

## An Analysis of Student Performance Benchmarks in Dental Hygiene via Distance Education

Jodi L. Olmsted, RDH, BS, MS, EdS, PhD

### Introduction

Educational opportunities continue to grow exponentially in colleges and universities across the United States because of the implementation of technologically based delivery systems.<sup>1</sup> Distance learning (DL) or distance education (DE), defined as the learner and facilitator separated by physical space, is facilitated by rapid advances in today's technology.<sup>2</sup> Technological changes, including computer use and fiber-optic cabling, synchronous interactive television systems (ITV) and other hybrid configurations, allow learning in other than the traditional face-to-face classrooms.<sup>3</sup>

In 2002, 1.6 million students took courses on-line across the United States. By 2003, the number of online course enrollees climbed to 1.97 million, succeeded by 2.33 million in 2004.<sup>4,5</sup> Delivery of online courses requires a technological platform and computer.<sup>6</sup> Continued growth and expansion of online coursework is now an integral element of mainstream higher education – 63% of schools offering undergraduate face-to-face programs also offer undergraduate programs online.<sup>7</sup> Three graduate programs, 35 undergraduate and 12 dental hygiene degree completion programs in the United States now use varying forms of DL.<sup>8,9</sup> Even though a significant body of literature exists documenting participant satisfaction using alternative mediums for delivering dental hygiene courses,<sup>10-12</sup> only one published quantitative

### Abstract

**Purpose:** Three graduate programs, 35 undergraduate programs and 12 dental hygiene degree completion programs in the United States use varying forms of Distance Learning (DL). Relying heavily on DL leaves an unanswered question: Is learner performance on standard benchmark assessments impacted when using technology as a delivery system? A 10 year, longitudinal examination looked for student performance differences in a Distance Education (DE) dental hygiene program. The purpose of this research was to determine if there was a difference in performance between learners taught in a traditional classroom as compared to their counterparts taking classes through an alternative delivery system.

**Methods:** A longitudinal, ex post facto design was used. Two hundred and sixty-six subject records were examined. Seventy-seven individuals (29%) were lost through attrition over 10 years. One hundred and eighty-nine records were used as the study sample, 117 individuals were located face-to-face and 72 were at a distance. Independent variables included time and location, while the dependent variables included course grades, grade point average (GPA) and the National Board of Dental Hygiene Examination (NBDHE). Three research questions were asked: Were there statistically significant differences in learner performance on the National Board of Dental Hygiene Examination (NBDHE)? Were there statistically significant differences in learner performance when considering GPAs? Did statistically significant differences in performance exist relating to individual course grades? T-tests were used for data analysis in answering the research questions.

**Results:** From a cumulative perspective, no statistically significant differences were apparent for the NBDHE and GPAs or for individual courses.

**Conclusions:** Interactive Television (ITV), the synchronous DL system examined, was considered effective for delivering education to learners if similar performance outcomes were the evaluation criteria.

**Key Words:** Distance Education, Distance Learning, Outcomes, Benchmarks, Dental Hygiene, Assessment, Student Performance, Allied Health

This study supports the NDHRA priority area, Professional Education and Development: Validate and test measures that evaluate student critical thinking and decision making skills.

research study existed verifying actual performance while receiving dental and dental hygiene education using various alternative delivery

systems.<sup>13</sup> Quantitative analyses of performance benchmarks from a programmatic perspective, such as grade point average (GPA), course

grades and scores on national examinations provide research evidence of individual's educational experiences in alternative delivery programs.

The purpose of this study was determining whether face-to-face learners performed differently on established benchmark assessments than their classmates located at a distance. The defined benchmarks include course grades, GPAs and the National Board of Dental Hygiene Examination (NBDHE). A longitudinal examination of benchmark scores during a 10 year period looked for statistically significant differences in performance. Evaluation of entire educational programs, rather than single courses, addressed issues concerning data reliability, validity and the American Dental Association Commission of Dental Accreditation (ADA CODA) Standard 1, relating to Institutional Effectiveness.

## Review of the Literature

The ADA CODA Standard 1 requires that "benchmarks or measures of learning are used to demonstrate effectiveness"<sup>14</sup> and are documented in the areas of planning and assessment. Addressing the quality of educational programs is the intent of this Standard. Educational programs have a responsibility to assure the ongoing cycle of educational assessment, planning and implementation. Evaluation assures learners receive current, relevant and cost efficient educational programming. Programs are accountable to stakeholders in assuring educational programs meets the ADA CODA Quality Standards. A key consideration of the Standards is broad-based, systematic, continuous data collection and analysis, which is designed to evaluate and promote achievement of program goals while maximizing academic success of enrolled students. The CODA Standard allows programs to identify their own goals, assuring competence within the discipline. Ongoing program assessment

uses the NBDHE, GPAs and course grades to provide direct benchmark measures that are indicators of Institutional Effectiveness. Indirect measures, including retention, attrition, program transfer and employer satisfaction data also identify and document areas for continuing process and program improvements.

Educational technology continues transforming dental hygiene education at a rapid pace. A review of the current dental hygiene literature indicates various program delivery models are being used by educational institutions and program administrators to implement alternative delivery methods for teaching and learning, as well as ongoing assessment.<sup>15-17</sup> As institutions consider expanding learning using DL as a delivery modality, theoretical constructs need to be considered, such as those offered by Gussy et al<sup>18</sup> and Magnussen,<sup>19</sup> or theorized by this researcher. Additionally, as institutions consider advancing the profession at large by expanding educational opportunities for degree completion as suggested by Monson and Engeswick,<sup>20</sup> it is crucial the concrete, statistical measures of predictive performance be examined.<sup>21-22</sup> A focus on statistical performance measures for authentication instead of learner satisfaction data can provide a solid, evidence-based groundwork for continued use of DL for dental hygiene education. As dental hygienists seek to pursue degree completion and additional certification, it is important that both institutional and programmatic decisions are made based on solid predictors of academic performance over time rather than only student satisfaction surveys or outlier data from 1 or 2 courses.<sup>10-12</sup>

## Methodology

This research was designed to address the question: To what extent was learner performance on standard benchmark assessments impacted when using technology as a delivery system? The evaluation of NBDHE scores, course grades and

GPAs may ascertain program effectiveness in the delivery of dental hygiene education. Learners were self-selected for statistical analysis based on location. The first group consisted of face-to-face (host site) learners while the second group consisted of learners located at a distance from the instructor via ITV. The study design evaluated if face-to-face and distance participants had statistically significant differences in performance.<sup>22</sup> Independent variables included location and time. Location determined group assignment while time included examining graduate populations from 1997 through 2006. Dependent variables included course GPAs, cumulative GPAs and NBDHE scores.

## Research Questions

Three questions were asked regarding documentation of performance between face-to-face and distance college learners:

1. Were there significant statistical differences in performance on the NBDHE?
2. Were there significant statistical differences in GPAs?
3. Were there significant statistical differences in individual course grades?

## Population

This study's research population began with 266 students from the graduating classes of 1997 through 2006. One hundred and eighty-nine students graduated from the program in 10 years. There were 117 (44%) face-to-face instructor-lead learners, while 72 (27%) used the ITV system. All data files for the learners who graduated (n=189) were used for the study.

Over the 10 year period, 77 students (29%) did not complete all educational coursework and graduate. Learners were required to complete exit interviews with a neutral party upon deciding to leave the program and institution. The data collected from individuals who did not complete the program (n=77) was used as part of the program effectiveness

process. Thirty–six persons (13.5%) not completing were located face–to–face and 41 persons (15.5%) received didactic education through ITV. Academic performance, while one reason for attrition, was not considered a major factor. Attrition was equally distributed between both groups and was attributed to several categories beyond academic performance, including personal, health, ethical conduct considerations, military commitments, the profession not being “right” for the individual and death of 1 participant. It should also be noted the majority of attrition occurred during the first year of the program. The state where the research data was gathered has a statewide curriculum in place for dental hygiene education. This permits students to change academic location, if space is available, within the state. As individual personal situations change and people move, they can still complete educational programs elsewhere. While considering the data, it should be noted a substantial number of individuals (n=14) transferred to different programs within the state, taking advantage of the statewide curriculum if personal situations warranted its necessity. Ten persons withdrew, citing they did not like instructor. This information is also important from a programmatic perspective as we consider CODA Standard 1. Seventy–five percent of participants completed the program and graduated. Colleges and universities have the latitude under the auspices of CODA Standard 1 to determine acceptable levels of attrition. While 29% of individuals not completing the program over a 10 year period might seem high, when considering Institutional Effectiveness, the program used the data to make continual revisions to the admissions process, faculty teaching assignments and tenure decisions. Positive impacts on increasing the state’s health care provider numbers and cost/benefit to the state’s economy were also factors documented to meet CODA Standard 1. Upon closer review, the

**Table I: Ten year Cumulative Analysis of National Board Dental Hygiene Examination Scores by Host and Distance Learners**

Year	Location	N	Mean	df	t–value	2–Tailed Prob.
1997–2006	Host	114	89.19	183	–.109	.914
	Distance	71	89.79			
*p < .05						

**Table II: Ten year Analysis of Cumulative GPAs by Host and Distance Learners**

Year	Location	N	Mean	df	t–value	2–Tailed Prob.
1997–2006	Host	117	3.37	186	–1.079	.282
	Distance	71	3.43			
*p < .05						

data demonstrates, despite this attrition, the program was effective in providing and graduating dental hygienists using DL as an educational delivery mechanism.

### Data Analysis

For each research question, independent group t–tests determined if any statistically significant differences existed. Data was analyzed year–by–year, course by course and through cumulative comparisons. Furthermore, a t–test was applied to the aggregated group’s data. Only a portion of the data findings are reported here. Data analysis was conducted for documenting program effectiveness of DL. The results of this study, in documenting learner performance for an entire program, addresses one of 2 “gaps” noted in the scientific literature by Phipps and Merisotis<sup>23</sup> – research learner outcomes for entire academic programs and not just for individual courses. Phipps and Merisotis also recommended proposing and using a conceptual framework for consideration and potential testing for further DL research, which is posited separately by this author.

### Statistical Significance

Statistical level of significance (p–value) was set at p<0.05. This value level is a routine alpha–level for probability testing of null hypotheses.

## Results

Each of the study’s research questions are addressed based upon the statistical analyses while looking at each individual supposition. Discussion highlights findings from a program perspective, examining program effectiveness over time that may be of concern to allied health administrators and educators.

### Research Question 1

The first research question asked: Did significant statistical differences in performance on the NBDHE exist between face–to–face and distance college learners? Cumulative data demonstrated no statistically significant difference existed between host and distance learners’ performance over a 10 year period (Table I).

### Research Question 2

The second research question asked: Did significant statistical differences in GPAs exist between face–to–face versus DE college–level learners? No statistically significant differences existed between host and distance learners’ performance related to cumulative GPAs for the 10 cohorts (Table II).

### Research Question 3

The third research question asked: Did significant statistical differences in individual course grades

exist between face-to-face and distance college learners? Data was analyzed answering this question in 3 different ways: cumulatively, year by year and course by course, to identify any existing statistically significant trends. Only the results of the cumulative analysis are addressed here. Comparing cumulative learner performance for the core dental hygiene courses revealed no statistically significant differences (Table III). It was determined no statistically significant differences existed in learner performance for the program's entire didactic academic curriculum over a 10 year period. It is important to note that year by year and course by course, statistically significant results were identified.

The results were evaluated from a programmatic perspective while examining trends that might be of concern when considering CODA Standard 1. The results of the study, reflecting a 10 year period of comparative data, identified no statistically significant performance differences between face-to-face and distance learners on the various benchmark measures evaluated.

Analysis of NBDHE scores, GPAs and cumulative core course grades were used to determine if CODA Standard 1 was met. Program completion rates, graduate success on the analyzed benchmarks, program improvement and change based on assessment data, plans, timelines and programs effectiveness in meeting the stated missions, goals and strategic plans are all used as evidence documenting Institutional Effectiveness. The data analyzed here as a component of effectiveness assessment suggests DE was as effective as traditional methods for delivering educational programming.

### Question 1

As a trend over time, no major differences were observed in performance on the NBDHE between host and distance learning cohorts. The research presented in Table I

**Table III: Ten year Analysis of Core Dental Hygiene Courses**

Oral Anatomy (508–101) Course Averages by Host and Distance Learners						
Student Year	Location	n	Mean	df	t-value	2-Tailed Prob.
1997–2006	Host	107	2.96	134	1.223	.223
1997–2006	Distance	69	2.84			
Dental Hygiene Theory I (508–113) Course Averages by Host and Distance Learners						
Student Year	Location	n	Mean	df	t-value	2-Tailed Prob.
1997–2006	Host	114	3.73	184	1.445	.150
1997–2006	Distance	72	3.64			
Nutrition (508–114) Course Averages by Host and Distance Learners						
Student Year	Location	n	Mean	df	t-value	2-Tailed Prob.
1997–2006	Host	107	3.36	177	.001	.999
1997–2006	Distance	72	3.36			
Periodontology (508–115) Course Averages by Host and Distance Learners						
Student Year	Location	n	Mean	df	t-value	2-Tailed Prob.
1997–2006	Host	111	3.05	179	.853	.395
1997–2006	Distance	70	2.97			
Oral Pathology (508–122) Course Averages by Host and Distance Learners						
Student Year	Location	n	Mean	df	t-value	2-Tailed Prob.
1997–2006	Host	109	3.41	129	1.19	.233
1997–2006	Distance	72	3.30			
Dental Pharmacology (508–123) Course Averages by Host and Distance Learners						
Student Year	Location	n	Mean	df	t-value	2-Tailed Prob.
1997–2006	Host	116	3.35	185	.322	.748
1997–2006	Distance	71	3.32			
Dental Hygiene Theory II (508–124) Course Averages by Host and Distance Learners						
Student Year	Location	n	Mean	df	t-value	2-Tailed Prob.
1997–2006	Host	117	3.65	187	1.199	.232
1997–2006	Distance	72	3.57			
Community Dental Health (508–131) Course Averages by Host and Distance Learners						
Student Year	Location	n	Mean	df	t-value	2-Tailed Prob.
1997–2006	Host	116	3.70	186	-1.09	.913
1997–2006	Distance	72	3.71			
*p < .05						

provides exploratory, longitudinal DL data for this national benchmark, providing documentation of learner success as an example of evidence meeting CODA Standard 1.

### Question 2

Based on the GPA evidence presented in Table II, the data suggests DE can be effective for dental hygiene education. This data may also

provide preliminary evidence for this national performance benchmark for DL programs. Furthermore, from a program perspective, this data also documents learner success as another example of evidence meeting CODA Standard 1. Even though some learners might not prefer DL for educational delivery, their individual performance, as evidenced by GPAs, was not impacted by its use.

### Question 3

Cumulative analysis of core didactic course grades also provides a pattern of evidence documenting meeting the intent of Standard 1. An examination of the data for significant trends indicates these courses' cumulative averages have remained consistent and stable over time. The 8 core dental hygiene courses did not show statistically significant differences in performance between face-to-face and distance students. This study documents one program's successful delivery of a dental hygiene educational program while using DL.

### Discussion

The statistical analyses of performance outcomes suggest CODA Standard 1 was met as evidenced by the 10 year cumulative NBDHE and GPA data, and the cumulative course by course data. The results documented learner performance for an entire academic program rather than only analyzing individual courses, addressing one of the research gaps noted by Phipps and Merisotis.<sup>23</sup> The data also helps answer the question: Is it prudent for colleges' and universities' dental and dental hygiene programs to continue expansion of the use of DE as a means of course and program delivery? Based on these preliminary research findings, the answer appears to be yes. It is important to note the study design limits findings to dentistry and might not be applicable to other

educational programming.

Another question posed is: Can a perspective body of knowledge be generated regarding learner performance on given standard outcome measures? Performance measured by GPAs and course grades as national benchmarks provide generalized, external validity to other programs because this study data lays the foundation for DL research related to academic programs. The findings of this research also provide insights into the use of DL as a viable delivery mechanism for education. In addition, it provides a foundational basis for benchmark comparison for future DL research for programs considering using this method for program delivery. If similar performance outcomes are the decision-making factor, the study findings suggest the use of DE is a viable mechanism for educational delivery. Finally, this research provides an analysis of performance over time, rather than 1 or 2 years, for an entire educational program using DL technologies. This data might assist administrators at various colleges or universities in decision-making processes regarding the implementation of DL programming for general education, allied health or, specifically, dental and dental hygiene programs.

### Conclusion

Allied health and dental hygiene programs should continue offering education using DL as an alternative delivery mechanism. This research identified learners at various locations who performed equally well on standard benchmark assessments documenting program effectiveness. DL was considered an effective medium for delivering educational programming, and the use of DL should be continued. Additionally, DL could be used for delivering not only other allied health programs, but could also deliver other educational programs in the

same manner.

A path analysis should be undertaken as we consider inferring data back to larger populations for both GPAs and course grades. It must be stated that DL is not for everyone. Further research may include analyzing this national benchmark data and determining what factors promote student success in dental hygiene DL programs.

Once research is conducted identifying persons for whom the DL option is not a preferred delivery mechanism, strong recommendations could be made to that individual or individuals to provide guidance into taking program courses with face-to-face cohorts for improving performance results, retention, learner satisfaction, perseverance and, ultimately, program completion and graduation.

There is a need to replicate this study using data from asynchronous DL programs, which have replaced the synchronous model studied in the current paper. .

*Jodi L. Olmsted is an Assistant Professor at the University of Wisconsin Stevens Point in the College of Professional Studies, Health Sciences Department and was with the first DH program that began offering its entire didactic curriculum to students via distance education. Jodi was the 2008 recipient of the ADHA Irene Newman Professional Development Award. She is the owner, president and distance education consultant for Kaleidoscope Consulting, LLC.*

### Acknowledgement

The author thanks Mary Jo Tietge and Amelia Ann Fox, technical writer, and the administration, faculty and staff of the Wisconsin Technical College System dental hygiene program, which allowed this study to be conducted.

## References

1. Wilson M. Distance Degrees. Oakland (OR): Umqua Educational Resource Alliance; 2001.
2. Wahlstrom C, Williams BK, Shea P. The successful distance learning student. Belmont (CA): Scratchgravel Press; 2003.
3. O'Lawrence H. The influences of distance learning on adult learners. *Techniques*. 2006;81:47–49.
4. Allen IE, Seaman J. Seizing the opportunity: The quality and extent of online education in the United States, 2002 and 2003. Wellsley (MA): Sloan Consortium; 2003.
5. Allen IE, Seaman J. Entering the mainstream: The quality and extent of online education in the United States, 2003 and 2004. Wellsley (MA): Sloan Consortium; 2004.
6. Rossman MH, Rossman ME. Facilitating distance education. San Francisco (CA): Jossey-Bass; 1995.
7. Allen IE, Seaman J. Growing by degrees: Online education in the United States, 2005. Wellsley (MA): Sloan Consortium; 2005.
8. Dental hygiene programs. American Dental Association [Internet]. 2004. Available from: <http://www.ada.org/prof/ed/programs/dahlt/alliedus.asp>.
9. Dental hygiene education programs offered by state. American Dental Hygienists' Association [Internet]. 2008. Available from: <http://www.adha.org>.
10. Moore W. An assessment of online learning in a dental hygiene baccalaureate degree completion program. *J Dent Hyg*. 2007;81:84–84.
11. Mitchell TV, Gadbury-Amyot CC, Bray KK, Simmer-Beck M. Advanced degree seeking students' satisfaction with online courses at UMKC—an early investigation. *J Dent Hyg*. 2007;81(3):62–62.
12. Grimes EB. Student perceptions of an online dental terminology course. *J Dent Educ*. 2001;66(1):100–107.
13. Olmsted JL. Longitudinal analysis of student performance in a dental hygiene distance education program. *J Dent Educ*. 2002;66(9):1012–1020.
14. American Dental Association, Commission on Dental Accreditation. Accreditation standards for dental hygiene education programs. Chicago (IL): American Dental Association; 2005.
15. Gadbury-Amyot CC, Fried JL, Syme, SE. Technology in teaching and online (distance) learning: Two model programs. *Access*. 2007;21:10–17.
16. Fried JL. Innovations in Education and Technology. *J Dent Hyg*. 2007;81(1):1–9.
17. Bray KS, Gadbury-Amyot CC, Mitchell TV. Providing advanced degrees in dental hygiene via computer mediated distance learning: A model program. *J Contemp Dent Pract*. 2006;7(5):96–107.
18. Gussy MG, Knevel RJ, Sigurdson V, Karlberg G. Theoretical and practical considerations for the development of online international collaborative learning for dental hygiene students. *Int J Dent Hyg*. 2006;4(3):154–159.
19. Magnussen L. Applying the principles of significant learning in the e-learning environment. *J Nurs Educ*. 2006;47(2):82–86.
20. Monson AL, Engeswick LM. ADHA's focus on advancing the profession: Minnesota's dental hygiene educators' response. *J Dent Hyg*. 2007;81(2):1–12.
21. Alzahrani MJ, Thomson EM, Bauman DB. Predictors of Student Success in an entry-level baccalaureate dental hygiene program. *J Dent Hyg*. 2007;81(2):1–13.
22. Bernard RM, et al. How does distance education compare with classroom instruction? A meta-analysis of the empirical literature. *Rev Educ Res*. 2004;74(3):379–434.
23. Phipps R, Merisotis J. What's the difference? A review of contemporary research on distance learning in higher education. Washington, DC: National Education Association; 1999.