

## Comparison of Students' Performance and Perceptions of a Web-based Distance Pharmacy Calculations Course to a Campus-based Course

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### **Abstract**

**Objectives:** This study compared full-time entry-level Web-based pharmacy student performance and perceptions to campus-based student performance in a pharmacy calculations course over 3 years.

**Methods:** Web-based and campus-based student performance was measured using identical assessments within each year, including an online mastery examination. Student perceptions were assessed using responses to the course evaluations each year.

**Results:** The study population comprised 172 students who completed the online course and 323 students who completed the on-campus course between 2001 and 2003. Campus-based students performed better than Web-based students in 2001, and both groups performed similarly in 2002 and 2003. Web-based students consistently evaluated the course more positively than campus students.

**Conclusions:** An entirely Web-based pharmacy calculations course appears to be well accepted by full-time Web-based entry-level students. However, additional strategies may be needed to support Web-based students to ensure similar levels of performance the first time an online course is offered.

**Keywords:** Pharmaceutical calculations, pharmacy education, Internet education, distance education, Web-based instruction

## Introduction

In the fall of 2001, Creighton University School of Pharmacy and Health Professions initiated the first entry-level, Web-based distance doctor of pharmacy degree whereby all didactic courses are delivered via the Internet. Details of the Web-based pathway are available online at [http://pharmacy.creighton.edu/spahp/non\\_traditional/rx/async\\_overview.asp](http://pharmacy.creighton.edu/spahp/non_traditional/rx/async_overview.asp).

The use of the Internet for delivering course materials to traditional or non-traditional students is not new to pharmacy education, although delivery of entirely online courses with no face-to-face contact during a semester is not common in entry-level pharmacy education. Several manuscripts describe technology-mediated innovations in teaching pharmacy calculations to enhance on-campus student learning, including use of Web-based technologies,[1,2] computer-assisted instruction,[3,4] supplementary materials on multi-platform CD-ROMs,[5] and computer grading of student answers.[6] One study described an online calculations course for foreign-licensed pharmacists seeking licensure in Australia.[7] However, no manuscript was found that evaluates the performance of entry-level students over several years in an entirely online pharmacy calculations course.

One challenge in developing and instructing basic science courses in the entry-level Web-based PharmD curriculum is the lack of documentation of the effectiveness of required courses in a full-time, entry-level, Web-based PharmD program. This manuscript compared the academic performance and perceptions of Web-based and campus-based students in a required pharmacy calculations course. The authors compared Web-based and campus-based student performance and course evaluations in each of the first 3 years of the Web-based pathway.

## Course Description

The pharmacy calculations course is a 2 credit hour required course in the first semester of the PharmD program. The same syllabus is used for both campus and Web-based sections of the course. The same instructors teach both campus and online students. Student performance was assessed using the same Web-based examinations and a single Web-based mastery examination. The instructors developed this mastery examination to extract possible questions from a large pool on each content area in the course. Students are allowed a maximum of 4 attempts to pass the mastery exam.

The final percent grade is based on the following weighted components: mastery examination 50%, examinations 40%, peer evaluation of team-based active learning 10%. The final letter grade is assigned based on earning the following minimum weighted overall percent scores: A = 96%, B+ = 91%, B = 86%, C+ = 81%, C = 71%, D = passes the mastery exam with 70% or higher score, and overall percent grade is less than 71%, F = does not pass mastery exam with 70% or higher score, regardless of overall percent score.

Campus-based students received assistance and clarification of content during scheduled class time and during office hours or by appointment. Web-based students received assistance and clarification of topics via e-mail, discussion board postings, and the telephone, including toll-free telephone access for students in the United States.

Both Web-based and campus-based students accessed instructor-generated course material through a course Web site. In 2001, the Web site was developed and maintained using Microsoft FrontPage (Microsoft Corp., Redmond, Washington. <http://www.microsoft.com/>

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frontpage). The instructors redeveloped the course Web site on the Blackboard Learning Management System in 2002 (Blackboard, Inc., Washington, DC, <http://www.blackboard.com>).

## Use of Technology

All entry-level PharmD students receive an intensive orientation by the school's Office of Information Technology and Learning Resources on the use of computer technology and its role in the pharmacy curriculum. All students are issued standard notebook computers immediately prior to the semester, and receive several full days of hands-on training in the use of the computer, Internet use and access, assessment software, discussion board postings, and instant messaging. Students are also introduced to active learning methods used in the curriculum. The use of notebook computers in the campus-based pathway preceded implementation of the Web-based pathway.

## Methods

### Data Collection

All students who completed the pharmacy calculations course between fall 2001 and fall 2003 were included in this study. The pharmacy calculations course is taught in the first semester of the entry level program. Table 1 lists the demographics for each entering class.

**Table 1.** Overall student demographics for Web-based and campus-based students entering the program in 2001 - 2003

	2001		2002		2003	
	Campus	Web	Campus	Web	Campus	Web
Total enrollment	102	53	111	60	110	60
Male	39 (38%)	23 (43%)	36 (32%)	19 (32%)	36 (33%)	20 (33%)
Female	63 (62%)	30 (57%)	75 (68%)	41 (68%)	74 (67%)	40 (67%)
Total Average GPA	3.21	3.17	3.36	3.31	3.47	3.40
Average Age	24	33	25	31	23	32
Students entering with a bachelor's or higher degree	40 (39%)	39 (74%)	36 (32%)	31 (52%)	37 (34%)	44 (73%)

Admissions demographics are provided in aggregate by the admissions office. Students who complete the pharmacy calculations course each year vary slightly from the program admissions figures shown in Table 1 due to students who transfer from other programs, withdraw from the program, transfer between pathways, or are granted a leave of absence.

### Study Variables

Independent variables for investigation were the year in which the course was offered (2001 – 2003) and the pharmacy calculations course section (Web-based or campus-based). The dependent variables, which were the students' final percent grades and final letter grades in the course, were selected as overall indicators of student performance outcomes. The weighted percent grades for assignments and letter grade assignments are included in the course description above. Each Likert-scaled question in the end-of-semester course evaluation was

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used as a dependent variable to compare student perceptions of the Web-based and campus-based sections.

### Data Analysis

SAS version 8.2 (SAS Institute, Inc., Cary, NC, <http://www.sas.com>) was used to perform all statistical tests. A non-parametric procedure using the Wilcoxon method was used to compare student perceptions, final percent grades, and final letter grades of Web-based and campus-based students within each year. The Wilcoxon method is appropriate for unbalanced groups for comparing ordinal (Likert-scaled responses), interval (final letter grades on a 4-point scale), and ratio (percent grades) data of 2 or more groups, and generates the rank-sum statistic for the Mann-Whitney-Wilcoxon test when comparing 2 groups [8]. An *a priori* level of significance of  $p < 0.05$  was selected for all statistical tests.

### Results

The overall student grades, shown as a percent of total possible points for campus and Web-based students in 2001 – 2003, are listed in Table 2.

**Table 2.** Comparison of final overall student grades, shown as percent of total possible points between Web-based and campus-based students for 2001 - 2003

Year	Campus			Web-based			p value
	N	Mean %	SD	N	Mean %	SD	
2001	103	94.52	5.24	49	90.17	7.48	< 0.0001
2002	109	91.98	5.61	62	88.45	13.64	0.3874
2003	111	94.38	5.11	61	93.83	6.95	0.6444

Campus-based students in 2001 had a higher overall final percent score compared with Web-based students ( $p < 0.0001$ ), although both groups demonstrated a high level of overall performance. There was no difference in percent scores in 2002 or 2003 ( $p = 0.3874$  and  $0.6444$ , respectively). A comparison was also performed for final letter grades within each year to determine if there were differences in final letter grades. Final letter grades for campus and Web-based students are listed in Table 3.

**Table 3.** Comparison of final letter grades between Web-based and campus-based students for 2001 - 2003

Year	Campus			Web-based			p value
	N	Mean grade point	SD	N	Mean grade point	SD	
2001	103	3.85	0.41	49	3.36	0.87	0.0002
2002	109	3.51	0.72	62	3.14	1.23	0.0901
2003	111	3.58	0.55	61	3.47	0.62	0.2368

Grade point scale conversion: F = 0, D=1, C = 2, C+ = 2.5, B = 3, B+ = 3.5, A = 4

Campus-based students in 2001 had higher letter grades on a 4-point scale ( $p = 0.0002$ ). There was no difference in distribution of final letter grades in 2002 or 2003 ( $p = 0.0901$  and  $0.2368$ , respectively).

**Table 4.** Comparison of student evaluation scores in the pharmacy calculations course between campus and Web-based students in 2003

Question	Campus		Web-based		p value
	Mean	SD	Mean	SD	
Components of the course provided a broader understanding of diversity	4.04	0.90	4.51	0.72	0.0008
Exams reflected the level of difficulty expected for student performance	4.26	0.81	4.66	0.54	0.0006
Material was assigned at a reasonable rate of speed	4.37	0.62	4.57	0.76	0.0060
The material available on the web aided learning	4.62	0.58	4.69	0.59	0.3332
The amount of work required for success in this course was accurately reflected in the number of credits assigned to the course	4.19	0.76	4.28	0.99	0.1169
The course content was related to the course objectives	4.59	0.57	4.70	0.78	0.0207
The course textbook effectively aided learning	3.43	1.11	3.67	1.21	0.1309
The attitude of the instructor encouraged learning	3.83	1.13	4.57	0.76	< 0.0001
The instructor demonstrated professionalism in interactions with students	4.38	0.67	4.74	0.57	0.0001
The instructor encouraged active participation in the course	3.73	1.24	4.72	0.52	< 0.0001
The instructor has demonstrated interest in student success	4.10	0.87	4.61	0.71	< 0.0001
The instructor incorporated technology appropriately to aid learning	4.40	0.64	4.62	0.69	0.0066
The instructor provided an organized framework (course outline) for presentation of the course content	4.32	0.77	4.80	0.51	< 0.0001
The instructor provided the class with clear learning objectives	4.31	0.72	4.79	0.45	< 0.0001
The instructor related to individuals in a manner that promoted mutual respect	4.19	0.82	4.60	0.72	0.0002
The instructor used teaching methods that were effective for learning the subject matter	3.85	1.06	4.49	0.83	< 0.0001
The instructor's presentation of content was clear	4.16	0.76	4.70	0.59	< 0.0001
This instructor has helped prepare me to think as a health care professional	4.21	0.80	4.72	0.52	< 0.0001
This instructor promoted learning with case-based examples	4.19	0.83	4.59	0.62	0.0011
When I contacted the instructor he/she responded	4.53	0.63	4.75	0.51	0.0202
On a scale of 1 to 5 (1 being easy and 5 being difficult) please rank this course in terms of difficulty	3.34	0.82	3.54	0.73	0.1240
Ranking Scale: All except the last question are rated on the scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree					

Evaluations of the course and instructor by Web-based students were consistently more positive than evaluation by campus students. All student responses to scaled questions on the 2003 course evaluation are summarized in Table 4.

Though evaluations were generally very positive for both campus and Web-based students, most questions showed a statistically significant difference indicating that Web-based students rated questions more positively than campus students.

Students also had the opportunity to provide free-response comments about the course and instructor. Student comments on the evaluations generally included 1 of 3 themes: first, students from both pathways responded favorably to the format of the course that allowed them repeated attempts at examinations, practice mastery exams, and the benefits of group work. Second, students found that the instructor-generated content for each topic was useful and assisted them in learning the content. Third, students indicated that they struggled with the concepts of mastery assessment and critical errors, at least initially.

## **Discussion**

Distance-based education on the Internet is a growing trend in higher education. One can often draw upon published literature to find advantages or disadvantages of new teaching methods. However, a descriptive comparison article on teaching and learning strategies for Web-based and campus-based pharmacy calculations courses has not been published.

The newness of the entry-level, Web-based distance doctor of pharmacy degree necessitates the measurement of outcomes for parity's sake. Documentation and measurement of student performance and perceptions in this required course is an expectation for maintaining the quality of education offered by the school.

Each year, the campus-based students earned higher overall percent scores and overall letter grades, and there was a statistical difference between campus-based and Web-based student performance in the first year. There are a few possible reasons for the differences of these scores. The first possible reason for the campus-based students to have higher overall scores is the tendency for Web-based students to hold full-time jobs while attempting to take full-time course loads in the professional program. The second possible reason is the tendency for Web-based students to procrastinate in completing course requirements, often waiting until the very last hours to complete the mastery exam. Consequently, if the Web-based student did not achieve a desired grade on the mastery exam, it was often too late to study and make corrections to improve overall performance. A third possible reason is that Web-based students may have been more interested in achieving a balance of school, work, family, or other commitments than maximizing an acceptable grade in a course.

The instructors believe that a series of concurrent changes that occurred within the pharmacy program may have negatively affected the perceptions and attitudes of campus-based students on the evaluations, resulting in the more favorable ratings on the evaluation scores by the Web-based students. In particular, the school has identified three core issues that negatively affected campus-based student attitudes. The core issues were the implementation of a laptop computer program one year prior to the implementation of the Web-based pathway, overzealous use of active learning strategies, and structure and process issues occurring in the development of the entire Web-based pathway. The authors felt that the campus-based students tended to be more critical of any course that relied heavily upon technology for implementation or delivery of learning materials.

The implementation of active learning strategies, which is one of the expectations of pharmacy program accreditation, is often not appreciated by campus-based students entering the PharmD

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program. Many campus-based students enter the program directly after completing pre-pharmacy requirements. Informal discussions with students indicate that many students do not have experience with team-based active learning in their previous academic experience. However, Web-based students do not perceive working with their classmates as a burden, perhaps because the technology provides both the social and academic networking between classmates, or perhaps because they recognize that participating in a team makes learning easier or more enlightening.

The instructors identified a challenging situation regarding to the amount of faculty time needed to prepare teaching and testing materials, monitor discussion boards, answer student e-mails, and design and maintain the course Web site. However, using new technology and new teaching methods allowed the instructors to develop new skills in electronic delivery of course materials. The instructors acknowledge that improvements made to the structure and design of the course Web site for the second and third course offerings, compared with the first offering in 2001, had a positive effect on the students. Web-based students appreciated a well organized and structured Web site that provides the course materials in a logical and intuitive format.

### **Limitations**

Although the first year of the Web-based pathway showed a statistically significant difference in student performance between campus and Web-based students, both groups still showed a high level of performance. A number of changes were made in the school, program, and course level over the first 3 years of the Web-based pathway, so it is not clear if the difference in performance seen in the first year was due to factors external to the course. Further study is needed to determine if these results are generalizable to on-campus entry-level students who enroll in a Web-based pharmacy calculations course. Students select the Web-based pathway at the time of application to the program, so it is not known if the comparison would be applicable to on-campus students.

### **Conclusions**

As pharmacy academia struggles to accommodate the current and predicted shortages of pharmacists, the academy will continue to observe the development of new programs to meet these dire shortages. Newer instructional methods and technologies will have to be utilized to meet the curricular requirements facing a shrinking and aging pool of pharmacy faculty.

An entirely Web-based course appears to be well accepted by full-time entry-level students in the PharmD program. A lower level of performance was noted for Web-based students the first time the course was offered. Therefore, additional support may be needed to ensure that Web-based students achieve similar levels of performance the first time an online course is offered. Following the initiation of the Web-based pathway, the school has increased staff support to facilitate the use of technology in both Web-based and campus-based teaching. Some of these staff resources include 3 instructional designers to support faculty use of technology for teaching, a graphic artist, a web designer, 2 staff members to support Web-based examinations, and 4 full-time information technology staff members. Email-based support and toll-free telephone support is available for students or examination proctors in the event of any technical problems. These staff positions are in addition to an increase in faculty positions over 4 years that is proportional to the increased number of students in the program.

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## References

1. Ramanathan M, Chau RI, Straubinger RM. Integration of Internet-based technologies as learning tools in a pharmaceutical calculations course. *Am J Pharm Educ.* 1997; 61(2):141-148.
2. Sause RB, Barcia SM. Computer assisted instruction in pharmaceutical calculations. *Am J Pharm Educ.* 1981; 45(Feb):41-47.
3. Delafuente JC, Araujo OE, Legg SM. Traditional lecture format compared to computer-assisted instruction in pharmacy calculations. *Am J Pharm Educ.* 1998; 62(1):62-66.
4. Tapia C, Sapag-Hagar J, Muller M, Valenzuela F, Basualto C, Zunino GF. Development of an interactive CD-ROM for teaching unit operations to pharmacy students. *Am J Pharm Educ.* 2002; 66(3):280-287.
5. Ramanathan M. Use of multiplatform CD ROMs for disseminating supplementary learning materials in a pharmaceutical calculations course. *Am J Pharm Educ.* 1999; 63(3):333-338.
6. Zatz JL. Computer grading of open ended pharmaceutical calculations exams. *Am J Pharm Educ.* 1982; 46(May):35-36.
7. Pappas A, Stewart K, Cesnik B, et al. Evaluation of a computer-based bridging course by overseas-qualified pharmacists seeking Australian registration. *Am J Pharm Educ.* 1998; 62(3):315-323.
8. SAS Institute Inc. The NPAR1WAY Procedure. In: *SAS OnlineDoc, Version 8.* Cary, NC: SAS Institute Inc.; 1999.