

Effectiveness of Implemented Course Components in Improving Student Learning Outcomes
and Course Perception in Online Environmental Biogeochemistry

Stephanie Tay Wester

University of Florida

Abstract

Environmental Biogeochemistry is a course offered at the University of Florida, through the College of Agriculture and Life Sciences, Soil and Water Sciences Department. The course is offered in two sections; one for campus based students who wish to take an online course, and one for students who take their courses through the 100% online baccalaureate program, known as UF Online. Based upon consultant and student feedback, from the spring of 2015 sections, certain course modifications were identified and put into place to increase student-learning outcomes and overall perception of the course. The feedback identified a need for more student-professor interactions and student-peer interactions. Two new course components were added to appease this need, including a weekly Q&A session and a group work component. The campus based section met in a face-to-face Q&A, thus creating a blended learning environment. The UF Online students were provided an opportunity to send questions to the professor and attend a weekly live chat session. If they were unable to attend, the session was recorded and uploaded so that students could watch later. Both sections were given a similar group project and groups were assigned at random. A survey was created and administered to students that assessed their perception on the importance and satisfaction they felt regarding the new course elements. This data coupled with the University's official course evaluations were analyzed in determining if the changes made to the course were beneficial to students. It was determined that students showed overall satisfaction in student-professor and student-peer interactions. However, students were still dissatisfied with student-content interactions. This was to be expected as no changes were made to address the course content. The additional course elements helped students reach learning outcomes when actually utilized. The UF Online students did not use the additional course elements as intensely as the campus-based students and their average grade did not change from the spring of 2015 to the spring of 2016. However, the campus-based students saw an increase in the class average grade of 10 points.

Keywords: online, higher education, student perceptions, blended learning

Effectiveness of Implemented Course Components in Improving Student Learning Outcomes
and Course Perception in Online Environmental Biogeochemistry

Introduction

The rise in popularity and overall availability of online higher education courses has created a need for research in the implementation and effectiveness of these courses. In the year 2013, it was reported that over 6.7 million higher education students were taking at least one course online. This equates to roughly 32% of all college students. The same study also notes that over 70 percent of colleges/universities felt that online instruction should be considered in long-term planning and strategy. Ten years ago, less than 50 percent agreed that online education was necessary for long-term planning (Allen and Seaman, 2013).

This particular study will focus on the online course of Environmental Biogeochemistry (SWS 4223) taught at the University of Florida. The school offers online courses in a variety of ways. Individual departments may offer coursework online, which are available to students who are enrolled at the university traditionally, i.e., on campus and taking an online course. The same coursework can also be offered through UF Online, the 100% online baccalaureate program. Environmental Biogeochemistry is offered both through the department of Soil and Water Science and UF Online.

Online Education Background and Framework Considered for Study.

Online coursework has skyrocketed in higher education in recent years. For example, from 2002-2008, the number of students taking an online class tripled. This shift in education can be seen by just considering all the recent emergent scholarly journals regarding distance and online learning, including The American Journal of Distance Education, Journal of

Asynchronous Learning Networks, Journal of Distance Education, Journal of Interactive Online Learning, Journal of Educators Online and the OLC Online Learning Journal (Edward and Pilati, 2011). Further evidence of the growth in popularity in online learning is through government funding for such programs. A stimulus package, that the Obama administration passed, provided 500 million dollars to community colleges to develop online courses (Wang, 2009).

One huge advantage in the usage of online learning in higher education is its ability to lessen the price of education by acting as a tool to control budget. The rise in popularity in online education has not come without criticism, however. Some feel that online curriculum may not be of high quality (Bowen, 2013). It has been suggested that the main drive of implementing online courses and programs is from a “capitalistic” mentality (Bruce et al., 2006). Some feel that online education may possibly turn higher education into a “commodity.” Its primary focus will be on profits, turning “institutions of higher learning into store fronts for knowledge,” and that online education will begin to produce “diploma mills” (Chau, 2010). This perception is backed by instructor opinion, in many cases. A poll of university faculty found that 70% think online classes are less rigorous as compared with a traditional classroom. It also showed that they felt online courses were difficult to develop (Clary and Wandersee, 2009). However, research is proving these opinions wrong. The US Department of Education conducted a study that evaluated over 1000 online learning studies. It found that students actually performed better when taking part of their coursework online and that a hybrid of online and face-to-face learning gave students the most “advantage” (Edward and Pilati, 2011). Another study showed that student-learning outcomes were not significantly different when comparing online learning to traditional learning. That particular study demonstrated that technology did definitely help with

the cost of education while still providing similar learning outcomes (Bowen, 2013). In another study, students had the same syllabus but learned via different routes, i.e. online, distance or on campus. It was found that test grades among the different kinds of students showed no significant difference. Virtual learners earned the same kinds of grades as on-campus learners. Ultimately, the study found that the mode of online or distance learning did not negatively impact a student's learning outcomes or grade (McPhee Tor Soderstrom, 2012). With regards to academic rigor, another study found that the majority of online students were engaged in higher order levels of learning due to the asynchronous nature of the courses, as they have to spend more time analyzing and synthesizing material (Hullinger, Hallett and Chin, 2008).

According to the literature, online coursework needs to contain certain qualities to be successful. One large component is student and faculty perception-there needs to be "buy-in". Faculty members must adopt best practices, as development of an online class cannot simply be posting lecture notes. Instructors should incorporate more interactive teaching methods (Edward and Pilati, 2011). "Though the student has the responsibility to engage in academic activities, it is the faculty member's role to create purposeful course designs that promote interaction, participation, and communication in the online learning environment" (Hullinger, Hallett and Chin, 2008). Faculty members need to adjust their lecture style to "optimize" the delivery (Paslow, 2006). Students should have interactions with faculty, other students and the course content (Gibson and Dunning, 2012). Students should not feel like they are a collection of people learning individually. Students who had active discussions and debates about particular subjects showed high content retention (Clary & Wandersee, 2009). This can be accomplished with peer discussion boards, group pages, or group work to create a single end product. In regards to

student/teacher interactions- this can occur via phone, web cams or email. Lastly, the students need to have different interactions with the content. This can be via a text, web page, lecture videos or virtual labs (Hallyburton and Lunsford, 2013). Also, when faculty have “clear standards for response time and availability, there is a positive effect on student learning and satisfaction”. Likewise, clear standards and instructions for students are important (Gibson and Dunning, 2012).

All of these studies support “a framework for the adoption of blended learning”. This framework examines three criteria: Readiness, Intensity and Adoption. “Readiness” refers to the University’s readiness to put an online learning program into place, and also the staff and student’s readiness to utilize such a program. As mentioned above, student and staff buy-in are very important in successful online education. University buy-in supersedes the staff and student readiness, as they provide the facilities and means of learning. Also as mentioned above, budget plays a large role in the institutions readiness for online learning adoption. The next criterion within the framework is “intensity”. The intensity of adoption of a program refers to the options that the staff and students have when choosing online learning programs. The final criterion, and the one that this study will focus upon is “impact”. Impact refers to the quality of learning (Wong, et. al., 2014). Discussed below is the “UF Standards and Markers of Excellence Scorecard”. This scorecard was developed as quality control for online courses. Changes made to this Environmental Biogeochemistry course were done so with the purpose of creating a higher quality online course.

UF Online and Score Card Background

UF Online is the 100% online baccalaureate program launched in January of 2014. UF Online coursework is only offered to students who are enrolled in the UF Online program, as these courses are given a significant tuition and fees discount. These students pay about 75% tuition as compared to a campus-based student, with the intent of this discount being that the students do not use campus facilities. These students are most probably “non-traditional student”. One study found that the average age of distance/virtual students was older than those who were on campus (McPhee Tor Soderstrom, 2012).

A course must adhere to certain standards to be converted into a UF Online course. An online course is effective when there is fidelity of implementation, or basically, consistency in delivery of the curriculum (Plass, et al., 2012). To ensure quality and that the appropriate amount of rigor is present, the use of a peer reviewed quality insurance process in the design of online courses is beneficial (Gibson and Dunning, 2012). As mentioned above, not every online course offered through the department is a UF Online course. Prior to the transition of a course into an UF Online course requires that the course work’s quality be validated through peer review/educational consultants. These consultants evaluate the online course and give feedback via the “UF Standards and Markers of Excellence Scorecard”. The scorecard is a means to evaluate aspects and instructional practices of an online course and is based upon the Online Learning Consortium’s “Quality Scorecard”. According to the Online Learning Consortium, quality within online instruction can be “complex and elusive”. The use of the OLC scorecard will allow instructors the ability to evaluate and improve upon the quality of their instruction/course.

The scorecard is sectioned into five categories: 1-Content, 2- Instructional Methods, 3-Communications and Interaction, 4-Technology and 5- Course Accessibility, Design, and Organization. Each of these categories contains about 10 practices or metrics that are considered best practices in an online course. These practices are rated with a 0-2 scale, where 0=absent, 1=Included/Needs Improvement, and 2= Included/ Satisfactory. Two anonymous reviewers evaluate the course and rate each practice. They may also leave free response comments. A course must earn a certain score to be converted into an UF Online course. If the course does not meet this score, there is a chance for remediation.

Based upon the literature review, scorecard and the UF faculty evaluation feedback, from the Spring of 2015 Environmental Biogeochemistry courses, the professor felt that some changes could be implemented to improve the course. Other motivation for making changes to the course included low class averages and an overall bad perception of the course itself. It should be noted that the professor observed that students were struggling in the course, as the class average, in the spring of 2015, had been its lowest since the course inception, or about ten years. There are three areas that should be considered when evaluating ways to improve upon a course: 1) student-professor interactions 2) student-peer interactions and 3) student-content interactions. All three areas were studied, however, it was felt that only two additional course components, addressing areas 1 and 2, should be added. Adding any more than these two additional course components would muddy the results making it difficult to determine what actually affected the outcome. It is hypothesized, that developing these two areas will improve student-learning outcomes and course perception. These changes were implemented in the spring of 2016 courses. The purpose of this study is to determine if these added course

components were effective in improving student–learning outcomes and student’s perception of the course as a whole.

BOX 1

Statement of hypothesis: The development of professor-student and student-peer interactions within the course will improve student learning outcomes and course perception.

Study Objectives:

1. Determine student perceptions about general course components and those specific to course.
2. Examine how students utilized each course component.
3. Evaluate if additional course components increased student-learning outcomes and course perception as compared to last year.
4. Compare outcomes of blended online course to UF online course.

Methods

Conception of Problem

The study was developed in reaction to student responses through course evaluations, feedback from educational consultants and low class averages from the spring of 2015 courses. It should be noted that the spring of 2015 Environmental Biogeochemistry course sections were facilitated exactly the same. Campus students taking an online course and UF Online students were all grouped in the same online class. The free responses from students on the University of Florida course evaluations were especially passionate. Of those students who completed the course evaluations (20% for on campus students and 72% for UF Online

students), 60% had overall negative comments, 20% had somewhat negative comments and 20% had overall positive comments. Comments related to general dislike of the course, lack of professor-student interactions, lack of peer interactions and dissatisfaction with course content are listed below.

Course Perception. 50 % of students who completed the course evaluation had negative comments that indicated the students had a bad perception of the course. These included:

- *“I have a very poor opinion of this course” –UF Online Student*
- *“I would not recommend this class to anyone”-UF Online Student*
- *“I’ve been taking online courses for several years and never felt as disconnected as in this class”-UF Online Student*
- *“It’s an okay course for those in biogeo/enviro fields, but not for those pursuing other majors”-UF Online Student*
- *“I would not wish this course on my worst enemy”- Campus-based Online Student.*

Professor-Student Interaction. 40% of students who completed the course evaluation had negative comments pertaining specific to professor-student interactions. These all came from the UF Online course section and included:

- *“Instructor seemed absent,” “Again, I cannot comment as the instructor seemed absent,” “He’s [the instructor] not providing any guidance,” “[Instructor] did not participate in any of the discussion or provide feedback on the discussion.”*
- *“Professor had very limited contact with students,” “Professor should make himself more available.”*

- “[Instructor] does not respond quickly to emails,” “[Instructor should] interact more with students.”
- “I feel that the TA did most of the work for this course.”

Student-Peer Interaction. 10% of students who completed the course evaluation had negative comments pertaining specifically to lack of student-peer interactions. These came from UF Online students only and included:

- “We were not allowed to get any help or work with any other student.”

Course Content. 100% of students who completed the course evaluation had negative comments pertaining specifically to dissatisfaction with course content. These included:

- “None of the course lectures were printable resulting in much difficulty as a lot of the test material was based off of the lectures,” “I strongly feel like PowerPoint lectures should have been made available to the students.”-UF Online Student
- “I would go into an exam thinking I had a pretty good handle on the information, but the results would tell a different story...not only would you have the normal a,b,c, & d selections but then there would be additional selections such as b & c, all of the above, none of the above. Seriously, 6-7 choices for some of the complicated processes we are trying to learn. My advice would be to be a little more straight forward and narrow down the field of choices.”-UF Online Student
- “Questions on exams can be exceedingly tricky and/or unrelated to the course content.”-UF Online Student
- “The test[s] were nothing like the teaching materials. The lectures were not informative at all, with very little information that was used on course materials,”

“The exams were completely different than the materials in the lectures and the exams were very tricky and misleading.”-UF Online Student

- *“There seemed to be an obvious disconnect between the printed assignments and the corresponding modules.”-UF Online Student*
- *“Multiple times I felt assignments tested us on information that was not well-demonstrated,” “I am hard of hearing so detailed notes are very helpful to me. Most of the instructors give a .pdf or .ppt file to follow along with. I believe this would be helpful in this course as well.”- UF Online Student*
- *“There were not printed materials to accompany the lectures which made me spend unnecessary time searching through lectures to get back to a specific idea that I was having difficulty with. Also, it was hard to know what to expect on the exams,” “I felt there was little instruction on how to do some assignments,” “Notes to accompany lectures would be greatly helpful”-UF Online Student*
- *“The instructor provided too much material (reading assignments, web searches, homework, and lectures) that were not connected to a main theme,” “The 6 of 8 assignments were given without any prior lecture or instruction,” “Lots of reading but it didn't get pulled together in cohesive topics,” “None of the powerpoints were available.”-UF Online Student*
- *“He likes to trick students on exams.”-Campus-based Student*
- *“Lectures are useless and boring,” “Tests were unfair,” “Textbook was useless,” “Exams are too broad to ask nitty-gritty questions.”-Campus Based Student.*

Also considered were those areas that received a low score on the consultant’s scorecard feedback. These included sections 2 and 3 from the scorecard. The practices that received scores

of zero within these sections were especially considered. The lowest scoring practices pertained to professor-student interaction and student-peer interaction, such as student feedback opportunities, peer assessments/presentations and the usage of video for student-student and student-professor interaction. Consultants recommended the usage of a student survey for specific class components, such as assignments, or the course in general and also the addition of videos of the professor.

Changes Made

Based upon the above listed feedback, and input from the UF's Agricultural Education Director of e-Learning Institute, it was decided that some course components needed to be added. As mentioned above, two course elements were put into place to address the student's negative perception of the professor-student and student-peer interactions. No course element was changed or added to address the negative student-content perception. These new elements included a "Questions and Answer" session and a group assignment. Firstly, the course would be split into two different online classes. The traditional online students would be separate from the UF Online students. The "Question & Answer" session was added to each class to help increase professor-student interaction. In the UF Online section, this was done weekly via a live chat facilitated through Adobe Connect. Students were encouraged to participate by both sending questions to the professor prior to the online meeting and attending and asking questions during the meeting. The chat sessions were recorded and made available if students were unable to attend. This was strictly optional, as synchronous meetings cannot be a required component of an UF Online class according to UF Online rules. The campus-based online students met in a face-to-face "Question & Answer" session. Unlike the UF Online class, the synchronous meeting

could be a required graded component of the course. To promote student-peer interactions, a group assignment was also given.

Collection of Data

Data was collected using a combination of the spring 2016 UF course evaluations, made available to the professor after the course ended, and a survey that specifically targeted student's perception on the added course components. A third component of student-content interaction was also examined to make the study more aligned with the literature. Also targeted in the survey was the student's utilization of each course component. The survey was uploaded to the course website and presented as an assignment. Students downloaded and completed the survey and then uploaded it to the course website. Completion of the survey was incentivized with 10 bonus points, or 1% of final grade.

The survey had five sections. The first section asked students to rate their feelings using a scale of 1(least)-5(most), on how important a component was to them in a course vs. how satisfied they were with that component in the Environmental Biogeochemistry course.

Questions were as follows:

- *How important is frequency of student/professor interactions during a course?*
- *Overall, how satisfied are you with the frequency of student/professor interaction in this course?*
- *How important to you is the frequency of interactions with fellow classmates during a course?*
- *Overall, how satisfied are you with the frequency of interactions with other students in this course?*

- *How important is frequency of content interaction during a course (amount of time you need to spend to review all assigned material)?*
- *Overall, how satisfied are you with the expected student to content interaction in this course (amount of time you need to spend to review all assigned material)?*
- *How satisfied were you with the length of each lecture in this course?*

The second section asked students to share how often they participated in a course component.

Options for answers included, “Never”, “1-4 Times”, “5-8 Times”, “9-12 Times”, and “Every Week”. These ranges were selected based upon the number of weekly modules within the course.

Questions were as follows:

- *How often did you attend the weekly Q & A sessions?*
- *How often did you watch the recorded weekly Q & A sessions if you were not able to attend?*
- *How often did you contribute to weekly Q & A sessions (asking during or emailing questions ahead of time)?*
- *How often did you reach out to your professor either through email/phone/canvas chat/etc.?*
- *How often did you reach out to other students either through messages/canvas chat/discussion board?*
- *How often did you review/complete all content provided for the week? (lectures, reading assignments, homework practice, etc.)?*

The third section allowed for free response. The questions are as follows:

- *Do you feel that the weekly Q & A sessions helped you better grasp the material and concepts presented?*
- *Do you feel that the group work helped you better grasp the material and concepts presented?*
- *Please add any thoughts you have about the interactions with your professor during this course. Is there room for improvement?*

- *Please add any thoughts you have about the interactions with your fellow students during this course. Is there any room for improvement?*
- *Please add any thoughts you have about the content presented in this course. Is there any room for improvement?*
- *As an online learner, how long to you feel a lecture should be?*

The fourth section asked students to rate various course components 1 (being the most helpful in success in the course) through 9 (least helpful in success in the course). They were to only use each number once. The course elements included: *Professor Interactions, TA interactions, Peer Interactions, Q&A Session, Discussion Posts, Assignments, Lectures, Quizzes and Exams*. The fifth section asked students their expected grade in the course.

Data Analysis

The first set of data analyzed was the first portion of the survey, where students were asked to rate how important a component was to them in a course vs. how satisfied they were with that component in the Environmental Biogeochemistry course. A mean was calculated for each question, as well as a mode. The mode of each question seemed important to consider because in some cases, a student may be highly satisfied with something because they found it unimportant, while the majority may have found it important and been dissatisfied. For example, John thinks group work is not important and therefore is highly satisfied with the lack of group work in the course, while the rest of the class highly values group work and therefore is unsatisfied. While all opinions are important, it was felt that the most popular opinion should also be communicated, as the mean could be skewed when working with such a small sample. The mean of each question pair, i.e., importance of frequency of interaction vs. satisfaction of interaction, were compared to one another. Then each mean was compared to the accompanying

mode. This was completed for each class section, campus-based online students taking vs. UF Online.

Next, section 2 of the survey was analyzed. The percentage of students utilizing each particular course component was calculated. This was calculated for each course, and the two course's participation percentages were compared. Section 3 free response answers were evaluated via tallying occurrences of negative and positive statements. Not every student answered every question, some referenced course components in different questions and some students answered with multiple statements, some of which had both a positive and a negative statement. These were turned into a percent and then along with the spring of 2016 UF course evaluation response, compared to the quotes from the 2015 UF course evaluations. Section 4 data was deemed unusable and therefore thrown out. The intention was for the students to rank in order the course elements from most helpful to least helpful. The survey directions did not convey this well enough, as students completed this several different ways. The data was not salvageable. Section 5, the portion of the survey that asked students to selected their expected grade, was used to separate students into two groups: students that received their expected grade and those that received lower than the expected grade. These two group's participation tendencies were then analyzed and compared within each section. Finally, the class averages for the 2016 class sections were compared to the corresponding class averages of the 2015 class sections.

Results

100% of the UF Online students and 93% of the campus-based online students completed the class survey. 25% of the UF Online students and 21% of the campus-based online students completed the 2016 UF course evaluations.

OBJECTIVE 1-Determine Student Perceptions about General Course Components and Those Specific to Course.

Professor-Student Interactions.

Importance of professor-student interactions vs. satisfaction. In the UF Online section, the mean score for student perception of importance of professor-student interaction was 3.25, while the mode was 3. The mean score for satisfaction was 4.12 while the mode was 4. In the campus-based online section, the mean score for importance was 3.76 and the mode 3. The mean score for satisfaction was 4.07 and the mode 3.

Survey Responses Regarding Professor-Student Interaction. In the UF Online section, 100% of related responses were positive. In the campus-based online section, 63% were positive responses and 37% negative. Quotes that went into detail are listed below. Any response of just a “Yes” or “No” is not included in the table.

UF Online Positive Comments	UF Online Negative Comments	Campus Based Positive Comments	Campus based Negative Comments
<p>“I don’t think anything needs to be improved upon on the professor’s part.”</p> <p>“The weekly Q&A and office hours made him very available.”</p> <p>“Response time from professor was fast.”</p> <p>“He was available.”</p>	N/A	<p>“They [interaction with professor] were helpful”</p> <p>“This [professor interactions] is what I expected for meeting once a week.”</p> <p>“Speaking directly to professor was fine and he was helpful when I had a question about the material.”</p> <p>“The professor gave us many options to talk to him.”</p>	<p>“[The] way information is presented [shows room for improvement].”</p> <p>“Professor did not respond instantly to emails.”</p>

		“The professor is very good at interacting with students.”	
--	--	--	--

UF Evaluation Responses Regarding Professor-Student Interactions. A very small number of students, 21% for on campus students and 25% for UF Online students, completed the UF course evaluations for the spring of 2016. Of these students, 40% seemed to have overall negative comments, 40% seemed to have somewhat negative comments and 10% had overall positive comments. Below are some examples of specific positive and negative quotes relating to professor-student interactions.

Table 2: Free Response Quotes Regarding Professor-Student Interactions			
UF Online Positive Comments	UF Online Negative Comments	Campus Based Positive Comments	Campus based Negative Comments
<p>“This professor did really well to take his time explaining concepts that were complex and difficult if presented all at once and too quickly.”</p> <p>“No [Qualities of Instructor that hindered success in course].”</p>	<p>“It was hard to get a response on the due date of the assignment from the TA or instructor.”</p>	<p>“[Professor] is always open to students asking questions or discussing biogeochemistry topics. He can be kind if he tries. He is knowledgeable and interested in this subject of biogeochemistry.”</p> <p>“I think [Professor’s] enthusiasm helped because the instructor was able to give many real life examples.”</p>	<p>“I felt like [Professor] was super judgmental about discussion posts. If a student posts misinformation I think there is a more tactful way of correcting them. The tone or laughing at people's posts in a negative manner is not conducive to learning.”</p> <p>“It seemed as though students were being picked on, rather than encouraged to share input. [Professor’s] tone was somewhat patronizing.”</p>

Student-Peer Interaction.

Importance of student-peer interactions vs. satisfaction. In the UF Online section, the mean score for student perception of importance of peer-student interaction was 3, while the mode was 4. The mean score for satisfaction was 4.62 while the mode was 5. In the campus-based online section, the mean score for importance was 2.23 and the mode 1. The mean score for satisfaction was 3.07 and the mode 4.

Survey Responses Regarding Student-Peer Interaction. In the UF Online section, 83% of related responses were positive and 17% negative. In the campus-based online section, 33% were positive responses and 67% negative. Quotes that went into detail are listed below.

UF Online Positive Comments	UF Online Negative Comments	Campus Based Positive Comments	Campus based Negative Comments
<p>“The weekly discussions were interesting and was great to see other’s point of view.”</p> <p>“I thought the discussions were structured well.”</p> <p>“The group discussions were interesting and engaging.”</p> <p>“No room for improvement, I liked the weekly discussions.”</p> <p>“Great discussions, I learned a lot from them.”</p> <p>“It was good.”</p>	<p>“It was hard to grasp the schedule of discussions.”</p> <p>“I don’t get much out of online student interactions.”</p>	<p>“They were all fine.”</p> <p>“ I interacted with students that I already knew. They were very instrumental.”</p> <p>“The student interactions were good.”</p>	<p>“There was no need for interactions with fellow students. I prefer it that way.”</p> <p>“Wish class discussions weren’t required for online classes.”</p> <p>“There could have been more opportunity to interact with students during class.”</p> <p>“Students didn’t have any interaction except the last assignment. Even then the students communicated little.”</p>

<p>“Interaction satisfactory.”</p> <p>“The weekly discussions allowed me to find real life uses/explanations of topics covered, and learn about what the other students found.”</p> <p>“The way the discussions went with student interaction was great.”</p>			<p>“More interactions with students is necessary. I don’t even know some of their names.”</p> <p>“Little interaction with other students.”</p> <p>“Little classmate interaction.”</p>
---	--	--	---

UF Evaluation Responses Regarding Student-Peer Interactions. A very small number of students, 21% for on campus students and 25% for UF Online students, completed the UF course evaluations for the spring of 2016. Of these students, 40% seemed to have overall negative comments, 40% seemed to have somewhat negative comments and 10% had overall positive comments. Below are some examples of specific positive and negative quotes relating to student-peer interactions.

UF Online Positive Comments	UF Online Negative Comments	Campus Based Positive Comments	Campus based Negative Comments
N/A	<p>“I would have liked more guidance on applying stoichiometry for the last assignment. Even working in a group, this was extremely difficult.”</p>	<p>“Discussions are to facilitate learning by discussing what we posted, what we learned from researching to put on our posts, and then adding on top of that. This happened occasionally.”</p>	<p>“[Would prefer] Having the discussions at the end of the week.”</p> <p>“Small group discussions with peers during class could have facilitated dialogue more easily than randomly selecting students who are not engaged. After a few minutes, one</p>

			member from each small group can summarize the points that the group discussed.”
--	--	--	--

Student-Content Interaction.

Importance of student-content interactions vs. satisfaction. In the UF Online section, the mean score for student perception of importance of student-content interaction was 4.75, while the mode was 5. The mean score for satisfaction was 3.88 while the mode was 5. In the campus-based online section, the mean score for importance was 4.23 and the mode 5. The mean score for satisfaction was 3.07 and the mode 4.

Survey Response Regarding Student-Content Interaction. In the UF Online section, 42% of related responses were positive and 58% negative. In the campus-based online section, 42% were positive responses and 58% negative. Quotes that went into detail are listed below. Any response of just a “Yes” or “No” is not included in the table.

UF Online Positive Comments	UF Online Negative Comments	Campus Based Positive Comments	Campus based Negative Comments
“I thought the content was great.” “The content was interesting.” “I like the layout.” “Content presented was great.” “Content was good.”	“I struggled to keep up with the current work.” “The tests seemed difficult. I would feel confident before but then see my low score afterwards.” “Last exam was hard.” “More precise lectures [needed]	“The material was interesting.” “It was well presented and contained a wealth of knowledge; no complaints.” “I think the content is very well distributed.” “The content is very interesting.”	“I don’t think the course had to be so hard.” “Speed of lectures were a little too fast...more reading material to supplement a shorter weekly lecture...instructions given were confusing at times.” “At times subject becomes very broad and it’s unclear what will be test on.” “The content is presented in

	<p>pertaining to testing.”</p> <p>“Some of the exam questions were too easy to talk myself out of... I know I understand the question...overthink the answer.”</p> <p>“Less math/number based assignments and more conceptual ones. A lot of exam questions were conceptual and I don’t feel like assignment reflected this.”</p>	<p>“Content was good.”</p> <p>“Overall it was pretty good content.”</p>	<p>a simplified manner but the type of content it is, is difficult to apply at a higher level as we were expected to do during later assignment/quizzes/exams.”</p> <p>“The notes could be more clear when explaining concepts.”</p> <p>“Content presented as more difficult than it should have been.”</p> <p>“The quizzes and tests were set up weird...the homework did not seem to be taught in lecture and not relevant to the quizzes and homework.</p>
--	---	---	---

UF Evaluation Responses Regarding Student-Content Interactions. A very small number of students, 21% for on campus students and 25% for UF Online students, completed the UF course evaluations for the spring of 2016. Of these students, 40% seemed to have overall negative comments, 40% seemed to have somewhat negative comments and 10% had overall positive comments. Below are some examples of specific positive and negative quotes relating to student-content interactions.

UF Online Positive Comments	UF Online Negative Comments	Campus Based Positive Comments	Campus based Negative Comments
<p>“I loved the layout of the lectures, it made it easier for me to get through a few at a time throughout my day, especially because the course moved at a faster pace than any of my other</p>	<p>I would have liked more guidance on applying stoichiometry for the last assignment. Even working in a group, this was extremely difficult. The exams would have felt more</p>	<p>“The assignments seemed connected to what we saw in the lectures”</p>	<p>“I would have gotten more out of them [assignments] if we practiced or discussed the application of concepts in class.”</p> <p>“The assignments were graded fairly</p>

<p>classes. The exams became increasingly more difficult. I thought the assignments were fairly relevant to course materials.”</p> <p>“Lecture format [contributed to success of course].”</p>	<p>fair to me if they had not included SO MANY questions that gave the option of "all of the above, none of the above, a and b, b and c" because it made me second-guess many answers that I might have been sure about before the exam. Also, the last exam felt like two exams put together because there were so many details to know from so many modules that it was hard to really study all of that and recall it.”</p> <p>“Did not adequately explain assignments.”</p> <p>“Too many lectures (length) for some modules.”</p>		<p>harshly.”</p> <p>“I am fine with the lectures being pre-recorded it is the execution of these recordings that can be refined. The lecture dialogue do not seemed to be well prepared or planned over time. I felt like the material could have been presented more concisely.”</p> <p>“How the course material is executed can and should be improved. For how it is now, I would not recommend the course to anyone because it can be infuriating. The directions to the assignments and the questions to the quizzes seem like you have to really interpret them to understand what [professor] wants.”</p>
--	---	--	--

Lectures.

Satisfaction in length of lectures. In the UF Online section, the mean score for student satisfaction with the length of the lectures was 4.38 and the mode 5. In the campus-based online section, the mean score was 3.23 and the mode 4.

Opinion on Length of Lectures. In the UF Online section, 38% felt the lectures should be 20 minutes or less, 25% said they were fine as is, 25% felt they should be the

equivalent of a campus lecture of 50 minutes to 1 hour and 12% felt they should be 30 minutes or less. In the campus-based online section, 33% felt they should be the equivalent of a campus lecture of 50 minutes to 1 hour, 33% said 20-30 minutes, 22% felt they were fine as is, and 12% said 15 minutes.

OBJECTIVE 2- Examine How Students Utilized Each Course Component.

Q&A Attendance. 75% of UF Online students never attended the Q&A, and 25% attended 1-4 times. 77% of campus-based online students attended the Q&A weekly and 23 % attended 9-12 times.

Viewed Recorded Q&A. 50% of UF Online students viewed the recorded Q&A session 1-4 times, and 50% viewed it 9-12 times. 54% of campus-based online students never viewed the recorded Q&A session, and 8% viewed it 9-12 times and 38% viewed it weekly.

Contributed to Q&A. 75% of UF Online students never contributed to the Q&A session and 12.5% contributed 1-4 times and 12.5% contributed 5-8 times. 31% of campus-based online students contributed to the Q&A session 5-8 times, 23% contributed 9-12 times, 23% contributed never and 15% contributed every time and 8% contributed 1-4 times.

Initiate Interaction with Professor. 75% of UF Online students initiated interaction with the professor 1-4 times, and 25% never attempted. 38% of campus-based online students initiated interaction with the professor 1-4 times, 31% never attempted, 23% initiated weekly and 8% initiated 5-8 times.

Initiate Interaction with Peers. 37.5% of UF Online students never attempted to initiate interaction with the peers, 37.5% initiated 1-4 times, and 12.5% initiated 5-8 times and 12.5% initiated weekly. 31% of campus-based online students initiated interaction with peers weekly,

23% initiated 1-4 times, 15% never attempted, 15% initiated 5-8 times and 15% initiated 9-12 times.

Completion of Module. 50% of UF Online students always completed all coursework in the module, 25% completed all coursework 9-12 times and 12.5% completed all coursework 5-8 times and 25% never completed all coursework. 77% of campus-based online students always completed all coursework in the module and 23% completed all coursework 9-12 times.

OBJECTIVE 3- Evaluate if Additional Course Components Increased Student-Learning Outcomes and Course Perceptions.

The 2016 UF Online section received a class average of 77%. This was not much of a difference from the 2015 UF Online class average of 77.5%. However, the campus-based section saw quite a leap in class average from 71.8% in 2015 to 81.7% in 2016.

Survey Responses Regarding Q&A. In the UF Online section, 83% of related responses were positive and 17% negative. In the campus-based online section, 50% were positive responses and 50% negative. Quotes that went into detail are listed below. Any response of just a “Yes” or “No” is not included in the table.

UF Online Positive Comments	UF Online Negative Comments	Campus Based Positive Comments	Campus based Negative Comments
“I liked reviewing the Q&A before each test.”	“The Q&A sessions didn’t help as much as reviewing the lecture material for me, but I didn’t usually attend and only watched a few.”	“It helps to hear other students questions, as they may be good questions I did not think of.”	“The Q&A sessions didn’t help me much unless it was going over the exam or reviewing for one.” “I do not think...the Q&A sessions helped.”

			<p>“More structure needed.”</p> <p>“If the Q&A were more timely in relation to material, that would improve the quality of the questions during the weekly sessions.”</p>
--	--	--	---

Survey Responses Regarding Group Assignment. In the UF Online section, 70% of related responses were positive and 30% negative. In the campus-based online section, 17% were positive responses and 83% negative. Quotes that went into detail are listed below. Any response of just a “Yes” or “No” is not included in the table.

UF Online Positive Comments	UF Online Negative Comments	Campus Based Positive Comments	Campus based Negative Comments
<p>“It was nice to be able to bounce ideas off of each other.”</p> <p>“Group projects are great tools for learning.”</p> <p>“Having a group for that particular assignment felt appropriate.”</p> <p>“Group work was good and helped,” “I generally do not like to work in groups, but the group interactions for this class worked out well.”</p>	<p>“I did not find the group work to be beneficial. The group assignment did not feel much like a group project.”</p> <p>“The one assignment where we had to work with peers was a little daunting.”</p>	<p>“Talking the material over with others can help.”</p> <p>“I see the value in working with others and collaborating ideas. I had no issue with working in a group in this course.”</p> <p>“The group work was very helpful in grasping the information.”</p> <p>“I found that working with a group helped.”</p>	<p>“I feel like the one group work assignment was pointless. It felt like a normal, solo homework. If the assignment was geared more towards group work, then I feel it would have been more successful.”</p> <p>“The group I was in all decided to work independently.”</p> <p>“I personally don’t like working in groups.”</p>

			<p>“The group assignment was not good.”</p> <p>“My group did not work together.”</p> <p>“My group mate got easily offended and did not work with us.”</p>
--	--	--	---

UF Evaluation Responses Regarding Overall Perception of Course. A very small number of students, 21% for on campus students and 25% for UF Online students, completed the UF course evaluations for the spring of 2016. Of these students, 40% seemed to have overall negative comments, 40% seemed to have somewhat negative comments and 10% had overall positive comments. Below are some examples of specific positive and negative quotes relating to overall perception of the course.

Table 9: Free Response Quotes Regarding Perception of Course			
UF Online Positive Comments	UF Online Negative Comments	Campus Based Positive Comments	Campus based Negative Comments
“Excellent.” [Opinion of Course].	N/A	<p>“The course is relevant.”</p> <p>“The overall subject matter is interesting and is useful for environmental fields to be aware of these interconnected cycles.”</p>	<p>“I think the course shouldn’t have to be so difficult. I wasn’t thrilled with grade point system.”</p>

OBJECTIVE 4- Compare Outcomes of Blended Online Course to UF Online Course.

UF Online students receiving expected grade. 50% of the UF Online students received either their expected or higher than expected grade. Of these students, 75% never attended or contributed to the weekly Q&A, however 100% watched the recorded sessions 9-12 times. 50% reached out to professor 1-4 times, 25% 5-8 times and 25% never reached out. 50% reached out to peers at least 1-4 times and 50% never attempted. 50% completed all course content every week and 25% did so 5-8 times and 25% never completed all course content. All of the students in this group earned a letter grade of a B or C. 50% did at least one of the course elements every week.

Campus-based section receiving expected grade or higher than expected. 62% of students received either a higher than expected grade or their expected grade. The students who received a higher than expected grade always utilized the Q&A session by both attending and contributing and finished all material weekly. Interaction with peers was used often, 5-8 times throughout the course. Those that received their expected grade scored high in utilization of the Q&A and completion of course content. 75% attended the Q&A and the remainder 25% attended 9-12 times. These results repeated for the completion of course content. 50% reached out to their peers weekly, and 25% reached out to the professor weekly. All of these students received an A or B in the course and completed at least 2 or more course component every week.

UF Online students receiving lower than expected grade. 50% UF Online received a lower than expected grade. Of these, 75% never attended the Q&A session nor contributed to them by sending questions. 100% of students tried to initiate contact with professor at least 1-4

times, and initiating peer interactions varied from weekly to never. 50% of students completed all content weekly and 25% completed it 9-12 times. 75% of these students never did at least 2 or more of the course elements.

Campus-based section receiving lower than expected grade. 38% received a lower than expected grade. 75% of these students did not use peer interaction well, with the majority never reaching out to their peers and the rest only reaching out 1-4 times. 50% of these students never reached out to the professor. However, 50% of these students did complete all content and attend chats weekly. 50% of these students never completed at least 3 course elements.

Course Averages. The 2016 UF Online section received a class average of 77%. The campus-based section's class average was 81.7%.

Discussion

Spring of 2016 students are more than satisfied with the student-professor and student-peer interactions according to the student responses regarding opinion of importance of course elements vs. satisfaction with course elements in Environmental Biogeochemistry. For both course sections, UF Online and campus-based online, averaged satisfaction responses scored higher than averaged opinion of importance responses. This suggests that the course element surpassed student's expectations. However, students were dissatisfied with student-content interactions. The averaged satisfaction responses scored lower than the importance responses, conveying that the students expected more from the course content. This data is not surprising as it was obvious students were not happy with the course content in the "conception of the problem." Changes to the course were only to address the student-professor and student-peer

interactions. No changes were made to the course content, so it would be expected that there would still be dissatisfaction.

The addition of the online Q&A session and the face-to-face Q&A session were added to combat any dissatisfaction with professor-student interactions. The campus-based online course was given a face-to-face Q&A, effectively turning the course into a blended course. In comparing the UF Online section and the campus-based online section, the UF Online section consistently participated less in the Q&A sessions in both attendance and contribution. It should be noted that the UF Online students viewed the recorded Q&A sessions more than the campus-based students, yet, still not in a consistent manner. This seems obvious, as the campus-based students were in actual attendance. UF Online students did not attempt to initiate contact with the professor as often as the campus-based students. The more interaction between the campus-based students and professor could be due to the campus-based student's requirement to see the professor weekly at the Q&A sessions. Regardless, it is clear that the UF Online students did not make a genuine effort to reach out to the professor. Student-peer interactions varied for both sections and were comparable. Campus-based online students also outperformed UF Online students in completing all coursework. These results back up the extreme grade point average difference between the two courses. It is obvious that the campus-based students are utilizing the course elements more so than the UF Online students. In comparing the grade point averages from the previous year, when these course elements were not in place, the campus-based online section saw a grade point average increase of about 10 percentage points, from 71.8% in 2015 to 81.7% in 2016. However, the UF Online student's average grade remained the same, 77% in 2015 to 77.5% in 2016. This shows that the addition of the course elements, when actually utilized, do indeed help the student succeed in the course. However, it could also demonstrate

that blended courses are more efficient, than 100% online courses, in helping students reach learning outcomes. It is hard to effectively determine this last statement however, because each course section did not utilize the course elements in the same manner.

Interestingly, even though they did not utilize the course components as well as the campus-based students, the UF Online students had a majority of positive remarks regarding the Q&A sessions, group assignment, professor-student interactions and student-peer interactions. The campus-based online students had a majority of positive remarks for only the professor-student interactions. The Q&A remarks were split 50/50, and the group assignment and student-peer interactions had a majority of negative remarks. Both sections had a majority of negative remarks regarding their interactions with the course content. This is expected, as no changes were made to the course content.

It is interesting that the campus-based students seem less interested in peer interactions and group work. One would assume it would be easier for these students to complete this sort of work considering their ability to see peers on a weekly basis. The UF Online students may be more satisfied with this course component because they crave any and all interactions of this kind. According to the literature, online students tend to feel isolated, so the group work and discussions could have helped to alleviate this, making the students general perception of the course better. It is perplexing however that these students do not take the initiative to create this sort of environment. The interest is there, but the motivation is not. Cultivation of this could be key in increasing student learning outcomes in the UF Online section.

The student- content may be scoring so low in comparison because nothing was changed within the course to address the course content. Also to note, the course content encompasses a lot of elements. If a student said something negative about the textbooks, exams, lectures,

quizzes, rubrics, etc., then it was considered course content. Whereas, the other categories were very specific, i.e., professor, peers, Q&A. This could have created an unbalanced comparison.

A higher percentage of campus-based students received their expected grade or higher as compared to the UF Online students. This can be correlated to the higher utilization of the course elements.

With regards to the data pulled from the UF course evaluations, the spring of 2015 had a total of 60% overall negative comments, whereas, the spring of 2016 had 40% overall negative comments. It seems that the addition of the course elements helped to make the course generally more pleasing. However, it should be noted that the participation in the UF course evaluations were lacking. In the spring of 2016, less than 25% participated in both sections. In the spring of 2015, only 20% participated in the campus-based online course. These comments also seemed to be somewhat personal, as if some students were using the course evaluation as a personal vendetta rather than a subjective means to give input to help better a course. The overall opinion of the small percentage that completed the UF course evaluations did not seem to match the survey opinions that had almost 100% participation. It is recommended that the survey be taken more seriously than the UF course evaluations in moving forward with future course changes.

Conclusions and Recommendations for Future

Regarding Professor-Student Interaction. The perceptions of professor-student interactions improved dramatically from the spring of 2015 to spring of 2016. However, some students felt that there was room for improvement regarding professor feedback. Moving forward, attention to tone of delivery and speediness in feedback response could be explored.

Regarding Student-Peer Interaction. Those that had negative opinions of the course group work were either unhappy that there was any form of group work/group discussions, or wished that there were more developed group work assignments. Upon initial evaluation, it seemed that the unhappy students were divided in that some felt that group assignments add no benefit to class, and others wanted more group work. However, these students really want the same thing, i.e., content that seems worth their time. The students who are craving more group work realize it will enhance their learning and just simply needs more developing within the course. The students who are complaining about the group work are doing so because the assignment did not enhance their learning in their opinion. Developing and facilitating richer group activities will help student performance and perception. It will create a better learning environment by fostering a classroom community. Creating this sort of community is beneficial to online students, as the literature supports this notion. Also worth noting, students felt that the group activity happened too late in the semester, and seemed more as an afterthought. Facilitating more developed group assignments/discussions earlier in the semester can only help develop the classroom environment.

Regarding Student-Content Interaction. There seemed to be repeated opinions regarding lack of clarity in assignment instructions and lack of connectedness between course content and exam material. As nothing was changed in this study regarding course content, this may be something the professor could specifically survey students on in the future.

Regarding the New Course Elements. The addition of course elements based upon the UF course evaluations and consultant recommendations proved to benefit the Environmental Biogeochemistry course. When the course elements were utilized routinely, student performance improved. This information alone could be used in future years to motivate students to be active

and engaged participants not only in Environmental Biogeochemistry, but also within all their online courses. The lack of utilization of some of the course components in the UF Online sections could be due to scheduling conflicts, and not lack of interest. Many online students work full time and do their coursework during non-working hours. The Q&A session was offered at 3 pm, and many could not attend. Polling students early in the semester, and determining when the majority of the class would like to meet for Q&A sessions, for example, could combat low attendance. This study demonstrated that the student survey/feedback process works. Utilizing student feedback was a major catalyst for the addition of course elements, and proved to benefit the students by improving performance and overall perceptions. It would be in the course's best interest to continue utilizing a student survey in future years.

Regarding the Difference in UF Online and Campus-based Online Students. The study demonstrated the differences between a blended course and a 100% online course. It was a solid choice in separating the UF Online students from the campus-based students, as they have proven to have different needs. It is suspected that the majority of UF Online students are alternative students, who may be working full time. Due to the characteristic differences among these student groups, the two course sections valued different course components, i.e., the UF Online students want more group and peer interactions. This specific course element therefore, could be something worth keeping and refining for the UF Online students and dropping for the campus-based students. Continuing to utilize a course survey, as a means for specific feedback, will help to further define the differences and needs of each of these different student groups, and therefore continue to improve upon the course in the best way possible for those students. Coursework should be dynamic and always improved based upon input from stakeholders.

Bibliography:

- Allen, I. E., & Seaman, J. (2013, January). Changing Course. Ten years of tracking online education in the United States. Retrieved May, 2016, from <http://www.onlinelearningsurvey.com/reports/changingcourse.pdf>
- Bauer, Adriana. "Queensland Museum Online Learning Resources." *Teaching Science* 55.2 (2009): 53.
- Bowen, William G., et al. "Online Learning in Higher Education." *Education Next* 13.2 (2013)
- Brecht, H. David. "Learning from Online Video Lectures." *Journal of Information Technology Education: Innovations in Practice* 11 (2012): 227.
- Bunce, Diane M., Jessica R. Vandenplas, and Katherine L. Havanki. "Comparing the Effectiveness on Student Achievement of a Student Response System versus Online WebCT Quizzes." *J. Chem. Educ. Journal of Chemical Education* 83.3: 488.
- Chau, Paule. "Online Higher Education Commodity." *Journal of Computing in Higher Education* 22.3 (2010): 177-91.
- Clary, Renee M., and James H. Wandersee. "Can Teachers Learn In An Online Environment?." *Kappa Delta Pi Record* 46.1 (2009): 34-38. *Education Full Text (H.W. Wilson)*. Web. 7 Jul. 2015.
- Clary, Renee M., and James H. Wandersee. "Virtual Field Exercises in the Online Classroom: Practicing Science Teachers' Perceptions of Effectiveness, Best Practices, and Implementation." *Journal of College Science Teaching* 39.4 (2010): 50.
- Davenport, R. John. "Are we having Fun Yet? Joys and Sorrows of Learning Online." *Science* 293.5535 (2001): 1619-20.
- Gibson, Pamela A., and Pamela Trump Dunning. "Creating Quality Online Course Design through a Peer-Reviewed Assessment." *Journal of Public Affairs Education* 18.1 (2012): 209-28.
- Hallyburton, Chad, and Eddie Lunsford. "Challenges and Opportunities for Learning Biology in Distance-Based Settings." *Bioscene: Journal of College Biology Teaching* 39.1 (2013): 27-33.
- Hilary MacQueen & Jeff Thomas (2009) Teaching Biology at a Distance: Pleasures, Pitfalls, and Possibilities, *American Journal of Distance Education*, 23:3, 139-150, DOI: [10.1080/08923640903080505](https://doi.org/10.1080/08923640903080505)
- Hullinger, Hallett, and Chin Robinson. "New Benchmarks in Higher Education: Student Engagement in Online Learning." *Journal of Education for Business* 84.2 (2008): 101-9.
- Kathy Michael, (2012), "Virtual classroom: reflections of online learning", *Campus-Wide Information Systems*, Vol. 29 Iss 3 pp. 156 – 165. <http://dx.doi.org/10.1108/10650741211243175>

Iain McPhee Tor Söderström, (2012), "Distance, online and campus higher education: reflections on learning outcomes", *Campus-Wide Information Systems*, Vol. 29 Iss 3 pp. 144 – 155.

<http://dx.doi.org/10.1108/10650741211243166>

OLC Online Learning Journal. (n.d.). Retrieved June, 2016, from <http://onlinelearningconsortium.org/read/online-learning-journal/>

Perry, Edward H., and Michelle L. Pilati. "Online Learning." *New Directions for Teaching and Learning* 2011.128 (2011): 95-104.

Phirangee, K., Demmans Epp, C., & Hewitt, J. (2016, June). Exploring the Relationships between Facilitation Methods, Students' Sense of Community, and Their Online Behaviors. *Online Learning*, 20(2), 134-154.

Plass, J. L., Milne, C., Homer, B. D., Schwartz, R. N., Hayward, E. O., Jordan, T., Verkuilen, J., Ng, F., Wang, Y. and Barrientos, J. (2012), Investigating the effectiveness of computer simulations for chemistry learning. *J. Res. Sci. Teach.*, 49: 394–419. doi: 10.1002/tea.21008

Prunuske, AJ, et al. "Using Online Lectures to make Time for Active Learning." *Genetics* 192.1 (2012): 67-U91.

Searls, DB. "Ten Simple Rules for Online Learning." *PLOS COMPUTATIONAL BIOLOGY* 8.9 (2012): e1002631.

Tantayanon, Supawan, et al. "Distance Learning in Green Chemistry." *Chemistry International -- Newsmagazine for IUPAC* 33.4 (2011): 6-10.

Wang, L. "LEARNING CHEMISTRY ONLINE." *CHEMICAL & ENGINEERING NEWS* 87.36 (2009): 97-9.

Wong, Lily, Arthur Tatnall, and Stephen Burgess. "A Framework for Investigating Blended Learning Effectiveness." *Education + Training* 56.2/3 (2014): 233-51.

Figures:

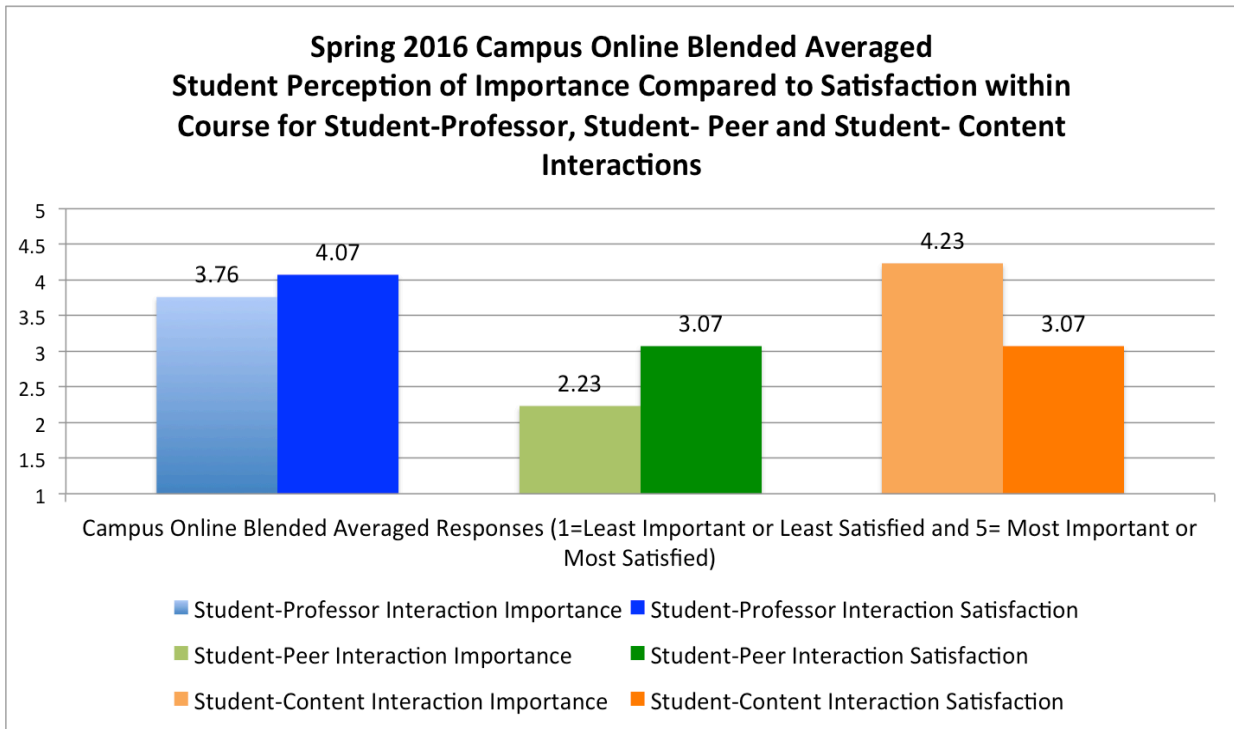
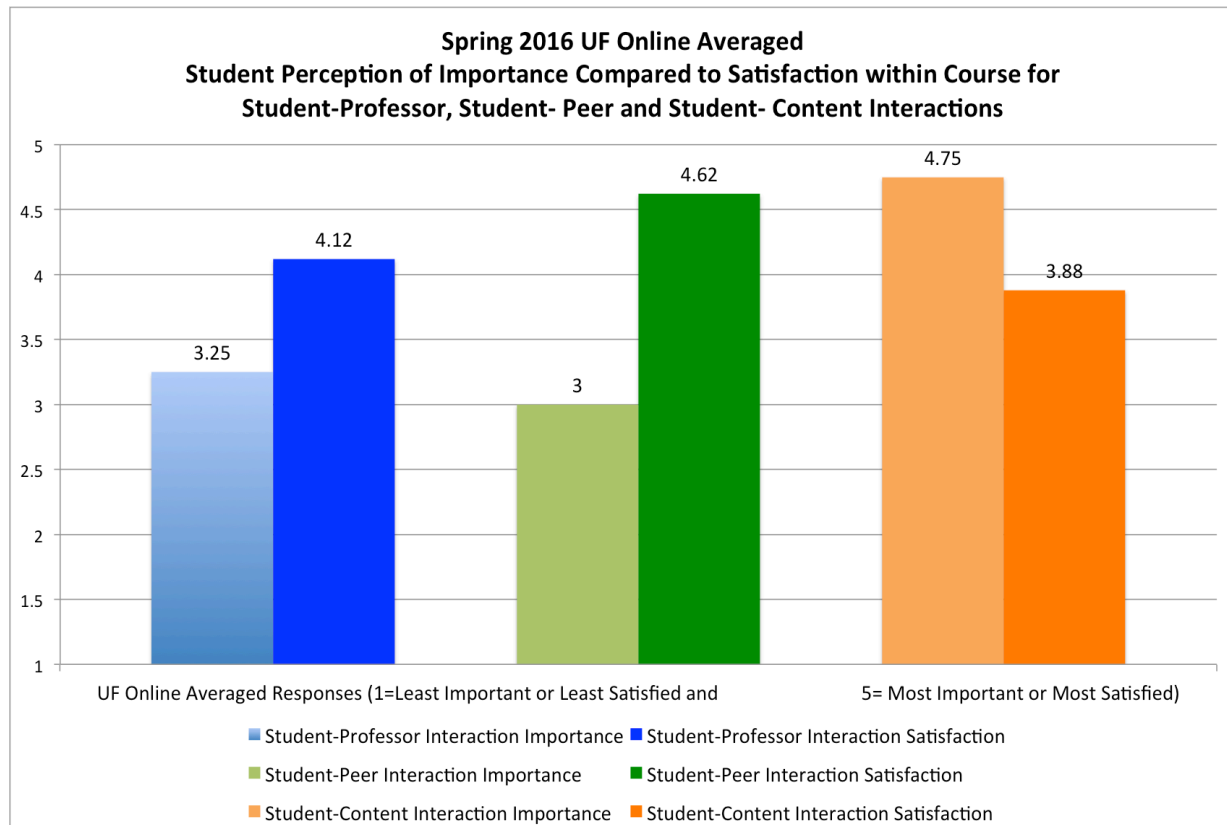


Figure 1: Campus-based online section's perception of importance vs. satisfaction of course elements.



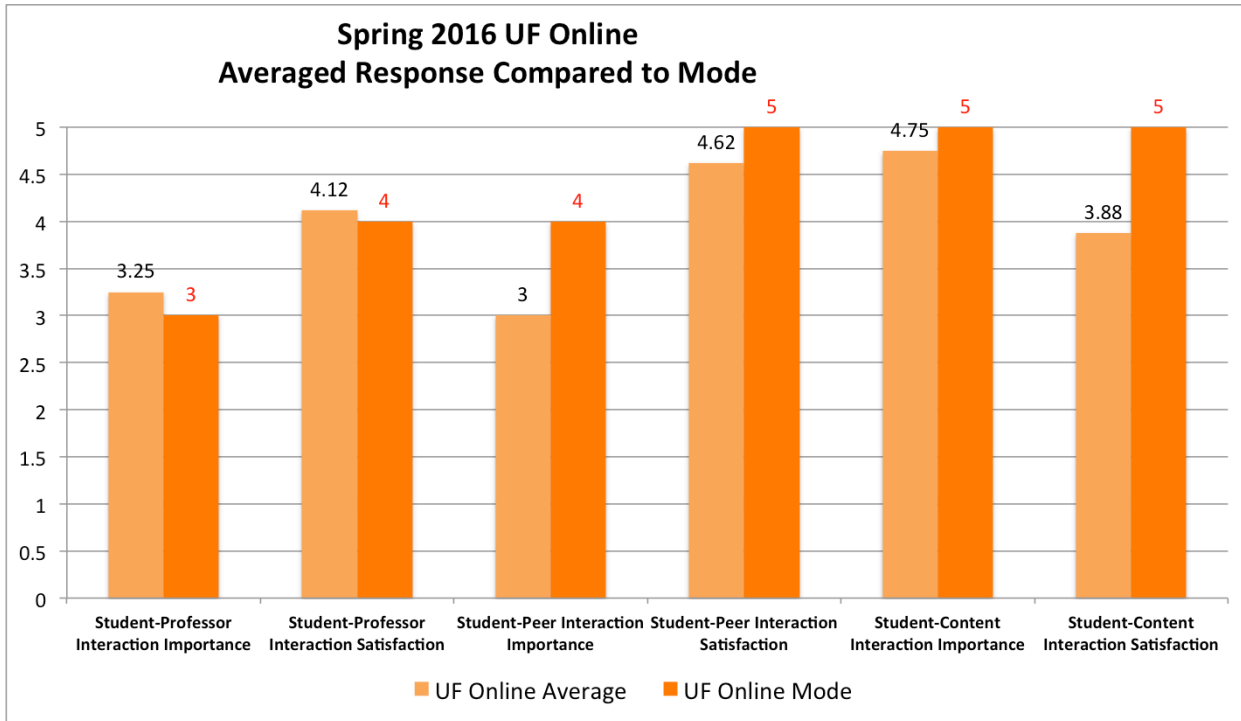


Figure 3: UF Online section’s Averaged perception of importance and satisfaction of course elements vs. mode

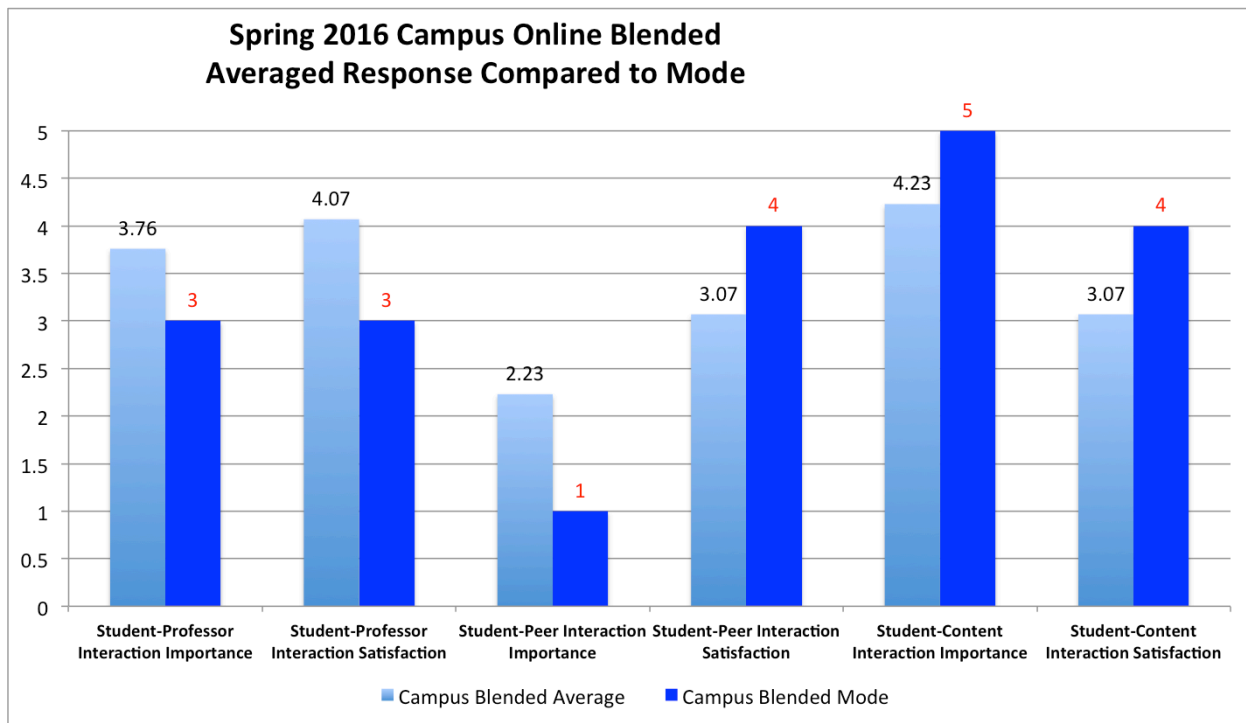


Figure 4: Campus-based Online Averaged perception of importance and satisfaction of course elements vs. mode

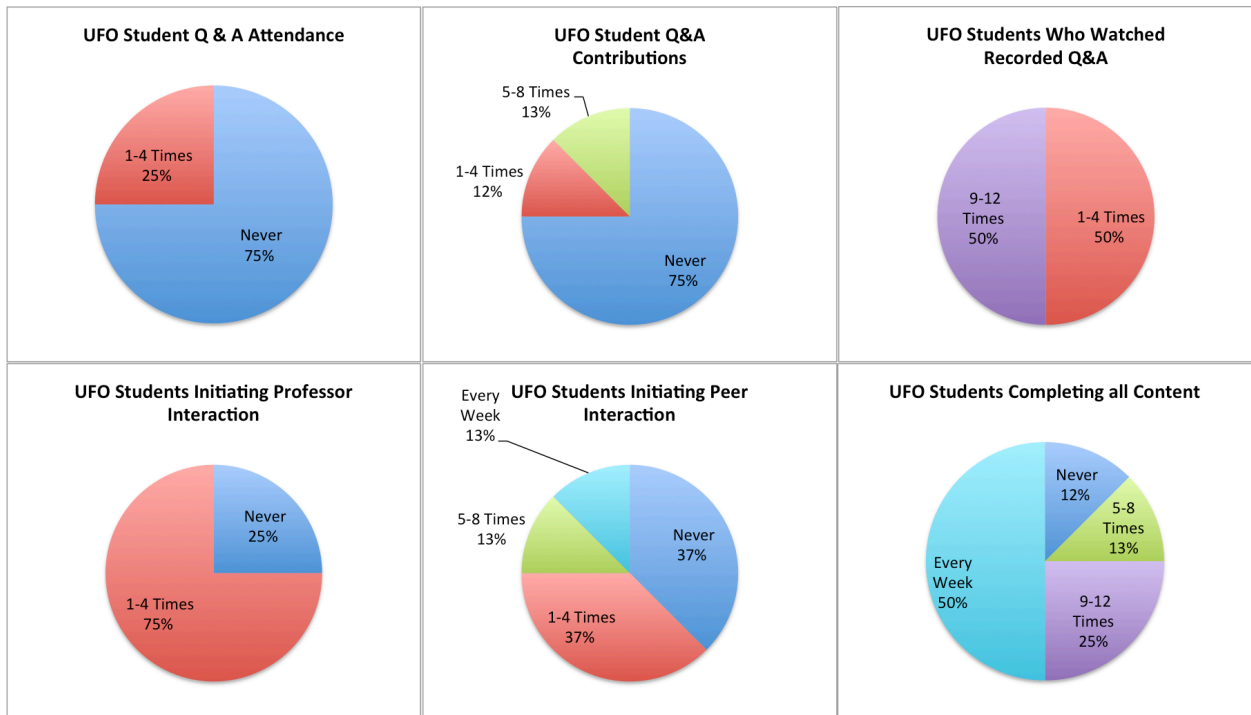


Figure 5: UF Online Participation

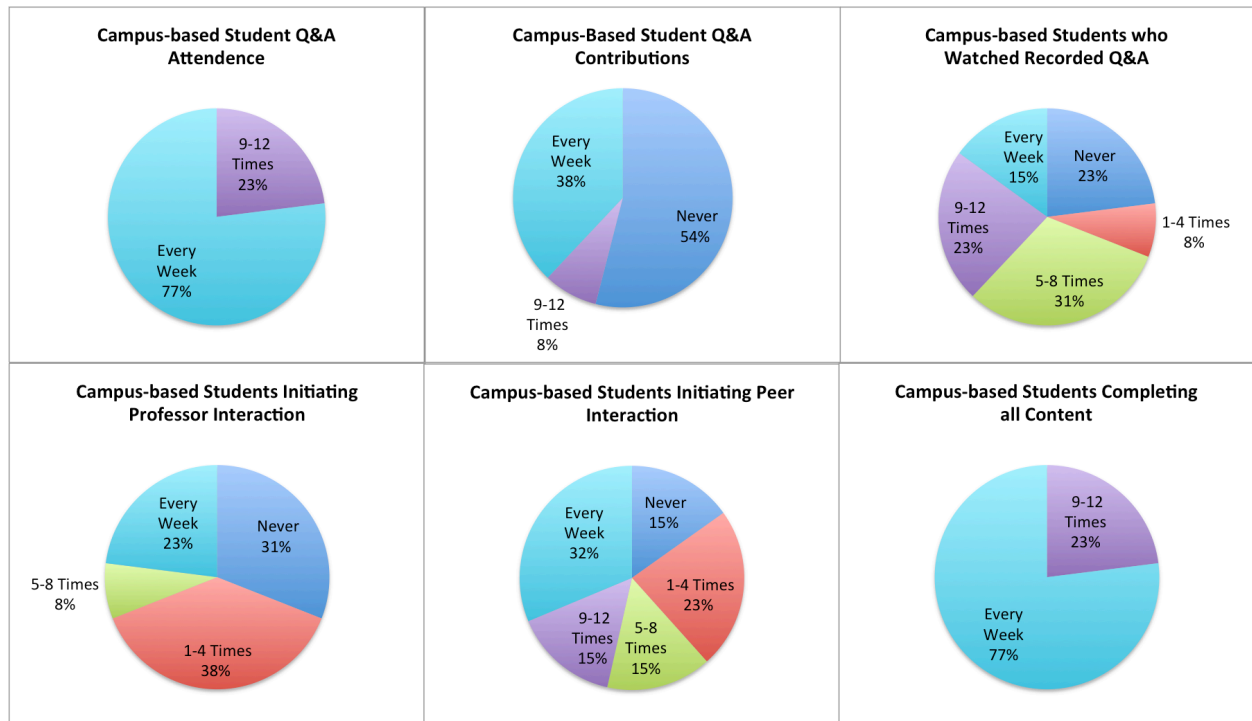


Figure 6: Campus-Based Online Participation

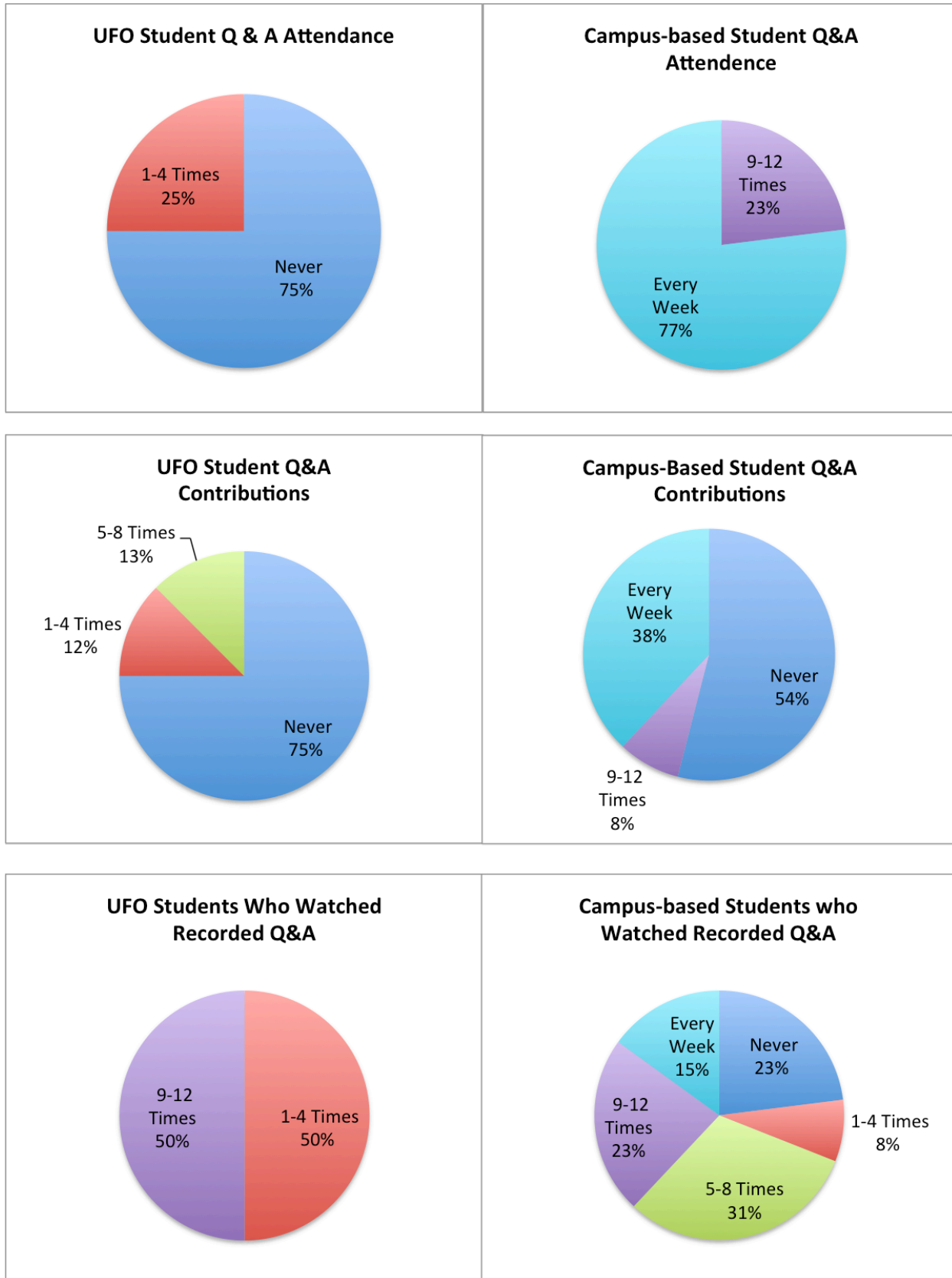


Figure 7: UF Online Participation vs. Campus-based Online Participation: Q&A

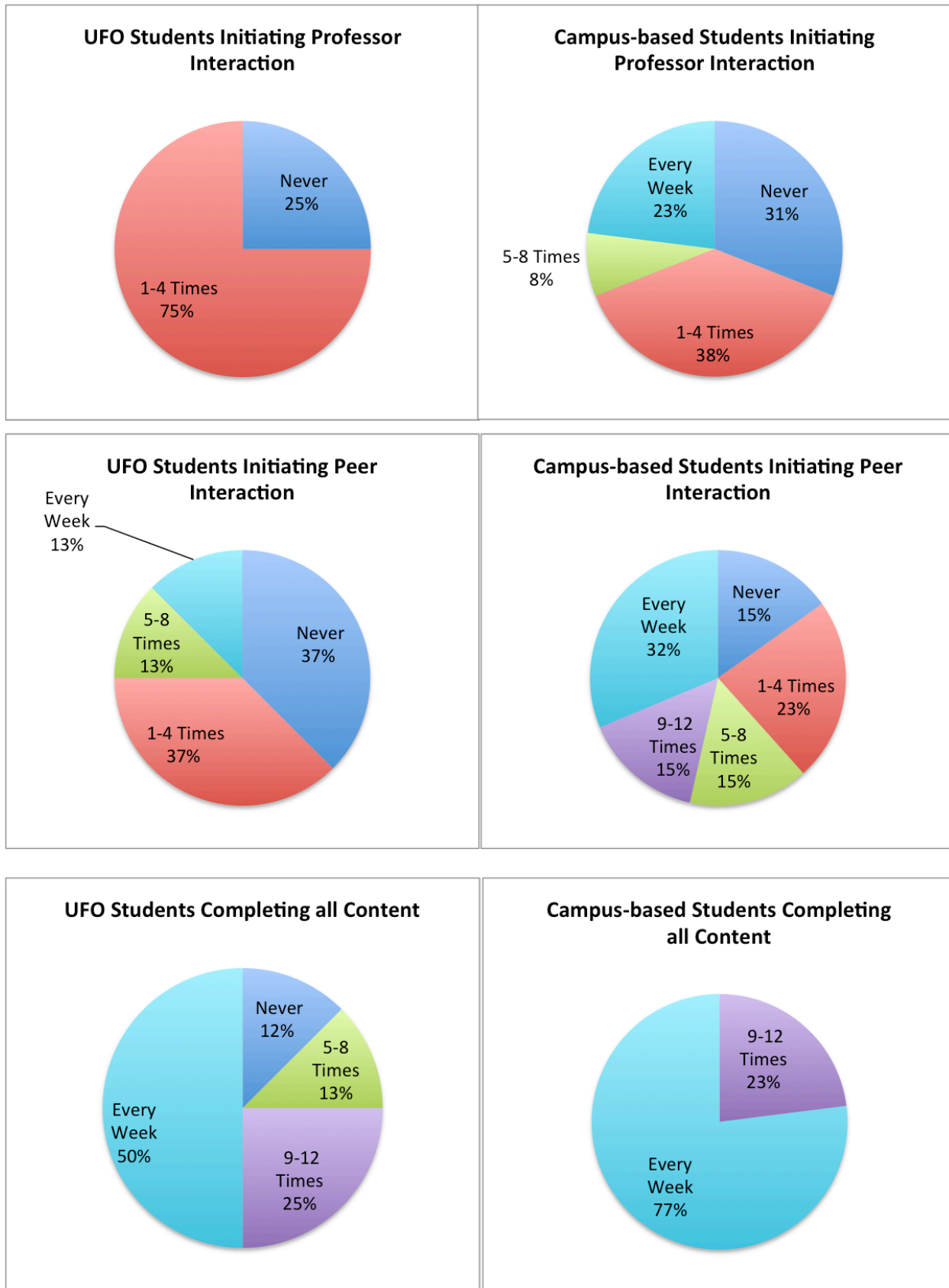


Figure 8: UF Online Participation vs. Campus-based Online Participation: Professor, Peer and Content Interactions

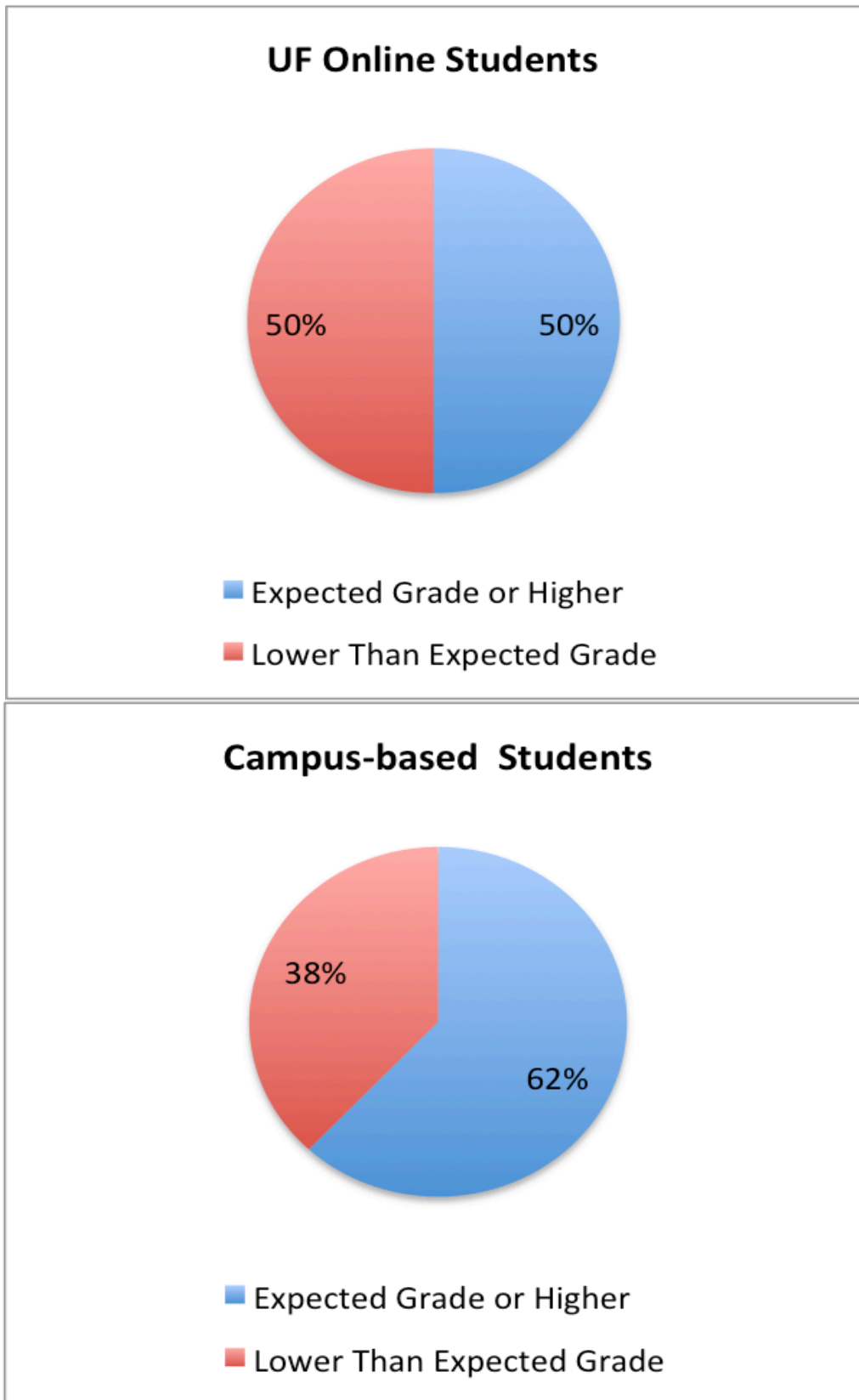


Figure 9: UF Online vs. Campus-based Online Grade Outcomes

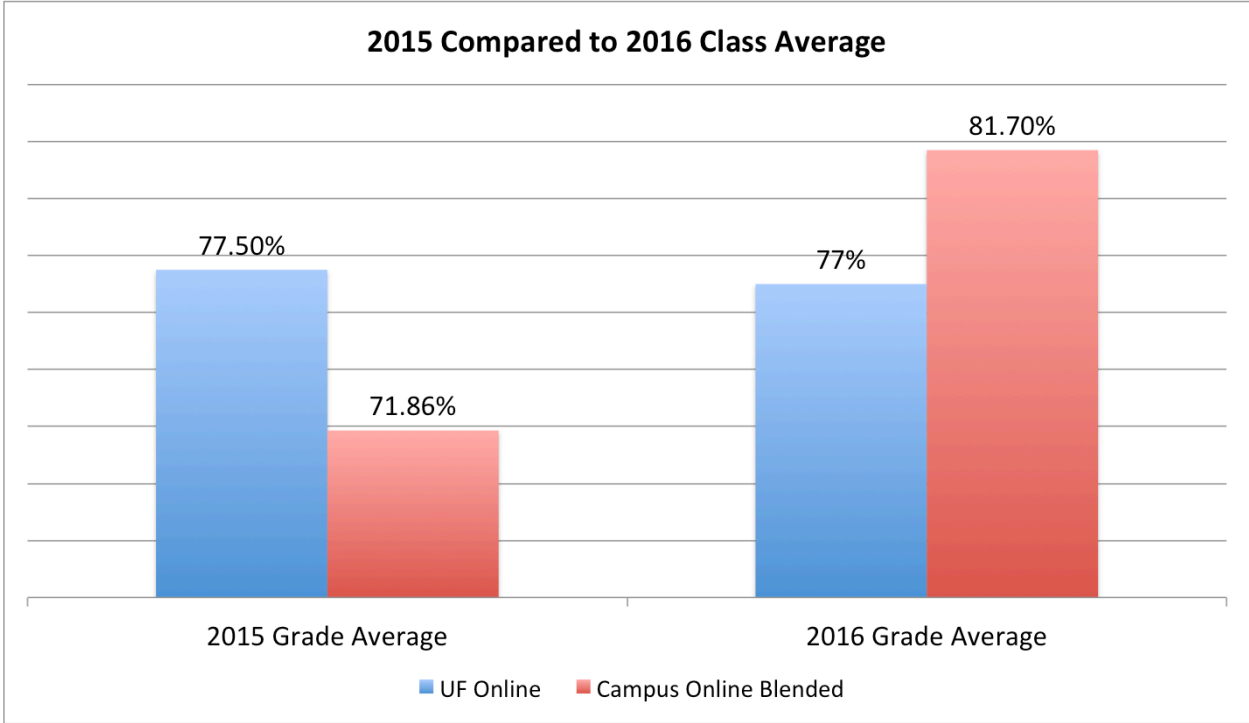


Figure 10: Spring 2015 vs. Spring 2016 Class Averages