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# ENRICHING RESPONSIVENESS TO ENHANCE STUDENT LEARNING IN ONLINE COURSES

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## **Enriching Responsiveness to Enhance Student Learning in Online Courses**

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### **ABSTRACT**

This paper assesses the effectiveness of three specific processes to enhance student interaction and collaboration by comparing their effectiveness for online courses with on-site courses. The processes include: 1) a full set of recorded lectures available in indexed segments of 5-10 minutes per segment, 2) mentored assignments, and 3) pre-recorded small group project presentations. Students find the recorded lecture segments very effective for reviewing and mastering concepts they had difficulty grasping when they were presented initially. The mentored assignment process enables online students to interact more effectively with other online students, by focusing their interaction on a few others rather than the whole class. Data is presented showing that quality of research, original thinking, understanding of the subject, and thoroughness of work is as good as or better for online students when compared with onsite students. Similar results are presented showing the effectiveness of having small groups work together to develop a recording of their findings. The process of developing the recorded presentation enables effective collaboration and frees students from obstacles that have been encountered in trying to make small group projects work in online courses. Data is presented showing that, using this approach, small group project quality is comparable for online and on-site courses. A survey focusing on student perception of the small group process, shows that most, but not all students find that the process improves their learning, their critical thinking and the quality of their work.

### **INTRODUCTION**

Considerable evidence has emerged showing that, given a choice, many students choose to take their university courses online (Study, 2008). More than 6.7 million students have taken at least one online course. This amounts to 32% of higher education students (Online Learning Consortium, 2012). There are many reasons for this. These reasons have been discussed extensively by others, for example (Gillingham and Molinari, 2012), (Glover and Lewis, 2013) (Mann and Henneberry, 2014), and (Jaggars, 2014), and it is not our intent to review the reasons behind students' choices in this paper. Instead, we concentrate on examining several approaches we have introduced to make online courses more effective, and we show the impact of these approaches for one challenging and complex graduate course in cybersecurity that is offered both online and on-site at our institution.

Debate has been ongoing for some years about whether online courses are as good as on-site courses, or whether they can be as effective. Allen and Seaman report that 77 percent of academic leaders "rated the learning outcomes in online education as the same or superior to those in face-to-face." (Allen and Seaman, 2013). Even as the debate has continued, online courses have improved substantially. The authors have found that online courses can be as effective as onsite courses, and a course taught online can be even more effective than the same course taught on site. Two key considerations are the design of the course and the approach used by the instructor.

Uhlig, Viswanathan, Watson and Evans showed that there was no statistically significant difference in learning between a sizeable number of on-site and on-line engineering courses. (Uhlig et al, 2007). Design of online courses is important to achieve this. The current paper reports on results of incorporating a number of best practices into a graduate course on Cybersecurity. The data below was obtained from four instances of a cybersecurity course taught in our Master of Science in Computer Science program. 39 students took the course onsite in February 2015. This was our control course, before the best practices discussed below were added. 17 students took the course in person onsite in July 2017. 20 students took the identical course online in December 2016, and 27 students took the identical course online in December 2017.

### THE IMPORTANCE OF ENRICHING RESPONSIVENESS IN ONLINE COURSES

A great deal of the effectiveness of any course depends on the way in which it is taught. Smyth (2011) observed that online students and on-site students value many of the same things in teaching, but in a different order. Nine key characteristics of effective teaching were identified, and ranked in order of importance. The most important characteristics for face-to-face teaching were identified in rank order as:

1. Respectful
2. Knowledgeable
3. Approachable
4. Engaging
5. Communicative
6. Organized
7. Responsive
8. Professional
9. Humorous

The same characteristics appeared in the rankings for effective online teaching, but the rank order of two of the characteristics changed significantly for online teaching. Respectful remained at the top in both lists. But Responsiveness moved from seventh place in face-to-face teaching to second place in online teaching. This should not be surprising in the digital age, where instant responses are more often than not the normal expectation. But, this significantly impacts the way an online course needs to be conducted.

The other characteristic that moved significantly was “Engaging.” Online students are less concerned about how engaging the instructor is. The characteristic moved from fourth place in face-to-face teaching to seventh place in online teaching. The three characteristics at the end of the list for online teaching are more difficult to observe and to convey in an online environment, and that may be part of the explanation for the drop in ranking of the “engaging” characteristic. The full rank ordered list for online teaching is:

1. Respectful
2. Responsive
3. Knowledgeable
4. Approachable
5. Communicative
6. Organized
7. Engaging
8. Professional

## 9. Humorous

Our experience affirms the importance of respect for students. We do this in a variety of ways, starting with asking them what they want to learn in the course. Most students respond favorably to being asked. Even if they don't say anything, they know that we care enough to ask.

A very important aspect of showing respect for students is providing timely feedback to questions and timely posting of grades on assignments, exams, and projects, which corresponds directly to the second item on the list – being responsive. Answers to most questions in on-site classes are given when they are asked. Many questions in online classes come in the form of email. Being responsive to these requires frequent checking for email from students, sometimes as often every two hours, and providing answers as quickly as possible. That often means responding by smartphone email.

### SOME BEST PRACTICES FOR ENRICHING RESPONSIVENESS

Three specific best practices were incorporated into the course and results were compared with student accomplishments before and after these practices were added. The three practices were: 1) 22 hours of indexed recorded lectures were made available for online courses, containing material identical to the lectures provided in on-site courses, 2) Mentored writing assignments and 3) Small group projects. For the mentored writing assignments, each student was mentored by two other students in the same class, For the Small Group Projects, online students produced group recordings of their findings.

#### Indexed Recorded Lectures

A complete set of recorded lectures is made available for the online course containing the same material as the lectures that are delivered in the on-site course. This is accomplished by adding voice annotation to the identical set of PowerPoint charts that are used in teaching the corresponding on-site course. The process of doing this, using the MS PowerPoint “Insert Audio” Command, is simple and effective. Captioning has also been added for the hearing impaired. The lecture does not need to be any more perfect than an on-site lecture. Natural inflections in the voice, pauses, and, even pauses by the professor to think, preceded by and “um” are okay. In fact, such natural delivery is more engaging. The student listening to the recording feels more like they are in a live class, rather than receiving a “canned” lecture.

The recorded lecture material is broken up into 5 to 10 minute segments, which online students can listen to whenever they have the time. Each lecture segment is posted to the appropriate weekly lectures in our learning management system. The length of each lecture segment is noted to help online students in budgeting their time. And a brief, one-line description of the segment provides effective indexing of the material. Students are invited to try to listen to the recorded lecture segments before a synchronous online session where that material will be reviewed. They can listen on a laptop, but to make the material more accessible, they have the option of listening to and viewing the material on their tablet or on their smartphone. Students have responded favorably to this approach.

It is interesting that these same recordings have benefited students in the on-site version of the same course. The indexed recordings have been made available to the on-site students as a form of review of the lectures delivered in class. On-site students reported that they found it helpful to be able to choose some recordings to review concepts they had difficulty grasping during the

live lecture. This can be particularly beneficial for students who learn best through the verbal/linguistic learning style. (Uhlig and Viswanathan, 2006)

### Impact of Mentored Assignments in Online Courses

One of the biggest issues with making teaching more responsive is how to stretch the instructor's time to respond to every student. This becomes particularly problematic in helping students when they are preparing a writing assignment in an online course. Most instructors have had the experience of several students in an on-site course describing their understanding of the assignment and asking for feedback on whether the way they plan to approach the assignment is appropriate. Mentored assignments have been developed to help students evaluate and analyze the direction they are taking in completing a writing assignment.

The particular assignment evaluated in the cybersecurity course studied is a 3 to 5 page written paper discussing how the student proposes to design an authentication system that learns by observing user behavior over time. Students have first been taught the basics of authentication, including how to develop strong passwords for systems that authenticate users based on an <ID, password> pair. The concept of multifactor authentication is also explained. For example, many online banking systems now send a code to a user's cell phone after they log in with <ID, password>, and the user must then enter the code. The user is only allowed full access to their data after the correct code is entered. For this assignment, students are encouraged to think about kinds of user behavior could be observed over time, so that the authentication process becomes stronger with time. This may include things like what location(s) the user tries to log in from, applications frequently used in a user's computer or smart phone, times of day when a user logs in, typing speed, writing style, and more.

Students first prepare a draft, and then provide it to both of their mentors. Two student mentors from the same class are assigned to each student, so that every student receives feedback from two fellow students in the same class. The mentors provide suggestions for improving the writing assignment. Students are free to accept the suggestions or to ignore them. Because each mentor is doing the same assignment, their own paper can benefit from what they learn in reading the drafts of the students they are mentoring. In effect, each student interacts with four other students in completing the writing assignment: the two who mentor them and the two whom they mentor. The instructor may still receive some questions from students, but most students are satisfied with the feedback they receive from their mentors. Additional details about the process have been provided by Uhlig, Sinha, Jawad, Dey and Amin (Uhlig et al, 2017).

Some problems have been experienced with the quality of feedback. Mentors are asked to provide meaningful, actionable feedback rather than inane comments like, "I really liked your paper." Some take this responsibility seriously and provide excellent feedback. Others do not. One example of serious feedback from one mentor is,

"I can see the different metrics, but it would help me understand the progression of the system if I knew what it did with this information. For instance if you, bring your laptop to a coffee shop every day at 5:00pm can the system ask 'what do you like to do at your current location?' once it sees the IP of the coffee shop. Or if you didn't go to the coffee shop at that time, would you be prompted with a security question? Also, would the user be allowed to choose what progression pathway to use? Or would they use all of the suggested options (i.e. device, time of day, session length, biometrics)?"

Some students provide their drafts to their mentors much too late to expect serious feedback. This is the natural result of not working on the assignment until the last minute. A part of the grade for each student is the quality of the comments made to students they mentored. When mentors do not receive a draft until the “last minute”, they are excused from making comments on those drafts.

The mentoring process has produced good results. As students make suggestions to one another, and review one another’s papers the quality of the proposed solutions has improved significantly. Meaningful learning from each other is taking place as a result of the process. This is demonstrated in the distribution of four grading elements for the assignments. The assignments are graded on the quality of research, original thinking, understanding of the subject, and thoroughness of sources. In each of these categories, students may receive an assessment of outstanding, very commendable, commendable, exceeds expectations, meets expectations, fair or poor, according to a detailed rubric. Two writing assignments were required in the instances of this graduate cybersecurity course taught in December 2016, July 2017, and December 2017. The two December classes were taught online. The July class was taught onsite. The first assignment in each class was mentored. The second assignment was not mentored. Figure 1 shows the distribution of these grading elements across the three classes for the mentored assignment versus the assignment that was not mentored. The mentoring process has moved a significant number of students up from the “Meets Expectations” and “Fair” categories.

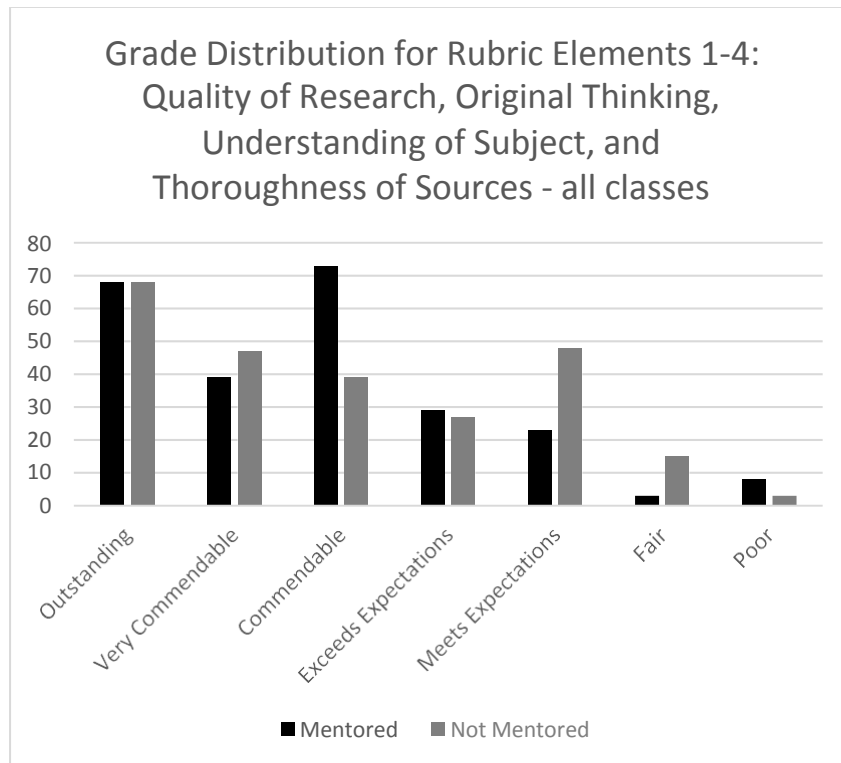


Figure 1 – Grade element distribution for Mentored vs. Non-Mentored Assignments

With equal numbers in the “Outstanding” category for both the mentored and non-mentored assignments, it might be inferred that the process may not help the “best” students as much as it helps the students who may be struggling. The better students help the students who

need the most help. And the students who need the help, receive the most meaningful comments and suggestions for improvement from the better students.

To better understand potential impact of the mentoring process for both the online versions of the course and the onsite course, we first compared the distribution of these same grading elements for the non-mentored assignment between the online and on-site versions of the course. Figure 2 shows the two distributions for the non-mentored assignment. The distribution for online courses contains actual numbers. To make it easier to compare the two distributions, the onsite distribution has been normalized to the total number of students in the two online courses. There does not appear to be any significant difference between the distribution for the on-site class and the distribution for the online classes, as we expected.

Figure 3 compares the distributions for the mentored assignment between the online and on-site versions of the course. There is a clear shift to better learning and better grades for the online courses. This demonstrates the effectiveness of the mentoring process. It is not surprising that the impact is greater for the online courses where there are fewer opportunities for students to interact with one another.

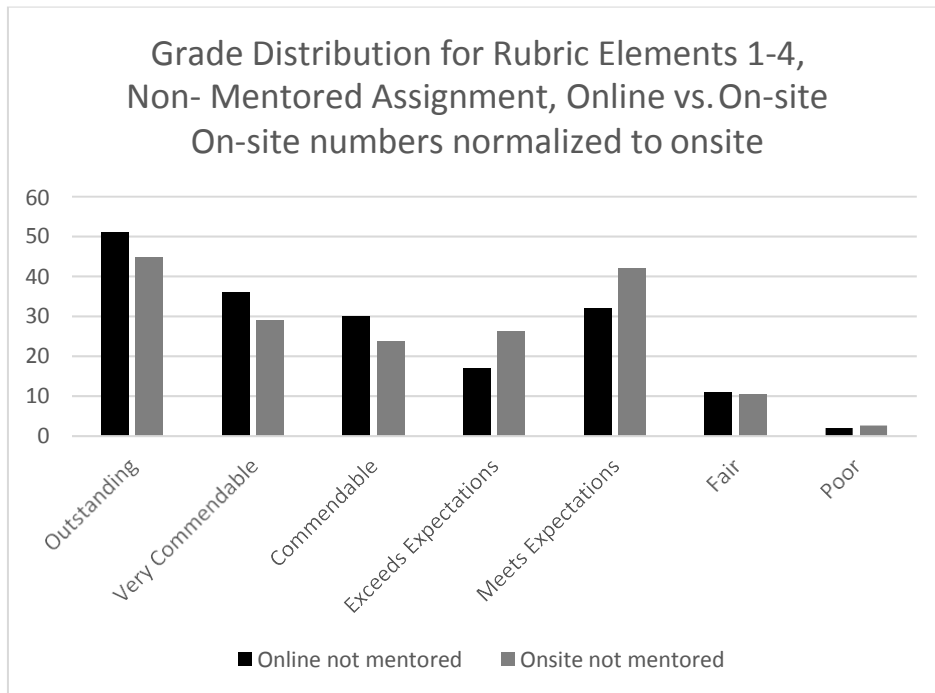


Figure 2 - Grading Distribution for Not Mentored Assignment – Online vs. On-Site

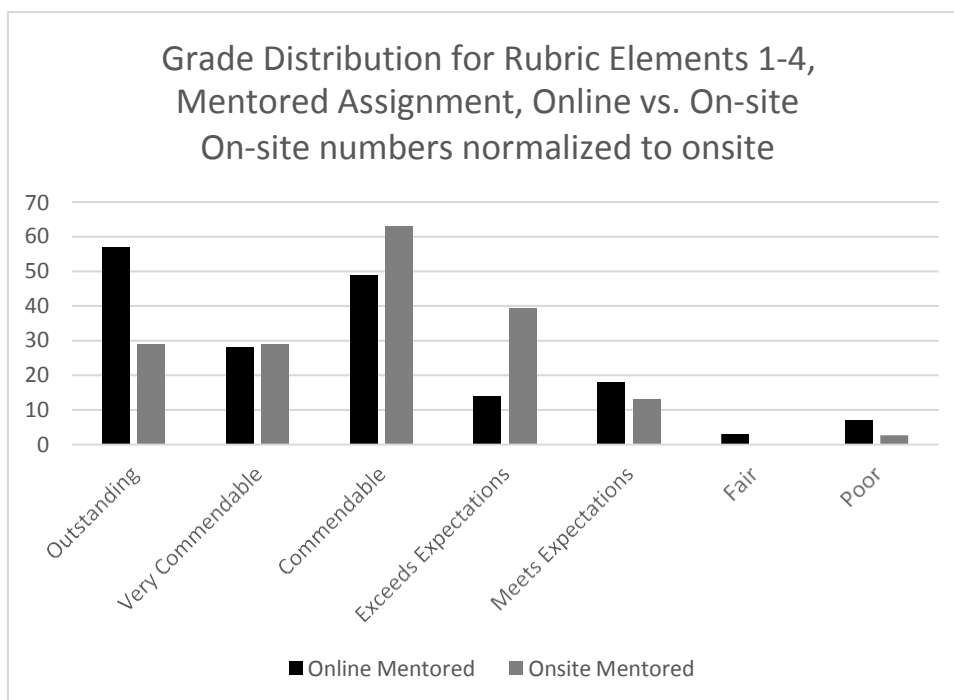


Figure 3 - Grading Distribution for Mentored Assignment – Online vs. On-Site

### Impact of Small Group Projects in Online Courses

Until recently, all members of a small group in an online course were required to participate simultaneously in a “live” presentation during a synchronous session. However, this was sometimes an obstacle, for example for a student whose job required working in the evening. To solve this problem, the format for small group presentations was changed to be a recording put together by the small group. This made it possible for online students to be part of their small group’s presentation, even if they could not participate in any synchronous class sessions. Details of the process have been discussed by Uhlig et al (Uhlig et al, 2017). This change produced unexpected dividends, and resulted in small group presentations that could be even better than “live” presentations in synchronous online sessions. The recorded presentations have generally turned out to be more polished, as a result of the process followed by the small groups.

The whole class gets engaged with the small group projects through use of an online threaded discussion question in which every member of the class is required to listen to one small group presentation other than their own group, and then discuss whether or not they agree with the findings of the other small group and why. This requirement, has proved to be useful in promoting group interaction with the class, particularly for controversial topics.

In the discussion by Uhlig et al (op. cit.) preliminary distributions of the same four grading elements used for small group projects were shown. Figure 4 shows these distributions extended to the additional classes now available. These distributions indicate that the online courses are at least as effective as the on-site course, if not more effective, insofar as learning from small group projects is concerned.



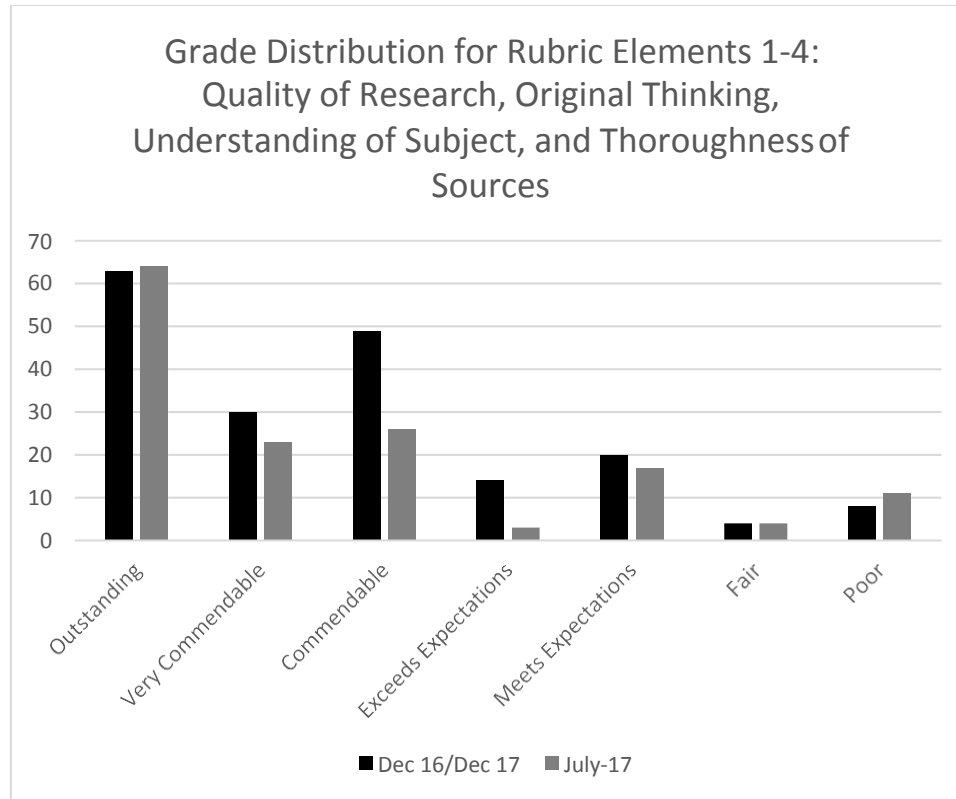


Figure 4 Grading Distribution for Small Group Projects – Online vs. On-Site

We previously compared overall grades for small group projects in an online class with grades for small group projects in an onsite class. Figure 5 shows these data extended to four classes. February 2015 and July 2017 were onsite classes. December 2016 and December 2017 were online classes of the same cybersecurity course. Small group project presentations were “live” in the February 2015 and July 2017 courses. All small group presentations were recorded in the December 2016 and 2017 courses.

	Dec-17				Jul-17				Dec-16				Feb-15			
	Online				On-Site				Online				On-Site			
	Avg	Std Dev	Max	Min	Avg	Std Dev	Max	Min	Avg	Std Dev	Max	Min	Avg	Std Dev	Max	Min
Project Set 1	91.81%	6.20%	98.90%	80.60%	90.96%	4.60%	96.60%	85%	95.37%	2.33%	98.20%	90.20%	90.91%	2.35%	95.60%	88.40%
Project Set 2	Project Sets 1 and 2 were combined in this class				93.12%	2.09%	96.40%	89.80%	95.60%	4%	100%	88.40%	90.60%	3.32%	96%	86.13%
Cracking WiFi Project	93.48%	5.11%	99.60%	83.30%	94.94%	3.73%	99.53%	89%	96.44%	2.85%	100%	91.20%	94.43%	1.70%	96.53%	91.00%

Figure 5 - Small Group Project Grades – Online vs. On-Site Versions of Same Course

Figure 6 shows a Box plot of project grades across the 4 different classes. Box plots are a graphical depiction allowing easy comparison of several sets of data through looking at their quartiles (McGill et al, 1978). The center of each box is the median grade, the top of the top box is

the third quartile, and bottom of the bottom box is the first quartile, and the whiskers in Fig. 6 show the maximum and minimum grades. It is clear from the boxes that there is no significant difference between student learning from small group projects in online courses and on-site courses. The process of generating a recorded presentation for online courses has leveled the playing field, so that the grades received are the same whether the course is taken online or on- site.

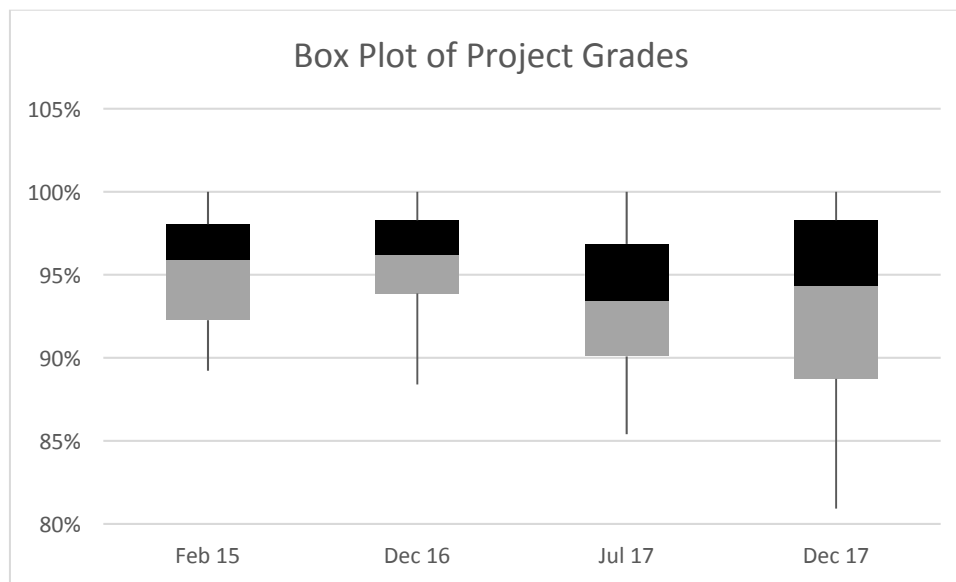


Figure 6 – Box Plot of Project Grades across Four Courses

### SURVEY OF STUDENT OF EFFECTIVENESS OF BEST PRACTICES IMPLEMENTED

A survey focusing on the small group projects was sent to all students enrolled in the three classes in which these best practices were implemented. A total of 20 responses were received from the 64 students surveyed, for a response rate of 31.25%. Students were invited to respond using a 5-point Likert Scale: Strongly Agree - 5, Agree – 4, Neutral - 3, Disagree - 2, Strongly Disagree – 1. The survey questions, along with the combined average responses to the survey are shown below in Figure 7.

The average for twelve of the thirteen questions ranged from a low of 3.75 to a high of 4.50. The question about the effectiveness of Blackboard group tools has a significantly lower average than the other questions. Only 3 or 4 out of the 20 respondents answered “disagree” or “strongly disagree” on the majority of the questions. There were no more than two “strongly disagree” responses to 12 of the 13 questions. Students were also invited to make any comments they wanted to make.

Most students found that the processes of mentored assignments and teamwork on projects improved the quality of their project report. Only three students “disagreed” or “strongly disagreed” with this question.

Fourteen students responded “strongly agree” or “agree” on question #4 about whether the collaboration helped their learning. Two students “strongly disagreed”. The assessment of improvement of critical thinking, # 12, is encouraging. 13 students responded “strongly agree” or

“agree.” Only two “disagreed” and one “strongly disagreed”. Students were satisfied with the instruction they were given about how to collaborate, and about the instructor’s contribution to the effectiveness of their groups’ collaboration. No students “strongly disagreed” or “disagreed” with these questions. All either “strongly agreed” or “agreed”.

1. **I was given adequate instruction about how to collaborate in a group**  
Weighted Average = 4.50
2. **My instructor contributed to the effectiveness of my groups collaboration**  
Weighted Average = 4.45
3. **The group collaboration improved the quality of my project?**  
Weighted Average = 3.80
4. **The group collaboration improved my learning**  
Weighted Average = 3.80
5. **I was effective in helping other members of my group learn**  
Weighted Average = 3.95
6. **The group collaboration improved the quality of my project report**  
Weighted Average = 3.95
7. **The use of Blackboard group tools improved my ability to interact constructively with my peers**  
Weighted Average = 3.25
8. **My peers provided constructive comments about my work/findings**  
Weighted Average = 3.90
9. **My group collaborated together effectively as a group**  
Weighted Average = 3.85
10. **All members contributed to the final results of my group**  
Weighted Average = 4.20
11. **My learning improved as a result of my interactions with other members of my group**  
Weighted Average = 3.75
12. **My critical thinking improved as a result of my group’s collaboration**  
Weighted Average = 3.80
13. **Feedback from my peers during group collaboration stimulated me to explore new ideas on my own**  
Weighted Average = 3.75

Figure 7 – Survey Questions on Effectiveness of Student Collaboration

The response to question, #9, indicates that students were pleased with the effectiveness of their group work. 9 students answered “strongly agree” on this question and 5 answered “agree.” A common complaint from students about group work is that some members of the group don’t contribute. However, the response to #10, indicates that, at least in these classes, students were satisfied with the contribution of the other members of their groups. However, one student complained about small group work in general, claiming it hurt his or her grade in the course.

The overall response to the survey indicates that most students agreed that the approach used for collaboration in these courses improved their learning experience. One of the student comments summarizes what the majority of students thought. The student wrote, “Initially, I thought that the mentored assignments and group projects were an overwhelming amount of work. They did, in fact, add a lot more time and effort to assignments that would otherwise be individual but I think the collaboration added value to the course. The amount of work is what I should expect from a Master’s course, so I am not going to complain about that. The collaboration definitely enhanced my learning experience.” Another student commented that this was a “perfect way of teaching.”

It is clear from the results on question #7 that the perception was that the group tools in our Learning Management System, Blackboard, did not enable students to interact as constructively with one another as they wanted. One student commented, “In regards to the usefulness of the Blackboard tools, I found them to be not at all ideal for efficient collaboration as compared to other tools like Google Slides/Docs.” Ten students “agreed” or “strongly agreed” on this question, while seven students “disagreed” or “strongly disagreed”. There were more who disagreed or strongly disagreed on this question than on any of the other questions.

## CONCLUSIONS

This research has looked at the impact of several best practices for online courses, assessed the effectiveness of those best practices by comparing results for the online courses with on-site courses in which the same subject was taught. Students have been very pleased with having a full set of recorded lectures available. Online students had the option of attending or not attending synchronous sessions to review the lecture material. Some students who did well in the course did not attend most of the synchronous sessions. Onsite students also reported that they found the recorded lecture segments very effective for reviewing and mastering concepts they had difficulty grasping when they were presented initially.

The mentored assignment process is particularly effective in enabling online students to interact effectively with other online students. By asking them to interact with four other students (two to mentor and to be their mentors), they are able to focus their interaction on a few other students, rather than trying to interact with all other students. Data has been presented that shows quality of research, original thinking, understanding of the subject, and thoroughness of work is as good as or better for the online students when compared with onsite students.

Similar results have been presented for small group projects in online courses. The process of having online students pre-record their small group presentation works, and frees students from the obstacles that have been faced in the past from trying to make small group projects work in online courses. Data has been presented showing that the small group project grades are comparable for online and on-site courses.

A survey focusing on student perception of the small group process, shows that most, but not all students find that the process improves their learning, their critical thinking and the quality of their work.

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