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Learning Outcomes in an online vs traditional course

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Abstract

Relative enrollment in online classes has tripled over the last ten years, but the efficacy of learning online remains unclear. While two recent Meta analyses report higher exam grades for online vs. traditional classes, this body of research has been marked by two recurrent limitations: (1) a possible problem of selection bias wherein students self select the mode of course delivery and (2) a relative lack of proctoring of exams in online sections. Both of these confounders contribute to observed differences in performance. The present study addresses these limitations. Data refer to 64 students enrolled in criminology classes at a Carnegie research extensive university. Due to an administrative error in the course schedule, which failed to list one section as online, students were unable to self select into the online section, creating a rare opportunity for quasi randomization of students into sections. Both sections were taught by the same instructor. The dependent variable is the score on the standardized final examination. All exams were proctored by the instructor. The central independent variable is method of delivery of content: online vs. the traditional classroom. Controlling for other constructs, there was no significant difference between exam scores. Also, student evaluations did not differ between sections. Controlling for selection effects and the proctoring of exams, the academic performance of online students was the same as that of traditional students. Future work is needed for other courses, other fields, and other types of academic institutions.

Keywords

learning, online teaching, traditional classes

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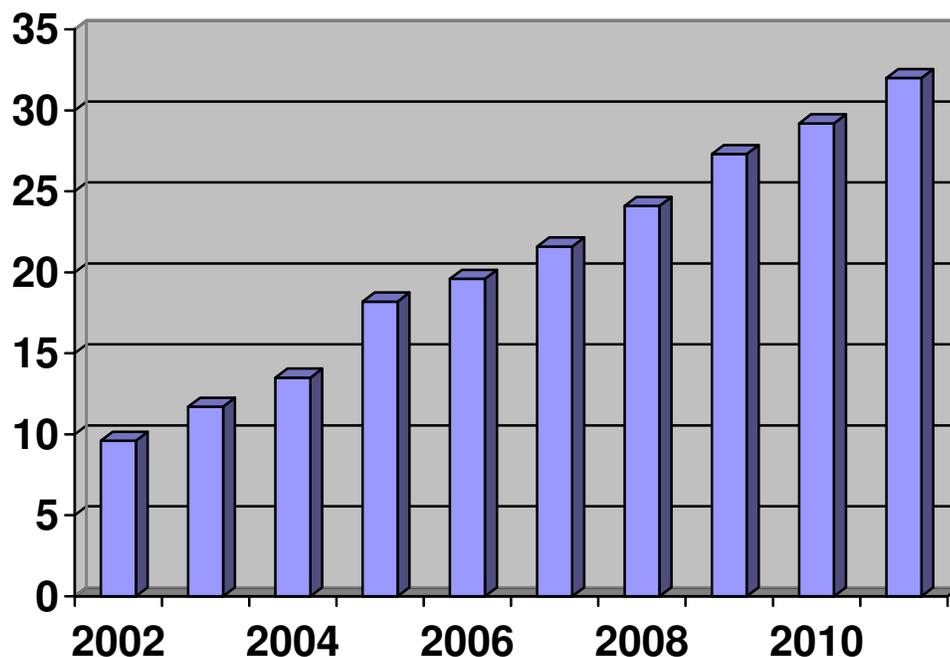
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On line instruction has been growing at a fast pace over the last decade. In 2002 a total of 1,602,970 students in higher education took at least one course online. By 2011 6,714,792 students took one or more online classes. This changes amounts to an increase of 318.9%, or a 4.189 to one ratio. The prevalence of online instruction can also be measured as online enrollment as a percent of total enrollment. This percentage increased over three fold from 9.6% in fall 2002 to 32.0% in fall 2011(Allen & Seaman, 2013). This trend is illustrated in figure 1. Based on annual survey data from chief educational officials at up to 2,800 institutions of higher education, these and other indicators of the prevalence of online instruction have tripled over the last decade (Allen & Seaman, 2013). Criminal justice programs have often provided leadership in the dissemination of online delivery of the curriculum.

Figure 1. Trend in Percent of Students Taking at Least One Online Course in American Degree-Granting Colleges and Universities, 2002-2011, all fields (Source: adapted from data in Allen & Seaman, 2013).



A recent development in online teaching is its extension to the MOOC. Free Massive Open Online Courses (MOOCs) have raised concern about the survival of higher education as we know it, a system centered on the traditional classroom delivery of knowledge. At present, 2.6% of higher education institutions have a MOOC while 9.4% report that they are in the planning stages (Allen & Seaman, 2013). Free MOOCs are often thought to be a means for ultimately recruiting tuition paying students. However, there are reported difficulties in getting MOOC students to enroll on campus, and attracting students who will pay a fee to take a MOOC for actual college credit (Kolowich, 2013). At present, research on learning outcomes of online vs. traditional classes has not rigorously assessed MOOCs. There is a substantial literature, however, on perceptions and analyses concerning student learning outcomes in online vs. traditional classes.

Given the increasing use of online instruction, it is important to assess the learning outcomes of students enrolled in online vs. traditional classes. In terms of perceptions, the opinions of chief academic officers at nearly 3,000 colleges are split on the extent to which student achievement is the same, higher, or lower in online vs. traditional classes. However, the greater the involvement of a college in online learning, the higher the probability that its chief academic officer believes that students learn more in online vs. traditional classes (Allen & Seaman, 2013). Whether or not the perceptions of higher education officials reflect reality is subject to a review of the quantitative work comparing grades achieved in online vs. traditional classes.

Previous research that rigorously compares student achievement between online and traditional classes is marked by some conflicting findings as well as some recurrent limitations (Bray, Harris & Major, 2007; Figlio, Rush, & Yin, 2010; Gratton-LaVoie, 2009; Harmon, 2006; Brown & Leidholm, 2002; Parsons-Pollard, Lacks & Grant, 2008; for reviews see Means, Toyama, Murphy, et al. 2010; Shachar & Neumann, 2003). First, in nearly all studies, students can freely select to enroll in online vs. traditional classes. To the extent that the characteristics of online

students differ from their traditional counterparts, in terms of such characteristics as GPA, age, marital status, maturity, and learning styles such as audio vs. visual learning, self selection can bias the results on academic achievement (e.g., Allen & Seaman, 2013; Bray, Harris & Major, 2007). Second, the procedures involved in the measurement of student achievement are largely unclear. To the extent that examinations are given online with little or no supervision, the achievement of students in online classes may be greater than in traditional classes. In traditional sections examinations are supervised, thus minimizing cheating and collaboration in test taking. There is evidence that the incidence of overall cheating (including cheating on exams, papers, and other modalities of evaluation) in online classes is up to four times greater than that in traditional classes (Lanier, 2006; Moten, Fitterer, Brazier, Leonard & Brown, 2013). To the extent that cheating is more prevalent in online instruction than traditional instruction, reported differences between groups in student achievement need to be interpreted with caution.

The present study contributes to the literature by addressing these limitations. First, it was able to inadvertently minimize opportunities for self selection into the online section of the course. Due to an administrative error in the schedule of classes, the online section was advertised as a traditional class. This feature of the study is relatively unique. It allows for controlling, at least in part, differences in learning styles and motivations, among the students in online and traditional sections of the same course. Second, it controls for the testing environment by proctoring exams on campus for both online and traditional sections of the course. Third, no course paper was required in any section, thus removing opportunities for cheating on that potential modality of learning outcomes. Finally, unlike some previous studies, the online and traditional classes were taught by the same instructor, thus minimizing instructor effects on achievement.

The present investigation will review the literature on student achievement in online vs. traditional classes. Some special

attention will be drawn to student achievement in criminology classes since the present study focuses on classes in that field. The investigation then will contribute new findings to the literature by performing one of the first studies close to a case-control design, minimizing self selection effects. This will be the first such study for the field of criminology.

LITERATURE REVIEW: ONLINE VS. TRADITIONAL STUDENT ACHIEVEMENT

While there are a large number of investigations on the possible impact of instruction online vs. traditional classes on student achievement, there are conflicting findings(e.g., Bray, Harris & Major, 2007; Figlio, Rush & Yin, 2010; Gratton-LaVoie, 2009; Harmon, 2006; Brown & Leidholm, 2002; Parsons-Pollard, Lacks & Grant, 2008; Russell, 1999; for analytical reviews of 86 and 50 studies respectively see Means, Toyama, Murphy, et al. 2010; Shachar & Neumann, 2003). Some investigations report that exam scores are higher for traditional classes than online classes (e.g., Brown & Leidholm, 2002; Figlio, Rush & Yin, 2010; Parsons-Pollard, Lacks & Grant, 2008) while others report the reverse, that student performance is higher for online sections (e.g., Gratton-LaVoie, 2009; Harmon, 2006; Means, Toyama, Murphy, et al., 2010). Still others report no significance difference in student performance between online and live classes (for a review see Russell, 1999). Caution needs to be exercised in interpreting the findings in this body of research for a series of methodological limitations. For example, some research compares online classes with traditional classes taught by different instructors. In such a research design observed differences may be largely due to teacher effects rather than mode of delivery effects (Brown & Leidholm, 2002). Online classes are thought to provide more opportunities for cheating, a behavior that can enhance student performance. Available survey data indicate a higher self reported instance of cheating in on line classes relative to traditional classroom based sections (Lanier, 2006; Morton, Fitterer, Brazier, Leonard & Brown, 2013).

A Meta-analysis of 86 studies determined that students in online sections of a course generally score higher on standardized final exams than students enrolled in traditional classes (Shachar & Neumann, 2003). The reported difference was large, amounting to a half of a standard deviation. A more recent Meta analysis, limited to 50 findings from the relevant research, also confirmed that academic performance was higher in online vs. traditional classes (Means, Toyama, Murphy, et al., 2010). However, there is a wide variety of confounders that may artificially enhance student performance in online classes. Most research was unable to or did not control for factors which may give students in online classes the edge over their traditional counterparts in exam scores. These factors include two which provide a focus for the present investigation: (1) selection bias in choice of mode of delivery (online vs. traditional), and (2) opportunities for cheating with a focus on the extent to which exams are proctored.

Most research has been unable to control for possible selection bias given such issues as practical barriers in randomly assigning students to online vs. traditional sections of a given course (for an exception see Figlio et al., 2010), and the unavailability of complete data on the background characteristics of students (Bray, Harris & Major, 2007). Students who freely choose online classes may have different characteristics than students who choose traditional, live classes. For example, students opting for online classes may be older, have children, and/or be fully employed (Bray, Harris & Major, 2007). Online classes can be attractive to such groups since they minimize commuting time and can reduce or eliminate the need for child care when studying course material. Online classes can resolve conflicts between work and schooling since online class material can be studied at night, on the weekends, and other times during non-work hours.

For example, a study of learning outcomes (exam scores) in online vs. traditional classes in microeconomics determined that students in the online class scored higher on the final exam than the traditional class (68.1% vs. 61.6%). However, the classes,

online vs. traditional, differed significantly in the kinds of students who chose each respective mode of delivery. For example the online students were older (25.3 vs. 20.7 years), more apt to be married (29% vs. 6%), to have children (21% vs. 4%), had a higher GPA (2.85 vs. 2.57), and to have taken a previous economics course (59 vs. 40%). Once these differences between groups in various background characteristics were controlled, there was no significant difference in exam scores (Gratton-Lavoie & Stanley, 2009). In order to fully control for background characteristics, a randomized case-control research design has been advocated (Bray, Harris, & Major, 2007). The present study addresses this call through a control for self selection.

Most research does not report the presence or degree of proctoring exams. The absence of a proctor during exams increases opportunities for cheating. While there have been technologies developed to reduce cheating, such as having students show ID's while taking exams on a webcam, it is not clear if these have been enough to reduce cheating. Students report that they are up to four times more likely to cheat in online classes compared to traditional classes (e.g., Moten et al., 2013). Traditional classroom instruction generally involves the presence of a proctor during exams. This generally assumed not to be the case in online classes. Research on online instruction often does not report the details of the online examination environment (e.g., Brown & Leidholm, 2002).

That the presence or absence of a proctor makes a difference is demonstrated in a study of online vs. traditional classes in introductory economics. Online students who were able to take the exams without the presence of a proctor did, on average, one letter grade better than online students whose exams were proctored (Wachenheim, 2009). Intuitively, this would be expected since the absence of a proctor can entail an "open book" exam, which can give the unproctored students an advantage over the students taking the exam with a proctor (presumably closed book). This may help explain the finding that online students tend to do better than their counterparts in traditional

classes traditional (Means et al., 2010; Shachar & Neumann, 2003).

There has been little research on the problem in the specific field of criminology. Only one previous relevant investigation was found. Parsons-Pollard, et al. (2008) assessed differences in student achievement in sections of introduction to criminal justice. The sample was based on 305 students in a large traditional section and 425 students in a large online section of the course. Students in the traditional section received significantly higher final grades than students in the online section, but the difference was not large (81% vs. 78%). Caution needs to be exercised in interpreting the results of the Parsons-Pollard, et al. (2008) study. The examinations were not exactly the same between sections, although they are reportedly "similar." Differences in the rigor of the exams might explain the reported differences in mean grades. It is not reported if the sections were taught by the same faculty member, so that teacher effects on learning may be present. Students self selected the online vs. traditional sections, opening up the possibility of selection effects. The examination environment is not described, so that it is not known if there were differences in the proctoring of traditional and online sections. Still, the direction of differences (students in the traditional section performed better than online students), runs counter to the conclusion of two meta-analytic reviews (Means et al., 2010; Shachar & Neumann, 2003). Further work is needed to address this issue.

The present analysis is able to address two limitations of previous work: selection effects and differences in the degree of proctoring of exams between groups. The present study was able to, in effect, quasi randomize students into online vs. traditional sections of the course. Second, it controls for the presence of a proctor by arranging for a proctor (the instructor) during exams in both the online and traditional sections of the course. It also contributes the first study of its kind for the field of criminology.

METHODOLOGY

Subjects were all students enrolled in two sections of criminological theory at a Carnegie research extensive university during fall 2005. Due to an error in the printing of the course schedule by the office of scheduling, neither class was defined as an online class. However, one was online and the other was a traditional live class. The students were all surprised in the online section when they found out it was an online course (the instructor was also surprised since it was the only time such an error appeared in course scheduling, and has never been the case since). Importantly, there was no differential exodus from the online section once the students found out it would be on line. Of the 33 students enrolled in the online section, only one dropped. Of the 34 students who enrolled in the traditional live class, only two dropped the course. Hence, complete data were available for 32 students in the online section and 32 in the traditional offline section.

The scheduling error resulted in a research design approaching that of a randomized clinical trial. As far as the author has been able to determine in a review of published research in refereed journals, the present analysis is the one that comes closest to randomizing students to an online and traditional section of the same course. This has the advantage of minimizing selection effects such as a common view that online classes attract and are best for the more disciplined students or for visual learners over auditory learners who thrive on instructional modalities such as classroom based, live discussions (e.g., Allen & Seaman, 2013).

The classes had exactly the same reading assignments and examinations. The power point slides (N=1,400) used in the traditional class, together with accompanying audio files of lecture in the traditional class, were required materials to be reviewed by members of the online section. There were opportunities for discussion in both classes, but the modalities were different. The traditional class had opportunities for questions from the students and subsequent discussions. The online class had a discussion

board to facilitate discussion of the course material, but participation, as in the traditional class, was voluntary.

The principle dependent variable is the score on the final examination. Importantly, the exams, including the final exam, were given under supervised conditions on campus. Online students were called back to campus for exams. The instructor was present to proctor all exams for both the online and traditional sections. This minimized opportunities for cheating on exams, removing one of the potential sources for measurement error in the past research (Lanier, 2006).

The central independent variable is a binary variable, type of course delivery system (0,1). Delivery is coded where 1=online delivery and 0= the traditional class.

Control Variables. Grades on the first hour exam are used as a proxy independent variable for several constructs thought to predict student achievement. These constructs include academic ability, amount of academic effort, and the amount of time spent and/or available for studying course material (Stack, 2013). Data on these specific constructs were unavailable, but it is assumed they are at least partially captured by grades on the first hour exam. In results not fully reported here, an average of the first two hour exams was used as the proxy measure of omitted variables. However, the results were essentially the same. In addition, a control is included for the gender of the student where 1=female and 0=male.

A second dependent variable to be analyzed is student evaluation of instruction. Student evaluation (SET) data is from the standard university SET forms. Each of three summary measures is employed. These are the three that are emphasized by the university administration: (1) How would you rate this course, (2) How much have you learned in this course, and (3) How would you rate the instructor's teaching in this course? Responses are based on a five point scale where 1=poor/nothing through 5= excellent/a great deal. Each subscale is analyzed separately.

ANALYSIS

Table 1 provides the mean scores on the variables for the traditional class vs. the online class. In preliminary results not fully reported here, Pearson correlation coefficients were calculated. Type of delivery system (offline vs. online) was unrelated to final exam scores ($r = 0.147, p > .05$). Type of course delivery system was also unrelated to scores on the first hour exam ($r = 0.201, p > .05$) and the second hour exam ($r = 0.105, p > .05$).

Table 1. Variable Means in the Traditional vs. Online Sections of Criminological Theory.

Variable	Mean, Traditional, Live Section (N=32)	Mean, Online Section (N=32)
Examination 1	67.5	72.1
Final Exam	56.6	59.9
Gender (Female=2)	1.48	1.56

The results of the multivariate analysis are provided in Table 2. Controlling for the other predictors, students in the online course delivery system did no better on the final exam than the students in the traditional class ($b = 1.14, p > .05$). The coefficient for the online course variable was only 0.46 times its standard error. Grades on the first hour exam predicted final exam scores ($b = .515, p < .05$). The coefficient for first hour exam grades was 4.74 times its standard error. Gender was unrelated to final exam scores ($b = -.217, p > .05$). The model as a whole significantly predicted final exam scores ($F = 8.51, p < .05$). From the R

squared statistic, the model explains 29.5% of the variance in final exam scores.

Table 2. The Effect of Mode of Delivery (Online Vs. Traditional Classes) on Student Achievement, First Hour Exam, and Gender on the Final Exam in Criminological Theory (N=64 students).

Variable	Regression Coefficient	Standard Error	t-test
Mode of Delivery (Online Class, 0, 1)	1.14	2.48	0.462
Grade, First Hour Exam	.515*	.109	4.76
Gender (female= 1)	-2.17	2.43	-.89
Constant	24.93*	8.55	2.91
F-Statistic	8.50*		
R-squared	.295		
	* p < .05		

Table 3 provides the results on the relationship between method of course delivery (traditional vs. online) and student perceptions of instruction. The overall student perception of the course did not differ by mode of delivery. This mean rating was 2.4 in both the traditional and online sections. The SET's were also identical on the perception of the amount learned. Students reported a rating of 2.8 in each section. The item: "How would you rate the instructor's teaching in this course?" received largely

the same mean score in each section, 2.9 in the traditional class and 2.8 in the online class. These SET scores are relatively low, but may be attributed to the instructor's grading policy. Available data indicate that the mean course grades of the students in both classes are relatively low for the department.

Table 3. Mean Student Evaluation of Teaching (SET) Scores in the Traditional vs. Online Sections of Criminological Theory (N=64 students).

Summary SET Item	Traditional, Live Section (N=32)	Online Section (N=32)
How would you rate this course? (1=poor through 5=excellent)	2.4	2.4
How Much have you learned in this course? (1=nothing through 5=a great deal)	2.8	2.8
How would you rate the instructor's teaching in this course? (1=poor through 5=excellent)	2.9	2.8

CONCLUSIONS

Online education as a means of course delivery has proliferated in the last decade. Both the number of students

taking online classes and the proportion of online classes of all classes have more than tripled (Allen & Seaman, 2013). While there is evidence that the achievement of online students is significantly higher than the achievement in classes taught in traditional classes (for reviews see Means, et al., 2010; Shachar & Newman, 2003), the interpretation of this finding is open to some question. Many previous studies were not able to control for selection effects. It is plausible that the more industrious, married, mature, older, self motivated students are more apt to select online classes than their counterparts as was found in a study of microeconomics classes (Gratton-Lavoie & Stanley, 2009). Bray, Harris & Major (2007) call for investigations that randomize students into online vs. offline sections. The present study answers this call.

The results of the present study find that there is not a significant difference in the final exam scores of the students in online and traditional sections of the course. Previous work has been largely unable to randomize students into experimental and control groups, online vs. traditional sections. In contrast, the present study, due to an administrative error, was able to essentially, randomize students into online and traditional sections of criminological theory. In the previous body of research, the lower achievement levels of students in traditional classes may simply be an artifact of selection effects.

In addition, given that online students have more opportunities for cheating and report up to four times more cheating in their online classes than their traditional classes, the higher achievement levels of online students may be subject to measurement error (Lanier, 2006; Moten et al., 2013). Online students often have advantages on exams including taking exams on an open book environment and with the help of other students in unsupervised environments. The present study minimized opportunities for cheating on exams by calling back the online students to campus to take all exams in a supervised environment. This element of controlling for opportunities for cheating also helps to explain the similarity of test scores between

online and traditional classes in the present investigation. In previous research the reported gap between learning outcomes in traditional vs. online classes may be, in part, an artifact of corresponding differences in the level of cheating.

Given its quasi randomization into experimental and control groups, and minimizing opportunities for cheating, the present study improves on previous research. It questions the reported higher levels of learning among online students found in previous work (Means et al., 2010; Shachar & Neumann, 2003). Given the rapid spread of online learning, future work is needed to control for these issues in other fields and other types of academic institutions.

The finding of no difference in SET scores between online and traditional classes is largely consistent with previous work on this issue (for a review see Parsons-Pollard, et al., 2008). However, in some previous research, students give online classes a lower rating, apparently due, in part, to malfunctions in online technology systems during examinations (Parsons-Pollard et al., 2008).

There has been only one previous similar study for the field of criminology. The results on student achievement in the present study contrast with the previous investigation. Parsons-Pollard, et al. (2008) reported that the grades received by students in a large traditional introductory level criminal justice class were significantly better than the online students. However, the difference, while significant, was small. The means were 81% vs. 78%. Nevertheless, some methodological differences between the present study and that study might help to explain the different results. For example, students could self select the method of delivery, most of the students were not criminal justice majors, the same exams were not given across sections, and details are lacking on possible differences in the proctoring of exams.

Finally, future research is needed on related issues beyond the scope of the present study. Retention and graduation rates may be related to mode of delivery. Perhaps traditional classes

might increase retention and graduation rates through face to face contacts between students, and between students and their professors.

The goal of maximizing learning through online delivery may be compromised in the interest of cost-cutting. It is not fully clear what drives the trend towards online instruction. Online instruction is often driven by a quest to cut costs. For example, monies can be saved when classrooms are not needed for instruction. It is also unclear if a quest after cutting costs through online instruction affects staffing decisions. At the present institution online instruction in CJ, and some other departments, is almost entirely done by part time faculty. To the extent that full time faculty are more capable instructors than part time faculty, it is important that full time faculty are represented proportionally in online instruction. An over-reliance on part time faculty for online sections, a pattern that lowers labor costs, may be associated with falls in student achievement, retention, and graduation rates.

Taken to the extreme, online instruction could be delivered through MOOCs centered at a relatively few traditional colleges and universities. Some experts suggest that in half a century there will only be 10 universities in the world, the ones that produce the MOOCs for a global audience. There are powerful social and economic forces involved in the trend towards MOOC delivery systems. The emergence of massive open online classes (MOOCs) has generally involved partnerships between corporations and non profit organizations on the one hand and universities on the other hand. MOOCs have spread through geographic space. The corporate/non profit developers include Coursera, Udacity, and edX in the US, Open2Study (Australia), FutureLearn (Britain), iversity (Germany), and Veduca (Brazil).

Recently, there has been some fall in concern concerning the extent to which MOOCs might replace university based online classes. Thus far, MOOCs have generally been offered for free and without college credits. An experiment in the fall of 2012 at Colorado State University-Global offered a MOOC for credit,

charging only \$89, the price of proctoring the final exam. However, no one registered for the course. This suggests that the audience for MOOCs is composed of persons not seeking college credit such as persons who already have college degrees, retirees, the curious who lack motivation for completing the course, and persons interested in only a subsection of the course. Nevertheless, corporations and non profit organizations are reportedly increasing efforts at advertising MOOCs in a quest to attract paying subscribers (Grossman, 2013; Kolowich, 2013). The extent to which MOOCs are a threat to traditional universities remains unclear.

Finally, future research needs to take into account “ways of teaching” online and traditional classes. For example, there are a number of strategies to improve the quality of student learning in traditional courses. These strategies include active learning, educative assessment, the use of small groups, and using the taxonomy of significant learning to define learning outcomes. Transporting such techniques from the traditional classroom to the online environment can present something of a challenge for future research.

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