

Paramedic Student Performance: Comparison of Online with On-Campus Lecture Delivery Methods

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Abbreviations:

AAS = Associate of Applied Science
EMS = emergency medical services
GPA = grade point average
GRSLSS = Grasha-Riechmann Student Learning Style Scales

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Abstract

Introduction: Colleges and universities are experiencing increasing demand for online courses in many healthcare disciplines, including emergency medical services (EMS). Development and implementation of online paramedic courses with the quality of education experienced in the traditional classroom setting is essential in order to maintain the integrity of the educational process. Currently, there is conflicting evidence of whether a significant difference exists in student performance between online and traditional nursing and allied health courses. However, there are no published investigations of the effectiveness of online learning by paramedic students.

Hypothesis: Performance of paramedic students enrolled in an online, undergraduate, research methods course is equivalent to the performance of students enrolled in the same course provided in a traditional, classroom environment.

Methods: Academic performance, learning styles, and course satisfaction surveys were compared between two groups of students. The course content was identical for both courses and taught by the same instructor during the same semester. The primary difference between the traditional course and the online course was the method of lecture delivery. Lectures for the on-campus students were provided live in a traditional classroom setting using PowerPoint slides. Lectures for the online students were provided using the same PowerPoint slides with prerecorded streaming audio and video.

Results: A convenience sample of 23 online and 10 traditional students participated in this study. With the exception of two learning domains, the two groups of students exhibited similar learning styles as assessed using the Grasha-Riechmann Student Learning Style Scales instrument. The online students scored significantly lower in the competitive and dependent dimensions than did the on-campus students. Academic performance was similar between the two groups. The online students devoted slightly more time to the course than did the campus students, although this difference did not reach statistical significance. In general, the online students believed the online audio lectures were more effective than the traditional live lectures.

Conclusion: Distance learning technology appears to be an effective mechanism for extending didactic paramedic education off-campus, and may be beneficial particularly to areas that lack paramedic training programs or adequate numbers of qualified instructors.

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Introduction

The traditional classroom long has been considered the standard of educational venues, but recent technological advances have brought a dramatic rise in educational offerings over the Internet. Many universities recognize how this technology can be used to increase student enrollment, resulting in the development of many new courses and even the awarding of college/university degrees using online techniques. For students, these online courses permit more flexibility to learn at an individualized pace, schedule course work

Course Introduction: Why Is Research Important?
Conceptual Framework for Research
Ethics in Research
Variables
Research Hypotheses
Research Designs I: The Basics
Research Designs II: Experiments
Research Designs III: Correlational and Quasi-Experimental
Observational Methods
Survey Research
Questionnaire Construction
Reliability and Validity
Writing the Research Proposal
Data Preparation and Analysis
Descriptive Statistics I: Central Tendency, Frequency Distribution, Sensitivity, Specificity, Positive and Negative Predictive Value
Descriptive Statistics II: Measures of Dispersion
Hypothesis Testing I: Inferential Statistics, Levels of Measurement, Hypothesis Testing
Hypothesis Testing II: SEM, p -Values, Type I and Type II Errors
Hypothesis Testing III: Hypothesis Testing using SPSS
Hypothesis Testing IV: Testing for Normality using SPSS
Using SPSS: The Unpaired t -test
Using SPSS: The Paired t -test
Using SPSS: ANOVA
Using SPSS: Chi-square (χ^2 test)
Using SPSS: Mann-Whitney test
Using SPSS: McNemar test
Using SPSS: Wilcoxon Signed-ranks test
Using SPSS: Pearson Correlation

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Table 1—Lecture outline

around their personal and professional lives, reduce or eliminate travel time, and provide the opportunity to review course materials as many times as they wish.¹⁻³ In addition, online educational programs provide students with an opportunity to receive a degree from a university that may be located considerable distances from their homes and/or places of employment.

However, disadvantages to online courses do exist. In order to be successful, students must possess a certain degree of technological competence prior to participating in online courses.^{4,5} Online courses may be more demanding for students because they require the student to assume more responsibility for their learning, force the student to engage more actively in course material, and compel the student to develop written communication skills.^{1,3,6} Many students will find that the actual time devoted to learning in online courses will exceed that required for traditional classes.^{7,8} Students also have cited a sense of isolation and

loss of personal interaction with instructors and peers as major disadvantages of online learning.² Consequently, anecdotal evidence suggests online course-completion and program retention rates are lower than for similar, campus-based programs.^{4,9,10}

Online courses also present challenges for instructors. Several previous investigations suggest online courses are time consuming to develop and deliver.¹¹⁻¹⁶ Instructors also may find that class size must be limited in order to be able to manage the increased demands for personal interaction with each student.¹³

While online learning promises substantial benefits in terms of convenience and accessibility for students, it is incumbent upon educators and educational institutions to ensure that the effectiveness of online courses and degree programs are at least equivalent to that of traditional course delivery methods.^{3,17} Furthermore, student satisfaction with online learning is essential for the learning process to

be successful. There is conflicting evidence whether there is a significant difference between student performance in online and traditional courses.^{1,17,18} The majority of investigations have concluded that online learning can be just as effective as traditional lecture courses; however, research on paramedic students' performance in online courses is limited.¹⁷⁻²² The objective of this study was to determine whether there were any differences in paramedic students' performance and satisfaction with online learning compared with paramedic students enrolled in an equivalent, on-campus, research methods course.

Methods

This study was given expedited Institutional Review Board approval. The setting was a university-based, bachelors'-level emergency medical services (EMS) program. The students' performance and perceptions between online and the traditional delivery methods for the lecture material from a two credit hour, senior level, undergraduate, research methods course were compared in this study. The course consisted of 28 lectures (Table 1), six critiques of peer-reviewed journal articles, 13 quizzes, four assignments, two examinations, and a formal research proposal. Both the online and traditional courses utilized WebCT, a course management tool widely used at the University for course enhancements such as e-mail with the instructor, a course home page, and online quizzes. The course syllabus, textbook, quizzes, examinations, and assignments were identical for both courses, and both courses were taught by the same instructor during the same semester.

The primary difference between the traditional students and the online students was the method of lecture delivery. Lectures for the on-campus students were provided live in a traditional, classroom setting using PowerPoint slides (Microsoft Inc., Redmond, WA) developed by the instructor. Each live lecture was delivered only one time as delineated by a fixed lecture schedule. Lectures for the online students were provided using the same PowerPoint slides with streaming audio, and when appropriate, streaming video. The online presentations were created using Pinnacle Studio (Pinnacle Systems Inc, Mountain View, CA) and Microsoft Producer (Microsoft Inc., Redmond, WA). The students who participated in the online version could view the lectures at any time and as many times as they desired.

Students in each course had equal access to the instructor, although the medium used for such interactions varied. Students enrolled in the on-campus course could interact with the instructor during class or during scheduled office hours. Students in the online course could contact the instructor during virtual office hours by telephone, e-mail, instant text messaging, Webcam, or using a real-time, online audio chat.

For both groups, critiques of the journal articles were completed online using a threaded-discussion format in a bulletin board. Once the discussion period had ended for each article, the course instructor posted a summary in the bulletin board for all students to read. In addition, each article was discussed during class for students enrolled in the

on-campus version of the course, and a summarizing lecture was provided via streaming media for the online students.

Prior to each scheduled written examination, review sessions were held on-campus for students enrolled in the traditional course. For the online students, Web-based audio chat was used to prepare students for the mid-term and final examinations. In addition, there were four scheduled face-to-face meetings between the online students and the instructor. These sessions were held on the campuses of two community colleges. These colleges were located centrally in North Carolina, which helped to limit the commuting distances for students. These sessions were used for written examinations, course reviews, and academic advising.

At the beginning of the course, all students were asked to complete the Grasha-Riechmann Student Learning Style Scales (GRSLSS) to identify his or her learning style. The GRSLSS is considered to be ideal for assessing learning styles in distance education because it addresses one of the key distinguishing features of an online class—the relative absence of social interaction between the instructor and the students and among students.²³ In addition, students participating in the online version of the course were asked to complete a 15-item survey to assess their competency with computer technology. Any students with identified weaknesses in computer proficiency received additional instruction during the orientation program conducted prior to the beginning of the course.

On a weekly basis during the course, all students were asked to log the time they devoted to the course. This measure of time-on-task included time in the classroom (campus students), viewing streaming lectures (online students), studying, reading the textbook, completing assignments, etc. These data were submitted to the instructor each week via e-mail. Upon course completion, the participants in the online version were also asked to complete a survey assessing their perceptions of online learning. The survey consisted of 12 items measured on a nine-point Likert scale.

Statistical analyses were performed using SPSS for Windows release 11.0.1 (SPSS Inc., Chicago, IL) and Microsoft Excel (Microsoft Inc., Redmond, WA). Interval level data were compared using *t*-tests, and unpaired, frequency data were analyzed using the χ^2 test or Fischer's exact test, as appropriate. Statistical significance was established at *p*-values <0.05.

Results

A convenience sample of 33 students (23 online and 10 traditional) provided informed consent to participate in this study. All of the online students were practicing paramedics, held the Associate of Applied Science (AAS) degree in Emergency Medical Science, and were returning to college to complete their baccalaureate degree. These students were located throughout the state of North Carolina. The non-equivalent comparison group was composed of 10 resident students enrolled in an on-campus, baccalaureate paramedic program. These students were in the senior year of their initial paramedic training. None of the study subjects had previously completed a research methods or statistics course. While all of the campus students

	Campus	Online	p-value
Number of students	10	21	
Age (mean \pm SD) (in years)	24 \pm 2.1	33 \pm 7.1	0.000
Male (%)	(70)	(62)	0.969
Married (%)	(0)	(81)	0.000
GPA prior to research methods course(mean \pm SD)	2.9 \pm 0.4	3.1 \pm 0.4	0.075

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Table 2—Demographics of the participants
(SD = standard deviation; GPA = grade-point average
using 4-point system)

completed the course, two of the online students dropped the course prior to course completion due to reasons unrelated to academic performance. Therefore, a total of 21 online students participated. Both groups were similar with respect to gender and grade point average (GPA). However, the online group was older (mean = 33 years vs. 24 years) and 81% of the online students were married while none of the campus students were married (Table 2).

With the exception of two learning domains, the two groups of students exhibited similar learning styles as assessed by the GRSLS (Table 3). The online students scored significantly lower in the competitive (online = 2.46 vs. campus, 2.99; $p = 0.018$) and dependent (online = 3.70 vs. campus = 4.20; $p = 0.010$) dimensions than did the campus students.

Academic performance was similar between the two groups (Table 4). There were no statistically significant differences in scores on examinations, assignments, or course averages. The online students devoted slightly more time to the course than did the campus students (online, 277; campus 244 minutes/week) although this difference did not reach statistical significance.

The results of the post-course survey completed by the on-line students are summarized in Table 5. In general, the respondents found the course content to be slightly greater in depth and range when compared to a traditional face-to-face course, and believed the audio lectures to be more effective than were the traditional live lectures. Although students indicated that they learned a great deal in the course, they also believed they invested a greater amount of time in the course than they would have a similar course offered in a traditional classroom environment. And while communication with the instructor was rated as somewhat

easier than in a traditional class, students indicated communication with their classmates and the opportunity for discussion equaled that of the traditional classroom.

Discussion

In this study, there were no significant differences in the academic performance between students enrolled in an online, research methods course compared to a control group enrolled in a traditional, campus-based course. Although no similar research has been conducted using paramedic students, these findings are consistent with other similar investigations of research methods courses in nursing and other allied health fields.^{3,19,22}

Although there were no differences identified in terms of outcome measures, there were differences observed in learning styles between the online and campus-based students. The online students' lower score on the dependent scale of the GRSLS may reflect a higher level of self-directed learning. It should be expected that students who prefer independent, self-guided instruction would select an online course. It may be that they are suited particularly to the relative isolation of the distance learning environment. These findings are consistent with those of Diaz and Carnal who compared learning styles between campus-based and online students enrolled in a health education class.²³

With this particular application of online teaching, the use of streaming audio, coupled with an automatically advancing slide show was well-received by the students. This finding is consistent with that of Spickard *et al* who conducted a randomized, controlled study of third- and fourth-year medical students in an effort to evaluate the impact of adding audio to an online lecture on medical screening. Those randomized to the audio group spent more time on the lecture, but were more satisfied and showed higher post-test scores than did those without supplemental audio.⁷ In addition, the students rated the multimedia lectures as being more effective than standard classroom lectures. It is unclear if this preference for streaming lectures is the result of learning-style preferences for multimedia or because they permit students to proceed at an individual pace and review lectures as often as they wish.

Unexpectedly, the students indicated they found interaction with the course instructor to be easier in the online course than they would have expected in a traditional classroom. This is inconsistent with previous studies in which communicating with the course instructor was rated neutral or problematic.^{1,17,20,24} However, this ease of communication was not reflected in their assessment of communication with other students. It is possible that this inconsistency may be the result of the use of virtual office hours, instant messaging software, and hyper-vigilance by the instructor.

Although it was determined that the online learners were equally successful compared to their campus-based counterparts, the ability to generalize these findings are constrained by several methodological limitations. The sample size was small, particularly in the traditional classroom (control) group. And, because neither group was limited to purely online or purely traditional delivery methods, the comparison is only limited to assessing the method of lecture delivery.

Dimension	Description ²³	Online (mean \pm SD)	Campus (mean \pm SD)	p-value
Independent	Prefer independent study, self-paced instruction, and prefer to work alone rather than engage in group activities.	3.5 \pm 0.44	3.8 \pm 0.44	0.069
Avoidant	Do not enjoy attending class or acquiring course content. They typically are uninterested, unengaged, and sometimes overwhelmed by classroom activities.	2.4 \pm 0.50	2.4 \pm 0.54	0.991
Collaborative	Acquire information by interacting with instructor and classmates. Prefer lectures with small-group discussions and working on projects with classmates.	3.9 \pm 0.56	4.23 \pm 0.62	0.114
Dependent	Rely upon instructor and classmates for guidance and as source of structure.	3.7 \pm 0.54	4.2 \pm 0.30298	0.010
Competitive	Learn in an effort to satisfy their need to outperform their classmates and receive recognition for their academic accomplishments.	2.5 \pm 0.48	3.0 \pm 0.662	0.018
Participant	Interested in class activities and discussion, and eager to complete assignments. Driven by desire to meet instructor's expectations.	3.8 \pm 0.44	4.1 \pm 0.44	0.215

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Table 3—Comparison of Grasha-Reichmann Student Learning Style Scale (GRSLSS) scores of online and campus students (SD = standard deviation)

	Campus	Online	p-value
Weekly time-on-task (minutes)	244.0 \pm 89.92	276.7 \pm 132.06	0.486
Quiz scores	85.2 \pm 10.70	85.0 \pm 9.35	0.979
Assignments	83.9 \pm 9.29	73.2 \pm 22.87	0.070
Journal club	81.0 \pm 15.47	91.3 \pm 17.17	0.120
Midterm exam	85.5 \pm 16.18	86.3 \pm 11.02	0.875
Final examination	85.3 \pm 7.91	85.8 \pm 8.78	0.866
Research proposal	93.5 \pm 3.50	93.3 \pm 1.92	0.851
Course average	86.4 \pm 5.65	85.1 \pm 7.82	0.631

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Table 4—Comparison of academic performance between online and campus students (mean values \pm standard deviation)

Evaluation Dimension	Scale	Mean \pm SD
Compared to a traditional course, the range of material covered was...	1 = much narrower 5 = about the same 9 = much wider	6.20 \pm 0.70
Compared to a traditional course, the depth of the course content was...	1 = much less 5 = about the same 9 = much more	6.65 \pm 1.424
Compared to a traditional course, the opportunity for discussion was...	1 = much less 5 = about the same 9 = much more	5.40 \pm 1.314
Compared to a traditional course, the ability to communicate with other students was...	1 = very difficult 5 = about the same 9 = very easy	5.80 \pm 2.419
Compared to a traditional course, the ability to communicate with the instructor was...	1 = very difficult 5 = about the same 9 = very easy	7.00 \pm 2.000
Compared to a traditional course, the extent of critical thinking was...	1 = much less effective 5 = about the same 9 = much more effective	6.80 \pm 1.281
Compared to a traditional course with live lectures, the effectiveness of the PowerPoint slides with audio lecture was...	1 = much less 5 = about the same 9 = much more	7.30 \pm 1.593
How effective was the use of e-mail, Web pages, and other technology in this course?	1 = not very effective 5 = about the same 9 = very effective	8.00 \pm 0.973
Compared to a traditional course, the responsiveness of the instructor to student needs was...	1 = much less 5 = about the same 9 = much more	7.95 \pm 1.605
Compared to a traditional course, if you desired help outside of class, to what extent was the instructor available and helpful?	1 = much less 5 = about the same 9 = much more	7.65 \pm 1.785
Compared to a traditional course, how much did you learn in this course?	1 = much less 5 = about the same 9 = much more	6.80 \pm 1.704
Compared to a traditional course, how much effort did you put into this course?	1 = much less 5 = about the same 9 = much more	7.45 \pm 1.234

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Table 5—Results of online student surveys

This study design employed a non-randomized, non-equivalent, comparison group. Even though none of the online students had taken a research methods course, their clinical experience and the older average of their ages may have provided them with experiential learning opportunities unavailable to the control group. Although not statistically significant, the GPA was higher for the online students. The GPA for the online students was calculated on course work completed at the community college level and may not be related directly to that of the control group whose GPA reflected university-level course work.

Conclusions

Despite the limitations of the study design, these findings are encouraging. Distance learning technology appears to be an effective mechanism for extending didactic paramedic education off of the university campuses and may be beneficial, particularly to the students in areas that lack paramedic training programs or adequate numbers of qualified instructors. Additional studies using randomized designs and larger sample sizes are warranted.

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