantly asking me who was in their group and wanting me to ask those members who were not posting to do so as soon as possible so that they could post peer responses. For each case study there was a deadline

of having students post their initial questions, but every time there would be students who did not post by this deadline which doesn't give the others much to discuss.

<u>Online versus Classroom Discussions</u>

Students often find it hard to carry on discussions in class, where they feel they have to compete with extroverted students or may not feel confident in speaking in front of peers. Whatever reason it may be the online discussion boards are an alternative resource for those students who consider themselves shy or introverted, or need more time to put their thoughts into words. On both surveys students were asked to rank themselves as being shy and if they rarely speak in class. On each, the majority of students ranked themselves as disagreeing with this statement, 53% on the pre-survey and 82% on the post-survey. In comparing students attitudes towards online versus face-to-face discussions 76% of the students said they preferred FTF or in class discussions to the online discussions. In favor of online discussions, students liked that it was "easier to concentrate" and "it helps you learn more about what you're doing that week." With the majority of students liking FTF discussions they commented "I don't think it is a full discussion when everyone doesn't respond," "I think that people need to talk more in public to get out of their comfort zone. That doesn't happen anymore because people in general use text or other forms of communication," and "because it is better to talk to someone face to face than online."
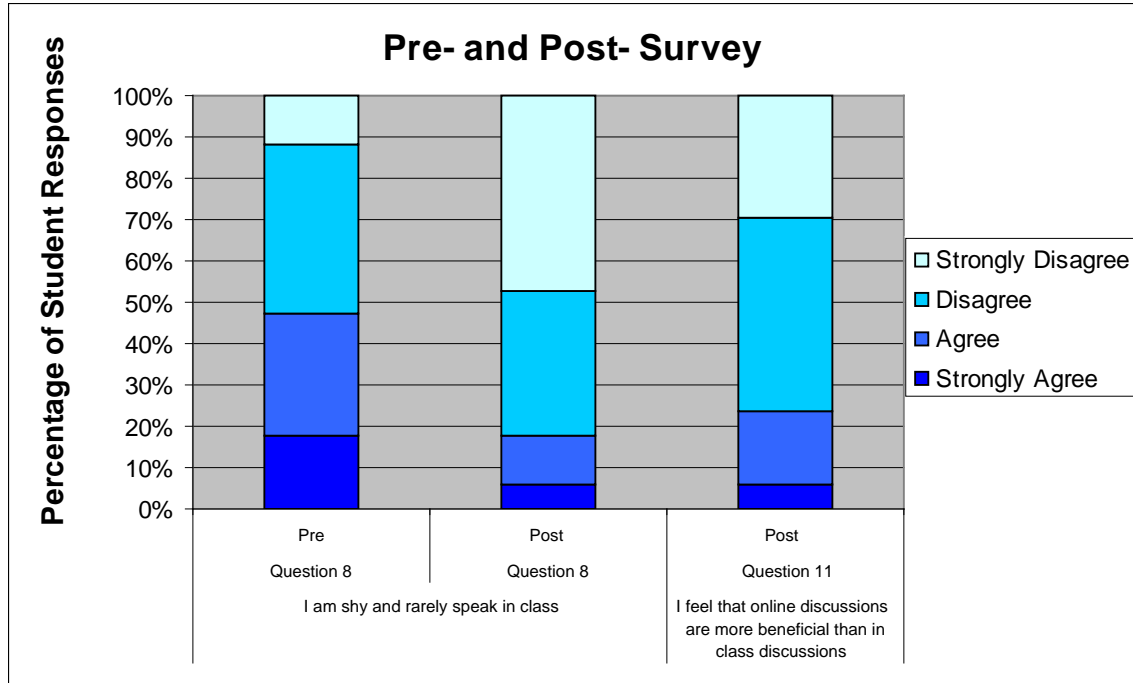
Figure 7: Pre- and Post- Survey Question 8, 11, (*N*=16).

Another quantative way of evaluating the effectiveness of online forums for shier students is comparing how the students ranked themselves on the pre-survey with the amount of times the student posted in the case studies. Table four ranks the amount of times students posted through-out case studies two-seven, including initial and peer posts. The students that posted the largest number of times either ranked themselves as slightly shy or not shy, showing a lack of correlation between perceived shier students and discussion participation. The students that posted the least amount of times also ranked themselves as slightly shy or not shy, whereas students ranking themselves as either very shy or not shy at all posted the median amount of times. Even though online discussions may not bring out the confidence of "talking" in discussion boards for all introverted students, they were valuable for the students who posted the largest amount of times contributing to the conversations.

Table 4
Shy Rating versus Times Posted, (*N*=16)

Student ID	"I am shy" Rating 1= Strongly Disagree= *Not* Shy 4= Strongly Agree= *Are* Shy	Amount of times the Student Posted in Case Studies 2-7 Maximum= 36
M	2	35
G	3	32
J	2	29
O	3	23
F	2	20
K	1	19
H	1	18
C	2	17
L	4	16
D	2	15
E	4	13
I	3	13
B	2	12
P	2	12
A	2	11
N	3	10

Motivation and Achievement

A third theme extracted from my data deals with the secondary question of "What are the motivational impacts of using online technology for students?" I wanted to focus on two major topics: how students perceived their achievement and motivation in class before and after treatment, and were grades a motivator for participation in the online discussions? I studied questions five and six from both the pre- and post- survey as indicators on how students perceived themselves in the class. Overwhelmingly students felt that they could and did achieve in this class with 100% on the pre-survey and 89% post-survey. They also felt strong confidence that they are motivated as students with 100% either strongly agreeing or agreeing on both surveys. The self-belief in achievement may have dropped based on students feelings towards how they performed

through-out the case studies and realized they didn't perform as well as they could, leading to disagreeing that they can achieve in the class. One student who answered with a strongly agree in question six said, "I am not the best at science but I will work hard to be good at it and will not give up if it gets hard." Another student, who also answered with a strongly agree, said "I do not sleep and I pay attention most of the time" which is interesting on measuring the degree of motivation from a student's viewpoint.
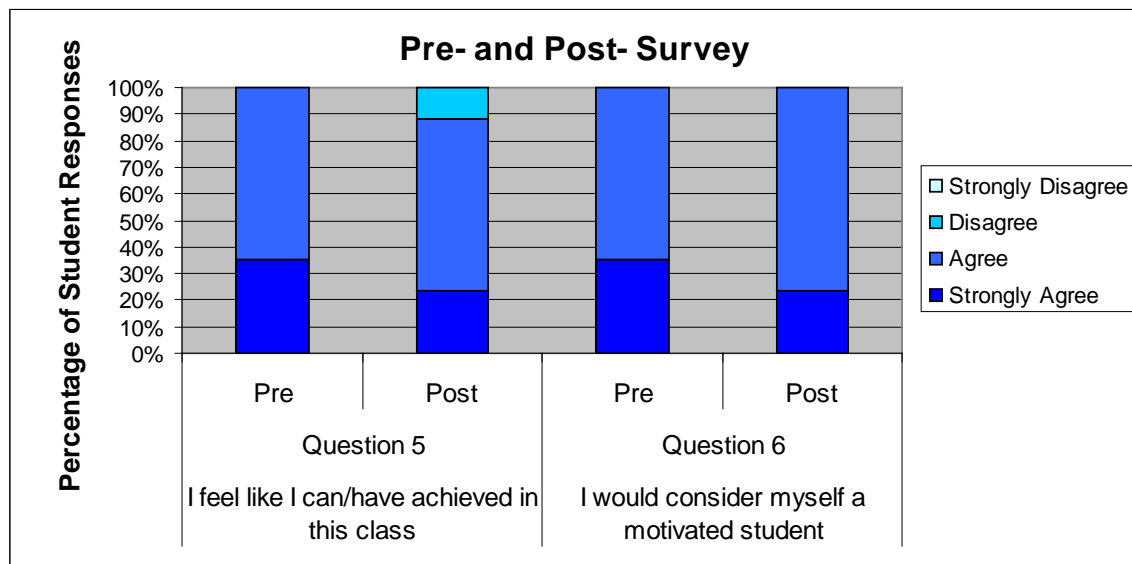
Figure 8: Pre- and Post- Survey Question 5, 6, (*N*=16).

In looking at the extent of grades as a motivator, I calculated the average points earned for group one (no grades assigned) and group two (grades assigned). Group one consisted of case studies two, three, and four and group two consisted of case studies five, six, and seven. I did not give immediate feedback or the rubric score for the group one case studies to the students. Beginning with case study five I immediately gave a copy of the discussion board rubric to the student to see if student performance on the forums would increase when given feedback. This rubric (Appendix G) noted how many times the student posted on the forum, but more importantly what their qualities of post

were. Based on the total rubric score students got a homework grade, detailed in the data

collection instrument section.

Table 5

Comparison of Points for Case Studies Presenting in Group 1 Versus 2

Student ID	Average Points for Case Studies 2,3,4 (Group 1)	Average Points for Case Studies 5,6,7 (Group 2)
	Highlighted box represents the higher value of points earned in comparing Group 1 and Group 2	
A	3.34	3.34
B	5	2
C	5	4.67
D	5	3.67
E	4.34	3.67
F	4.34	7
G	10.34	11.33
H	6.34	4.67
I	3.34	3
J	8.34	7.34
K	5.34	6.34
L	4.67	4.67
M	11	11.67
N	5.67	3.67
O	8	5
P	4	3.67

In comparison eleven out of 16 students earned more points before given

feedback and grades for the discussion forum in case studies two, three, and four. In a

similar comparison two out of 16 students earned the same amount of points for both sets

of case studies, graded and ungraded. Three out of 16 students earned more points during

the feedback and grade set of case studies of five, six, and seven. Case studies two, three,

and four were part of group one treatment in which students were not given graded rubric

scores, and overall students performed more positively in both amount of times posting

and quality of posts before getting graded. Treatment group two consisted of case studies

five, six, and seven, and students were given immediate feedback and a grade based on the amount and quality of posts. The three students (F, G and K) who had over a point gain in their rubric scores in group two both expressed concern about their overall class grades, and when they realized they were now getting a class work grade for the discussions they rose to the occasion. Students who had more than a two point drop in the scores (B, N, and O) were just not posting on the discussion boards. Student B posted to her peers one time within all six case studies, not even getting the chance to earn points for peer responses or quality of peer responses. Students did not perform as positively when given graded feedback suggesting grades were not a motivator for participation rate in discussion boards. I would have actually thought that students would have improved their performance once grades were involved, but as shown in other work this semester most students still lack the motivation or care about doing well with class grades.

CONCLUSION

Research Questions

My topic focused on using online discussion forums to promote self-direction and engagement. Therefore, my primary research question was: How does the use of online collaboration impact student engagement and communication in Environmental Science? From this initial topic I had several secondary questions that can be researched and measured that dealt with engagement, communication, and motivational impacts of the use of online discussion boards and case studies of science topics.

For the first question, "Do online discussions enhance engagement in the topic," students were excited initially about their interest in environmental science and that they thought this subject was important in their life (Figure 1). After implementing the unit

case studies, that involved reading an article relating to the topic of the unit, answering

questions and participating in an online discussion, students were equally agreeable that

they were excited about Earth/Environmental science and that this subject is important in

their life. However, student participation showed a lack of engagement in the discussion

boards. Out of a class of 16 students, only two excelled at posting the required times and

showing high quality in their postings, while six earned around the median rubric score,

and eight also earned below a median rubric score as an average score within the six case

studies.

Even though I did not measure student work in class, students who did not excel

at the discussion boards are also those not excelling in class (Figure 2). There is a link

between those that did postings on time and participated in the discussion with a higher

grade in class versus those that earned lower rubric scores and have a lower grade in

class. In looking at whether the case studies had a positive or negative impact on student

interest, some students decreased their attitude ranking negatively towards being

interested in case studies after the treatment, from 71% to 47% being interested.

Therefore, the use of case studies and online discussion boards did not enhance

engagement in the topics. Conversely, in the post-survey a higher percentage of students,

47%, can relate science concepts to their life, an increase from 29% pre-survey (Figure

1). Engagement is making an investment in what one is learning, and a main strategy to

enhance this in a classroom is having students make that constructed connection with the

material. Even though the online discussions may have not been the best avenue for this

class in increasing engagement, they did increase interest in a relatable fashion for

students who can make constructivism connections with Earth/Environmental Science

topics. I think that any extra and relevant material introduced to students will increase the interest factor and for the students that are slightly less motivated then their peers this increased interest could push them a little farther with becoming engaged with the topics in class.

The next secondary question, "How well did students communicate with each other?" was critical in showing how well students participated in the online discussion boards for each case study. None of the six case studies had significant interest or lack of interest, showing that students participated in the case studies, but they did not do so to the extent of ongoing conversations for each unit. Overwhelmingly, students did participate in the discussion boards by posting to the initial questions. However they fell short when posting peer responses to keep the conservation flowing. During an informal interview with one student, who consistently posted to the boards, she stated her dislike for the case studies. Her main reason for the dislike being the wait time for her group members to post responses so a discussion could either be started or continued. She would rather do an activity and be done with it in one class period versus keeping the discussions open for a week or more. This student's insight shows a trend amongst students to want to finish and be done with things instead of taking time to reflect on their work. She also touched on one of the points of this project of wanting these discussions to be continuous conversations to spark engagement. I thought students would look at the forums outside of class and post more than the required minimal amount, but they did not, as is typically with other types of out of class work. Only a few students said they looked at Moodle outside of class time, and none of the students posted more than the minimal requirement.

The third question looked at motivational impacts of using online technology for students. Students ranked themselves very positively on how they perceived their achievement level and motivation in class. 100% of the class considered themselves motivated students, however I have seen with other assignments in class I would have to disagree that they are all strongly motivated. Motivation is a desire to work towards and eventually complete a goal, such as schoolwork. As much as I was excited that this class considers themselves motivated students informally evaluating them with other school related tasks there are at least seven, if not more, students who rarely turn in homework and complete classwork in the required time. There are plenty of students who are interested in science topics, but motivation and then achieving that goal does not solely come from being interested in something. Interest is a large first step, but when students are actually willing, and do, completes a goal then that shows the ability of those students to reach motivational levels. And from these levels students are either absorbed in the material or show a lack of engagement. For students, several factors could play a role in motivation such as time, interest, other commitments, support, grades, and overall work ethic. Grades was one factor that I used as a comparison, and my data showed that students did not perform as positively given graded feedback, therefore indicating that grades were not a motivational factor for this sample. I gave grades out for the last three case studies and students may have been inundated with case studies by that point and not putting in the same effort as they did at the beginning of the treatment. Another idea is simply that the class work grades they earned from the discussion board rubric from each unit were not important to the students. When I handed back the graded rubric most

students glanced at it to see their score, but did not take time to look at the rubric as to why they received that particular score or inquire how to increase the score.

VALUE

<u>Personal Implications</u>

My Action Research topic will be a valuable tool for my own classroom, school, and district. I began to be interested in online learning opportunities when our district announced plans for a one to one laptop ratio for students to be implemented in the 2012-2013 school year. As part of this program teachers were encouraged to think and then implement the use of the laptops into our classrooms. I had already started to upload Power Point presentations and guided notes onto the Moodle2 online program, but wanted to devise a beneficial use of online learning for students to use more than just viewing the lectures.

This incorporation of laptops has taken place in our school this 2012-2013 school year, and will be part of the rest of our district schools in the upcoming school year. I believe my research will be helpful to teachers who are unsure of the benefits and challenges of using online learning, as well as to give ideas on how to advantageously use the laptops in their curriculum. For this school year we have five 'hybrid' or professional development workdays that are focused on the transition into the new standards and technology. I have already heard that several colleagues are unsure of this transition, while another few colleagues are eager to jump on board and create a complete switch of their traditional classroom into an online learning experience. Since I already have a basic understanding of Moodle2, the program that all of the teachers will be using, I hope to aid teachers into developing an online portion of their class during these professional

development days. With both local and national audiences technology will, if it has not already, play a huge role in how students are learning because of the lifestyle of our students, and I hope my research will aid in understanding the important function online learning can have in traditional classrooms.

Through this project I found that by using case studies as a way to deliver information students were introduced to situations and events that were relatable to the Environmental Science topics in class. The case studies served as extensions to class content and students showed an increase in the ability to relate science to things in their life, supporting the value of constructivism. I enjoyed the additions of these case studies in my classroom because anything that may get one student even a bit more interested in the material will be beneficial for the classroom overall. Plus I liked the pre-treatment research of finding articles that I then learned from and wanted to do more research. The online discussion forums were also a learning curve for me. While setting up the project I learned that there have been very few teachers that have used the discussion boards on Moodle2, let alone divide the class into groups each week and have the forum be a weekly task. Even though the data shows that students did not become engaged by communication using online discussion I still feel that the forums have benefits. Since the class was grouped randomly each week the students got a chance to "talk" to peers that they may normally not interact with during the day. Also, this type of discussion gave students time to reflect on their work, whether it was taking time to read the article or deciding what to type in response to a question by their peers, without the pressure of finishing within a set time in class.

Modifications

From the beginning of the treatment I did not give immediate feedback to students based on how they were posting to the case studies. I informally reminded individuals to post if I saw they had not by mid-week, but there was not a daily form of feedback given. During the introductory unit I had given examples of various qualities of posts, but I did not interject during the discussions by encouraging a higher quality of responses. I posted the initial questions, but then let the students have control over the discussions. Since these 9th grade students had minimal experience with discussion forums I should have structured appropriate ways to respond to your peers to give value to the discussions and given that feedback at least once before the end of each unit (which is when I gave a rubric score). I also could have been involved with the discussion by asking for clarification or other questions to lead to a greater participation rate.

A second idea on modifying this project is adding academic value to the study. I did not use the case studies or discussions as assessments until giving grades based on rubric scores in case studies five, six, and seven. I could have given pre and post unit assessments comparing the impact of the use of online discussions on grades. I viewed the case study discussions as extensions to the class. Therefore the content delivered online was not directly tested, but the general ideas behind the case studies were linked to the content from class that was tested.

Conclusion

There has, and will continue to be, hype concerning 21st century learners and the best ways to teach the new generation of students. From less traditional teaching methods to a flipped approach, ideas are being explored by teachers as new ways of

presenting material through the use of online resources. However, does the use of online forums, videos, or activities replace the benefits of face to face instruction? Even though online learning can give students the content does this type of instruction miss out on social and developmental benefits of the traditional classroom environment? The way content is delivered needs to be meaningful for the student to make connections for higher order thinking skills and communication, which will then increase academic success for students.

REFERENCES

Best High Schools Ranking (2013) Retrieved June 2, 2013 from,
http://www.usnews.com/education/best-high-schools/north-
carolina/districts/transylvania-county-schools/brevard-high-14723

Chiu, L. (1997). Development and Validation of the School Achievement
Motivation Rating Scale. *Educational and Psychological Measurement*, *57(2),*
292-305.

Hendricks, C. (2009). *Improving Schools Through Action Research.* Upper Saddle
River, New Jersey: Pearson Education, Inc.

Hsiao-Lin T., Chi-Chin C., & Shyang-Horng S. (2005). The development
of a questionnaire to measure students' motivation towards science learning.
International Journal of Science Education, 27(6), 639-654

Maeroff, G. (2003). Online Learning Holds Promise. *The Masthead*, 55*(4)*,
12-17. Retrieved March 26, 2012 from,
http://go.galegroup.com.proxybz.lib.montana.edu/ps/i.do?id=GALE%7CA111403
893&v=2.1&u=mtlib_1_1123&it=r&p=AONE&sw=w

Neuhauser, C. (2002). Learning Style and Effectiveness of Online and Face-to
Face Instruction. *The American Journal of Distance Education*, *16(2)*, 99-113.
Retrieved March 23, 2012 from,
http://web.ebscohost.com.proxybz.lib.montana.edu/ehost/pdfviewer/pdfviewer?si
d=e3e99050-27e6-4c8f-88c8-5d3a73dae781%40sessionmgr10&vid=7&hid=19

Oliver, R. (1999). Exploring strategies for online teaching and learning. *Distance
Education, 20(2),* 240-254. Retrieved March 25, 2012 from,
http://dx.doi.org/10.1080/0158791990200205

Perry, E. & Pilati, M. (2011). Online Learning. *New Directions for Teaching and
Learning, 128*, 95-104. DOI: 10.1002/tl.472. Retrieved March 25, 2012 from,
http://ejournals.ebsco.com.proxybz.lib.montana.edu/Direct.asp?AccessToken=95
X5JIQ8XID9DDPJIP9JIEJUU9RP8Q5JJD&Show=Object&msid=934173417

Seng, L. & Mohamad F. (2002). Online Learning Is It Meant For Science Courses?
Internet and Higher Education, *5(2),* 109-118. Retrieved March 25, 2012 from,
http://www.sciencedirect.com.proxybz.lib.montana.edu/science/article/pii/S10967
51602000878

Strommen, E. & Lincoln, B. (1992, August). Constructivism, Technology, and the Future
of Classroom Learning. *Education and Urban Society, 24(4),* 466-476. Retrieved
March 31, 2012 from, http://alicechristie.com/classes/530/constructivism.pdf

Swan, K. & Mitrani, M. (1993) The Changing Nature of Teaching and Learning in Computer-Based Classrooms. *Journal of Research on Computing in Education*, *26(1),* 40-54.

Tallent-Runnels, M., Thomas, J., Lan, W., Cooper, L., Ahern, T., Shaw, S., & Liu, X. (2006, Spring). Teaching Courses Online: A Review of the Research. *Review of Educational Research, 76(1),* 93-135. Retrieved March 30, 2012 from, http://www.jstor.org/stable/3700584

APPENDICES

<u>APPENDIX A</u>

BLOOM'S TAXONMY LEVELS

APPENDIX A
BLOOM'S TAXONMY LEVELS

	Level	Description	Key Words	Example from Case Studies
Lower-Order Thinking Skills	Remembering	The learner is able to recall, restate, and remember information	List, Identify, Name, Find, Recite	CS#2: List at list 3 things the owl is dependent on for survival
	Understanding	The learner grasps the meaning of information by interpreting and translating what has been learned	Summarize, Describe, Observe, Define	CS#5: In your own words, describe what an urban heat island is defined as.
	Applying	The learner makes use of information in a context different from the one in which it was learned	Translate, Exhibit, Interpret, Apply, Construct	CS#7: This eruption is hypothesized to have caused what major event...? In what ways do the researchers support this hypothesis?
Higher-Order Thinking Skills	Analyzing	The learner breaks learned information into its parts to best understand that information	Compare/ Contrast, Distinguish, Examine, Criticize, Research	CS#6: If a species can no longer survive in its habitat what does it does (what is its response)? However, why is this response no longer something every species can do to survive?
	Evaluating	The learner makes decisions based on in-depth reflection, criticism, and assessment	Hypothesize, Judge, Test, Validate, Infer, Measure, Defend	CS#3: Does anyone have the 'right' to use a given water source? What reasons give some groups/individuals more rights to a water source versus others?
	Creating	The learner creates new ideas and information using what has previously been learned	Design, Construct, Propose, Invent, Develop, Predict	CS#4: You have been called in to help clean up the Marine debris found in the Pacific Trash Gyre. What are some strategies you would use to tackle this problem? What are some ways to prevent trash accumulating in this area?

APPENDIX B

MOODLE2 SCREENSHOT OF CASE STUDIES

APPENDIX B
Moodle2 Screenshot of Case Studies

Chapters 15 & 16: Oceanography

📄 Chapter 15 Resources
📄 Chapter 16 Resources
Case Study #4: First: Read the following article 'Great Pacific Garbage Patch' by opening the website below.

Second: Initial Questions: Open the forum and respond to the initial 3 questions by Wednesday 2- 13.

Third: Peer Response: Go through and read other classmates' responses. Respond to at least (but not limited) to 3 posts. This can include responding to a question or thought that someone posted on your initial response. Please do this by Friday 2-15

📄 Case Study #4: Pacific Garbage Gyre
Click on the above link to read an article to assist with the discussion questions

📄 Case Study #4: Pacific Garbage Gyre
Video, through SchoolTube, on the Great Pacific Trash Patch. Originally seen on Good Morning America.

👥 Case Study #4: Pacific Trash Gyre Forum

Chapters 17, 18 & 19: Plate Tectonics, Volcanoes & Earthquakes

📄 Chapter 17 Resources
📄 Chapter 18, 19 Resources
Case Study #7: First: Read the following article 'Ancient Volcanic Eruptions...' by opening the PDF file below

Second: Initial Questions: Open the forum and respond to the initial 4 questions by Thursday, March 21st

Third: Peer Response: Go through and read other classmates' responses. Respond to at least (but not limited) to 3 posts. This can include responding to a question or thought that someone posted on your initial response. Please do this by Tuesday, March 26th

You will be receiving a completion grade based on your discussions. Your grade will reflect 1)posting by the deadlines 2)responding to all questions and 3 peer posts 3)quality of posts– did you ask questions and engage in a discussion? something more than simply agreeing or disagreeing with someone, should explain your thoughts through your posts

📕 Case Study #7: Volcano Article
Read to help with discussion questions on the forum

📄 Permian Period Background
National Geographic Page on the Permian Period (299-250 Million Yrs Ago)

👥 Case Study #7: Volcanoes and Mass Extinctions

APPENDIX C

STUDENT PRE-SURVEY

<u>APPENDIX C</u>
Student Pre-Survey

Earth/Environmental Science   Name_____
Student Survey

Students, please read and respond to the following statements. Each statement will be based on your reaction and you will not be judged as 'right' or 'wrong'. Please be honest in your responses and answer any follow-up questions in the space provided. Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

Rate each statement and respond by circling only one of the numerical values. The values are based on how much you agree with the statement. You must select one of the following options:

4= Strongly Agree
3= Agree
2= Disagree
1= Strongly Disagree

	Strongly Agree	Agree	Disagree	Strongly Disagree
1. I think that learning Earth/Environmental Science is important in my life	**4**	**3**	**2**	**1**
Why or why not?				
2. I can relate science concepts to experiences in my life	**4**	**3**	**2**	**1**
If you agreed, please provide an example.				
3. I am excited about Earth and Environmental Topics	**4**	**3**	**2**	**1**
4. I often think of stories or examples that relate to the content of the day	**4**	**3**	**2**	**1**
5. I feel like I can achieve in this class	**4**	**3**	**2**	**1**
6. I would consider myself a motivated student	**4**	**3**	**2**	**1**
If you disagree, please explain what would help you to become motivated?				
7. I participate in classroom discussions	**4**	**3**	**2**	**1**
Why or why not?				
8. I am shy and rarely speak in class	**4**	**3**	**2**	**1**
9. I would be interested in reading case studies or current events that relate to our material	**4**	**3**	**2**	**1**
10. I am capable of using technology, such as email, opening documents online, instant messaging & posting on walls	**4**	**3**	**2**	**1**
If you agree, what kinds of technology do you use on a regular basis?				
Do you have any other comments or ideas you would like to share regarding this class?				

APPENDIX D

STUDENT POST-SURVEY

APPENDIX D
Student Post-Survey

Earth/Environmental Science   Name_____
Student Survey

Students, please read and respond to the following statements. Each statement will be based on your reaction and you will not be judged as 'right' or 'wrong'. Please be honest in your responses and answer any follow-up questions in the space provided. Participation in this research is voluntary and participation or non-participation will not affect a student's grades or class standing in any way.

Rate each statement and respond by circling only one of the numerical values. The values are based on how much you agree with the statement. You must select one of the following options:

4= Strongly Agree
3= Agree
2= Disagree
1= Strongly Disagree

	Strongly Agree	Agree	Disagree	Strongly Disagree
1. I think that learning Earth/Environmental Science is important in my life	**4**	**3**	**2**	**1**
Why or why not?				
2. I can relate science concepts to experiences in my life	**4**	**3**	**2**	**1**
If you agreed, please provide an example.				
3. I am excited about Earth and Environmental Topics	**4**	**3**	**2**	**1**
4. I often think of stories or examples that relate to the content of the day	**4**	**3**	**2**	**1**
5. I feel like I have achieved in this class	**4**	**3**	**2**	**1**
6. I would consider myself a motivated student	**4**	**3**	**2**	**1**
If you disagree, please explain what would help you to become motivated?				
7. I participate in classroom discussions	**4**	**3**	**2**	**1**
Why or why not?				
8. I am shy and rarely speak in class	**4**	**3**	**2**	**1**
9. I am interested in reading case studies or current events that relate to our material	**4**	**3**	**2**	**1**
10. I fully participate in the Moodle online discussions	**4**	**3**	**2**	**1**
If you disagreed, why didn't you fully participate?				

11. I feel that online discussions are more beneficial than in class discussions	4	3	2	1
Why or why not?				
12. I was engaged and interested by the material presented in the case studies	4	3	2	1
What did you enjoy most about reading and discussing the case studies?				
What did you enjoy the least about reading and discussing the case studies?				

APPENDIX E

PRE AND POST SURVEY RESULTS

APPENDIX E
Pre and Post Survey Results

	Q1			Q2			Q3			Q4			Q5			Q6			Q7			Q8			Q9		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
A	3	4	1	2	2	0	2	3	1	3	2	1	4	3	1	4	3	1	3	4	1	2	1	1	3	1	2
B	3	3	0	2	2	0	3	2	1	3	2	1	3	2	1	2	3	1	3	3	0	3	2	1	3	1	2
C	1	2	1	2	2	0	2	2	0	2	2	0	3	3	0	3	3	0	2	2	0	2	2	0	2	2	0
D	3	3	0	3	4	1	4	3	1	3	2	1	4	3	1	4	3	1	3	2	1	2	1	1	4	1	3
E	3	3	0	2	2	0	3	2	1	3	1	2	3	3	0	3	3	0	2	2	0	4	4	0	3	1	2
F	2	2	0	3	2	1	2	2	0	3	2	1	3	3	0	3	3	0	2	2	0	2	2	0	2	3	1
G	4	3	1	3	3	0	3	4	1	3	3	0	4	4	0	4	4	0	3	3	0	3	3	0	3	4	1
H	3	3	0	2	2	0	3	3	0	2	3	1	3	3	0	4	3	1	3	3	0	1	1	0	2	1	1
I	2	3	1	3	3	0	2	2	0	2	3	1	3	3	0	3	3	0	3	3	0	3	3	0	3	3	0
J	3	3	0	3	3	0	3	2	1	2	3	1	3	2	1	3	3	0	3	3	0	2	1	1	3	2	1
K	3	3	0	2	3	1	3	3	0	3	3	0	3	4	1	3	4	1	3	4	1	1	1	0	3	3	0
L	2	2	0	2	2	0	2	3	1	1	2	1	3	3	0	3	3	0	2	2	0	4	2	2	2	2	0
M	3	3	0	2	2	0	4	3	1	2	3	1	4	4	0	3	3	0	3	3	0	2	2	0	3	3	0
N	3	3	0	2	3	1	2	3	1	2	4	2	3	4	1	3	4	1	3	1	2	3	2	1	2	3	1
O	3	3	0	2	3	1	3	3	0	3	3	0	3	3	0	3	3	0	3	3	0	3	1	2	3	3	0
P	3	3	0	2	3	1	2	3	1	3	2	1	4	3	1	3	4	1	3	3	0	2	1	1	3	3	0
AV	2.8	2.9	2	2.3	2.6	4	2.7	2.7	0	2.5	2.5	0	3.3	3.1	3	3.2	3.3	1	2.8	2.7	1	2.4	1.8	10	2.8	2.3	8

Pink= Negative Change

Green= Positive Change

APPENDIX F

DISCUSSION FORUM STUDENT WORK SAMPLES

APPENDIX F
Discussion Forum Examples

Case Study #6: Mammals Feel the Heat Discussion.   Script from Question #1 represents a lower-order level (Remembering) and Question #3 represents a higher-order level (Analyzing) of questions. Scripts are from two separate groups, each group contains three students.

Question #1 *by Teacher*- "Why are species being left 'homeless'?"

Re: Question #1 *by A*- "species that live in the forest like trees."

Re: Question #1 *by B* – "Your right because that is a not the only solution, we can be more environmentally friendly and try to help their environment"

Re: Question #1 *by C*– "Is finding a new home the only solution?"

Re: Question #1 *by C*– "probably due to power plants"

Re: Question #1 *by B* – "Why are the habitats being torn down and what is tearing them down."

Re: Question #1 *by B* – "This is true but have you thought about why global warming could cause animals losing their habitats or why we help cause global warming?"

Re: Question #1 *by C* – "Their habitats are being torn down"

Re: Question #1 *by A* – "Because of reconstruction and house building"

Re: Question #1 *by B* – "Because if or when bad weather conditions hit certain types of animals they will not be able to move to find a new home therefore they will parish."

___

Question #3 *by Teacher* – "If a species can no longer survive in its habitat what does it do (what is its response)? However, why is this response no longer something every species can do to survive?"

Re: Question #3 *by A* – "The species will migrate to another habitat but if its like a penguin living in the arctic and all of the ice is melting they cant go any where"

Re: Question #3 *by B* – "1. The species might have to adapt to a new area.
2. Lack of resources, predators, and other things can cause a species to not adapt. because there less dominant."

Re: Question #3 *by C* – "It either moves away to find a new home or it adapts to the new climate or habitat"

APPENDIX G

DISCUSSION BOARD RUBRIC

APPENDIX G
Discussion Board Rubric

Discussion Board Rubric   Name: _____

               Total Points: _____= _____%

	0	1	2	3
Initial Posts by Deadline	Did not post to initial questions	Posted to 1 initial question	Posted to 2 initial questions	Posted to 3 or more initial questions
Peer Responses by Deadline	Did not respond to peers	Responded 1 time to peers	Responded 2 times to peers	Responded 3 times to peers
Quality of Initial Posts	Posts show little or no evidence that readings were completed	Posts show limited supporting statements that link the question and readings	Posts show evidence that link the question and readings	Posts show evidence that link the question and readings plus additional research or questions supporting the concept
Quality of Peer Responses	Responses show little or no evidence that peer posts were read	Posts are not original or substantial, does not add value to the conversation	Posts are original and substantial, contributes ideas and value to the conversation	Posts are original and stimulates conversation, contributes new ideas and questions that lead to further discussion

APPENDIX H

IRB CONSENT FORM

APPENDIX H
IRB Consent Form

INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
FWA 00000165

960 Technology Blvd. Room 127
c/o Immunology & Infectious Diseases
Montana State University
Bozeman, MT 59718
Telephone: 406-994-6783
FAX: 406-994-4303
E-mail: cherylj@montana.edu

Chair: Mark Quinn
406-994-5721
mquinn@montana.edu
Administrator:
Cheryl Johnson
406-994-6783
cherylj@montana.edu

MEMORANDUM
....

TO: Laura Patch and Walt Woolbaugh

FROM: Mark Quinn, Chair *Mark Quinn cjj*

DATE: December 21, 2012

RE: *"Online Collaboration Impact on Student Engagement and Communication in Environmental Science"*
[LP122112-EX]

The above research, described in your submission of December 21, 2012, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

X   (b) (1)   Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

X   (b) (2)   Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.

_____   (b) (3)   Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

_____   (b) (4)   Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.

_____   (b) (5)   Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

_____   (b) (6)   Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.

<u>APPENDIX I</u>
DISCUSSION BOARD RUBRIC SCORES BY CASE STUDY

APPENDIX I

Discussion Board Rubric Scores By Case Study

Student ID	CS1	CS2	CS3	CS4	CS5	CS6	CS7	Avg 1-7	Avg 2-7	Avg 2,3,4	Avg 5,6,7
A	5	5	3	2	3	2	5	3.57	3.33	3.33	3.33
B	3	7	3	5	0	4	2	3.42	3.5	5.0	2.0
C	6	5	5	5	4	5	5	5.0	4.83	5.0	4.66
D	5	4	8	3	4	2	5	4.42	4.33	5.0	3.66
E	5	5	5	3	0	5	6	4.14	4.0	4.33	3.66
F	7	4	2	7	5	10	6	5.85	5.66	4.33	7.0
G	9	12	10	9	10	12	12	10.57	10.83	10.33	11.33
H	10	7	4	8	5	5	4	6.14	5.5	6.33	4.66
I	2	3	0	7	0	5	4	3.0	3.16	3.33	3.0
J	5	10	10	5	8	5	9	7.42	7.83	8.33	7.33
K	8	5	5	6	5	5	9	6.14	5.83	5.33	6.33
L	5	5	5	4	4	5	5	4.71	4.66	4.66	4.66
M	7	11	12	10	12	11	12	10.71	11.33	11.0	11.66
N	5	3	9	5	5	0	6	4.71	5.66	5.66	3.66
O	9	10	7	7	4	5	6	6.85	6.5	8.0	5.0
P	3	5	3	4	3	3	5	3.71	3.83	4.0	3.66
Average by Case Study	5.87	6.31	5.68	5.62	4.5	5.25	6.31				