Selecting Technology to Promote Learning in an Online Introductory Statistics Course

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Online courses are becoming an increasingly more common option for college students and technology plays a critically important role. The instructor must make many decisions about what technology to use in order to achieve a successful course. How can a course be taught in a way that engages the students so that they master the material just as well as in a traditional classroom? How do you build a sense of community with students that don't physically see each other? In order to help accomplish these goals various technological packages must be chosen to bridge the gap between the traditional and online course. This paper will discuss the technological setup of a new online Statistics course, review why the specific technologies were chosen, its implementation and any problems that may have arisen. The paper will concentrate discussion on five areas: content building software (interactive websites), computer/video screen capture, interactive communication programs (chat rooms, etc.), online grading, and the tablet PC. In addition to the instructor's observations about these packages, student's perspectives will be included from a pre and post survey. In synopsis, the paper will include a brief literature review, summarize findings and give ideas for future research.

INTRODUCTION TO THE TECHNOLOGY

The paper will talk about the use of various forms of technology used to implement an online Introduction to Statistics I course for the first time. The purpose of this paper is to help other instructors who are asked to teach an online course for the first time to learn from these experiences. This paper will discuss content building software, computer/video screen capture programs, interactive communication programs, hardware used and grading of high stakes testing. At the end of the paper, several recommendations will be made for instructors who plan on teaching an online statistic course for the first time. Below is a summary of the types of technology that will be discussed.

Content Building Software

How to deliver content is often the first area of need that instructors must satisfy for an online course. The paper will discuss SoftChalk, a lesson building software package that can be used to build lessons with videos, short quizzes, and flash based activities. In addition to the instructor prepared website lessons, the textbook publisher's website called MyStatLab will also be briefly discussed.

Interactive communication programs

Communication between the student and the teacher as well as communication among students is critical for a good learning environment. Several forms of communication programs will be discussed including programs within Sakai (the course management system) and Elluminate by Blackboard. Elluminate is an online office hour software package that includes video chat, text chat, and an interactive whiteboard. Sakai is an open source course management system operated by the university that includes a text chat room and discussion board.

Hardware

A brief review of the hardware used in the creation of the recordings for the online course will be covered including the tablet PC and wireless microphone systems.

Grading

How do you handle formalized assessment exams in an online environment? How do you test the student's understanding of the material when you are not physically in the same location? How do you ensure the integrity of the exam? An online test proctoring service, ProctorU, will be discussed as well as suggestions for a positive proctored exam experience for the teacher and student.

SETUP

This research was conducted with a class of 67 undergraduates at a large research institute in the United States. The course was taught during the summer over a period of six weeks. The stipulation made by the university was that the students would not be required to come to campus for any portion of the class and therefore everything had to be done completely online. There were multiple areas of assessment in the course: exams, daily lesson quizzes, chapter quizzes, small group discussion board assignments, daily homework and a final project. Each of these assignments utilized technology at some level.

The students were asked, but not required to complete a 38 question pre-survey and a 40 question post survey. Out of the 67 students enrolled in the course, 28 started the pre-survey and 25 completed the pre-survey. For the post survey, 28 started the post-survey and 22 completed the survey. All students who completed the survey were 18 years old or older. See the below tables for a brief overview of the demographics of the survey.

Table 1. Class Demographics: Year In School

Year in School	Percent
Freshman	0%
Sophomore	47.4%
Junior	42.1%
Senior	10.5%

Table 2. Class Demographics: Have you taken a statistics course previous to this one?

Answer	Percent
No.	73.7%
Yes, a statistics course in high school, but not AP	5.3%
Yes, I took AP statistics in high school.	21.1%
Yes, I took another college statistics course.	0%
Yes, I have taken STA 2023 before.	0%

Table 3. Class Demographics: Gender

Gender	Percent
Male	10.5%
Female	89.5%

Table 4: Class Demographics: What are you plans after graduating with your Bachelor's Degree?

Plan	Number
Going to medical school.	7
Going to dental school.	0
Going to veterinary school.	1
Going to graduate school.	10
Going to law school.	3
Entering the work force	1
Entering the military	1
Entering a service organization, such as the Peace Corps.	1

On Table 4, students were allowed to mark more than one answer and 10 students didn't reply to this question.

These demographics show that most students that completed the survey were female, had not taken a previous statistics class and were planning for a post-bachelor degree.

BACKGROUND

For more than a decade, statistics educators have been researching how to implement statistics courses online and determining if there is a difference between online courses and traditional courses.

Stephenson (2001) compared students who watched videotaped lectures with students in the live audience. The lectures consisted of Powerpoint and overhead slides. The lectures also included hands-on activities. "In summary, there was very little difference between on and off campus students in terms of performance in the courses. The off campus students tended to rate the course about the same as the on campus students except in those semesters where the number of off campus students was quite large and there were logistical problems with the delivery of the course or with computing."

Utts (2003) compared a traditional course to a hybrid course (partially online) that met only once a week. She found that "performance of students in the hybrid course equaled that of traditional students, but students in the hybrid were slightly less positive in their subjective evaluation of the course."

Dutton (2005) discussed a comparison of online and traditional students. The course included "40 lessons covering the material" on the course website, but no further explanation was given. They concluded, "Finally, we looked at the comparisons of academic performance. We performed regressions to identify which factors helped predict success in the course. The major result here was that students in the online section had higher academic performance, even when we controlled for other important variables. The difference in performance ranged from 3 to more than 8 percentage points in grades and was statistically significant."

Tudor (2006) discussed a course for public health students. This course included a voice over Powerpoint slides and quizzes for self-assessment. The quizzes were static quizzes on Word files with answers supplied. She did include discussion board assignments in her course, but concluded that ". . . , it appears that the effectiveness of online discussion in a statistics class is still debatable. The biggest factors affecting their success may be the topic of discussion and the quality of the questions."

Everson (2008) discusses "the way in which the GAISE (Aliaga, Cobb, Cuff, Garfield, Gould, Lock, Moore, et al., 2005) recommendations have been implemented in one key component of the online course: small-group discussion." The article by Everson serves as a model of how future online courses should be developed to support the GAISE guidelines. The GAISE guidelines are a series of guidelines for educators teaching statistics in the United States. The GAISE guidelines recommend "that instructors

1.) Emphasize statistical literacy and develop statistical thinking
2.) Use Real Data
3.) Stress Conceptual Understanding rather than mere knowledge of procedures.
4.) Foster active learning in the classroom.
5.) Use technology for developing conceptual understanding and analyzing data
6.) Use assessments to improve and evaluate student learning."

Mills (2011) summarizes and compares twenty articles about online courses in statistics over the past decade. Mills asserts that "In the middle to latter part of this decade, more importance was and has been placed on:

- Selecting "appropriate" uses of technology for the online statistics environment.
- Improving interaction among students and the instructor.
- Enhancing the overall learning experience for online students.
- Conducting formative and summative evaluations to carefully monitor the teaching and learning process."

In addition to statistical education literature, general education literature can also tell us about the important components of an online course. The text, "The Online Teaching Survival Guide: Simple and Practical Pedagogical Tips", contains a list of 10 best practices for online teaching;

- Best Practice 1: Be present at the course site.
- Best Practice 2: Create a supportive online course community.
- Best Practice 3: Develop a set of explicit expectations for your learners and yourself as to how you will communicate and how much time students should be working on the course each week.
- Best Practice 4: Use a variety of large group, small group, and individual work experiences.
- Best Practice 5: Use synchronous and asynchronous activities.
- Best Practice 6: Ask for informal feedback early in the term.
- Best Practice 7: Prepare discussion posts that invite responses, questions, discussions, and reflections.
- Best Practice 8: Search out and use content resources that are available in digital format if possible.
- Best Practice 9: Combine core concept learning with customized and personalized learning.
- Best Practice 10: Plan a good closing and wrap activity for the course. "(Boettcher, J. and Conrad, R., 2010)

These best practices describe the necessity of building community in an online course as well as the need for a variety of assignments. The discussion board assignments, final project and chat room office hours were specifically designed in order to reflect GAISE guidelines as well as the best practices.

TECHNOLOGY

Technology plays a vital role in an online course; however, the technology should be there to assist the course not be a hindrance. The subject matter of the course should be of primary importance for the students, not the technology used to deliver the course. Each of the five areas of technology used in the course will now be discussed in greater depth.

Hardware

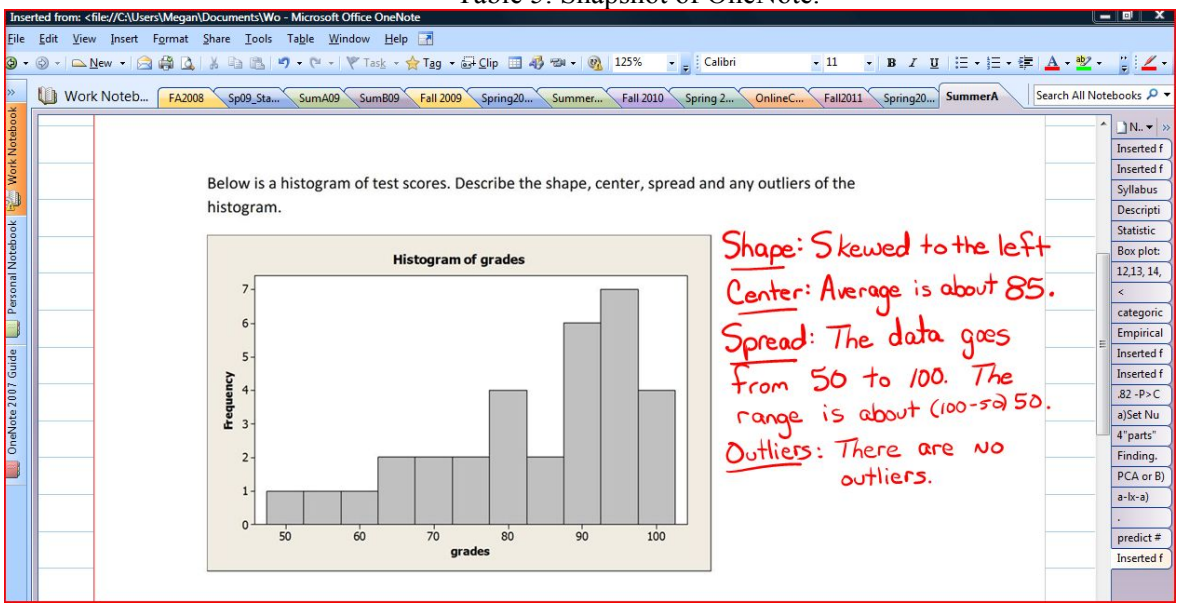
For this course, the student needed a copy of the textbook and a copy of the course notes. The shell of the notes, a workbook, is a 120 page document with the examples, exercises, terms and important concepts for the course; however, the examples and exercises are not completed. The students complete these examples and exercises with the instructor as they watch the tutorials. This allows for the students to concentrate on statistical understanding, rather than copying.

For course creation the instructor required several pieces of hardware, including a microphone, webcam and a laptop tablet PC with a stylus pen. The laptop was a Fujitsu Lifebook T5010 series running Windows Vista with 4GB of memory. A large amount of memory and a fast processor is needed due to the high degree of recorded graphics in order for one of the programs used for recording the course, Microsoft OneNote, to run smoothly.

In order to understand the course design, it is necessary to understand the capabilities of Microsoft OneNote for the tablet PC. The program allows a user to include handwritten notes in a file by using a stylus. So, instead of working out a problem on a chalkboard, the instructor could work out the problems on the screen in OneNote. The instructor can write directly on the screen using the stylus and write words, draw pictures or shade in graphics. The stylus on the Fujitsu tablet was very easy to use and worked essentially as a real ink pen. In OneNote, the color of the pen and width of the pen could be easily changed during the course of the lecture. Unlike in some other programs that shade entire screens unless used in a completely enclosed area, the pen would only shade in areas that it was directed to shade even if the area had an opening in the "box". This intelligent shading is very important when shading the area under Normal Curve. Another benefit

of Microsoft OneNote is that you can insert other documents such as Word files or PDF's into the program and write directly on those documents. The shell of the notes that the students had was therefore imported into OneNote and then the instructor recorded video tutorials of the discussion and completion of the notes by writing on the screen of the tablet PC. Microsoft OneNote was chosen rather than Microsoft Powerpoint because it allowed for a less restricted working space and allowed the instructor to work out the problem more similarly to how it would be done on a blackboard or on a sheet of paper. One of the benefits of this setup is that tutorials could be easily and quickly recorded. Several times during the semester additional video tutorials were recorded based on student requests. Table 5 below shows a snapshot of OneNote.

Table 5: Snapshot of OneNote.



As for sound in the video tutorials, four sets of microphones were tested: the microphone built into the tablet PC laptop, the Azden WLX-PRO VHF Wireless Microphone, the Samson SWAM2SES N6 Airline Micro Wireless Earset, and an H530 Logitech Headset Microphone. Two things should be considered when evaluating a microphone for online course use; the sound quality of the recording and the ease of use. All of the microphones except for the Samson microphone had poor sound quality in the instructor's opinion. The breathing of the instructor was picked up on the recording and the slight movement of a paper caused a distracting loud crackly noise on the recording. The laptop microphone was the easiest of the four to use, but the poor sound quality made it a poor choice. The Samson microphone did not pick up the breathing of the instructor and filtered out surrounding area noise making it the best option of the four.

Table 6. Breakdown of microphones tested.

Type	Ease of Use	Quality of Sound
Microphone on laptop	Very Easy	Picked up ambient room noise
Azden	Easy	Poor
Samson	Three buttons to operate.	Clear, no ambient noise
Logitech	Easy, but the instructor was connected to the machine by a cable.	Picked up breathing of the instructor

Content Building Software

The content for the course was delivered in multiple ways using instructor built lessons and publisher supplied materials. For this course, SoftChalk was used to create a course website built by the instructor which covered 24 detailed lessons spanning 143 web pages and included complete topic explanations, 254 quiz questions, and 128 short instructor videos. The lessons also contained 22 activities including flash based dynamic study tools written in SoftChalk, online applets and exercise problems for the students to solve using StatCrunch. The SoftChalk lessons were written

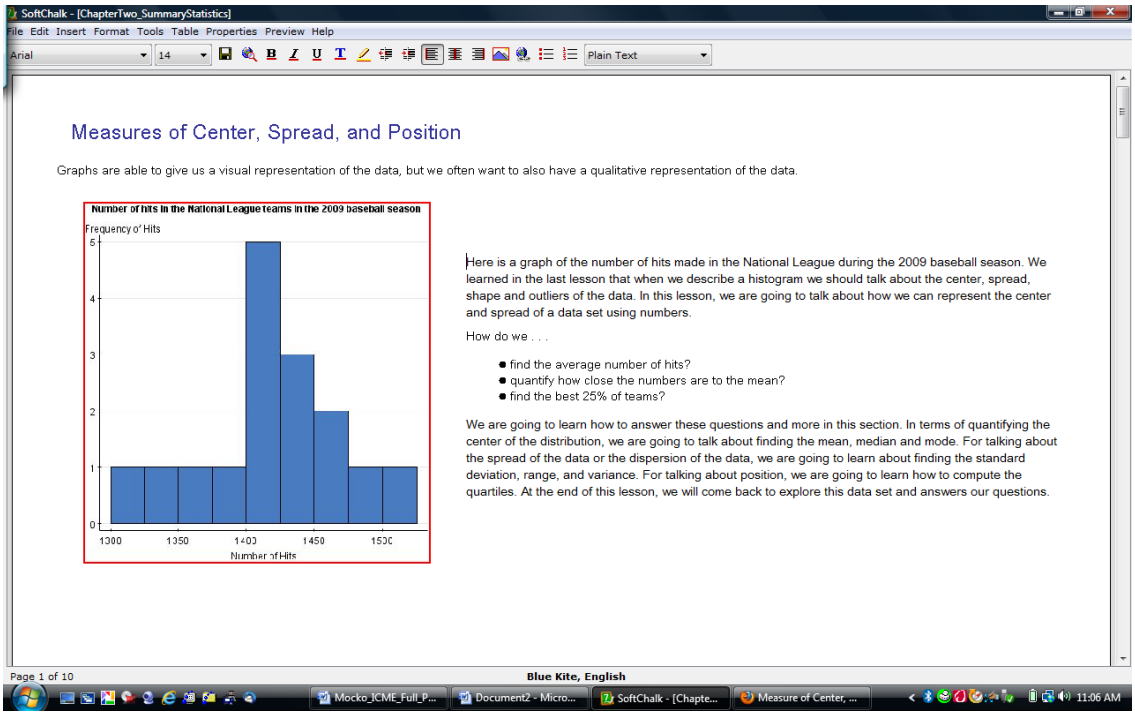
by the instructor and are meant to be completely interactive. The lessons start with a list of about 3 to 8 objectives that the student should master for that day. The lesson then steps the student through learning each of those objectives by first giving an explanation of why the objective is important and how it relates to the other material in the course. After the lesson objectives is a video or a series of videos that explain the main concepts of those objectives. Most of these videos are short, between five to ten minutes, but a few are a little longer to fully explain a complex concept. Following the video(s) there is usually either a quiz exercise, or flash based study tool such as flashcards that helps the student test their knowledge about what they have just learned on the video. For some objectives the students are asked to step through a series of procedures in a statistical applet in order for them to see the concept in action. Each day of the course the students were required to complete a lesson on a particular topic.

The SoftChalk software package (Version 6) was chosen because it was easy to use and little additional training was needed. SoftChalk made it very easy to insert graphics, videos, soundclips, and webpages. It was also possible to test the students on what they had learned, prepare flashcards of important topics for the students to use to study and even to make games for students to match terms to definitions. For example, the students were asked to match the properties of the binomial and the normal distribution with their respective distributions. The students' participation in these activities were recorded and included in their grade. This ensured that the student actually completed the activities and hopefully reached a higher level of engagement in the material.

The university supported the use of Adobe Dreamweaver or SoftChalk; however, Dreamweaver would have required much more extensive training for the instructor. Additionally, Dreamweaver did not have the ability to include graded interactive questions in the lessons so the students couldn't test their knowledge as they worked on the material. Since SoftChalk allowed for the course to have a more interactive feel, SoftChalk was chosen to deliver the material.

For example, one of the first lessons of the course discusses "Measures of Center, Spread and Position". The lesson starts out with a histogram of the number of hits by the US National League Baseball teams in the 2009 season. There is a brief discussion about why it would be important to quantify the measure of center, spread and position. Below is a table that shows the introduction of this lesson.

Table 7. First Page of Lesson in SoftChalk.



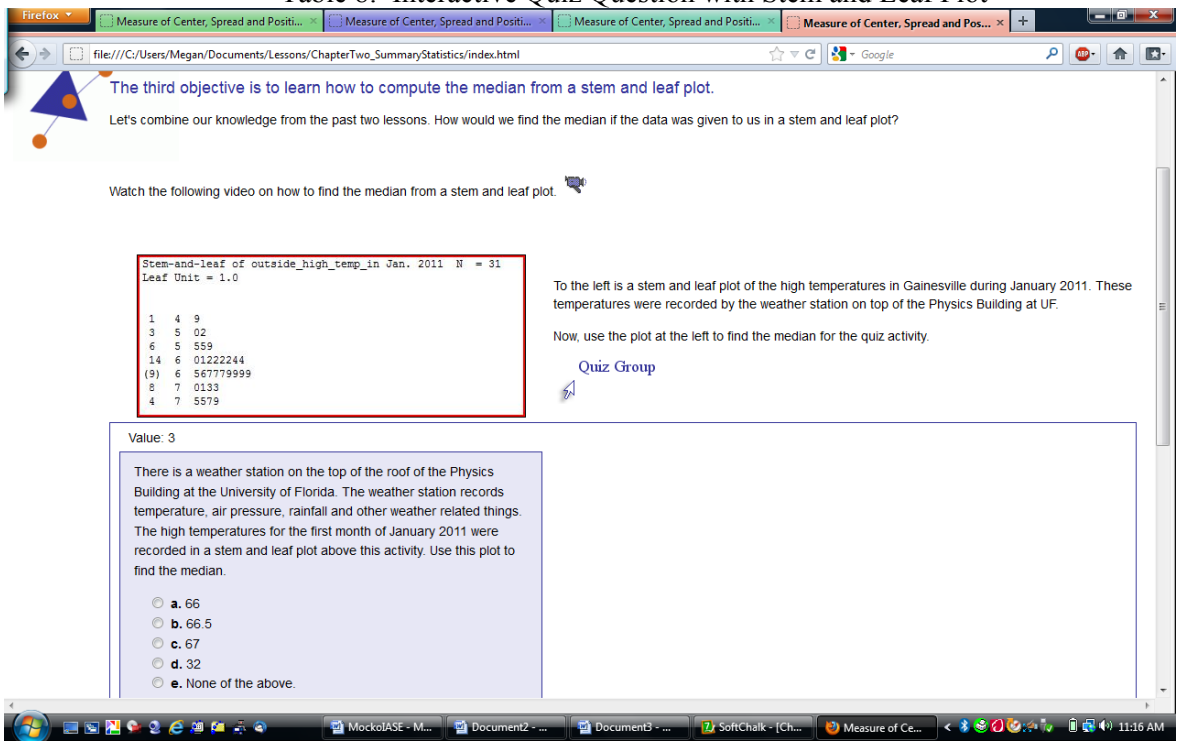
The objectives of the day are then presented: 1.) Compute and define the mean, median, and mode. 2.) Describe the effects of outliers on the mean and median. 3.) Be able to find the median from a stem and leaf plot. 4.) Be able to compute and define the measures of spread. 5.) Be able to use the Empirical Rule and know when it is correct to use it. 6.) Be able to compute and define the quartiles and to be able to use the quartiles to create boxplots. 7.) Be able to use StatCrunch to make graphs and compute summary statistics.

On the next page of the lesson, the first objective is discussed with a short tutorial which explains the definitions of the mean, median and mode as well as finding the mean and median of two data sets. The students are then asked to complete a quiz where they have to find the mean and median of a data set in addition to matching the terms mean, median and mode with their definitions.

For the second objective, the students are asked to explore the effect of an outlier on the mean and median by playing with an applet designed by the publisher of the textbook. The students are then quizzed on their findings.

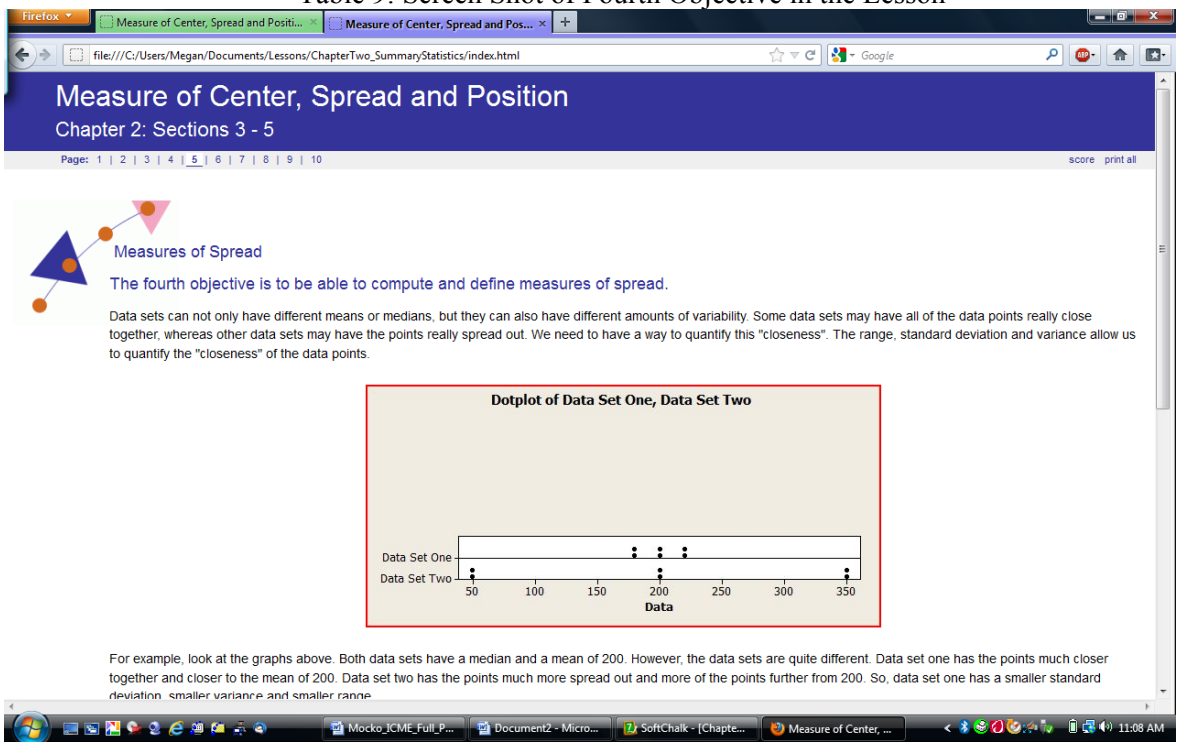
For the third objective the students are reminded about the stem and leaf plot that they learned about in a previous lesson. The students then watch a short video that shows them how to compute the median from a stem and leaf plot from Minitab, a statistical software package. The students are then asked to find the median from another stem and leaf plot. The image below shows the stem and leaf plot and an interactive quiz question.

Table 8: Interactive Quiz Question with Stem and Leaf Plot



For the fourth objective the students are shown two dotplots that have the same mean and median, but have quite different spreads. This demonstrates why it is also important to talk about measures of spread. The measures of variance, standard deviation and range are discussed in a short video and then the students are asked to compute these values for a data set as well as to predict the effect of an outlier on these measures. A screen shot of this page is below in table 9.

Table 9: Screen Shot of Fourth Objective in the Lesson



For the fifth objective, the empirical rule is explained in a short video and the students are asked to answer a brief question about the rule.

The sixth objective includes two short videos, one of the videos shows how to compute the quartiles from a set of the data and the other video shows how to use the quartiles to make boxplots. Additional discussion is also given on how to interpret and read boxplots. The objective finishes with the students answering three questions which require them to compare side-by-side boxplots.

On the next page, the students see a small cartoon from the CAUSE website to break up the lesson a little bit. The last objective discusses the fact that computers are very important to statisticians and that in this course the students would see output from Minitab and would work with StatCrunch on the web. They were then asked to watch a video by Webster West, the creator of StatCrunch. After the watching the video, the students were asked to use StatCrunch to analyze a data set about lobster fishermen from the StatCrunch database.

The last page of the lesson reviews the important concepts that they have learned.

From an instructor's point of view, SoftChalk was easy to use and allowed for a lot of flexibility in terms of activities that could be used to engage the students such as matching questions, flashcards, and linking to applets. The newest version of SoftChalk, SoftCalk 7, even allows for lessons to be completed on smart phones and tablets. Version 7 also has activities that don't depend on the use of a Flash software player package.

From the student's point of view, many did not have any problem using the lessons. Initially, some students using Google's Chrome browser had problems; however, after switching to another browser those problems were resolved. Additionally, a few students had to install Flash player software on their computer in order to participate in some of the lessons. One student had a lot of problems getting the lessons beyond the first one loaded to appear. The SoftChalk helpdesk worked with her and was able to determine that the student's very slow connection speed and computer was the issue. The helpdesk recommend that instead of bundling the 24 lessons it might be better to bundle them into two sets of about twelve lessons.

In addition to the SoftChalk lessons, the students also used MyStatLab for homework problems provided by the publisher. For each lesson assignment, students were required to complete a homework assignment in MyStatLab. The homework problems accompanied the

textbook, *Statistics: The Art and Science of Learning from Data* by Agresti and Franklin(2009). The lessons and homework problems were due within three weekdays of being assigned.

From an instructor's point of view, the assignments were easy to select and assign. The instant feedback that the students received was a nice feature. The only problem that was experienced during the semester was that in one question it was necessary to get an exact p-value from a t distribution with a high degree of freedom. This was a problem because students were taught to use a table to get an approximate value of the p-value. The students were shown how to use an applet to solve this problem. The students adapted to the use of the applet very quickly and there were no other issues.

What was the experience from the student's point of view? How much time did it take for the students to complete the assignments? In the post survey, the students were asked how much time they spent working on the course (including everything related to the course: activities, quizzes, watching lectures, doing homework, studying) per day? The average amount of time spent on the course per day was 3.05 hours. The standard deviation was 2.76 hours. The data did have one outlier where the student said that they spent 15 hours per day on the course, which seems doubtful. If this point is removed, the average is 2.47 hours with a standard deviation of 0.75 hours. The students were also asked how many hours they spent on the course per week. The average time spent on the course was 11.64 hours and the standard deviation was 5.36 hours. The minimum number of hours per week was 3 and the maximum number of hours per week was 28.

Additionally, the students were asked in the pre-survey how much of the homework they planned to complete. All but one of the responses said 100% on the pre-survey (one response said 80%). On the post survey, the average response for the percent of homework completed was 97.5% and the standard deviation was 3.628%. The minimum was 90% and the maximum was 100%.

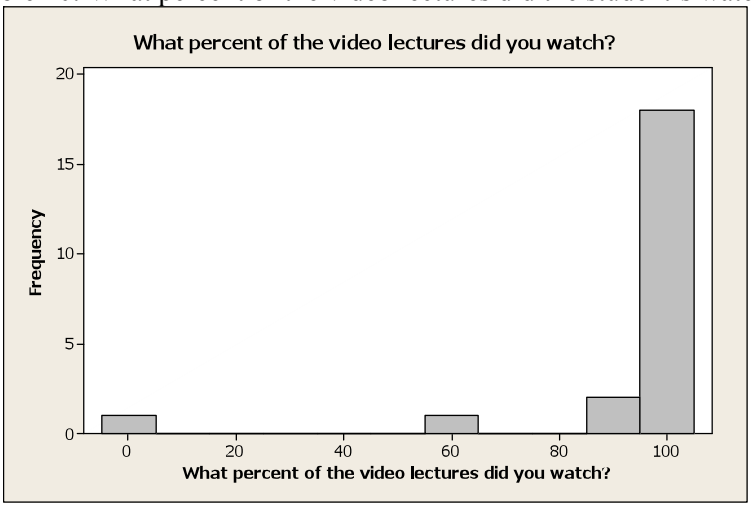
Computer/Video Screen Capture

Two forms of lecture capture software programs were used during the semester, Camtasia Relay and Jing!.

Camtasia Relay was chosen to use for the course because it was supported by the university and video storage was free. The limitation of the Camtasia Relay software was that our campus supported version did not allow for much additional editing of the video beyond setting start and end times. A more advanced version of Camtasia is available with full editing features but the instructor did not have that program available. Additionally, for Mac users an extra program called Flip4Mac had to be downloaded so that the students could watch the videos. Otherwise, Camtasia Relay was very easy to use and the instructor did not need an in depth knowledge of how to store streaming video.

At the end of the semester, the students were asked what percentage of the videos they watched. The average percentage of videos watched by the students was 91.73%; however, please notice from Table 10 that one student said that he watched 0%, one student said 60%, and the rest said 90% or higher.

Table 10. What percent of the video lectures did the student's watch?



The other video capture program used was Jing! and it was selected for the student's projects because it was free and easily accessible online for students to use. The main limitation of Jing! was that it only allowed for recorded videos less than five minutes long. Since the projects for the course only required a five minute presentation, this worked very well. A few students initially had issues understanding how the program worked and were resistant to learning a new software program by this point in the semester. However, after they were pointed to the help tutorials on Jing!'s website, they were quickly able to figure out how to make the software work. Only one student ended up using a video recorder instead of Jing! due to technical issues. Afterwards several students noted how easy the program was to use and how they planned on using it in the future.

Interactive communication programs

During the semester, interaction was also encouraged between the students and between the instructor and the students. Several formats of interactive computer programs were used: email, the chat program in Sakai, the discussion board in Sakai and the Elluminate software package.

The students were sent listserv emails almost every day of the course reminding them of upcoming deadlines or giving additional instructions. The students were also encouraged to email questions about grades or other personnel issues directly to the instructor. In the syllabus, the instructor requested that students post all questions about the content of the course and the administration of the course on the Q/A board, such as questions about when an assignment was due. However, the instructor did not adhere firmly to that rule. The students simply seemed more comfortable directly asking the instructor questions via email.

The chat program in Sakai was another primary mode of communication. The chat function was easy to use and simply required typing. The instructor had initially thought that not having a whiteboard in the chat function would be limiting, but this really didn't become an issue. In the few cases where a whiteboard was needed, the instructor simply made a short video using Camtasia Relay and posted it for the students. The students seemed to feel very comfortable in the Sakai chat environment. On the day before the project was due, the instructor spent almost 10 hours chatting with students about the impending project that was due.

Elluminate was another communication program that was used briefly in the course. The Elluminate software allows instructors to conduct online office hours with a package that includes video chat, text chat, and an interactive whiteboard. It is possible for multiple users to speak and to write/draw on the white board. Additionally, it was possible for students to be polled about a concept or simply asked to raise their hand. Although the program had many capabilities, it was very hard to use. There were too many buttons and options that needed to be understood and it was just too difficult to operate the program and teach at the same time.

The initial plan for the online office hours for the course was to use the Sakai Chat room and then to transition to Elluminate. Since the students felt so comfortable in Sakai chat room, the instructor delayed the transition to Elluminate. The Elluminate software was used several times to do question and answer sessions but both students and instructor found the environment cumbersome to work in and several times it was not possible to get the microphone to work on the student's computer. The instructor felt that there had to be an easier platform to communicate with online students. It felt that the Elluminate software had become the primary focus rather than the course material.

The course also used the discussion board in Sakai. The discussion board in Sakai was used for two reasons; for a question and answer board and for a small group discussion board. Students were encouraged to post questions about the content of the course and general administration issues on the question and answer discussion board. The small group discussion board was used for discussion between randomly selected groups of about eight students. The students were asked to complete five activities during the six week semester. The first activity was for the students to introduce themselves to the group and then to reply to at least three other students' introductions. The second activity was for the group to select three articles from the internet that contained information about an experiment and/or survey. The students were then asked to identify various aspects of the study such as the explanatory and response variable and to discuss what aspects of the experiment/survey were good and what could be improved. The group

was then asked to rank each of the three surveys/experiments in terms of quality and adherence to the good survey/experimental protocol that they established. The third activity was for them to conduct a lesson style called a Four Corner Debate that has the students debate a particular concept. The idea for a Four Corner Debate came from the talk by Michelle Everson and Jackie Miller at USCOTS 2011 (For more information on a Four Corner Debate visit this website http://www.educationworld.com/a_lesson/03/lp304-04.shtml). The concept for the debate was for students to consider issues about privacy and ethics as it relates to data collection and statistical analysis. Sometimes it is helpful for students to see other sides of an issue by not getting to pick the point of the view that they are arguing. So each student was told that in a few days a statement was going to be posted to the discussion board which they would need to debate. However, they had to pick their point of view before the statement was posted. The students had to pick if they "strongly agreed", "somewhat agreed", "somewhat disagreed" or "strongly disagreed" with the statement. Several days later the statement that "Data can only do good things in today's world," was posted. The students then had to support their point of view in respect to this statement. The fourth activity asked the students to complete a collaborative quiz on four questions with multiple parts about the sampling distribution of the sample proportion and the sample mean. The students were first asked to complete the assignment on their own and post their answers and then to work together as a group to complete a response from the whole group. This idea of the use of a collaborative online quiz came from Audbjorg Bjornsdottir who also presented at USCOTS 2011. Only the final quiz responses from the entire group were graded and participation in building the team's response to the assignment was a part of the grade. The last assignment was for the students to critique other students' semester project.

The instructor found grading the discussion board very time consuming for 67 students. It was important to the instructor that every post be read and for each assignment to be commented upon. In particular, grading the second assignment was exceptionally time consuming and using this assignment with more students would be unreasonable. The students also resisted the group components of the activities. They were uncomfortable coordinating group activities with other students not in the same town and became very frustrated with students that didn't respond in a timely manner. Additionally, for the fourth assignment there was very little discussion over the quiz answers. Students didn't want to point out that another student was wrong in this environment. The instructor expected the students to have worked together more to make sure that all of the answers submitted were correct. In the future, the instructor plans to have the students submit a group contract laying out each student's responsibilities to help students feel more comfortable with the group assignment.

The discussion board, chat room, Elluminate software and email were all used to improve interaction in the online course and to help build a sense of community. The students were asked in the pre and post survey how important these issues were to them. Below are a few of the results of the questions asked to the students about interaction and the communication programs.

At the beginning of the semester, the students were asked. "How important is interaction with the instructor to you?" The possible responses were "very important", "somewhat important", "minimally important", and "not at all important".

Table 11. " How important is interaction with the instructor to you?"

	Very Important	Somewhat Important	Minimally Important	Not at all Important
Interaction in general	55%	35%	10%	0%

At the end of the semester, the students were also asked about the importance of the various types of interaction in the classroom. The question stated was "How important was ___ with the instructor to you?"

Table 12. "How important was _____ with the instructor to you?"

	Very Important	Somewhat Important	Minimally Important	Not at all Important
Email	88%	8%	8%	0%
Discussion Board	40%	28%	20%	16%
Online Office Hours	32%	12%	36%	20%

The students were also asked how important was interaction with other classmates in the course through their Small Group Discussion Board, and the Q & A Discussion Board was to them.

Table 13. "How important was interaction with other classmates in the course on the Small Group Discussion Board and the Q&A Discussion Board?"

	Very Important	Somewhat Important	Minimally Important	Not at all Important
Small Group Discussion Board	8%	24%	40%	28%
Q&A Discussion Board	12%	12%	44%	32%

The students were also asked how frequently they visited the Small Group Discussion Board and the class Q&A Discussion Board.

Table 14. "How frequently did you visit the Small Group Discussion Board and the Q&A Discussion Board?"

	Every Day	Two or Three Times a Week	Several Times a semester	Only Once per Semester	Did Not Participate
Small Group Discussion Board	4%	52%	44%	4%	0%
Q&A Disc. Board	0%	16%	12%	32%	40%

Although this survey does not represent a random sample of students, it is interesting that the students preferred form of communication was still email.

Grading

Determining how to setup high stakes testing in an online environment can be very difficult. The instructor needs to think about what type of assessments work the best at determining how well the students have learned the material, what type of mechanisms need to be in place to ensure that the students are who they say they are and that the security and integrity of the exam itself remains protected.

For this course, the instructor determined that the best way to conduct high stakes testing was with an online proctored multiple choice test. Some schools require students of an online class to meet on campus for the test. However, the university gave specific requirements that the course had to be completely online including assessments so the instructor determined that using our course management system to deliver multiple choice tests was the option that would work the best under the constraints. How then could you make sure that the questions on the test remained secure? To do this, the instructor determined a small time frame for the students to take the test. All students had to begin their exam within three hours of the first exam being started. The ordering of the questions and the answers was randomized for each student. The students would also be allowed a digital formula sheet that the instructor provided. Additionally, makeup exams had a completely different set of questions from the main exam. The students were also directly proctored during the exam by an online test proctoring company called ProctorU. The student initially had to register with ProctorU before the exam date and pick a time within the three hour window to take the exam. The actual cost of the proctored exam was covered in the course fees but if the students registered with ProctorU late on the day of the exam they had to pay an additional small penalty fee. Before the exam, the students were also encouraged to perform a system check

of their computer to make that sure that it would fully function with ProctorU's monitoring software. On the night of the exam, the students logged in to the ProctorU software and were greeted by a proctor in a video chat using a webcam. The students would then allow the proctor to see their computer screen so that whatever is on the computer screen is viewed by the both the student and proctor as well. The proctor then asked to see the student's id and asked a few questions to ensure their identity. The company also took a picture of the student that could be used for later reference if needed.

From an instructor's point of view, setting up the exam time with ProctorU was very easy. The company requires that the instructor complete a short Excel spreadsheet that includes start and stop time of the exam, exam length, the date of the exam, the password of the exam, and if any special accommodations were needed. The instructor then setup the exam within the course management system and set a password for the test. The proctor at ProctorU inputs the password allowing the student to only then proceed to take the exam.

There were two tests conducted this way for this course. For the first exam, there were only two students who had trouble completing the exam at the scheduled time; however, these issues had nothing to do with the proctoring company. For the second exam, there were multiple problems during the testing period. The first problem was that the test did not release in the course management system due to a problem within Sakai. After the test was forced to release, the new password had to be related to the proctoring company. The new password was sent by email and called into the testing center on the East Coast of the United States. Unfortunately, the proctoring company did not relay that password on to their second testing site on the West Coast (who handled the later night exam start times), so more students were delayed while the instructor had to email and call in the new password yet again. Additionally, the proctoring company did not update their internal record about the student's ability to use an electronic formula sheet during the exam. So, an additional phone call and email had to be made to the proctoring company to fix the problem. In short, the first exam went very well, but the second exam had multiple technological and communication issues with ProctorU after an initial issue in Sakai delayed the exams release.

CONCLUSIONS

For conclusions, the specific course assessment will be given as well as a set of recommendations for teachers teaching the course for the first time.

Specific Course Evaluation

As for the course, the course will be evaluated in two ways, the overall instructor evaluation and the overall course grades given. The overall course rating done in course evaluations was 4.42 out of 5. The table below shows the final grade distribution for the course.

Table 15. Grade Distribution for the Course

Grade	A	A-	B+	B	B-	C+	C	D	E (failure)	Dropped
Number of Students	19	5	9	10	4	4	6	2	3	5

Grades are a fairly limited source of assessment because they can be arbitrarily determined by the instructor. However, it does show that most students were successful in the course. The drop rate was 7.5% and although this value is similar to other non-online courses taught by the instructor, it would be nice if the drop rate was smaller.

Overall Assessment of Technology

1.) SoftChalk was an easy program to learn for someone without a strong website HTML programming background. The SoftChalk program worked well at presenting formulas and graphs, which is very important for an introductory statistics course. Additionally, the ability to add quizzes and other activities helped improve the learning experience.
2.) The tablet PC was a good tool allowing for quick graphics to be drawn for illustrating statistical concepts.

3.) Camtasia Relay recordings with the use of the tablet PC were easy to make and allowed for quick explanations of material to be presented to students.
4.) StatCrunch allowed for the students to collect and investigate their own data as encouraged by the GAISE guidelines.
5.) SoftChalk Lessons and MyStatLab allowed for immediate feedback while students were practicing working with statistical concepts.

Recommendations for Instructors for Introductory Statistic Teachers

1.) Don't assume that students will quickly pick up different software. Introductions to all forms of software used in the course should be provided to make the students more comfortable with the environment.
2.) Encourage communication through email and chat rooms. Students should be encouraged to send email for questions, since this is still their most comfortable form of communication. Also, students preferred the chat room in Sakai that was much simpler to use and more similar to the text function on their cell phone rather than Elluminate's more complex interface.
3.) Software for a course should be chosen to enhance a course and should take the back stage to the course material. The Elluminate software was cumbersome to use and that fact kept it from being used more frequently, whereas the SoftChalk lessons, Camtasia Relay videos, MyStatLab, Jing!, StatCrunch software and online statistical applets really added to the learning experience. The programs were easy to use, worked seamlessly in the background and aided in the learning of the material.
4.) More interference from the instructor to stimulate discussion and team work should be made. The discussion board assignments did not generate the sense of community that was their primary goal. Additionally, the instructor should not assume that students will be completely comfortable in an online discussion board even though they may be digital "natives" and have grown up with email and the internet. As a result, the students did not work together well to make sure that the work submitted was correct.
5.) Always be online for support during proctored exams. The online proctoring worked, but there were some rough spots. Extra effort should be made to communicate with ProctorU and the instructor should always be available through email during the exam to fix any problems that may arise.

FUTURE RESEARCH

The next step in this research is to see what type of improvements to small group assignments in an online course are the most effective. What methods result in a larger sense of community, greater self-efficacy and higher test scores? What type of team building works well in this environment? Additionally, what other technological options should be investigated as outlets for interaction beyond the discussion board in the course management system? Perhaps wikis, Facebook or Google+ Chat rooms, etc. should be used. Should assignments be synchronous modes of interaction (planned "chat room sessions" or "planned group activities") rather than asynchronous discussion board assignments?

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