Summary Report: A Comparison of Student Success in Undergraduate Online Classes and Traditional Lecture Classes at the University of Missouri

Presented at the 2014 Celebration of Teaching, University of Missouri (MU), May 20-22, 2014

Research team

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The term "no significant difference" refers to the theory that the modality by which instruction is delivered does not affect learning outcomes. According to the theory, in and of itself, technology neither improves nor degrades instruction (Russell, 1999). A substantial body of literature supports this theory, however, there is also research that reports contrary findings. One study conducted at MU compared student achievement in an online and a traditional face-to-face statistics class (Summer, Waigandt & Whittaker, 2005). Results indicated no significant difference in grades between the two modalities. Similar results were found in a study of face-to-face and online mathematics courses (Jones & Long, 2013). Two recent studies that report online learners perform worse than face-to-face learners examined students at community college systems in Washington (Xu & Jaggars, 2013) and Virginia (Xu & Jaggars, 2011). In general, the research suggests that community college students perform better in face-to-face classes than in online classes, but that university students perform similarly regardless of modality. Students who are less academically prepared, in particular, those enrolled in a remedial class, perform better in face-to-face classes.

Online learning opportunities at MU have grown steadily over the past decade. In the 2014 academic year alone, there were 29,537 enrollments in 1,561 sections of online classes taught by 542 instructors across 84 subject areas. Students can choose from over 90 online programs. 34.3% of undergraduate campus students enrolled in at least one online class in AY 2014. Overall, 41% of MU students enrolled in at least one online class in AY 2014.

Research questions

1. Is there a statistically significant difference between grades earned by students across modalities?
2. Is there a statistically significant difference between students' perceptions of teaching effectiveness across instruction mode?
3. What are instructor perceptions of sameness in matched classes?

Methods

Data were gathered from three sources:

1. Student Level Data: Instructors who in AY12 through AY13 taught a like undergraduate course as both online and traditional lecture were identified along with the courses taught in both formats. For each student enrolled in these targeted classes, the following demographic information was pulled from myZou: age, gender, level, citizenship, first-generation college, academic advising group, ACT score, GPA, and grade in the class.
2. Instructor Level Data: Course evaluation data on items relating to course quality, amount of student learning, and assessment were pulled on all these courses from The Assessment Resource Center's (ARC) archives.
3. Instructor Level Data: Instructors of like classes were invited to participate in an online survey. The questionnaire asked instructors about their role in the class and their experience teaching in each modality. They were also asked to compare aspects of their undergraduate face-to-face and online courses such as amount of effort and time, similarity of components, and perceptions of rigor. ARC developed and administered the survey.

Taking advantage of the unique "matched-by-instructor" and multilevel features of the MU data, statisticians from the MU Social Sciences Statistics Center compared student success attributes and instructor characteristics by class modality. Statistical techniques include descriptive and graphical methods and inferential mean comparisons. Results from multilevel modeling techniques that incorporate all the demographic and academic variables from the student-level data, as well as the instructor-level attributes, are also presented.

Student data

Statistical analyses were performed on data pertaining to 20, 690 unique students representing 36,328 enrollments in 102 matched classes taught by 92 instructors during the designated time frame of academic years 2012 and 2013. Seventy-five percent of students were enrolled in face-to-face classes; 12% were enrolled in semester-based online classes; and 13% were enrolled in self-paced online classes. Fifty-four percent of the students were female; 25% were first-generation college students and 97% were US citizens. Student demographic variables of class grade, ACT score, GPA, gender, first-generation college, and citizenship were analyzed to determine their ability to explain differences in performance by modality.

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Hierarchical linear modeling, with each analysis comparing only one pair of modalities (i.e. face-to-face and semester-based online, face-to-face and self-paced online, semester-based online and self-paced online), was used to answer the question of whether grade in class is related to class modality. Class grade was the

dependent variable. The student demographic variables identified previously and class size were covariates.

Results

Overall, several covariates were associated with student performance. Females earned significantly higher grades than males (p<.0001). Non U.S. citizens earned significantly higher grades than U.S. citizens (p=.0754). Non first generation students earned significantly higher grades than first generation (p<.0001). Class size has a significant relationship with grades, with large classes (>80) having the lowest grades. (p<.0001). There was also a significant positive relationship between students' ACT scores and grade in class (p<.0001).

Mean scores for grade in class were calculated based on the scale used by the University to calculate grade point average: *A+* (4.00), *A* (4.00), *A-* (3.7), *B+* (3.3), *B* (3.00), *B-* (2.7), *C+* (2.3), *C* (2.00), *C-* (1.7), *D+* (1.3), *D* (1.00), *D-* (0.7), and *F* (0). The grades of *S, U, NR*, and *W* are not incorporated in the grade point average. Mean scores for grade in class were 2.86 for face-to-face (n=27,095), 3.06 for semester-based online (n=4533) and 2.53 for self-paced online (n=4700).

Grades of 25,417 enrollments in 102 paired semester-based online and face-to-face classes were compared. Results indicate that there is insufficient statistical evidence to conclude that a difference exists in outcomes for the two modalities. Grades of 730 enrollments in three paired semester-based online and self-paced online classes were compared. There is statistical evidence to conclude that students in semester-based online classes earn significantly higher grades (p=.0002). Grades of 14,631 enrollments in 26 paired self-paced online and face-to-face classes were compared. There is statistical evidence to conclude that students in self-paced online classes earn significantly lower grades (p<.0001). For the six fixed effect/parameters in the model, there are 15 possible interactions, and it did not make sense to include all of them. In arriving at the "final, best model," we checked some interactions (that made sense) and deemed them not necessary, as they did not improve the model fit, p-values and final diagnostics.

Student responses (n=14,704) to five course evaluation items were compared for 40 matched semester-based online and face-to-face classes. The five items were:

- Availability of extra help when needed (response options: 1=Easily Available to 5=Generally Not Available)
- The course as a whole was (response options: 1=Excellent to 5=Poor)
- Amount you learned in the course was (response options: 1=Excellent to 5=Poor)
- Evaluative and grading techniques (tests, papers, projects, etc.) were (response options: 1=Excellent to 5=Poor)
- Grade I expect to receive

"Availability of Instructor" is the only item with a significant modality effect. Students perceived their instructors to be less easily available in the online classes

(p<.0001). Comparative data were not available for self-paced classes as a different evaluation instrument was used for those classes.

Instructors (n=87) of paired classes who had valid email addresses were asked to participate in a survey regarding likeness of their paired classes. Fifty instructors (53%) provided information on 52 classes. Of those responding, 45 instructors taught 47 matched online (semester-based and self-paced) and face-to-face classes during the timeframe of the study. Forty-seven percent are ranked faculty (n=21). The majority of instructors (89%) indicated they had designed the classes about which they responded. Overall, instructors had much greater experience teaching their paired classes in the face-to-face format with 53.1% (n=25) having taught the class in that modality at least seven times. Only 19.1% (9) indicated they had taught the class online (semester-based, 8.5%; or self-paced, 12.8%) seven or more times.

When asked to compare their efforts for face-to-face and online classes (semester-based and self-paced), instructors reported that teaching the class and preparing to teach required more effort for their face-to-face classes, whereas preparing and grading assignments required more effort for online classes. There was no significant difference in effort for preparing and grading quizzes, preparing and grading exams or moderating discussions.

Instructors were given a list of five course components and asked to compare course modalities by rating each component regarding its similarity between the traditional face-to-face and the online like courses (both semester-based and self-paced). A mean score was calculated for each of these components with items coded one for "not at all similar" to five for "exactly the same." A higher mean score indicates greater similarity between the face-to-face and online courses for any course component. Learning objectives ($\bar{x}$=4.4) and content ($\bar{x}$=4.0) were most similar across modalities. With mean scores of 3.4, both student work requirements and student assessments were only moderately similar across the course modalities. Organization of content ($\bar{x}$=3.8) was very similar across modalities.

Instructors were given a list of 13 possible course components and were asked to select the components used with each type of course modality in which they taught. All courses were taught as a face-to-face traditional course. Of the 13 components, significantly more instructors reported using the following components more in face-to-face classes than in semester-based online classes:

1. office hours (in-person/online/phone),
2. lectures (live or recorded),
3. class discussions (live or online),
4. group project(s),
5. exam(s) worth 20% or more of grade, and
6. a final, cumulative exam.

Significantly more instructors reported using individual project(s) and quiz(zes) in their semester-based online classes than in face-to-face classes. Of the 13 like

classes taught as self-paced online, 100% of instructors used reading assignments and 77% used writing assignments and exams worth 20% or more of grade; however, no instructors used class discussions, group projects, presentations, or case studies.

Instructors were asked to compare their use of seven course components (reading assignment, writing assignments, quizzes, exams, presentations, projects and class discussions) between their face-to-face and online courses by type of online course. Instructors reported using writing assignments more often in both types of online courses than in their face-to-face course. Quizzes, exams, presentations, projects and class discussions were used less often in self-paced online classes than in face-to-face. With the exception of quizzes, these components were also used less often in semester-based online classes than in self-paced. Exams, presentations and class discussions were used less often in semester-based online classes than in face-to-face.

Instructors were asked to rate the amount of academic rigor required of their students in their online semester-based and self-paced class in relationship to their face-to-face class. Instructor responses indicate that students in online semester-based classes appear to be challenged slightly more than students in a like face-to-face class and more than students in online self-paced courses.

Discussion

Students perceived the instructors to be less available for extra help when needed in semester-based online classes than in face-to-face. This perception could be shaped, at least in part, by instructors' tendency to omit discussions and office hours from their semester-based online classes more often than face-to-face. Physical distance may also contribute to this perception as students do not have the opportunity to speak with instructors before or after class.

Students in self-paced online classes earned lower grades than those in semester-based online or face-to-face classes. In order to success in the self-paced mode, students must be self-motivated learners with good study habits. Anecdotal information suggests that students who drop a semester-based class (online or face-to-face) because they are doing poorly, may pick up a self-paced class to maintain a full-time course load and their progress toward degree completion. These students may be less academically prepared or committed, which increases the likelihood that they will not perform well in the self-paced class. Additional research in needed in this area.

Overall, instructors tend to incorporate a greater variety of learning and assessment components in their face-to-face classes. The increased variety has the potential to create a richer learning environment. It is unclear what influences instructors' use of various components in any modality. It is possible that instructors choose not to include some components in their online classes because they are uncertain about how to use them effectively to enhance learning. Exams worth 20% or more of the

grade are used less in online classes than face-to-face. This is a positive finding, consistent with best practices for online classes.

Additional research is needed to better understand factors that influence student performance in self-paced classes. In-depth study of individual pairs of matched classes would contribute to greater understanding of how instructors make decisions about use of learning and assessment components.