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Web-based vs. Traditional Classroom Instruction in Gerontology: A Pilot Study

Judith E Gallagher, Kathleen A Dobrosielski-Vergona, Robin G Wingard and Theresa M Williams

Judith E. Gallagher is assistant professor in the Dental Hygiene Program, School of Dental Medicine; Kathleen A. Dobrosielski-Vergona is associate chair and associate professor in the Division of Oral Biology, School of Dental Medicine; Robin G. Wingard is instructional designer at the Center for Instructional Development and Distance Education; and Theresa M. Williams is data research coordinator at the University of Pittsburgh Medical Center; all are at the University of Pittsburgh, Pennsylvania.

***Purpose.** Numerous studies have documented comparable outcomes from Web-based and traditional classroom instruction. However, there is a paucity of literature comparing these two delivery formats for gerontology courses in dental hygiene curricula. This study examines the effectiveness of alternative methods of course delivery by comparing student profiles and instructional outcomes from a dental hygiene gerontology course offered both on the Web and in a traditional classroom setting.*

***Methods.** Questionnaires were sent to both groups of students completing the course. The instrument was designed to establish profiles of the participating students. The data collected included familiarity with Web-based instruction, extent of prior computer training, previous interaction with the elderly, and student evaluations of course effectiveness. Traditional instructional outcomes from evaluated course work were compared, as were post-course exam outcomes that assessed retention of course information six months after course completion. The statistical significance of these data was determined using Statistical Package for Social Scientists software (SPSS, Inc., version 12.0, Chicago, IL).*

***Results.** A comparison of student characteristics enrolled in the two course formats revealed marked differences. The Web-based group (n=12) included dental hygiene students (67%) and other health care providers (25%). All participants in the traditional classroom format (n=32) were dental hygiene students. Half of the Web-based respondents were over 25 years of age, and the majority (n=8) had previously taken an online course. The majority of traditional classroom students were 25 years of age or younger (n=21) and had never taken a Web-based course (n=20). Statistically significant differences in instructional outcomes were observed between students enrolled in these two formats. Student retention of course material six months after completion of the course was greater in the Web-based format.*

***Conclusions.** Students selecting a Web-based course format demonstrated greater motivation and learning success based on final course grades, completion of assignments, and knowledge retention over time. Age, previous experience with online courses, and selection of teaching mode are factors that may confound course delivery method to influence instructional outcomes in a gerontology course within a dental hygiene curriculum.*

Keywords: Gerontology, Web-based instruction, distance education, dental hygiene education

Introduction

This country's rapidly increasing elderly population, and its diversity, has inspired educators to include the study of aging in many academic and professional programs. This trend is reflected in an increase in gerontology content incorporated into dental school curricula in the United States and Canada.¹ Geriatric education has grown in dental education in recent years, and at least 30% of dental schools surveyed in 2001 planned to expand their existing geriatric curricular content.² When surveyed, a high proportion of dental school senior students believed that geriatric dentistry should represent more hours in the dental curricula.³ Increasing the exposure of students to geriatrics was shown to significantly improve students' self-assessed competencies in geriatric dentistry.⁴

The recognized need for increased exposure of health professionals to gerontology education has prompted the University of Pittsburgh Dental Hygiene Program to include a gerontology course, "Gerontology: Perspectives on Aging," in the core curriculum. The students participating in this study were enrolled in this gerontology course offered in both a Web-based and a traditional classroom format. This upper-level, social gerontology course addresses the processes, effects, and trends of aging in today's society from biological, psychological, and social perspectives. Students relate and apply their specific disciplines through assignments, exercises, and a case study project. The University of Pittsburgh distance education and advanced computer technology services supported the design and delivery of the Web-based gerontology course. The traditional gerontology course was offered simultaneously, with the same content and instructor. The purpose of this study was to compare the effectiveness of a Web-based course with a traditional classroom course, in terms of the instructional outcomes of both formats. The study reported here also compares characteristics of students that might influence their choice of teaching methods and learning outcomes in a gerontology course.

Review of the Literature

A Web-based gerontology course offers a learning environment in which students can participate at different times and places than the course instructor and support staff.⁵ A significant number of today's students must achieve their academic goals while meeting other important personal and professional responsibilities. Because of this trend, teaching gerontology by distance education has been gaining in popularity in recent years.⁶ A description of various approaches to gerontology education using distance learning methods can be found in Schneider et al,⁷ and in Braun, Roberts, Dubanoski, Lenzer, and Goodman.⁸

The distance learning format offers many advantages over the traditional classroom teaching style. Broader course accessibility, increased scheduling flexibility, adaptability for working and part-time students, and less strain on the physical resources of a university have all been reported.^{5,9,10} Yet, the debate continues over the quality of learning achieved by Web-based distance instruction compared with traditional classroom methods.^{5,9,10}

As of 2002, distance education had been introduced into the curricula at 22% of the 255 dental hygiene programs in the United States.¹¹ In 1993, Northcentral Technical College (NTC) in Wausau, Wisconsin, was the first dental hygiene program to provide its entire didactic, non-clinical curriculum online. Olmstead (2002) reported no statistically significant differences between the scores on the National Board of Dental Hygiene Examination (NBDHE) achieved by students taking traditional classroom instruction and students using the distance learning mode.¹² An online course in dental terminology, first developed in 1999 at the University of Vermont Department of Dental Hygiene, has also been assessed. No statistically significant differences were observed between the learning outcomes of students taking the course in a distance learning or traditional approach, although a small sample size limits the validity of this report.¹³

As pointed out by Piercy, it is important that educators choosing to develop and offer a course using Web-based distance methods determine the effectiveness of these formats.⁶ However, the amount of research concerning dental hygiene student performance in distance education is limited. Traditionally accepted measurements of educational outcomes include performances on assignments, class projects, examinations, and final course grades.¹²

It is reasonable to assume that individual student attributes impact learning styles and, thereby, affect instructional outcomes. For example, student levels of maturity, mastery of necessary computer skills, and motivation contribute to successes in learning.¹⁴ Sherry points out that the greater ability students have to handle autonomy and to complete assignments independently, the greater the impact on their mastery of the learning objectives in a Web-based course.¹⁵ Thus, the paucity of literature on the instructional outcomes of gerontology courses offered online highlights the benefit of introducing and evaluating the effectiveness of such courses in dental hygiene curricula.

Methods and Materials

Study Design

This study, which was approved by the Institutional Review Board of the University of Pittsburgh (IRB# 01001105), was designed to compare similarities and differences in student outcomes, learning, and satisfaction in a gerontology course. The same course content was offered both online and in a traditional classroom setting. Baccalaureate degree completion and career entry-level dental hygiene students were allowed to choose their preferred teaching mode. Both courses were taught by the same instructor using the same required textbook and assignments. Student responses to a student profile questionnaire, grades on assignments, student exam results, grades on a case study project, the final course grade, and the result of a content retention review questionnaire were collected and compared. The student profile questionnaire was sent to all students enrolled in each course, along with a description of the project and a self-addressed stamped envelope. The students were asked to complete and return the anonymous questionnaire within 30 days. Compliance with the study and completion of the questionnaire had no impact on the students' course grades.

Data was summarized as means and standard deviations. The statistical method one-way analysis of variance was used to identify the significance of differences observed. The non-parametric test, Wilcoxon Mann-Whitney was used to concur with the study's findings given the non-normal distribution of the data. Analysis was done using Statistical Package for Social Scientists software (SPSS Inc., version 12.0, Chicago, IL). $P < 0.05$ was considered as statistically significant.

Student Profile Questionnaire

The student profile questionnaire was developed to identify any pre-existing variability in experience with computers and Web-based instruction between student groups prior to enrolling in this gerontology course. Specifically, students were asked for their ages, occupational goals, computer competencies, extent of their prior interactions with persons over 65 years of age, formal exposure to the discipline of gerontology, and any prior course work in gerontology. The student profile questionnaire information was compared to identify and distinguish characteristics among the students selecting the different instructional methods. The students were also asked to provide their evaluation of the effectiveness and benefit of the gerontology course that they completed. These responses provided the students' general opinions on the value of the course and its content.

Instructional Outcomes

The coursework assessed consisted of weekly assignment grades, course examination scores, completion of a case study project, and final course grades. The two course examinations consisted of multiple choice and essay questions. The case study was based on an interview with an elderly person to learn about his or her aging experience.

Post-Course Retention Questionnaire

Six months after completing the course, both groups were sent 20 multiple choice review questions to answer and return. The review questions addressed course content on demographics, biological and psychological dimensions, social perspectives, and general terminology used in the text. These results were compared to determine if one method of instruction appeared more effective than the other, based on information retention.

Results

Student Profile Questionnaire

The profile questionnaire response rate was favorable, with 34 of the 44 (77%) returned. The majority of students returned the questionnaire in both the Web-based (n=11) and the traditional classroom (n=23) formats.

All students in the traditional course were dental hygiene students, while 67% of the Web-based students were dental hygiene students. The remaining 25% of Web-based students were in other health care disciplines (Table I). In the traditional course, 66% of the students were between 18 and 25 years of age, as compared to 42% of the students in the Web-based course. A third of the students in the Web-based course were between 26 and 35 years of age, and 17% were between 36 and 46 years of age (Table II).

Table I: Occupation of Students in Web-based and Traditional Classrooms

Future Occupation	Web-based Students	Traditional Classroom Students	Totals
Health Care Provider	3 (25%)	0	3 (7%)
Dental Hygienist	8 (67%)	32 (100%)	40 (91%)
Unknown	1 (8%)	0	1 (2%)
Totals	12	32	44

Table II: Age of Students in Web-based and Traditional Classrooms

Age	Web-based Students	Traditional Classroom Students	Totals
18 – 25 years	5 (42%)	21 (66%)	26 (60%)
26 – 35 years	4 (33%)	2 (6%)	6 (14%)
36 – 46 years	2 (17%)	0	2 (4%)
Unknown	1 (8%)	9 (28%)	10 (22%)
Totals	12	32	44

A majority of responding students in both groups owned computers (Table III) and reported more than three years of experience using computers (Table IV). The similarity of the groups in this regard suggests that neither ownership nor experience using a computer determined the course delivery mode selected by the students. Nearly three-quarters of the students that selected the Web-based format reported experience using the CourseInfo course management system with one or more courses. Fewer than half of the students selecting the traditional classroom mode reported experience with at least one course using the CourseInfo system (Table V). Prior experience with an exclusively online course also influenced the course mode selection. More than half of the students in the traditional course format had never taken a Web-based course, while more than half of the students in the Web-based course had previously taken at least one Web-based course (Table VI).

Table III: Computer Ownership

Computer Owner	Web-based Students	Traditional Classroom Students	Totals
YES	10 (83%)	20 (63%)	30 (68%)
NO	1 (8%)	3 (9%)	4 (9%)
Unknown	1 (8%)	9 (28%)	10 (23%)
Totals	12	32	44

Table IV: Years of Computer Use

Years of Computer Use	Web-based Students	Traditional Classroom Format	Totals
Never	0	2 (6%)	2 (5%)
1 year	0	1 (3%)	1 (2%)
2 years	0	2 (6%)	2 (5%)
3 years	2 (17%)	0	2 (5%)
4 or more years	9 (75%)	18 (56%)	27 (61%)
Unknown	1 (8%)	9 (28%)	10 (23%)
Totals	12	32	44

Table V: Experience with CourseInfo Enhancements

Experience with CourseInfo Enhancements	Web-based Students	Traditional Classroom Students	Totals
None	2 (17%)	16 (50%)	18 (41%)
One Course	7 (58%)	2 (6%)	9 (20%)
Two Courses	1 (8%)	2 (6%)	3 (7%)
Three Courses	0	1 (3%)	1 (2%)
Four or More Courses	1 (8%)	2 (6%)	3 (7%)
Unknown	1 (8%)	9 (28%)	10 (23%)
Totals	12	32	44

Table VI: Experience with Exclusively Online Courses

Experience with Exclusively Online Courses	Web-based Students	Traditional Classroom Students	Totals
None	3 (25%)	20 (63%)	23 (52%)
One Course	7 (58%)	2 (6%)	9 (20%)
Two Courses	1 (8%)	1 (3%)	2 (5%)
Three Courses	0	0	0
Four or More Courses	0	0	0
Unknown	1 (8%)	9 (28%)	10 (23%)
Totals	12	32	44

A majority of students in both instructional formats described their familiarity with the elderly as moderately familiar. More than half of the students in both groups reported at least weekly interactions with persons over 65 years of age. A majority of students in both courses described their exposure to formal gerontology as less than moderate. Most of the students had never taken a course with a gerontology component (Table VII).

Table VII: Prior Experience with the Discipline of Gerontology

Query	Options	Web-based Students	Traditional Classroom Students	Totals
How familiar are you with the elderly?	Not at all	0	1 (3%)	1 (2%)
	To a small degree	0	4 (13%)	4 (9%)
	Moderately familiar	9 (75%)	17 (53%)	26 (59%)
	Very familiar	2 (17%)	1 (3%)	3 (7%)
	Unknown	1 (8%)	9 (28%)	10 (23%)
	Totals	12	32	44
How often do you interact with a person over 65 years of age?	Daily	2 (17%)	3 (9%)	5 (11%)
	Once a week	6 (50%)	13 (41%)	19 (43%)
	Once a month	2 (17%)	7 (22%)	9 (21%)
	Once a year	1 (8%)	0	1 (2%)
	Unknown	1 (8%)	9 (28%)	10 (23%)
	Totals	12	32	44
Prior to this course, how much formal gerontology exposure have you had?	None	4 (33%)	7 (22%)	11 (25%)
	Slight	3 (25%)	13 (41%)	16 (36%)
	Moderate	4 (33%)	3 (9%)	7 (16%)
	Extensive	0	0	0
	Unknown	1 (8%)	9 (28%)	10 (23%)
	Totals	12	32	44
Before this course, how many courses have you taken that included a gerontology component.	None	6 (50%)	17 (53%)	23 (52%)
	One	4 (33%)	6 (19%)	10 (23%)
	Two	1 (8%)	0	1 (2%)
	Three	0	0	0
	Four or More	0	0	0
	Unknown	1 (8%)	9 (28%)	10 (23%)
	Totals	12	32	44

As shown in Table VIII, all of the students reported that the course format they selected was an effective instructional method for this gerontology course. There was a minor difference in opinion regarding the benefit each student derived from the course. While 50% of the students in the Web-based course described the experience as greatly beneficial, 31% of the students in the traditional classroom course considered their experience greatly beneficial and 38% considered their experience moderately beneficial.

Table VIII: Student Evaluations of Course Effectiveness

Query	Options	Web-based Students	Traditional Classroom Students	Totals
Do you agree that the format you elected was effective for this course?	Yes	11 (92%)	23 (72%)	34 (77%)
	No	0	0	0
	Unknown	1 (8%)	9 (28%)	10 (23%)
Totals		12	32	44
How much did you benefit from this course?	Not at all	0	0	0
	Slightly	1 (8%)	1 (3%)	2 (5%)
	Moderately	4 (33%)	12 (38%)	16 (36%)
	Greatly	6 (50%)	10 (31%)	16 (36%)
	Unknown	1 (8%)	9 (28%)	10 (23%)
Totals		12	32	44

Instructional Outcomes

Instructional outcomes were compiled for the two courses to determine possible differences in learning success between the two instructional formats. The criteria considered included letter grades on assignments, a case study project grade,

grades on two examinations, and the final course grade. The mean, standard deviations, and the statistical significances of differences in these instructional outcomes are summarized in Table IX and were derived using a one-way ANOVA test. With the exception of the first exam, a statistically significant difference was observed in student performance between the two instructional formats. Students enrolled in the Web-based format scored significantly higher on the second exam, assignments, the case study project, total final points, and final percent. The final course grades assigned to the students in the two teaching formats revealed that students in the Web-based course had greater success in accomplishing the learning objectives of this course, compared to the students in the traditional classroom course.

Table IX: Statistical Analysis of Outcomes

Variable	Web-based (N=12)				Traditional Classroom (N=32)				Significance (P value)
	Min.	Max.	Mean	SD	Min.	Max.	Mean	SD	
Exam #1	64	92	82.1	7.6	70	97	82.7	6.6	0.885
Exam #2	80	93	88.4	3.6	73	91	83.5	5.33	0.005*
Project	100	100	100	0	85	100	93.6	5.4	<0.001*
Assignments	55	55	55	0	35	55	50.8	6.4	0.028*
Final Points (Total)	317	344	334.7	8.5	285	347	317	14.9	<0.001*
Final Percent	89	97	94.3	2.5	80	98	89.3	4.3	<0.001*

* Denotes significant differences ($P < 0.05$)

Post-Course Retention Questionnaire

Assessment included a measure of post-course retention (Table X). Six months after the completion of the course, each student was mailed a 20-item multiple choice objective test to be returned within the following 30 days. Willingness to participate in the retention exercise, as indicated by the completion and return of the post course test, was generally high for both groups. Most of the students who had taken the gerontology course by the Web and by traditional classroom format returned completed retention tests (75% vs. 78%, respectively). Overall, the response rate was 77%.

Table X: Retention of Course Content Six Months after Course Completion

#Correct Responses/ 20 items	Web-based Students	Traditional Classroom Students	Totals
20 (100%)	0	0	
19 (95%)	1 (8%)	0	1 (2%)
18 (90%)	2 (16%)	3 (9%)	5 (11%)
17 (85%)	4 (33%)	6 (19%)	10 (23%)
16 (80%)	1 (8%)	1 (3%)	2 (4%)
15 (75%)	0	6 (19%)	6 (14%)
14 (70%)	1 (8%)	5 (16%)	6 (14%)
13 (65%)	0	0	0
12 (60%)	0	1 (3%)	1 (2%)
11 (55%)	0	1 (3%)	1 (2%)
10 (50%)	0	2 (6%)	2 (4%)
Unknown***	3 (25%)	7 (22%)	10 (23%)
Totals	12	32	44

***Response rate was 34/44: 9 of the 12 Web-based students returned the post-course test and 25 of the 32 traditional classroom students returned the post-course test.

Retention of information presented in the gerontology course was highest among the students who had taken the course in the Web-based format. All of the responding students in the Web-based course answered 70% or more of the test questions correctly, while 84% of the students in the traditional classroom scored as high (Table X). Eighty-nine percent of the Web-based students who responded answered between 75% and 95% of questions correctly, while only 64% of the traditional class students performed in the same range. The highest score achieved on the review test was a 95%, which was achieved by a student in the Web-based course (Table X).

Discussion

Prior to the report published by Grimes, there were no published descriptions of Web-based courses in a dental hygiene curriculum. Among the courses described by Grimes, no dental hygiene program used distance education methods to teach a gerontology course.^{11, 13} A need for research on student performance in distance learning courses in dental hygiene curricula has been noted.¹² This study provided measures of the instructional outcomes and student perspectives resulting from Web-based delivery of a gerontology course offered to dental hygiene and other health care students.

Student profiles from this study revealed that younger dental hygiene students preferred to take the gerontology course in the traditional classroom format. This choice may reflect past computer experience and/or familiarity with the Blackboard or CourseInfo System used for the Web-based course. The younger students were expected to come to the course with greater computer confidence and experience than the older students. However, the student profiles revealed that the older students that elected the Web-based format had used the computer for a greater number of years and had more experience with online instruction. These latter considerations may have outweighed the initial age-dependent prediction that the younger students would show a greater interest in the online course format. In the University of Vermont Department of Dental Hygiene, four out of 19 students (21%) chose to take a dental terminology course online. No student profiles were given, so factors that may have influenced the online students are unknown.¹³ The student profile data in this study suggest that previous experience with online courses, the online system, and/or general computer use were the most influential factors in choosing between a Web-based or traditional format. The students' life circumstances may have also played a part in the decision. Students in the Web-based course may have been selecting a format to accommodate conflicting adult and professional demands, as well as comfort levels with technology.

Prior experience with the discipline of gerontology covered a wide range in both groups of students. The student profile information revealed that, while 33 % of the students in the Web-based course had at least one previous course with gerontology content, only 19% of the students in the traditional classroom had at least one previous course with gerontology content. Familiarity with the elderly may have been a characteristic that provided a broader knowledge base and, therefore, contributed to the better score by the Web-based students on the test that measured retention of the gerontology course content, rather than the effectiveness of the course itself. Similarly, the applicability and relevance of the topic may have been more apparent to the older students, many of whom were already working professionally.

Thus, the instructional outcomes measured by test scores and graded assignments and projects present a distinction between the effectiveness of the Web-based and the traditional classroom methods of teaching a gerontology course in a dental hygiene program. Although a statistically significant higher level of performance by the students enrolled in the Web-based format was observed, the sample size of this preliminary report limits the strength of the study findings. This observation is not consistent with most reports in the literature, as others have failed to find a significant difference in student performance when comparing distance learning to learning that results from teaching a course in the traditional classroom.^{12, 16, 17}

Grimes asked dental hygiene program directors to indicate their satisfaction with distance education.¹¹ Overall, they were satisfied. This study surveyed the students enrolled in the gerontology course to learn their level of satisfaction with the Web-based vs. traditional classroom formats. Students in both course formats unanimously agreed that the method of instruction they chose was effective. All but one student in each course reported that they benefited moderately or greatly from this gerontology course. The Web-based students were more likely to report "greatly beneficial," as compared to more "moderately beneficial" reported by the traditional classroom students. Interestingly, the Web-based students were also more likely to return the questionnaire than the traditional group.

In spite of the modest differences, it might be suggested that the older students selecting the Web-based course were more likely to have background knowledge on the topic of gerontology and to recognize the relevance and professional applicability of the issues covered in the course, while the dental hygiene students had not yet entered professional practice. Students in both groups were satisfied with their choice of course delivery formats, suggesting that the student's individual circumstances in relationship to the discipline studied determines the most suitable delivery mode for them at any given time. There are both disadvantages and advantages to developing and teaching a course online. Grimes summarized those reported by dental hygiene program directors.¹¹ Experiences of these researchers, and those shared by the students in this study, add to this compilation. A major disadvantage for the instructor is the time and effort expended in the design and development of a Web-based course. Burrow et al. estimated that a basic online course could be developed in six months if release time from other faculty responsibilities was provided.¹⁶ In general, an instructor can expect to devote at least a year to developing a course for distance education, as release time is limited for most faculty. Web-based delivery may, however, reduce the time required for face-to-face meetings with students. Students must have compatible software and computer hardware to access the course material to avoid delays at the beginning of the term. Students electing to take a course online must have the self-discipline to work independently and practice efficient and effective time management. These skills may be more evident with older adult students who also tend to select Web-based instruction.

The advantages of Web-based course delivery include flexible monitoring of work and assignments and flexibility of communicating with students through email and online announcements. Students can also access their grades at any time, if a grade book is incorporated into the software used in the Web-based course. Distance learning has obvious utility for working health care providers completing degree course work. Enrolling in courses offered online may be the only way for some students to continue their educations.

Many health care professionals are treating an increasing percentage of older adults in their practices, but they may have received little, if any, formal training in gerontology while in school. Self-reported surveys of dental professionals revealed that only 17% of dental hygienists and 11% of dentists had a geriatric dentistry course in their dental hygiene or dental curricula. Further, 37% of the dental hygienists and 31% of the dentists attempted to fill this deficiency by taking continuing education courses in geriatrics sometime after graduation.^{18,19} Web-based gerontology courses could help to better prepare these health care providers to meet the special needs of older adults.

These data will be collected over a five-year period, and instructional outcomes and student perceptions will again be assessed. A larger sample size should allow for more reliable and sophisticated statistical analysis. We encourage continued assessment of Web-based instruction, as it interacts with different disciplines, different student populations, and different learning and instructional styles. Identifying institutional and personal characteristics that differentially interact with instructional delivery modes would enhance educators' abilities to optimize instructional outcomes for a diverse student population.

Conclusion

The students choosing a Web-based course over a traditional format were older, had previously taken coursework online, and were familiar with the online system software that supported this course. The scores on measures of instructional outcomes were significantly higher for students enrolled in the Web-based format. In addition, post-course retention was highest among students who had taken the course in the Web-based format. The small overall number of students and the unequal size of the two groups limit the variability within and between groups and, therefore, the validity of these results.

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Notes

Correspondence to: Judith Gallagher at jeg13@dental.pitt.edu

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