

A Comparison of Students' Performance Under Full-Time, Part-Time, and Online Conditions in an Undergraduate Nursing Microbiology Course

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Abstract

The purpose of this study was to compare undergraduate nursing students' achievement on examinations for three groups in a mandatory microbiology course. The study represents one aspect of a larger research project designed to gain insight into factors that may influence online learning for distance education nursing students at a Canadian community college. Data were collected from full-time ($n=206$) and part-time ($n=39$) students in a traditional face-to-face learning environment, and from part-time students in an online learning environment ($n=54$). Three examinations for all course sections (two midterms, one final) were used to evaluate students' outcomes. Data analyses showed no significant statistical difference in students' outcomes on either of the midterm examinations, but on the final examination full-time students in the face-to-face instructional environment outperformed students who took the course online. Further analysis of online students showed an interaction between age and examination performance over time, such that older online students outperformed their younger counterparts as they gained more experience in the online environment. A follow-up to this research study has been proposed that would incorporate more controls in order to increase internal validity.

Résumé

L'objectif poursuivi par cette étude consistait à comparer les résultats des étudiants de premier cycle en nursing lors des examens, dans trois groupes, dans un cours obligatoire de microbiologie. L'étude représente un aspect d'un projet de recherche plus large conçu pour mieux comprendre les facteurs qui peuvent influencer l'apprentissage en ligne des étudiants de nursing en apprentissage à distance dans un collège d'une communauté canadienne. Des données ont été recueillies de la part d'étudiants à temps plein ($n=206$) et à temps partiel ($n=39$) dans un environnement d'apprentissage direct et d'étudiants à temps partiel dans un environnement d'apprentissage en ligne ($n=54$). Trois examens pour toutes les sections du cours (deux mi-semestre, un final) ont été utilisés pour évaluer les résultats des étudiants. Des analyses de données n'ont démontré aucune différence statistique importante entre les résultats des examens des étudiants des deux examens semestriels, mais les étudiants à temps plein lors d'un examen final dans un environnement direct ont mieux réussi que les étudiants qui suivaient le cours en ligne. Une analyse plus

poussée des étudiants en ligne a démontré une interaction entre l'âge et la performance à l'examen, alors que les étudiants en ligne plus âgés ont mieux réussi que les plus jeunes à mesure qu'ils gagnaient plus d'expérience dans l'environnement en ligne. Un suivi de cette recherche a été proposée, qui incorporerait plus de contrôles afin d'augmenter la validité interne.

Introduction

The use of technology to provide instructional material to those studying nursing education at a distance creates an instructional environment of flexibility and opportunity (DeBourgh, 2003; Halstead & Coudret, 2000). The ability to reach students at a distance has encouraged rural health care authorities to develop educational programs that permit students to participate without giving up their jobs or leaving their communities to attend classes. As Frase-Blunt (2000) points out, "distance courses fight 'brain drain' from rural areas: students who learn within their own communities are more likely to practice there, and working nurses taking advanced degrees via technology can continue to serve their patients" (p. 1). In many cases students are experienced nurses who generally speaking are older adult learners attracted to the flexibility offered by the online distance learning environment.

The American Association of Colleges of Nursing (AACN, 1999) addressed a number of important issues in distance technology for nursing education. Specifically, they stressed the importance of rigorous evaluation of online education and encouraged increased funding for future studies. Subsequently, researchers have investigated various issues surrounding cost, access, and quality of online nursing and allied health professions (Wright & Thompson, 2002). Distance learning relies heavily on the combination of appropriate instruction and students' personal discipline, cognitive learning style, and motivation for independent work (Alonso, Lopez, Manrique, & Vines, 2005; Hillman, 1999; McDonald, 2002). As Buckley (2003) recently pointed out, although many nursing programs use Information Communication Technology (ICT) for distance education programs, the effectiveness of using ICT is unknown, largely due to the complexity of conducting experimental studies. Research findings from several nursing studies show no statistical differences in examination scores between face-to-face and e-learning environments (Buckley, 2003; Leasure, Davis, & Thievon, 2000). However, e-learning research is continually evolving in an effort to identify key factors that may influence performance outcomes (Bolliger & Martindale, 2004; Koochang, 2004). A deeper understanding of nursing students' characteristics relative to their performance outcomes on examinations may help guide instructors in their design and development of e-learning environments. For our study we sought to investigate the influence of age in three

groups of learners. We postulated the following research question: Are there performance differences in a microbiology nursing course among Full-time (FT), Part-time (PT), and Online (OnL) students delineated into two age categories (i.e., 25 years and under, 26 years and over)?

Method

Course Description

A causal-comparative design (Gall, Borg, & Gall, 1997) was based on the examination results of students in three groups: FT, PT, and OnL students. The three conditions of the course ran concurrently for 16 weeks. All students covered the same course content and used the same textbook, although several instructors taught the classes in each group setting. The classroom-based sections met once a week for a three-hour lecture, which was scheduled during a weekday for FT students and on Saturdays for PT students. The online course was designed and delivered on the basis of a popular educational course management tool, WebCT, which included various asynchronous and synchronous communication methods available to students (e.g., chat rooms for virtual office hours, discussion forums, whiteboard, posting course resource material, and assignment submission).

Data consisted of two midterm examinations and one final examination, which were scheduled at the end of each module. The examinations consisted of multiple-choice items only and were administered in paper-and-pencil format in a classroom setting for all three groups: FT, PT, and OnL students.

Participants in the research study were undergraduate nursing students enrolled for one semester in a microbiology course at a degree-granting college. There were many more FT students ($n=206$, 69%) than PT ($n=39$, 13%) and OnL students ($n=54$, 18%). Most were female ($n=275$, 92%). Students' age ranges were similar across the instructional settings (i.e., 18-47 for FT, 19-45 for PT, and 19-55 for OnL). The students were delineated into two age categories: 25 years and under and 26 years and

Table 1
Mean Ages by Instructional Setting and Age Group

Instructional Setting	M (SD)	Age Group		M (SD)	n
		Younger (≤ 25)	Older (> 25)		
FT students	20.94 (2.04)	165	33.93 (7.02)	41	
PT students	21.95 (1.94)	22	33.00 (5.81)	17	
OnL students	21.60 (2.22)	30	32.42 (6.69)	24	

over. The cut-off age was chosen following inspection of the age distributions for each of the three instruction groups. For the FT students, the age distribution was positively skewed with most students being 25 and under. The distribution was bimodal for the PT students, with ages 25 and 26 separating the two modes. The age distribution of OnL students was approximately rectangular. Although there were almost equal numbers of students in the two age groups for the PT and OnL instructional settings, there was a disproportional number of younger students in the FT class, as is evident in Table 1. The mean and standard deviation of the ages of the younger and older cohorts were consistent across instructional settings, providing evidence that the age grouping was appropriate for these data. Keen (1999) also chose to group undergraduate distance education students at a similar break point based on observations of program enrollment patterns.

Results

The data were analyzed using an analysis of variance (ANOVA) design. Pairwise comparisons were evaluated using the 95% confidence interval of the estimated mean; group means were considered significantly different from one another when the confidence intervals did not overlap. For all ANOVAs, the assumptions of homogeneity of variance and sphericity were met. Cell means are presented in Table 2.

To determine whether there was differential performance of students in the three instructional groups and two age categories, a 3 (examination

Table 2
Mean Performance of FT, PT, and OnL Students Across Exams by Age cohort

Age Cohort	Exam			Mean
	Midterm 1	Midterm 2	Final	
<i>FT Students</i>				
Younger	75.97	70.48	69.36	71.94
Older	80.18	76.56	75.57	77.44
Mean	78.08	73.52	72.47	
<i>PT Students</i>				
Younger	76.09	69.00	63.64	69.58
Older	76.35	74.29	70.35	73.67
Mean	76.22	71.65	67.00	
<i>OnL Students</i>				
Younger	76.53	71.23	60.93	69.57
Older	71.25	69.38	62.42	67.68
Mean	73.89	70.30	61.68	
Grand Mean	76.06	71.82	67.05	

scores) by 3 (group) by 2 (age) repeated-measures ANOVA was performed, with repeated measures on the first factor.

The three-way interaction of examination by group by age was not significant ($F(4, 584)=0.79$, ns), but the interaction of examination scores by instructional group was significant ($F(4, 586)=7.33$, $p<0.001$). Review of the confidence intervals of the estimated means indicated that the instructional groups did not differ on the two midterm examination scores, but FT students performed better than the OnL students on the final examination ($M=72.47$ vs. $M=61.68$). There was also a significant interaction of age by examination scores ($F(2, 586)=6.29$, $p<0.01$). The performance of students in the younger cohort tended to decline over time (i.e., $M=76.20$, 70.24 , 64.64 respectively), whereas no differences were detected in the performance of students in the older cohort across time ($M=75.93$, 73.41 , 69.45 respectively).

Two main effects were significant. A main effect of examination scores ($F(2, 586)=76.34$, $p<0.001$) revealed that students' performance declined over time ($M=76.06$, 71.82 , 67.05 respectively). A main effect of instructional group ($F(2, 293)=6.81$, $p=0.001$) indicated that FT students ($M=74.69$) outperformed OnL students ($M=68.62$), but neither group differed from PT students ($M=71.62$).

Although the three-way interaction was not significant, it was of interest to unpack the examination scores by age interaction to see if the patterns were consistent across each instructional group. Three 2 (age) \times 3 (examination) ANOVAs were run, one for each instructional group.

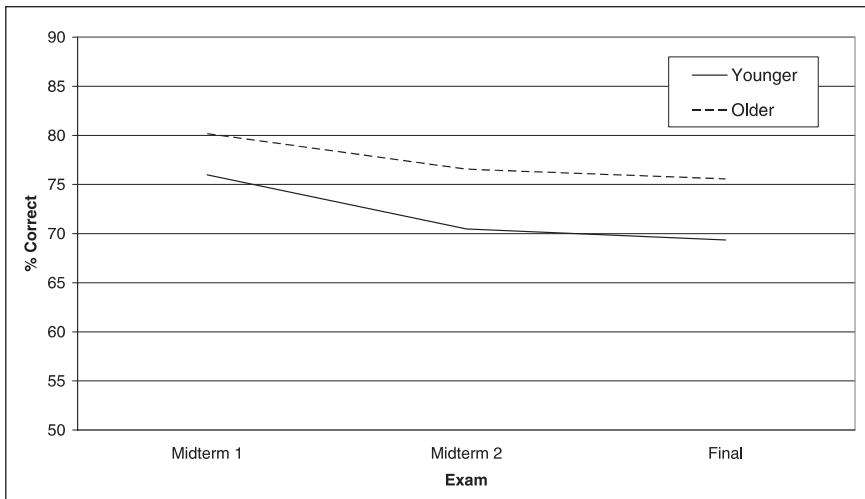


Figure 1. Mean performance of full-time students by age group across examinations.

FT students. Results indicated that the interaction of examination scores by age group ($F(2, 408)=0.91$, ns) was not significant. The main effects of examination scores ($F(2, 408)=25.81$, $p<0.001$) and age group ($F(1, 204)=10.32$), $p<0.01$) were significant. The main effects are clearly demonstrated in Figure 1, where students performed better on the first midterm ($M=78.08$) than they did on the second ($M=73.52$) and final ($M=72.47$), and older students ($M=77.44$) outperformed younger students ($M=71.94$).

PT students. The interaction between examination scores and age group was not significant ($F(2, 74)=2.31$, ns), although the slopes of the lines look different (Figure 2). A significant main effect was observed for examination scores ($F(2, 74)=17.08$, $p<0.001$), but not for age group ($F(1, 37)=0.99$, NS). Figure 2 demonstrates the main effect of examinations, where students performed better on the first midterm ($M=76.22$) than on the final ($M=67.00$).

OnL students. The interaction between examination scores and age group was significant ($F(2, 104)=3.30$), $p<0.05$) (Figure 3). The younger students performed better on the two midterms ($M=76.53$, 71.23 respectively) than they did on the final examination ($M=60.93$). In contrast, the older students performed similarly across the three examinations ($M=71.25$, 69.38 , and 62.42 respectively). The main effect of examination scores ($F(2, 104)=45.47$, $p<0.001$) was significant, but the main effect of age group was not ($F(1, 52)=0.45$, ns). Like the PT student data, the main effect of examination scores was due to students performing better on the first midterm ($M=73.89$) than on the final examination ($M=61.68$).

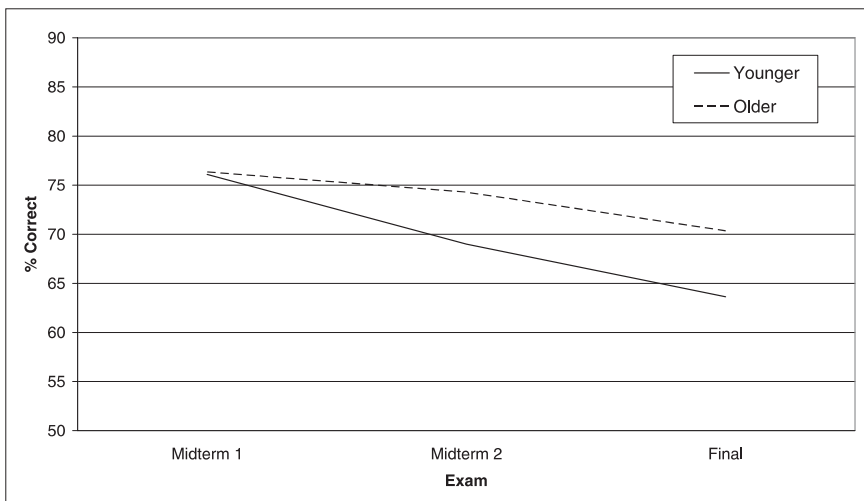


Figure 2. Mean performance of part-time students by age group across examinations.

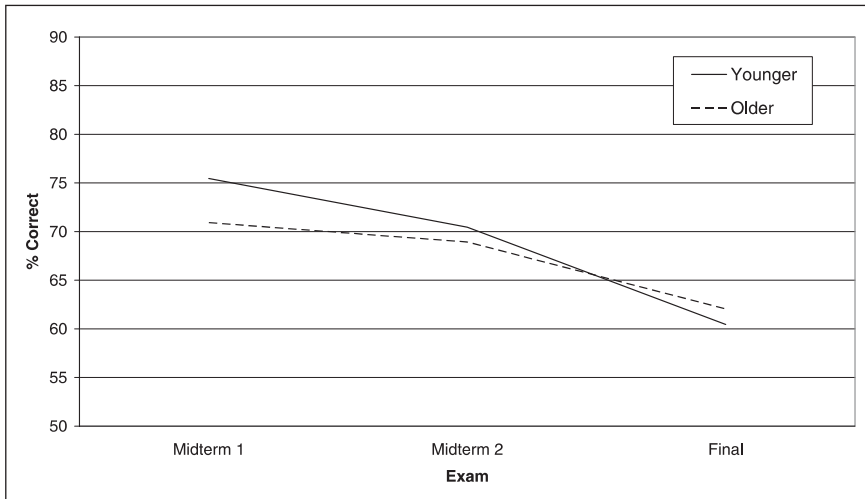


Figure 3. Mean performance of online students by age group across examinations.

Discussion

Overall, there were no differences between instructional groups on both midterms, but FT students outperformed OnL students overall and on the final examination. It is worth noting that there was a disproportionate number of younger students in the FT group compared with the PT and OnL groups. These results may stem from the limitations of this naturalistic study. The most apparent of these are: (a) lack of a pretest measure; (b) students were self-selected into instructional groups; (c) different instructors in the course sections; and (d) the issue of sample size. Russell (1999) pointed out that the importance of achieving statistical significance may be overrated and noted that the lack of significance among instructional groups indicates that these groups can be said to be equivalent (in the statistical sense) with respect to the outcome measures. Furthermore, Russell stated that increased positive outcomes may be possible by further modifying the content to suit the technology better, for example, in this case online course materials used only text and graphics, whereas audio and video might have been more appropriate to communicate the content.

There was a general tendency for students to do significantly better on their earlier than later tests (i.e., midterm1 > midterm2 > final). Such results may be due to the increasing complexity of the course material and the sheer volume of information the students needed to learn as the course progressed. Further analysis revealed that younger students demonstrated a steady decline in performance across examinations, whereas older students' performance remained relatively constant. A possible ex-

planation for this may be that mature students have shown a higher level of dedication toward goals and a better realization that early success does not translate into later success (Devlin, 1996; Smith, 1999).

It is worth emphasizing that PT students' performance did not differ from that of either FT or OnL students, perhaps because PT students share some characteristics with FT and OnL students. Based on demographic characteristics, PT and OnL students may self-select these instructional groups due to family or job commitments that may prevent them from attending school full time. On the other hand, both FT and PT students experienced their instruction in a face-to-face learning environment. The similar nature of the instructional group may have been responsible for the two groups not being significantly different.

Age-related performance in each instructional group was also analyzed. Regardless of the instructional group, students performed better on the first midterm than they did on the final examination. Interestingly, the older group of FT students did significantly better than their younger cohort across the examinations. Figure 1 clearly shows that older FT students outperformed younger students while maintaining the same relative performance difference across each examination. Although older PT students did not differ significantly from their younger counterparts, the means from the second midterm and final appear to be the same relative distance apart as they were for the FT students (see Figure 2). Closer inspection of the confidence intervals surrounding the means for the PT students on the second midterm and final examination revealed a lack of statistical power to detect a possible difference, probably due to inadequate sample size. However, in this study the data support the trend of older students outperforming their younger counterparts in the face-to-face learning environment.

The results from the OnL instructional group are by far the most interesting. Although there was no significant main effect for age, there was a significant interaction for examination scores by age. Figure 3 clearly indicates the slopes crossing between the second midterm and the final examination, indicating that the older students experienced less of a decline on the final compared with the second midterm.

Two important points follow from this observation. First, older OnL students outperformed their younger counterparts on the final examination, but not at a statistically significant level. In this sense, the pattern for the older OnL students for the final examination is analogous to that of their older cohorts in both the FT and PT groups. Second, based on observed means, younger OnL students outperformed the older OnL students for the first and second midterms, but not on the final. These findings are contrary to those found for younger and older cohorts in the face-to-face learning environment. Therefore, although the younger OnL

students did better on both midterms than their older counterparts, the older students eventually surpassed them on the final examination. One hypothesis is that the younger students generally felt more comfortable with the technology and/or with the instructional group than the older students. As the older students gained confidence in the e-learning environment, the gap between the performance of younger and older students diminished, leading to the observed interaction. Graham and Donaldson (1999) found that mature students grew academically at a rate equal to or greater than that of their younger counterparts. Bradley and Graham (2000) suggest that mature students are able to apply a more sophisticated knowledge-base to problem-solving and to direct their learning to topics that are highly relevant to their life situations. Results from this study suggest that age may play a role in the performance outcomes for nursing students learning in OnL environments. Further research is required to verify these results and to investigate the possible reasons for the observed interactions between age and performance when students work online. For example, such variables as learner characteristics (e.g., learning styles), employment status, parental responsibilities, and support systems are factors that may influence the performance of nursing students working online.

At the same time, the purpose of this study was to extend our understanding of a demographic variable (age) that may influence examination outcomes in a particular topic area among nursing students who freely opted for one of three instructional groups. In a perfect Campbell and Stanley (1963) design, all competing hypotheses would be held constant, and random assignment of participants would be used to determine group membership. In the real world, a researcher's ability to design experimental studies is limited by numerous institutional and personal constraints for both the instructors and the students. In the case of this study, we let the cards fall, so to speak, and then made an observation about one specific interest point, age. We did this knowing that quantitative comparison studies of the type have come under varying degrees of criticism (Clark, 1983, 1994; Smith & Dillon, 1999; Bernard et al., 2004). In any case, without any variable manipulation and employing a simple causal-comparative design, we observed an interesting phenomenon with respect to age as a factor related to performance in one specific context described in this study.

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