THE EFFICACY OF USING VOICETHREAD AS A FORMATIVE ASSESSMENT TOOL AND A WAY TO FOSTER A GREATER SENSE OF ONLINE COURSE COMMUNITY IN A HYBRID GEOSCIENCE COURSE

by

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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 borrowers under rules of the program.

Natasha L. Cleveland

July 2012

DEDICATION

This paper is dedicated to my children, Coldon and Reygan, who were both born during my pursuit of the MSSE degree. Thank you for making life and everything in it mean so much more! May you each discover your passion and love of learning.

And to my husband Jeff, for your unwavering love and support, especially as my two year jaunt became a six year marathon!

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ABSTRACT

VoiceThread replaced traditional PowerPoint lecture notes and discussion forums in the online component of a hybrid geoscience general education course. This technology facilitated a greater sense of course community and instructor presence, which increased student engagement and learning. The ability to make comments using various text and audio capabilities around visual media improved student-teacher and student-student interactions. Audio capabilities were not well utilized by students but students appreciated the instructor audio comments and feedback. Student comments on VoiceThread enabled the instructor to have a clearer understanding of student learning and misconceptions, which was then used to plan interventions and modifications in learning strategies.

INTRODUCTION AND BACKGROUND

Project Background

For the past nine years I have been teaching geoscience and physical science courses at Frederick Community College (FCC) in Frederick, MD. Frederick is the second largest city in Maryland but remains a mostly rural and middle-class community. The courses that I teach are required science lab courses in the Associates of Arts and Teaching degree for early childhood and elementary education programs. Typically one half to two thirds of my students plan to teach at the K-6 level. The rest of the students take these courses to fulfill college General Education requirements. The majority of my students are usually female and, as with FCC as a whole, are mostly Caucasian American.

One of my core courses, PC 115 Introduction to Geoscience, covers a variety of topics in the geosciences. The focus of the course is on the processes that happen in and between the four earth spheres: the hydrosphere, the geosphere, the atmosphere, and the biosphere. The course typically fills to capacity with 20 students. Traditional face-to-face (f2f) sections combine a wide variety of pedagogic practices to enhance learning, including lectures, large and small group discussions, small group and individual problem solving, and hands-on labs and activities.

Since Fall Semester 2007 I have taught at least one section of PC 115 per academic year as a hybrid course. Hybrid courses meet on campus once a week for a two and a half hour face-to-face (f2f) lab experience and the rest of the course, including discussions, lectures, assignments, etc. are offered online. For the first time in Spring

Semester 2011 PC 115 was offered as a 7-week intensive hybrid section. The class met for 5.25 hours on Saturdays and the rest of the class content was offered online. Eighteen students were enrolled in the class and all but one were female.

The most challenging aspect for me about online teaching and learning has been to fully understand what students are doing and learning during the online portion of the course. I have offered online lecture notes via traditional PowerPoint slides, and though I have received favorable student feedback about the lecture slides, they are a one-way path of communication from instructor to student. I also have typically utilized online discussion forums for student-driven discussions about relevant events and topics associated with weekly concepts, but participation in those discussion forums has not yielded much useful information about student learning. Responses are typically not as reflective and thoughtful as I hope. They are also quite repetitive, making it obvious that students are not reading or responding to posts made by their classmates. With a few exceptions each semester, most students seem to focus on posting the minimum number of discussion comments each week rather than sincerely engaging with the subject material.

Another strategy that I have tried in an attempt to collect information about online student learning is to devote a discussion forum to student questions about course concepts. However, students typically only use this forum to clarify assignment due dates and rarely ask questions about course concepts. As an online course I do not receive the immediate verbal and nonverbal cues that I can use to make near immediate modifications in teaching strategies to improve learning and understanding as I typically am able to do in a f2f course. Online student silence has been my greatest frustration,

especially when I observe during campus labs that student preparation and understanding are often lacking.

One of the great advantages of online teaching is the capacity to utilize web technologies to enhance asynchronous learning. In Summer 2009 I was introduced to a web technology called VoiceThread. VoiceThread is a collaborative, multimedia slide show that allows users to interact and make comments via webcam, microphone, telephone, and text. I immediately recognized the potential this technology has for online learning to blend what I had been doing with online lectures and discussion forums and produce a richer, more collaborative learning environment. VoiceThreads enable the participant to participate in discussions and ask and answer questions in a variety of ways, many of which include easy-to-create voice comments. This technologic tool could provide instructor and students alike with an improved ability to clarify concepts and actively engage with other class members while still maintaining the flexibility and convenience of an asynchronous online course.

Focus Question

Concern about student learning and engagement and the desire to correct misconceptions and other problems in student learning prior to campus experiences and summative assessments led me to my primary focus question: Are VoiceThreads an effective way for me to formatively assess student learning? I also wanted to know if VoiceThread was an effective alternative to traditional lecture notes and discussion forums to encourage student online interaction and collaboration.

CONCEPTUAL FRAMEWORK

College graduates often have difficulty retaining and applying information that they have learned in science classes and/or their understanding is filled with misconceptions (Lord & Baviska, 2007). This is especially true when pedagogy consists of mostly traditional lecture, where students passively receive information from the lecturer, and when assessment of learning is mostly based on memorization and recall of facts and concepts. As educational goals change and expand to meet the demanding needs of the 21st century, so must the ways to meet and measure achievement of those goals (Association for American Colleges and Universities, 2000).

Expectations of improvements in student learning and assessment of that learning are as much a part of online and hybrid (half online, half campus) courses as they are traditional courses. These types of alternative courses are increasingly being offered at institutions of higher education, particularly community colleges, as a way to accommodate education needs of a diverse student population. In the Fall 2010 semester, over 6.1 million students, or approximately 31% of higher education students, were taking at least one online course. The growth rate of online course offerings (10%) has far outpaced the rate of total student enrollment (<1%). Most colleges and universities, especially those that currently offer online courses, expect that this trend will continue (Allen & Seaman, 2011).

While there are some faculty who continue to perceive face-to-face (f2f) instruction as superior to online delivery, there is compelling evidence that online learning is as effective, or even more effective, at facilitating student learning as traditional f2f courses (Jones & Chen, 2008; U.S. Department of Education, 2009). A

meta-analysis conducted by the U.S. Department of Education (2009) of over a thousand empirical studies of online learning completed between 1996 and 2008 suggests that "classes with online learning (whether taught completely online or blended) on average produce stronger student learning outcomes than do classes with solely face-to-face instruction" (p. 18). This analysis also revealed that the benefit is even greater for hybrid learning. However, the meta-analysis also concluded that the differences in learning outcomes between online and f2f instruction are probably not due to the medium of course delivery, but rather to the learning conditions, such as time spent on learning, pedagogy, and curriculum. Online and hybrid learning tend to use more active learning strategies, problem based learning, collaborative learning, and independent practice, instructional strategies that have been shown to enhance student learning, regardless of the medium of course delivery (Edvantia, 2005; Hanover Research Council, 2009; Froyd, 2007). In the end, using a variety of research-based teaching strategies for course design and delivery, regardless of the delivery format, has been shown to enhance student learning and engagement.

A strong sense of learning community, partly defined as 1) a sense of shared purpose, 2) interaction among members, and 3) a level of trust, respect, and support, is an important component to overall academic success and course satisfaction, particularly in online courses (Vesely, Bloom, & Sherlock, 2007) . Vesely, Bloom, and Sherlock (2007) report that online faculty and students perceive that being a part of a learning community enhances student learning and academic performance. However, both groups also perceive that building community in online courses is more challenging compared to f2f courses. Unlike traditional f2f courses, where many learning activities and assessments

depend on the f2f interaction of students and instructor, online instructor-student and student-student interactions largely take place asynchronously (Austin & Mescia, 2001). Online community may be more challenging because 1) text-based communication usually lacks nuance, 2) any collaboration time is spent working on assignments rather than sharing personal experiences that typically foster community, and 3) there is often lack of participation on the parts of online learners (Vesely et al., 2007).

Richardson and Swan (2002) suggest a positive correlation between student perceptions of online social presence from both the instructor and student and overall perceived learning. This study also suggests a link between student perceptions of overall instructor satisfaction and overall perceived learning. In fact, instructor social presence seems to play a key role in modeling and facilitating online community and learning. Shea, Fredericksen, Pickett, and Pelz (2003) define instructor presence as 1) instructional design and coordination, 2) facilitation of discourse, and 3) direct instruction. Students who report high levels of instructor presence also report high levels of learning and course satisfaction (Shea, Fredericksen, Pickett, & Pelz, 2003; Shea, Pickett, & Pelz, 2003). A survey conducted by Vesely, Bloom, and Sherlock (2007) reveal that students rank instructor modeling behaviors (participation, feedback, and communication) as the most important factor in building course community.

The use of audio features may enhance a sense of online instructor presence, which can thus improve student perception of course community. Through student surveys and interviews, Ice, Curtis, Phillips, and Wells (2007) found that using audio feedback for student work, including discussion postings and submitted assignments, yielded several positive themes. First, audio comments improved ability to convey

nuance, which can reduce the potential confusion and misinterpretation often associated with text-based comments. The second theme that emerged was the feeling of increased involvement, or sense of community, as students reported feeling more a part of a real class. The third theme was improved content retention, as the learning style for some students was more conducive to audio rather than written comments. Finally, there was a sense that instructors were involved in the learning process and cared about student learning.

Hornsby (2008) has summarized several guiding principles for designing effective and learner-centered online courses. These principles include establishing well-constructed discussion assignments with balanced instructor participation, student participation in diverse, student-centered learning activities, and ongoing feedback consisting of both summative and formative assessment strategies. The goal of formative assessments is to provide information about student learning that both instructor and student can use to alter and adapt teaching and learning strategies. Ideally, formative assessments help close the gap between what teachers think student have learned and what students actually understand. Effective teachers use this feedback to make pedagogic adjustments, such as re-teaching, including additional practice problems, activities, analogies, and/or examples, and allowing additional time on especially problematic concepts. Consistent and on-going assessment can help correct misconceptions and improve learning prior to summative assessments (Boston, 2002; Angelo & Cross, 1993).

Formative assessment tends to be even more challenging in online courses due to the lack of immediate visual, verbal and non-verbal cues typically observed in a f2f

course. The online course's asynchronous learning environment and potential technical issues also present obstacles to the goal of immediacy in formative assessment feedback. Also, if students do not initiate questions, it is difficult for the instructor to assess learning. Student silence does not guarantee student understanding, nor does it guarantee lack of student understanding. Beyond counting the number of posts in online discussion forums or the number of times students login to course managements systems, effective online formative assessments must encourage student self-monitoring and regulation, a learning community, and learner autonomy. Because of the unique learning environment, assessment strategies that are effective in f2f courses may not be directly transferable to online environments (Beebe, Vonderwell & Boboc, 2010).

Quality and consistency of interactions, such as discussions, seem to be one of the best online formative assessment practices. Discussions are a common cooperative learning technique in both online and f2f courses that generally focus on student-student interaction facilitated by the instructor. This type of interaction encourages a deeper engagement with and reflection on course topics, which deepens student learning. Discussions can also serve as a formative assessment tool that allows the instructor to "observe" student ideas and then modify teaching practices as needed (Harris & Sandor, 2007). While student centered discussions in f2f courses tend to be unstructured, spontaneous and take less time, online discussions are more reflective, structured, asynchronous and require more time (Wang & Woo, 2007; Meyer, 2003). They also tend to encourage more student participation since students who may be more reticent in a traditional classroom are more likely to participate in online forums (Beebe, Vonderwell, & Boroc, 2010).

Paradoxically, though discussion participation and reflection can deepen in an online environment, students in online courses still report feeling disconnected and isolated compared to f2f courses (Stodel, Thompson, & MacDonald, 2006; Wang & Woo, 2007). Surveys of student perceptions of asynchronous online discussions suggest the following disadvantages: 1) ideas are often repeated by other students, suggesting that previous threads had not been reviewed, 2) there is a lack of tone and body language that can help convey meaning, 3) the time lag between comments disrupts the natural robustness of discussion, 4) humor and energy that are often found in f2f discussions are missing, 5) lack of comments to a student's post can lead to a feeling of isolation and a sense of being ignored, and 6) discussions can be viewed as overly positive and fake, with the preponderance of "Good point" and "I agree" responses (Stodel et al, 2006; Ellis, 2001). Also, the reliance on written comments in most types of discussion forums may marginalize those learners that benefit from vocal cues (Wang & Woo, 2007).

Though asynchronous online discussions may have some inevitable limitations, such as the time lag between comments, due to the very nature of such discussions, there are potential Web 2.0 technologies that can mitigate other limitations, such as the sole reliance on written comments and the lack of visual media around which discussions may center. One of these technologies is VoiceThread. A VoiceThread is a collaborative slide show that displays and shares text, images, documents, and videos. What sets VoiceThread apart from other collaborative forums is the ability for users to post comments via a webcam, microphone, keyboard, or telephone. Thus, a user's audio and video comments can enhance the virtual collaborative learning experience and the feel that one is communicating with a "real" person. Users can also use a "Doodle" tool to

draw on the slides in order to emphasize comments. The result is a Flash-based animation that preserves both the original artifact and the recorded comments (and Doodles) that students may revisit for review. This technology helps bridge the gap between real time conversations and recorded podcasts and/or lecture presentations. VoiceThreads can be embedded into class blogs or course management systems (such as Blackboard) and, just like discussion forums, users can access and post to the thread from any location at any time (VoiceThread, 2012; Educause Learning Initiative, 2009; Brunvand & Byrd, 2011).

As a relatively new type of collaborative social media, there are few formal studies concerning the efficacy of VoiceThreads as a learning tool. Borup, Graham and Velasquez (2011) used VoiceThread as part of a study exploring the efficacy of using asynchronous video communication in a blended learning class. Their results suggest that this technology facilitated improved student-instructor communication. Instructor observations suggest that video communication effectively communicates nonverbal cues such as student frustration or confusion that would otherwise be missing from text-based comments. Most students in the study had a favorable perception of VoiceThread. Favorable comments focused on a heightened sense of instructor immediacy and presence and the ease by which students could participate in conversations without being in a physical class. However, the majority of students also felt that VoiceThread did not allow them to better get to know their peers.

McCormack (2010) used VoiceThread as a way to elicit more reflective and in-depth responses from undergraduate teacher candidates. Students in the study reported that using the technology heightened their ability to reflect and apply correct terms to

case study assignments provided via VoiceThread. It encouraged them to be more purposeful in their responses and spend more time interpreting and analyzing given problems. McCormack concluded that VoiceThread is a tool that has the potential to enhance and augment student reflections.

Friedman and Lee (2009) compared middle and high school debates using traditional methods and VoiceThread and concluded that there was little difference in the degree of student engagement. This study highlighted a few pedagogic characteristics of VoiceThread, including 1) the need to use visuals, 2) the need for added commentary, and 3) the linear flow of information. However, the authors do admit that enabling students to upload their own images may have elicited improved student engagement.

Burden and Atkinson (2008) underscores the need for sound planning in course design, especially when using an emerging technology. The use of VoiceThread technology itself does not necessarily improve assessment, learning, or sense of community. Like any educational technology or instructional strategy, VoiceThreads must be carefully planned and developed according to clearly defined learning objectives. Otsuka and Vieira da Rocha (2007) suggest a general model of online formative assessment that consists of planning, monitoring, and implementation phases. The planning and monitoring phases can be specifically applied to the use of VoiceThreads as a formative assessment tool. The planning phase consists of identifying learning goals and behaviors and establishing criteria to evaluate progression toward those goals. The monitoring phase consists of continual analysis of learner participation and progress and includes three levels of monitoring: 1) individual student monitoring in specific learning

activities, 2) general monitoring of the class through each learning activity, and 3) global monitoring of the class over a set of learning activities

Pacansky-Brock (2010), an online instructor and 2010 Sloan-C Effective Practices Award recipient, has used VoiceThread in her online courses as a formative assessment tool. Students posted comments and perspectives on weekly VoiceThreads, which provided a "safe" learning environment that would prepare them for future summative assessments. Student feedback suggests that the use of VoiceThreads in this class fostered a greater sense of community and collaborative learning. Many students noted that VoiceThreads were faster, easier, more convenient, and richer than a traditional discussion forum and avoided some of the miscommunication that can often occur with text-based messages. Several students also stated that as visual learners, VoiceThreads enhanced their learning far more than discussion boards because discussions were directly associated with some sort of visual artifact. There were also several comments that VoiceThreads made the class feel more interactive, like a traditional course.

The aforementioned studies suggest that VoiceThread may be a suitable alternative to traditional online discussion forums and lectures. It has the potential to foster a greater sense of course community and social presence by inviting other forms of communication, including audio and video. Most importantly, VoiceThreads have the potential to help improve an instructor's ability to formatively assess learning with the overall goal of improving students' online learning experience.

METHODOLOGY

The methodology that I used to assess the use of VoiceThread as a tool to formatively assess student learning and to foster a greater sense of online student community consisted of both qualitative and quantitative data collection strategies. 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.

At the beginning of the seven week geoscience course I gathered baseline data concerning student perceptions of online discussions and content knowledge by administering two questionnaires: the Student Perception Survey about Online Discussions (SPSOD) and selected questions from the Geoscience Concept Inventory (GCI). I developed the SPSOD to gather information about student perceptions related to past experiences using discussion forums in online and hybrid courses (Appendix A). It consisted of Likert-style questions with four possible responses: *strongly agree, somewhat agree, somewhat disagree,* and *strongly disagree.* Each response was tallied and reported as percentages. It also included open-ended questions regarding student perceptions of the challenges and benefits of online discussion forums.

The GCI is an assessment instrument that has been developed to assess entry-level college student understanding of various topics within geoscience. GCI questions have been reviewed and validated by scientists and science educators and have been piloted with over 3500 students representing 60 universities and colleges nationwide (Libarkin & Anderson, 2007). I compiled approximately 25 of the GCI questions that most directly relate to the topics that are covered in my geoscience course. The same selection of

questions was also given to students at the end of the class session as a post-assessment of learning. I calculated the average and median pre- and post-GCI scores as well as the pre- and post-average scores for individual questions. The pre- and post-averages were then compared to provide an indication of overall student learning.

I used VoiceThread as the platform to share online lecture notes and conduct online discussions. Each VoiceThread presentation contained a mix of lecture notes, figures, photographs, and small group and class discussion questions. Short articles that describe the development of important scientific theories were also included. A total of seven VoiceThreads, one for each of week of the class session, were created and linked from the course management system (Blackboard). I used student comments made on each weekly VoiceThread to glean information about student learning. This information was used to develop formative assessment strategies that were implemented at the beginning of each weekly campus meeting.

The goal for week one of the seven week course session was for students to become acquainted with VoiceThread. This included successfully registering for a free account on the VoiceThread website, posting an introduction on the Module 1 VoiceThread, and reviewing Module 1 lecture notes (Plate Tectonics and Earth's Interior). For Modules 2-6 of the course session, students were required to post at least five comments on at least two different days. Weekly topics included Earthquakes, Volcanoes, and Minerals (Module 2), Rocks and Earth History (Module 3), Oceans, Groundwater, Glaciers, and Rivers (Module 4), Weather and Climate (Module 5), and Solar System and Universe (Module 6). Week 7 activities were devoted to preparing for the cumulative final exam and providing substantive feedback about VoiceThread.

I kept a record of my project reflections in a researcher reflection journal where I reflected on the types and quality of student comments made on the weekly VoiceThreads. Each weekly entry included at least three parts: reflections upon what I learned about online student learning, plans to modify teaching practices based upon that learning, and reflections upon the consequences of those modifications. My reflections upon student learning also included reflections of gaps identified from VoiceThread participation. For example, if student participation was low or non-existent on certain VoiceThread discussion questions, I had to assess if that lack of participation was due to a sufficient number of other more desirable opportunities to participate or if it was due to possible problems in student understanding related to that concept. The reflection journal was key to developing the formative assessment exercises implemented each week during the campus, or face to face (f2f), part of the course.

An important part of the project was to modify practices based on what I gleaned about student learning from each weekly VoiceThread. These modifications were made as a direct result of observations and reflections noted in the researcher reflection journal. Opportunities to participate in weekly VoiceThreads closed at approximately midday each Thursday, which provided me the opportunity to reflect upon student responses and plan interventions to address potential misconceptions and points of confusion. The reflection journal shared those plans, which largely comprised of the development of Think-Pair-Share questions and other formative assessment assignments, such as concept mapping. These formative assessments were completed during the first 45-60 minutes of the weekly Saturday f2f component of the course.

I also kept a headcount of the total and types of student participation on each weekly VoiceThread (Weekly VoiceThread Headcount, or WVH). The WVH also indicated whether or not the comment was made using one of the audio features available on VoiceThread. Categories of student participation included question or comments to lecture slides, responses to peer questions, participation in small group discussion problems, participation in class discussion slides, participation in post-lab review questions, and participation in recommended Checkpoint questions from the textbook (Appendix B). I tallied the total number of student comments on each VoiceThread and the percentage of this total that were made in each category. I also tallied the total number of student audio comments made on each weekly VoiceThread.

A very important part of my methodology was gathering student feedback about the use of VoiceThread technology as a learning and discussion tool. I gathered this feedback in three ways. First, the final VoiceThread of the class (week seven) was devoted to gathering student responses to five open-ended questions (Appendix C). Unlike the other VoiceThreads used in the course I did not show student comments to the class. Thus, only I and the student making the comment could see the responses to each question.

Second, the Student Perception Survey about VoiceThread (SPSV) was administered on the last day of class. The SPSV was very similar to the SPSOD administered at the beginning of the session, but it focused on the use of VoiceThreads in the class rather than on past online discussion forums (Appendix D). To avoid acronym confusion the two surveys will forthwith be referred to as the pre-survey (SPSOD) and the post-survey (SPSV). Just as with the pre-survey, I summed the Likert-type responses

for each post-survey question and reported the results as percentages. I then compared the responses from both surveys to help me assess student perspectives of whether or not VoiceThreads effectively address potential problems common in discussion forums.

Third, I used student feedback about VoiceThread that appeared in the standard student evaluations that are administered in most courses at Frederick Community College. These evaluations include open-ended questions where students identify components of the course that helped and did not help their learning. The total number of times that VoiceThread was mentioned in these responses as well as how it was described, either favorably or unfavorably, were tallied and reported.

In addition to comparison of pre- and post-GCI scores, information about student learning was gleaned from results from the comprehensive final exam. The average and median scores on the final exams were compared with the average and median scores of the final exam from the previous year. Though not identical the two final exams were highly comparable. Table 1 contains a summary of research questions and data collection techniques and instruments.

Table 1
Data Triangulation Matrix

Research Questions	Data Source			
	1	2	3	4
Is a VoiceThread an effective formative assessment tool?	Reflection Journal	Pre- and Post-GCI	Week 7 VoiceThread Feedback	
Is VoiceThread more effective at engaging students in the learning process than online discussion forums?	Reflection Journal	Comparison of pre- and post-surveys	WVH	FCC Student Evaluations
Do VoiceThreads foster a greater sense of online student community?	Reflection Journal	Comparison of pre- and post-surveys	FCC Student Evaluations	Week 7 VoiceThread Feedback
Does using a VoiceThread as a formative assessment tool enhance student learning?	Reflection Journal	Pre- and Post-GCI	Comparison of 2010 and 2011 Final Exam Scores	Comparison of pre- and post-surveys

DATA AND ANALYSIS

Results from the Student Perception Survey of Online Discussions (SPSOD) showed that 78% of registered students had previously taken at least one hybrid or online course, but none had any experience using VoiceThread technology (N=18). All of those prior online and hybrid courses had required participation in an online discussion forum. The SPSOD showed an overall favorable perception that students had of their past experience with online forums, with 85% of students noting they *strongly agreed* or *somewhat agreed* that online forums help them feel a part of a course community and enhanced their ability to learn the subject matter. The most commonly cited advantage of online discussion forums was the flexibility and the "ability to go to them when you want." Disadvantages of online discussion forums included the potential to be

"misunderstood" when "trying to get points across." Several students also noted the lag time between comments as a disadvantage, and one commented that "the large amounts of comments can be overwhelming."

Beginning in Module 2 (Earthquakes, Volcanoes, and Minerals), students were expected to make at least five VoiceThread comments per week. I kept track of the number and types of student responses in a Weekly VoiceThread Headcount (WVH). The average number of total weekly student VoiceThread comments was 95.2 or approximately 5.29 comments per student per week. The highest per student weekly average was 5.78 comments made during week 5 (The Atmosphere). The lowest average number of student comments was 4.94, which occurred during week 4 (The Hydrosphere) (Figure 1).

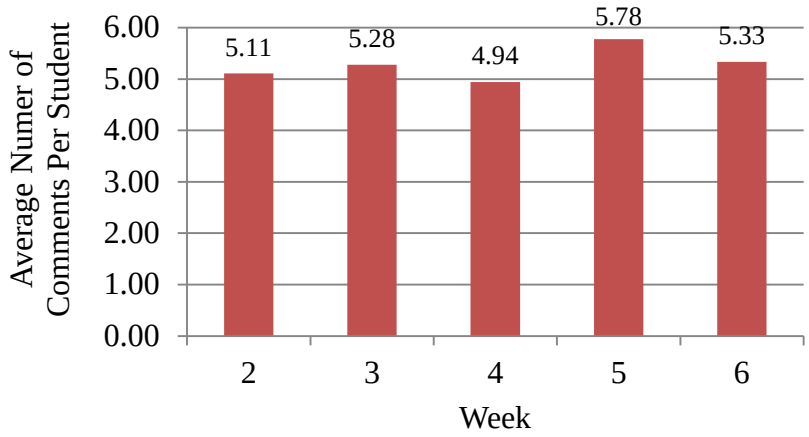


Figure 1. Average number of weekly student VoiceThread comments, (*N*=18).

The majority of the types of student comments seemed to be fairly evenly split between Small Group Discussion questions (21-26% of total), recommended textbook Checkpoint Questions (20-25% of total), and Questions and Responses that students made on lecture note slides (17-28% of total). Participation in Lab Review Questions

and in Class Discussion questions was highly variable, with numbers ranging from 2 to 22% of the total for the former and from 9 to 24% for the latter (Figure 2).

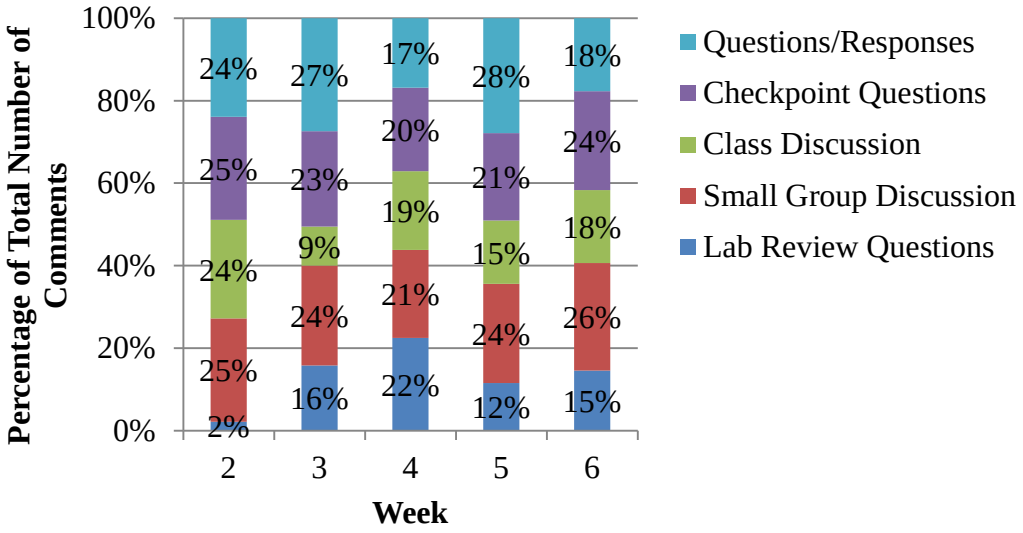


Figure 2. Percentage of types of student participation in weekly VoiceThreads, (*N*=18).

I also used the WVH to keep track of the total number of VoiceThread audio comments made each week (Figure 3). Though the average number of weekly comments was 95.2, the total number of audio comments ranged from 4 to 7, with an average of 5.4 audio comments made each week of the course session. The remaining comments were all text-based.

Reflections from my weekly researcher journal indicated surprise at the low number of weekly audio comments: "I thought students would be more likely to make verbal comments, especially as I am offering one bonus point per week for making at least one audio comment. Only a small handful (three to four) of students utilized this feature, and even then it was only for one of their five required comments." Informal conversations recorded in my journal reveal that embarrassment and nervousness may be the reason: "(Students said they) were too nervous to make audio comments and feared

they would just begin laughing and mess them up. One student said she wrote down everything she wanted to say and just read from the script. There continues to be a lack of use of the audio feature, and it appears that embarrassment may be the primary reason."

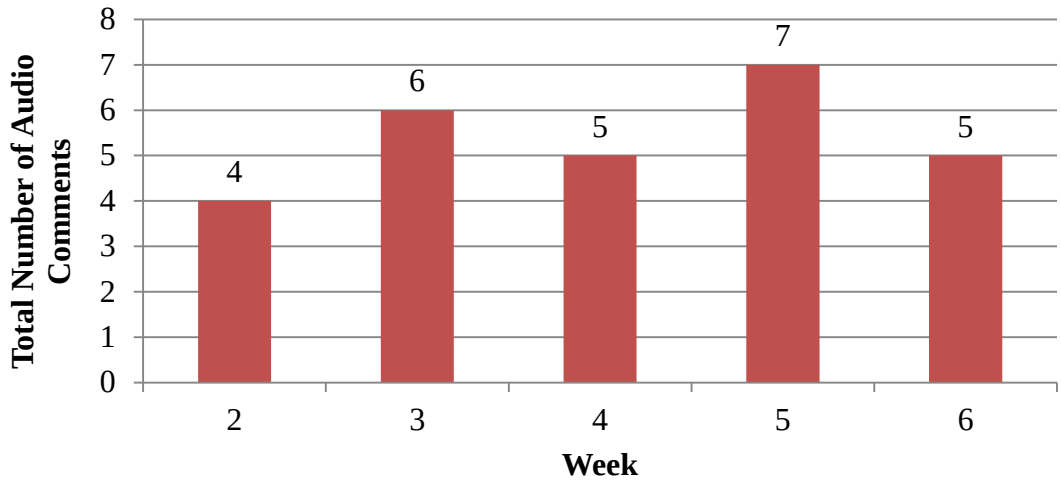


Figure 3. Total number of weekly VoiceThread audio comments, (*N*=18).

I used my weekly reflections from my researcher journal to develop formative assessment exercises to address apparent gaps in student understanding. For example, upon reviewing student VoiceThread comments for Module 2 (Earthquakes, Volcanoes, and Minerals), I stated in my reflection journal that student responses to post-lab review questions showed that "there is still confusion about the difference between Earth's physical and compositional layers, specifically regarding the difference between the crust and the lithosphere." I addressed these misconceptions by creating an erroneous diagram of earth's layers, which was used as a Think-Pair-Share (TPS) question (Figure 4). Appendix E shows representative samples of the formative assessment exercises that I developed each week as a direct result of what I gleaned about student learning from student VoiceThread comments.

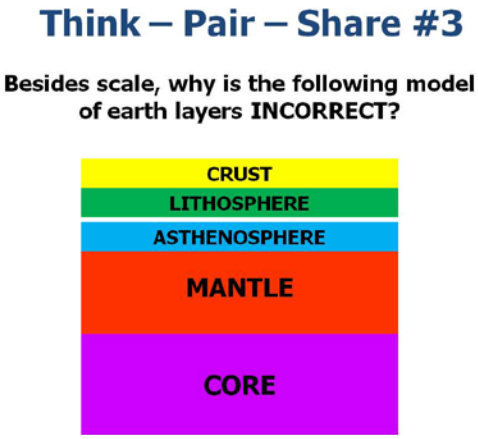


Figure 4. Example of Think-Pair-Share exercise developed in response to information gleaned about student learning in Module 2 VoiceThread.

Comparison of results from the pre-survey SPSOD and the post-survey Student Perception Survey of VoiceThreads (SPSV) yielded several themes. The first theme that emerged is that students perceive that online discussions, regardless of the format, are equivalent or superior to face-to-face (f2f) discussions in effectively facilitating discussion participation and learning. Seventy-seven percent of students in the pre-survey *strongly agreed* or *somewhat agreed* that they learn as much from online discussion forums as they do from f2f discussions (*N*=14). The percentage rose by 11% when asked the same question about VoiceThread discussions in the post-survey (*N*=18) (Figure 5). One student commented that VoiceThreads allow students to have "the same benefits as a face to face course." Another noted that they feel that VoiceThreads facilitate more participation because "unlike in (a) classroom where usually one student answers a question, every student had (an) opportunity to reflect and answer."

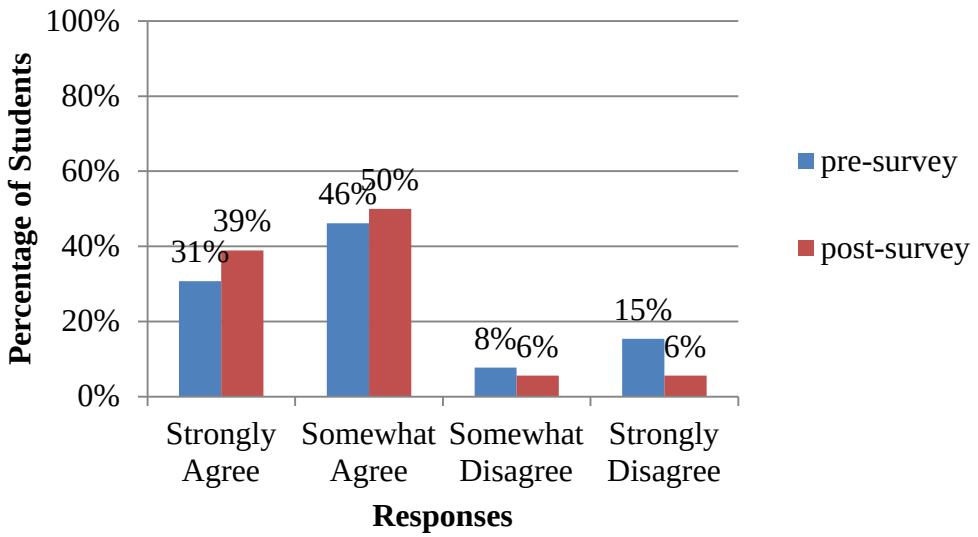


Figure 5. Responses to pre-survey (*N*=14) and post-survey (*N*=18) to "I learn as much or more from (online discussions/VoiceThreads) as I do from f2f class discussion."

When it comes to interactivity, 69% of students in the pre-survey *strongly agreed* or *somewhat agreed* that online discussion forums are as interactive as f2f discussions. This percentage jumped to 100% when asked the same question on the post-survey about VoiceThread interactions (Figure 6). Student comments revealed that interaction was better using VoiceThreads compared to traditional discussion forums. One student commented that VoiceThread "is easier to use compared to discussion boards and I felt that peer interaction was better on voicethread compared to discussion boards." Another student noted that she does not find the format of the typical online forum very appealing so she typically focuses on "one person's response." However, "with VoiceThread I looked at what everyone else posted because it is easy to do and it made me feel connected with my peers."

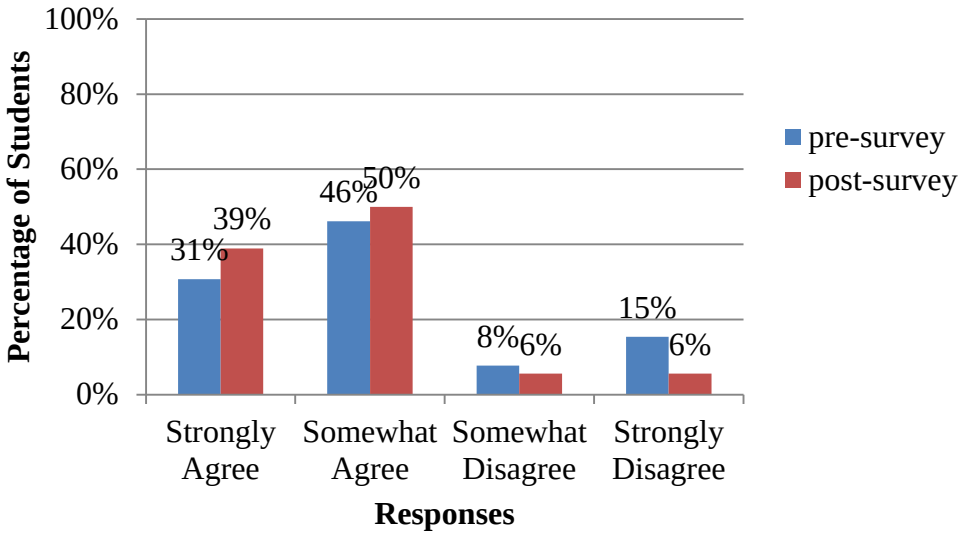


Figure 6. Responses to pre-survey (*N*=14) and post-survey (*N*=18) to "(Online discussions/VoiceThreads) are as interactive as f2f discussions."

The majority of students in both the pre-survey and the post-survey *strongly agreed* or *somewhat agreed* that their comments were more reflective in both online discussion forums (92%) and VoiceThread discussions (89%) (Figure 7). One student commented that VoiceThread in particular "helps the introverted person feel more comfortable participating in a discussion" and that this discussion format provides "more time to think about what your response is."

The second theme revealed by results from the pre- and post-surveys is the importance of a learning community. Responses from both surveys show that students feel that being part of a learning community is an important part of their learning experience. Eighty-five percent of students on the pre-survey (*N*=14) and 100% of students on the post-survey (*N*=18) *strongly agreed* or *somewhat agreed* that they are more motivated to succeed when they feel a part of a community in an online course (Figure 8). The percentage of students on the pre-survey who *strongly agreed* that online discussion forums help them feel a part of a course community was 62% (*N*=14).

This number increased by 21% when asked the same question on the post-survey about using VoiceThreads (*N*=18) (Figure 9).

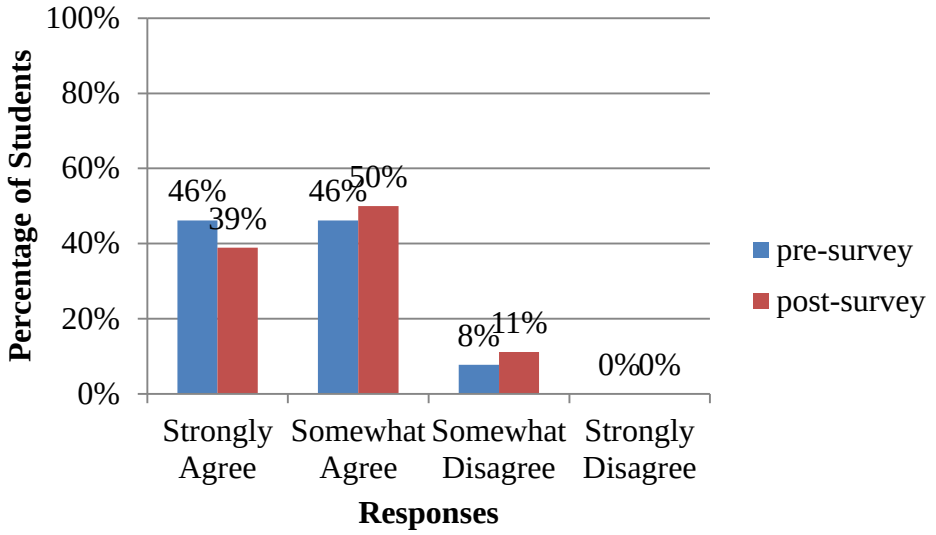


Figure 7. Responses to pre-survey (*N*=14) and post-survey (*N*=18) to "My (online discussion/VoiceThread) comments are more reflective and well thought out than my comments in a f2f discussion."

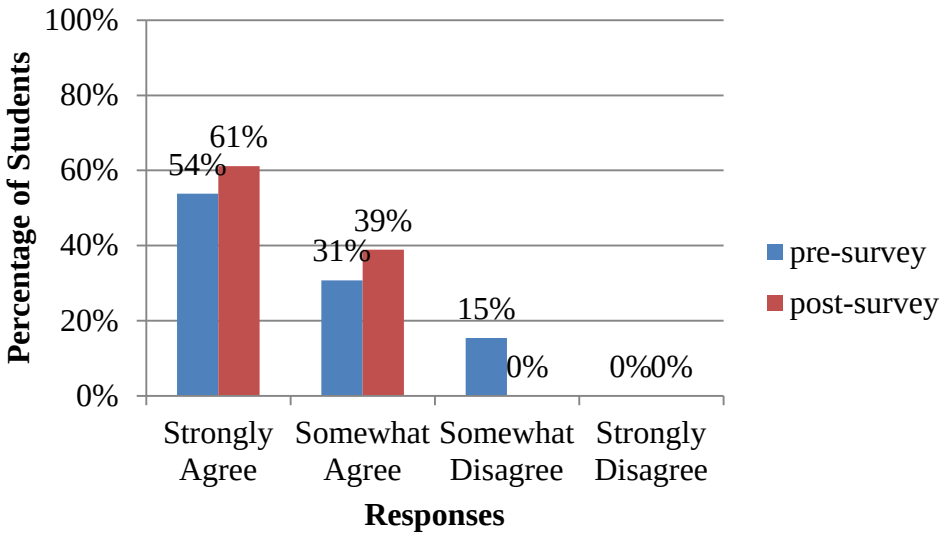


Figure 8. Responses to pre-survey (*N*=14) and post-survey (*N*=18) to "In general, when I feel that I am a part of a community in an online class I am more motivated to succeed."

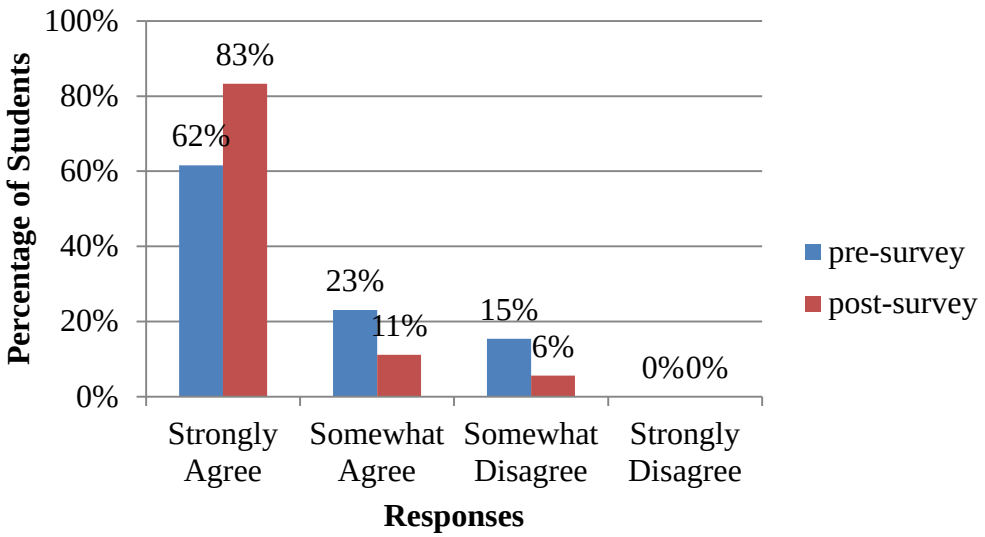


Figure 9. Responses to pre-survey (*N*=14) and post-survey (*N*=18) to "Online discussion forums/VoiceThreads) help me feel a part of a class community."

Student comments on the post-survey also indicated that VoiceThreads facilitate a sense of course community. One student noted the "strong learning community" provided by VoiceThreads where there is a "more comfortable environment to share and comment." Several students commented that they liked how VoiceThread was "more class-like" where one could "actually see other students." One student noted that VoiceThread is more informal, and "makes an online class seem more personal" which gave another student "a better feeling community with the class."

The importance of learning community also appeared in student responses on the Week 7 VoiceThread Feedback. When asked if VoiceThread helped establish a sense of course community 14 students responded in the affirmative (*N*=17). Peer interaction on specific slides was cited as the number one way that community was fostered. One student cited a specific example, where peers interacted on VoiceThread 6, when "most people had trouble with checkpoint 2.3" and "we were asking each other questions about it and trying to come up with the answer through various reasons." Another student

noted that interaction was easier using VoiceThread because “instead of reading through every post, you can just go to the slide you want to see what was said.”

Two students were unsure about whether or not VoiceThread enhanced a sense of community. Both stated that they didn’t really pay attention to their peers’ comments: “I was more concerned (about) getting my 5 (required weekly comments) in than responding and interacting with my classmates.” Another student said that even though VoiceThread did help establish course community, that “working together in the classroom has probably been a bigger factor.”

My weekly researcher journal also yielded observations about VoiceThread instructor-student and student-student interactions. For example, week 1 reflections revealed a significant difference in VoiceThread interaction verses previous student-instructor interactions: “students have asked several questions on VoiceThread to clarify concepts, which is one of the major things that was lacking in past online lectures and discussion.” Several weeks into the project I reflected that “my initial impression of VoiceThread is that it encourages a lot more interaction, especially between me and students. Students are most likely to interact and respond to each other on slides that contain class discussion questions. There was also some back-and-forth on slides that contain small group discussions.” I also reflected on the time commitment required for this type of interaction: “For me, VoiceThread is much more time intensive because I need to check in every day to effectively moderate comments. I also need to make sure that student questions are addressed in a timely manner.” However, I also noted the time demands required for this course were partly due to the intense nature of a 7-week course.

The third theme that emerged from comparison of the pre- and post-surveys is the overall preference for VoiceThreads over discussion forums. When asked on the post-survey about which format students would choose for online lectures and discussions 100% of students declared their preference for VoiceThread (*N*=18). The most commonly cited reason for the preference was due to VoiceThread's multi-media capabilities. Many students commented that they appreciated the ability to post comments directly on the slides: "you have the material right in front of you so you are commenting and receiving feedback on that particular slide." Several students also stated that it was easier and more convenient to post comments right on the slide in question: "if you have a question or comment you can post it on that slide where you can't on a BB (Blackboard) discussion forum."

The multi-media capabilities also appealed to a variety of different learning styles. One student noted that "I'm a visual learner and someone with a short attention span. It's been hard to keep my focus in online class discussions/lectures before…I honestly feel that VoiceThread has enhanced my learning in this class." Another noted that "it helps when I can hear and see what I'm learning. VoiceThread helped me understand and learn new material because of the visual aids that were given along with the audio response." Students were also more likely to read and respond to other students' VoiceThread comments because "you can easily see what others have posted on each slide and see if they have the same comments/questions or answers to questions you have." One student noted that though you "can do the same on a BB discussion forum but the layout makes it harder to see everyone's posts all at once." This student also noted that "from personal

experience people do not take BB seriously, but people in this class took VoiceThread seriously, which enhanced my learning."

The other commonly cited reason why students preferred VoiceThread over traditional lecture notes and discussion forums was because it seemed more interactive and helped students feel more connected to each other. Several students commented that VoiceThread made comments easier to follow which "made you feel more connected to the members of your group." Another student noted that VoiceThread provided a "friendlier learning environment" that "makes the learning community feel more personal and interactive."

Sixteen of the seventeen students who provided feedback on this question in the Week 7 VoiceThread Feedback preferred VoiceThread over traditional discussion forums. The most commonly cited reasons included the various ways to interact, which "makes the interaction so much more dynamic," and the appeal to a wide variety of learners (visual and auditory). Many students also noted the VoiceThread discussions also helped focus their learning because conversations took place around specific visual media: "I like that as I comment I can see what I am commenting on." Students could also easily go back and review certain concepts and conversations because "instead of reading through every post, you can just go to the slide you want and see what was said." The one dissenter on this question didn't see the difference between the VoiceThread and online discussion forums, but admits that on VoiceThread "you get to see the teacher give the information without reading it in some text."

The final theme that emerged from the pre- and post-surveys was the importance of instructor involvement in online discussions, regardless of the format. Eighty-five

percent of students on the pre-survey (*N*=14) and 94% of students on the post-survey (*N*=18) *strongly agreed* that instructor involvement in online discussions enhanced their learning experience (Figure 10). One student commented that a challenge with traditional online discussion forums was "when the instructor does not enter the discussion." Another student noted on the post-survey that VoiceThread "made it nice that the instructor was able to post an audio comment to clarify or explain certain points."

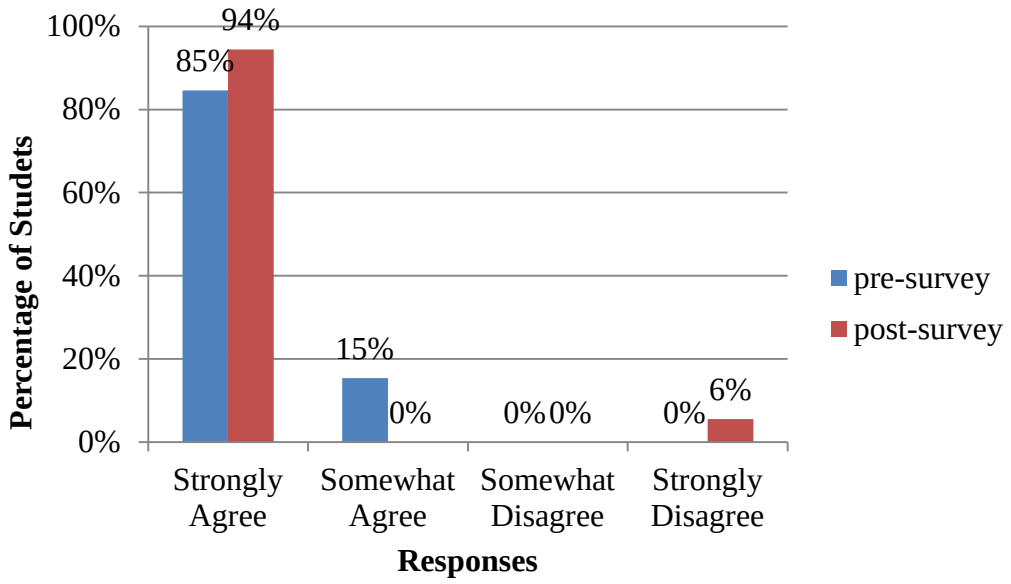


Figure 10. Responses to pre-survey (*N*=14) and post-survey (*N*=18) to "Instructor participation in an online discussion forum/VoiceThread enhances my learning experience."

When asked on the Week 7 VoiceThread Feedback if audio comments positively added to their learning experience, the majority of student responded in the affirmative, especially when it came to the instructor comments. Several students said that audio comments facilitated their learning because they helped clarify potentially confusing information: "sometimes it's easier to get what someone is trying to say through audio because you can hear the tone of the person instead of just reading the words." One

student noted that audio comments helped convey instructor enthusiasm about course material: "You were there to guide us through the whole process and really were attentive. It showed you were engaged with us which made me feel more interested in the content." Other students said that instructor audio comments saved time from having to complete additional reading: "The audio is a huge help in relaying information that I can process in a shorter amount of time than reading a lengthy post and spacing out halfway through." Other students said that audio comments provided more of a traditional classroom experience. One student said that "it gave me the sense that I was actually sitting in a classroom with you" while another noted that audio comments helped "humanize the slides."

There were a few students who did not like the audio comments. One student noted that "it's much easier for me to just read text comments and not have to worry about the audio…I'd rather just have the normal 'simple' comments be in plain text." Other students said that audio comments did not fit their learning style. For example, one student said that "I can learn better by reading than listening" while another noted that "it takes me a few extra seconds to process information," which is more conducive to reading typed comments rather than listening to recorded ones.

The final question in the Week 7 VoiceThread Feedback encouraged students to add anything else about their experience using VoiceThread. Seventeen students left comments and all of them were very favorable about their experience with VoiceThreads. Several students focused on how VoiceThread had facilitated their learning through its multi-media capabilities: "voice threads (sic) allowed me to feel you were there and ready to answer our questions" and "I wish I could communicate how grateful I was for

the ability to see, comment, ask questions, and see what others are learning as well! It was a wonderful experience!" One student said that "(VoiceThread) helped me learn faster and better than any other online course and I have taken about ten online courses." Several students commented that they hoped that this technology would be used in other online courses: "I'd like to see this learning community used in more if not all my online classes" and "I would like to see other online courses start moving towards using them."

A couple of students shared their initial skepticism about this technology that stemmed from either never before having taken an online or hybrid course or having had negative experiences using traditional discussion forums: "I wasn't sure how I would like taking a hybrid class because it was partially online. In the end I enjoyed it and wouldn't mind taking an online class. I believe Voice Threads were a key factor in giving me a positive experience when it comes to the online half of the course." Finally, as a future teacher, one student recognized the potential appeal of this technology: "From a teacher's point of view I also see them as valuable. If you assign a PowerPoint for us to read you have no idea what we understand or are struggling with. But there were several instances this semester when you saw we were not getting something, and you either created an explanatory audio post or you decided to make a formative assessment for Saturday."

The standard course evaluation completed in most classes at Frederick Community College includes two open-ended questions where student cite the aspects of the course that best helped them learn and those aspects that did not help them learn. Eleven of the completed course evaluations mentioned VoiceThread in these open-ended questions (N=16). All 11 comments cited VoiceThread as a positive aspect of the course.

Several students noted that VoiceThread is an effective “learning tool” that encouraged completion of assigned readings and assignments. One student said that this technology “helped me focus on the main facts and the breakdown of the concepts we learned.” Several students noted that VoiceThread “made it more similar to an in-class environment than the usual discussion board” and that it “made the hybrid class more personal.”

VoiceThread was also referenced in three of the submitted course evaluations as an aspect that did not help students learn (*N*=16). All three negative comments appeared on evaluations where VoiceThread was also described as a positive learning feature. The three negative comments associated with VoiceThread focused on the early participation deadline for weekly comments (Thursday at noon): “I have a very hectic schedule and it was difficult to get them done on time.” All three students expressed a desire for a Thursday night or Friday participation deadline.

Student learning was measured using the Geoscience Concept Inventory given as a pre-test at the beginning of the course session and again as a post-test on the last day of class. Seventeen students took the pre-test and eighteen students took the post-test. The average number of correct responses on the 25-question pre-test was 9.2 with a median score of 11 (*N*=17). The average rose to 13.7 on the post-test with a median score of 15 (*N*=18) (Figure 11).

The distribution of scores revealed that post-GCI scores shifted toward the right, or from an average score of 36.8% to an average of 54.9% (Figure 12). The number of students who scored above a 50% rose from 3 on the pre-GCI to 11 on the post-test. Matching pre- and post-tests for individual students showed that 15 students scored

higher on the post-test compared to the pre-test while 2 scored slightly lower on the post-test (Figure 13). Furthermore, of the fifteen students who had higher scores on the post-test, nine students improved their scores by a minimum of 5 points, or 20%.

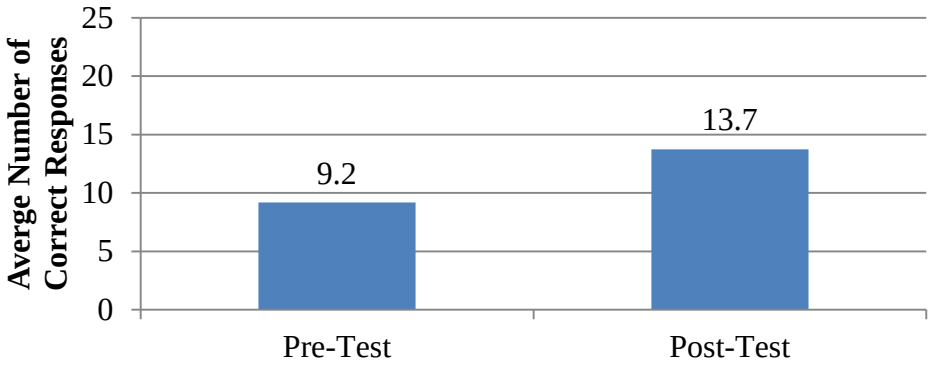


Figure 11. Average number of total correct responses on the GCI pre-test (*N*=17) and the post-test (*N*=18).

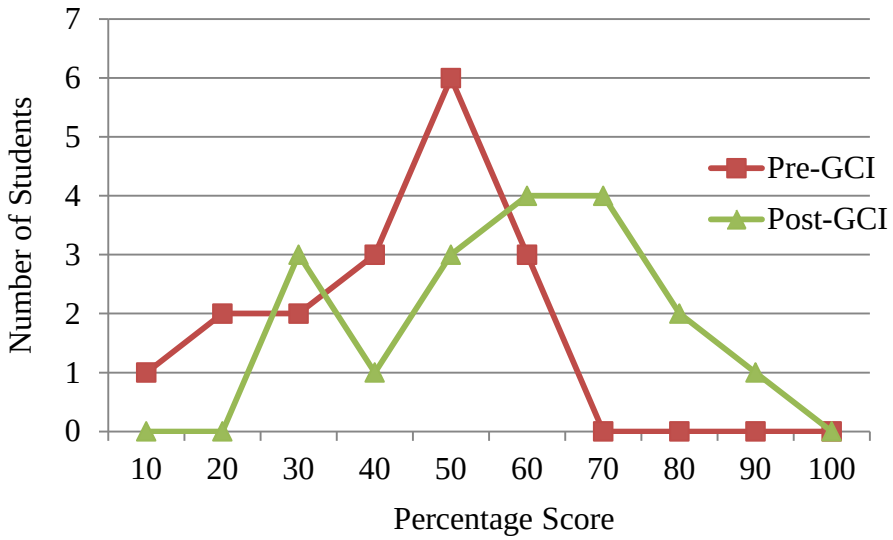


Figure 12. Distribution of pre- (*N*=17) and post- (*N*=18) GCI scores.

The questions chosen from the GCI were those that most closely matched topics taught in the course. Table 2 summarizes the number of GCI questions per topic area emphasized in the course. Several of the broad topics covered in the course, such as the

Hydrosphere, the Atmosphere, and the Exosphere, were not well represented or included at all in GCI questions.

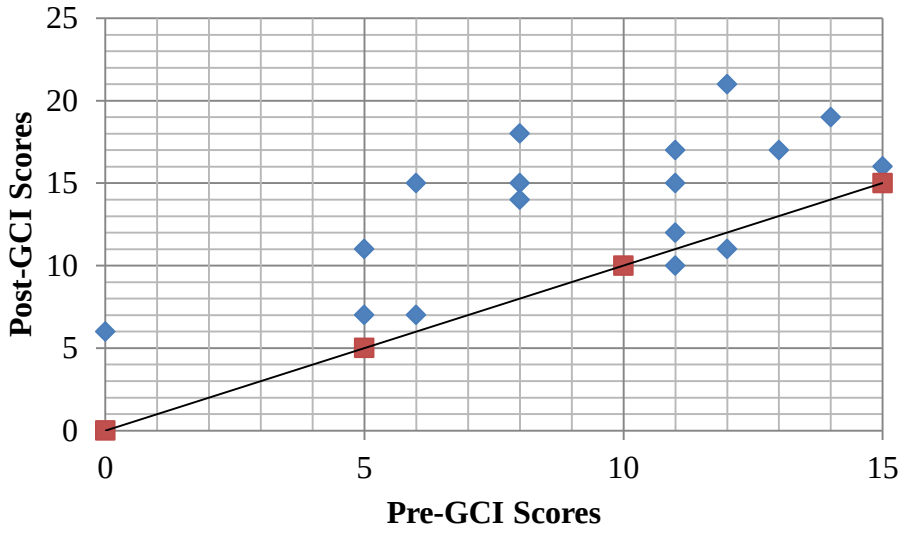


Figure 13. Matched pre- and post- GCI scores for individual students. The line represents no change in scores. Points above the line represent an increase in scores from pre to post-GCI test. Points falling below the line represent a decrease in scores from pre- to post-tests, (*N*=17).

Table 2
Number of GCI questions by course topic.

Course Topic	*Module(s)*	*Number of GCI Questions*
Earth's Interior	1	4
Plate Tectonics	1	5
Earthquakes & Volcanoes	2	5
Minerals & Rocks	2, 3	4
Geologic Time & Earth History	3	4
The Hydrosphere	4	3
The Atmosphere	5	0
The Exosphere	6	0

A comparison of pre- and post-GCI test scores broken down by question topic revealed that there was improvement in all topic areas (Figure 14). The greatest improvement in average scores occurred with questions related to Geologic Time, where

the average number of correct answers on those questions rose from 3 on the pre-test to 7.25 on the post-test. Questions related to Plate Tectonics and Earthquakes & Volcanoes showed the least improvement, where the average number of correct answers on related questions rose from 6.2 to 8.6 and from 6.8 to 9.2, respectively.

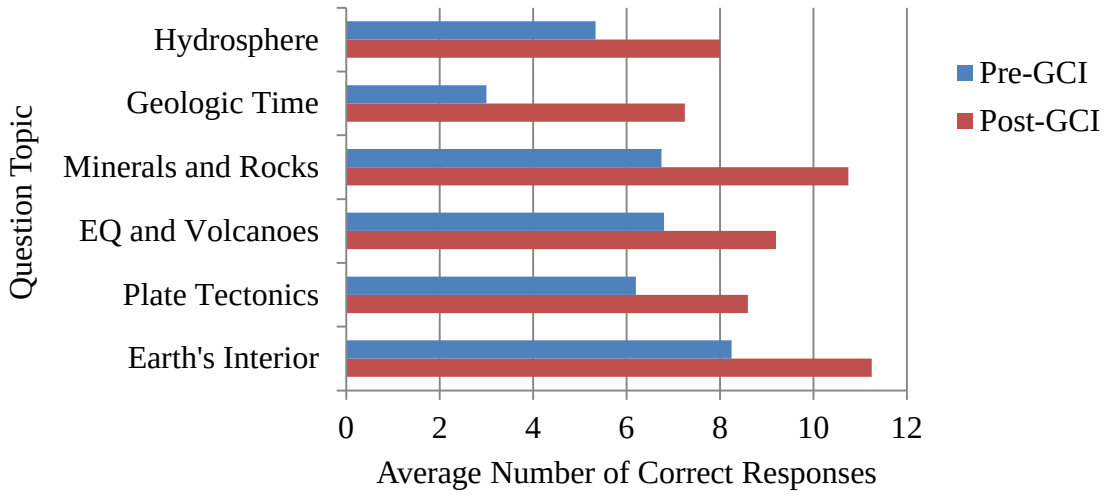


Figure 14. Average number of correct responses on pre- and post-GCI tests as a function of question topic, (*N*=17).

Finally, a comparison of the comprehensive final exam scores from the Spring 2010 and Spring 2011 hybrid PC 115 courses indicated that the average score rose from 100.36 points out of 155, or 64.7%, to 111.64 out of 155 points, or 72.0% (Figure 15). The main differences between these two courses were 1) the 2010 course spanned 15 weeks while the 2011 course spanned 7 weeks, and 2) the 2010 course employed traditional lecture notes and discussion forums while the 2011 course employed VoiceThread.

My researcher journal also suggested that VoiceThread was useful in helping me formatively assess student learning. My entry at the end of week 4 of the project summarized the general reflections regarding VoiceThread and learning: "I feel like I

have a better finger on the pulse of student learning in the online portion of the course that enables me to create and implement effective formative assessments at the beginning of each campus session. I have also found that I am better able to make modifications in campus lab activities."

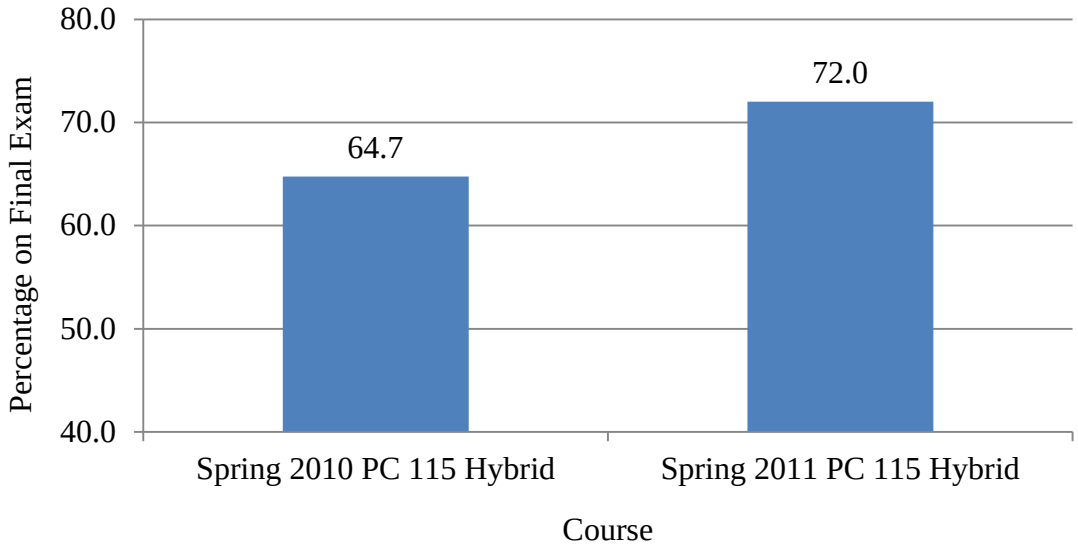


Figure 15. Average final exam scores from the Spring 2010 (*N*=18) and Spring 2011 (*N*=18) hybrid PC 115 courses.

INTERPRETATION AND CONCLUSION

This study provided evidence that VoiceThread technology is an effective tool that promotes online student learning and sense of course community. Results from student surveys revealed that students were overwhelmingly enthusiastic about the use of VoiceThread, preferring its interaction and multi-media capabilities over traditional discussion forums. Surveys also suggested that students perceive that VoiceThread fosters a greater connection to the course community, which also facilitated their learning. This result agreed with the conclusions found by Richardson and Swan (2002) about the link between course community and perceived learning.

The ability to have and record conversations around visual media enabled students to easily ask and answer questions about course content, which enabled me to have a much better understanding of potential gaps and limitations in student learning. I then used this information to develop timely interventions and modifications in learning strategies prior to summative evaluations, such as exams. The ability to formatively assess student learning fostered by VoiceThread technology was a major improvement over previous hybrid courses I had taught which utilized traditional lecture notes and discussion forums.

The difference in mean scores between the pre-GCI (36.8%) and the post-GCI (54.9%) was 18.1% (N=17). These results are higher than those reported by other studies where pre- and post-GCI results have been used to measure student learning. For example, Petcovic and Ruhf (2008) report an increase of 4.2% between pre- and post-test scores using a 15 question GCI (N=122). Furthermore, the pre-GCI test was taken during our first campus meeting at the end of Module 1, after students were to have already completed text readings and VoiceThread notes on Earth's Interior and Plate Tectonics. Nine out of the 25 GCI questions covered these topics. It is reasonable to assume that the average number of correct responses on the pre-test to questions in these categories (6.2 and 8.25, respectively) were a bit higher due to content exposure throughout the week.

The difference in average scores on the cumulative final exams between the Spring 2010 hybrid and Spring 2011 hybrid courses (64.7% and 72.0%, respectively) also indicated that VoiceThread did improve student learning. The primary difference between these two courses was the delivery format (VoiceThread or traditional) for lecture notes and discussions. Voicethread enabled me to better assess student learning

and intervene via responses or additional clarifications posted on VoiceThread, development of formative assessment exercises during the first part of our campus meeting, and modifications to campus lab exercises.

One of the drawbacks for me with traditional discussion forums was that students always seemed to post the minimum number of comments at the last possible minute. Though students obviously found VoiceThread participation to be more valuable than what they indicated about their past experience with discussion forums, there was still a tendency to post the minimum number of weekly comments (5). The average number of weekly comments per student was 5.29, and ranged from a low of 4.94 to a high of 5.78. Overall, students seem to have still focused on completing a minimum number of required weekly comments.

Though students were required to post a minimum number of weekly comments for full credit they had the freedom to choose the type of participation. I made it clear at the beginning of the semester that VoiceThreads were a safe learning space, meaning that students did not need to worry about point deductions for "being wrong." The majority of student participation was fairly evenly split between participation in small group discussion questions (21-26% of total), recommended checkpoint questions from the textbook (20-25% of total), and questions and comments posted on lecture notes (17-28% of total). It appeared that students took advantage of a variety of ways to participate in the online conversations and tended to be more drawn to those slides where they were able to clarify concepts and/or practice applying new concepts via small group discussions and textbook checkpoint questions. Interestingly enough, these types of

participation seemed to mirror the participation preferences that I witness in my traditional face-to-face courses.

One of the things that surprised me early on in this project was the importance of instructor involvement in the online learning environment. Student comments seemed to echo the conclusions made by Shea, Fredericksen, Pickett, and Pelz (2003) and by Vesely, Bloom, and Sherlock (2007) about the importance of online instructor presence on student perception of learning and community. Regardless of the format, students value instructor involvement in online discussions.

I was also surprised by the apparent disconnect between the large number of positive comments about how much students enjoyed the range of ways to participate in VoiceThread conversations (text, audio, and video) and the frequency in which they utilized any of the non-text comment options. The total number of audio or video comments each week ranged from four to seven, with a weekly average of 5.4. The average number of total weekly comments was 95.2, which means that only 5.7% of the comments utilized audio capabilities. This percentage can probably be attributed to the one bonus point I awarded each week to students who posted at least one audio comment.

Though students did not seem to like to use the audio features themselves, they overwhelmingly appreciated my use of them. Overall student feedback about instructor use of audio comments matched the conclusions made by Ice, Curtis, Phillips, and Wells (2007). Audio comments seemed to improve a sense of instructor presence and helped convey my enthusiasm for the topics that would have most likely been lost in purely text-based communication. This presence helped students feel a greater connection to the class because they sensed my interest, concern, and involvement in their learning. Audio

comments also appealed to students with different learning styles, who benefited from explanations that were not reading-based.

VALUE

As a result of this study I have gained a much better appreciation for the role that technology may play in improving the quality and enjoyment of online teaching and learning. As I learned how to use VoiceThread and adapted my lectures to this technology I found that I had to completely rethink the way that I viewed online education. I had tried to make information available to students in the most interesting way possible in the hopes that students would engage with the material and ask questions via the discussion forums or email. Unfortunately, students rarely utilized these opportunities. The result was that I didn't know where the problems in learning were until we met during our campus lab, or worse, after exams. All I knew was that there were problems.

VoiceThread has provided an excellent way to improve communication and interaction among all participants in the learning community. This technology enabled students to easily post comments and questions as they arose around the visual lecture notes. I could respond to these questions and often clarify misconceptions in a timely manner, while we all still benefited from an asynchronous learning environment. These conversations were recorded, which allowed all students to easily locate and review the conversation thread around specific topics. Since the end of my Capstone project I have used this technology in two other hybrid science courses. In both cases, my rapport with

students, overall test grades, and student course evaluations have all shown significant improvement.

The enthusiasm demonstrated by students involved in this project made me feel a responsibility to them to spread the word about VoiceThread to other online faculty. Since the conclusion of my Capstone project I have given various presentations to faculty and administration groups at my college. The interest generated by these presentations spawned a second phase to this project. This phase involves the participation of 8-10 online faculty members who have agreed to implement VoiceThread pedagogy into their own courses within the next academic year. Faculty members include representatives from math, foreign language, communication, and science disciplines. I am serving as Project Coordinator and will be responsible for compiling student and faculty survey data into a final report. The hope is that results from this phase will continue to attract additional interest and support for online faculty to implement VoiceThread and other innovative technologies.

Though I have gained great enthusiasm for VoiceThread technology I also understand some of the limitations. For example, for students to feel a strong sense of instructor presence I have to check in and respond to questions on a frequent basis. This may be different for instructors who are used to student-driven discussion forums where instructor involvement is often limited. It can be difficult to completely disconnect from work, which is a common struggle for those who try to blend work and life. Fortunately, VoiceThread now has an iPhone and iPad app, which allows for easy review and posting of text, audio, or video comments.

Another limitation is that VoiceThread conversations are not threaded. Comments appear in the order that they occur and it is common for a student to post a question and other comments are posted by other students before I had a chance to respond. It would be nice if VoiceThread creators had the capability of moving comments around to provide a more clearly threaded conversation. It is not that much of an issue for class sizes under twenty, but I imagine the issue would become more significant as the number of participants increases.

The best decision I made during my MSSE experience was to change my Capstone project. This change was brought about by taking the Web Tools for Teachers course during Summer 2009, where I was lit on fire by the potential of heretofore unknown web technologies, among them VoiceThread. Changing my project involved a great deal of work, but it has also been the most exciting, renewing, and innovative experience that I have been involved with in my nine years of college teaching. The primary reason is because of the drastic differences that I have witnessed in student motivation, engagement, and learning as a result of VoiceThread implementation.

The way I changed as a teacher through this project is that I now appreciate the importance of social presence among all participants in the facilitation of course community, improved rapport between students and between students and instructor, and improved student perception of learning. I once thought that my rapport with students would understandably be lower in a hybrid course than it typically is in a f2f course because my time with students is cut in half. Appropriate use of technology has turned that belief on its head as I have experienced as good or better student-instructor rapport

with my hybrid students in the three sections that I have used VocieThread compared to my other f2f courses.

Another way that I have changed as a teacher is that I now use even more formative assessments in both my hybrid and f2f courses. This project encouraged me to pay even closer attention to student cues about learning and to initiate timely interventions that effectively address misconceptions. Now there is rarely a class that goes by where I do not employ think-pair-shares, concept mapping, small group discussion problems, clicker questions, etc. as a way to engage students and assess learning. This project allowed me to formally experience the importance of such exercises, particularly in online learning.

REFERENCES CITED

Allen, I. E. and Seaman, J. (2008). Going the Distance: Online education in the United States, 2011. Needham, MA: Sloan-C. Retrieved on February 9, 2012 from http://www.onlinelearningsurvey.com/reports/goingthedistance.pdf.

Angelo, T. and Cross, P. (1993). *Classroom assessment techniques: A handbook for college teachers (2nd ed.).* San Francisco, CA: Jossey-Bass.

Association of American Colleges and Universities. (2000). Greater expectations: A new vision for learning as a nation goes to college. Retrieved on March 2, 2007 from http://www.greaterexpectations.org/.

Austin, D. and Mescia, N. (2001). Strategies to incorporate active learning into online teaching. *ICTE Tallahassee 2001*. Retrieved on September 8, 2010 from http://www.icte.org/T01_Library/T01_245.pdf.

Beebe, R., Vonderwall, S., Boboc, M. (2010). Emerging patterns in transferring assessment practices from f2f to online environments. *Electronic Journal of e-Learning*, *8*(1), 1-12.

Bonwell, C. and Eison, J. (1991). Active learning: Creating excitement in the classroom. *Eric Clearinghouse on Higher Education*. Washington, D.C.: Jossey-Bass.

Borup, J., Graham, C.R. & Velasquez, A. (2010) The use of asynchronous video communication to improve instructor immediacy and social presence in an online course. In D. Gibson & B. Dodge (Eds.) *Proceedings of Society for Information Technology & Teacher Education International Conference 2010*. (pp. 337-344). Chesapeake, VA: AACE. Retrieved on February 9, 2012 from http://www.mendeley.com/research/asynchronous-video-communication-improve-instructor-immediacy-social-presence-blended-learning-environment/#

Boston, C. (2002). The concept of formative assessment. *Practical Assessment, Research & Evaluation*, 8(9). Retrieved on September 22, 2010 from http://pareonline.net/getvn.asp?v=8&n=9.

Brunvand, S. and Byrd, S. (2011). Using VoiceThread to promote learning engagement and success for all students. *TEACHING Exceptional Children*, *43*(4), 28-37.

Burden, K. and Atkinson, S. (2008). Evaluating pedagogical affordances of media sharing web 2.0 technologies: A case study. A*scilite, 2008*. Retrieved on March 11, 2012 from http://www.ascilite.org.au/conferences/melbourne08/procs/burden-2.pdf.

Educause Learning Initiative. (2009). 7 things you should know about… VoiceThread: Retrieved on September 9, 2010 from http://net.educause.edu/ir/library/pdf/ELI7050.pdf.

Edvantia. (2005). Effective instructional strategies. *Research Digest*. Retrieved on August 31, 2010 from http://www.edvantia.org/pdta/pdf/Effective_Instructional_Strategies.pdf.

Ellis, A. (2001). Student-centred collaborative learning via face-to-face and asynchronous online communication: What's the difference? in G. Kennedy, M. Keppell, C. McNaught & T. Petrovic (Eds.), *Meeting at the Crossroads.* Proceedings of the 18th Annual Conference of the Australian Society for Computers in Learning in Tertiary Education. 169-177.

Friedman, A. and Lee, J. (2009). Using VoiceThread as a debate tool. Paper presented at the James F. Ackerman Colloqium on Technology and Citizenship Education, W. Lafayette, IN. Retrieved on March 9, 2012 from http://www.scribd.com/doc/16584963/Using-Voicethread-1-Running-Head-USING-VOICETHREAD-Using-VoiceThread.

Froyd, J.E. (2007). Evidence for the efficacy of student-active learning pedagogies. *Project Kaleidoscope*. Retrieved on September 7, 2010 from http://www.pkal.org/documents/BibliographyofSALPedagogies.cfm.

Hanover Research Council. (2009). Best Practices in Online Teaching Strategies. Retrieved on August 31, 2010 on http://www.hanoverresearch.com/library/assets/libPdfs/Best%20Practices%20in%20Online%20Teaching%20Strategies%20-%20Membership.pdf

Harris, N. and Sandor, M. (2007). Developing online discussion forums as student centred peer e-learning environments: *Ascilate Singapore 2007*. Retrieved on September 8, 2010 from http://www98.griffith.edu.au/dspace/bitstream/10072/18326/1/49273_1.pdf.

Hoellwarth, C. Moelter, M.J., and Knight, R.D. (2005). A direct comparison of conceptual learning and problem solving ability in traditional and studio style classroom: *American Journal of Physics*, *73*(5), 459-462.

Hornsby, K. (2008). A learner-centered online course design. *Academic Exchange Quarterly*, *12*(4).

Ice, P., Curtis, R., Phillips, P., and Wells, J. (2007). Using asynchronous audio feedback to enhance teaching presence and students' sense of community. *Journal of Asynchronous Learning Networks, 11*(2), *3-25.* Retrieved on March 11, 2012 from http://sloanconsortium.org/jaln/v11n2/using-asynchronous-audio-feedback-enhance-teaching-presence-and-students%E2%80%99-sense-community.

Jones, K.T. and Chen, C. (2008). Blended learning in a graduate Accounting course: Student satisfaction and course design issues. *The Accounting Educators' Journal, 18,* 15-28.

Libarkin, J.C., and Anderson, S.W. (2007). Development of the Geoscience Concept Inventory, in Proceedings of the National STEM Assessment Conference, Washington DC, October 19-21, 2006, 148-158.

Lord, T. and Baviska, S. (2007). Moving students from information recitation to information understanding. *Journal of College Science Teaching, 36*(5), 40-44.

McCormack, V. (2010). Increasing teacher candidate responses through the application of VoiceThread. *International Journal of Arts and Sciences, 3*(11), 160-165.

Meyer, K. (2003). Face-to-face verses threaded discussions: The role of time and higher-order thinking: *Journal of Asynchronous Learning Networks, 7*(3), 55-65.

Otsuka, J. and Vieira da Rocha, H. (2007). Online assessment: supporting the formative assessment of collaborative learning activities. *IADIA Conference WWW/Internet 2007*. 35-42. Retrieved on Septebmer 26, 2010 from http://www.iadis.net/dl/final_uploads/200712L005.pdf.

Pacansky-Brock, M. (2010). Teaching highlights added: VoiceThread design strategies and student perspectives: *21st Century teaching and learning.* Retrieved on September 9, 2010 from http://mpbreflections.blogspot.com/search?q=voicethreads.

Petcovic, H., and Ruhf, R. (2008). Geoscience conceptual knowledge of preservice elementary teachers: Results from the Geoscience Concept Inventory. *Journal of Geoscience Education, 56*(3), 251-260.

Richardson, J. and Swan, K. (2002). Examination of social presence in online learning: Students' perceived learning and satisfaction. *Journal of Asynchronous Learning Networks, 7*(1), 68-88.

Stodel, E.J., Thompson, T.L., and MacDonald, C.J. (2006). Learners' perspectives on what is missing from online learning: Interpretations though the community of inquiry framework. *International Review of Research in Open and Distance Learning, 7*(3).

Shea, P., Fredericksen, E., Pickett, A., and Pelz, W. (2003). A preliminary investigation of teaching presence in the SUNY learning network. *Elements of Quality Online Education: Practice and Direction*. Needham, MA: Sloan-C. Retrieved on March 12, 2012 from http://www.suny.edu/sunytrainingcenter/files/TeachingPresence.pdf.

Shea, P., Pickett, A., and Pelz, W. (2003) Follow-up investigation of "teaching presence" in the SUNY learning network. *Journal of Asynchronous Learning Networks, 7*(2), 61-80.

U.S. Department of Education. (2009). *Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies*. Washington DC. Retrieved on August 25, 2010 from http://www2.ed.gov/rschstat/eval/tech/evidence-based-practices/finalreport.pdf.

Vesely, P., Bloom, L., and Sherlock, J. (2007). Key elements of building online community: Comparing faculty and student perceptions. *MERLOT Journal of Online Learning and Teaching*, *3*(3).

VoiceThread. (2012). VoiceThread Overview. Retrieved on February 9, 2012 from http://voicethread.com/about/features/.

Wang, Q. and Woo, H. (2007). Comparing asynchronous online discussions and face-to-face discussions in a classroom setting: *British Journal of Educational Technology*, *38*(2), 272-286.

APPENDICES

APPENDIX A

STUDENT PERCEPTION SURVEY ABOUT ONLINE DISCUSSIONS (SPSOD)

Student Perception Survey about Online Discussions

1. How many online/hybrid classes have you taken?

2. Of the online/hybrid course you have taken, how many have included a required online discussion forum?

3. Approximately how many hours per week do you typically spend on an online discussion forum for one class?

    a. Less than 1 hour per week
    b. 1-2 hours per week
    c. 3-4 hours per week
    d. 5-6 hours per week
    e. 7+ hours per week

The following questions assess your attitudes and perspectives regarding online and face-to-face course discussions:

1. In general, when I feel that I am a part of a community in an online class I am more motivated to succeed.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

2. Online discussion forums help me feel a part of a class community.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

3. Online discussion forums enhance my ability to learn the subject matter.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

4. Instructor participation in an online discussion forum enhances my learning experience.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

5. I occasionally feel ignored or isolated in an online discussion forum.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

6. My online discussion comments are more reflective and well thought out than my comments in a face-to-face discussion.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

7. My ideas are sometimes misinterpreted or taken out of context in an online discussion forum.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

8. I learn as much or more from an online discussion as I do from a face-to-face class discussion.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

9. I feel as energized from online class discussions as I do from face-to-face class discussions.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

10. I am more likely to participate in an online course discussion than I am in a face-to-face course discussion.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

11. I enjoy being able to enter and leave online discussion threads at will.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

12. I often miss the energy and spontaneity of a face-to-face class discussion.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

13. Online discussions are as interactive as face-to-face discussions.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

14. I think I come across to others in an online discussion the same as I come across to others in a face-to-face discussion.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

15. Online discussion forums facilitate the development of my relationships with other students.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

16. My participation in online discussion forums is primarily driven by the minimum number of required weekly postings.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

17. Online discussion forums facilitate the development of my relationships with my instructors.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

18. One of the disadvantages of online discussions forums is that they rely on text-based comments.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

19. From your perspective, what are some benefits of an online discussion forum?

20. From your perspective, what are some of the challenges associated with online discussion forums?

APPENDIX B

WEEKLY VOICETHREAD HEADCOUNT (WVH)

Weekly VoiceThread Headcount

Week: _____

Student	Questions or Comments on Lecture Slides	Small Group Discussion Questions	Class Discussion Questions	Post-Lab Review Questions	Recommended Checkpoint Questions

* Indicates audio comment

Appendix C

Week 7 VoiceThread Feedback Questions

Week 7 VoiceThread Feedback Questions

1. Has the use of VoiceThreads enhanced your learning experience this semester? If so, how?

2. Do you think that VoiceThreads helped establish a sense of community in the class? Please explain.

3. Do the audio comments positively add to your learning experience? Explain.

4. Are VoiceThreads a more effective alternative to traditional online discussion forums? Why or why not?

5. Do you have anything else to add about your experience using VoiceThreads this semester?

APPENDIX D

STUDENT PERCEPTION SURVEY ABOUT VOICETHREAD (SPSV)

Student Perception Survey about VoiceThread

1. Approximately how many hours per week did you typically spend on a VoiceThread (reviewing and making comments)?

    a. Less than 1 hour per week
    b. 1-2 hours per week
    c. 2-3 hours per week
    d. 3-4 hours per week
    e. More than 4 hours per week

2. In general, when I feel that I am a part of a community in an online class I am more motivated to succeed.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

3. VoiceThreads have helped me feel a part of a class community.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

4. VoiceThreads enhanced my ability to learn the subject matter.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

5. Instructor participation in a VoiceThread discussion enhanced my learning experience.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

6. I occasionally felt ignored or isolated in a VoiceThread.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

7. My VoiceThread comments are more reflective and well thought out than my comments in a face-to-face discussion.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

8. My ideas were sometimes misinterpreted or taken out of context in a VoiceThread discussion.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

9. I learned as much or more from a VoiceThread as I predict I would have in a face-to-face class discussion.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

10. I felt as energized from VoiceThread discussions as I usually do from face-to-face class discussions.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

11. I was more likely to participate in a VoiceThread discussion than I would be in a face-to-face course discussion.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

12. I enjoy being able to enter and leave the VoiceThread at will.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

13. I missed the energy and spontaneity of a face-to-face class discussion.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

14. VoiceThread discussions were as interactive as face-to-face discussions.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

15. I think I came across to others in a VoiceThread the same as I come across to others in a face-to-face discussion.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

16. VoiceThread discussions facilitated the development of my relationships with other students.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

17. My participation in VoiceThreads was primarily driven by the minimum number of required weekly postings.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

18. VoiceThread discussions facilitated the development of my relationship with my instructor.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

19. Audio/video comments on VoiceThread enhanced my learning experience.

Strongly Agree Somewhat Agree Somewhat Disagree Strongly Disagree

20. From your perspective, what are some benefits of VoiceThread?

21. From your perspective, what are some of the challenges associated with VoiceThread?

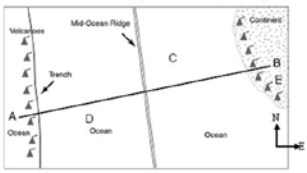
22. In the past, I have used PowerPoint to post lecture notes and class discussions took place in a traditional Blackboard discussion forum. VoiceThread took the place of both online features. What format do you think would better facilitate your learning? Please provide a rationale for your response.

APPENDIX E

SAMPLES OF FORMATIVE ASSESSMENT EXERCISES

Samples of Formative Assessment Exercises

Module 1: Think-Pair-Share (sample)

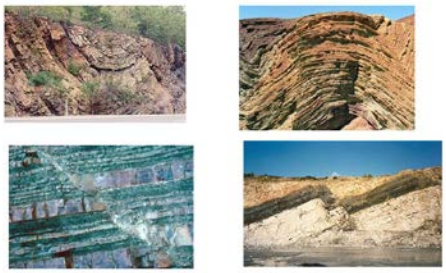


Refer to the diagram above:

a. How many tectonic plates are represented?
b. What is the relative direction of motion for points A and D?
c. What is the relative direction of motion for points C and D?

Module 2: Think-Pair-Share (sample)

Identify the following structures:



Module 3: Concept Review

Match each word/phrase with the most appropriate rock type:

(igneous, metamorphic, or sedimentary)

- Foliation
- Classified based on texture and composition
- Clastic
- Intrusive
- Heat and pressure
- Change in the solid state
- Weathering, erosion, deposition, and lithification
- Rate of cooling

Module 4: Think-Pair-Share (sample)

A stream channel narrows between support columns under a bridge. If discharge does not change, predict how stream velocity would be altered as water flowed under the bridge.

Module 5: Think-Pair-Share (sample)

Consider the table below.

a) What is the permeability of rock sample A?
b) What is the porosity of rock sample B?

Rock Sample	Height (distance) of rock column (cm)	Time it takes for water to reach bottom of beaker (s)	Volume of rock (ml)	Initial water level in graduated cylinder (ml)	Final water level in graduated cylinder (ml)
A	10	3	200	100	40
B	12	9	350	120	15

Module 6: Think-Pair-Share (sample)

What is the final stage for:

a) our Sun?
b) a star 1.5-3 times as massive as our Sun?
c) a star that is not massive enough for nuclear fusion to begin?
d) a star more than 3 times as massive as our Sun?