# Evaluating Distance Learning in Clinical Laboratory Science

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**OBJECTIVE:** The purpose of this study was to determine if there were any significant differences in academic performance between distance students and on-campus students in clinical laboratory science.

**DESIGN:** A quantitative causal comparative research design was used.

**SETTING:** The research study was conducted at an academic health sciences university in the eastern United States.

**PATIENTS OR OTHER PARTICIPANTS:** Anecdotal graduate data were collected from students that had graduated from the Clinical Laboratory Science (CLS) program.

**INTERVENTIONS:** The students had either received their CLS education via distance or through the traditional on-campus methods.

**MAIN OUTCOME MEASURES:** Academic performance was the major outcome measured. This was determined by comparing distance students' final grade point average (GPA) scores and certification scores to their on-campus counterparts.

**RESULTS:** The researchers found no significant difference in gender between distance and on-campus students; however, there was a significant difference in age. On average the distance students were older than their on-campus counterparts. There were no significant differences found for mean overall admission GPA, mean math science admission GPA, mean final GPA score, and mean certification score. There were also no differences found in any of the subcategories of the certification exam except for urinalysis. For the urinalysis subcategory the distance students significantly outperformed their on-campus counterparts. Correlation studies showed that there were significant positive correlations between overall admission GPAs, math science admission GPAs, final GPA scores, and certification scores.

**CONCLUSIONS:** The researchers have shown that distance learning CLS graduates are as academically prepared as their on-campus counterparts.

**ABBREVIATIONS:** ASCP = American Society for Clinical Pathology; CLS = clinical laboratory science; CLT = clinical laboratory technician; GPA = grade point average.

**INDEX TERMS:** academic performance; clinical laboratory science; distance education; distance learning.

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Many higher education institutions have changed their traditional pedagogical practices. Educational courses for centuries have been taught with face-to-face interaction between the instructor and students. With this form of educational delivery, the student traveled to the instructor's classroom. The technological advances of the late twentieth and early twenty-first centuries have developed to the extent that this is no longer necessary. Through distance learning, students are able to obtain their degree where they live and work.

Educators of clinical laboratory science (CLS) have also grasped the distance learning paradigm and have begun offering degrees via distance learning[1] with the hope that non-traditional methods of degree obtainment will help alleviate the critical shortage of qualified clinical laboratory professionals. The Bureau of Labor Statistics reported that the job opportunities for clinical laboratory scientists are expected to be excellent. In 2004, clinical laboratory technologists and technicians held 302,000 jobs in the United States. Employment projections through 2014 are reported to increase 18% to 26%.[2] The 2005 Wage and Vacancy Survey of Medical Laboratories found that there was a 6.0% overall vacancy rate for certified medical technologists or clinical laboratory scientists.[3] The 2002 Wage and Vacancy Survey for Medical Laboratories report noted that 72% of the current workforce was greater than the age of 40.[4] The number of clinical laboratory scientists leaving the field or retiring has led to a critical shortage in qualified personnel.

Distance learning programs can reach large audiences and can increase enrollments.[5] Problems have occurred though when using distance learning as a means of educational delivery. Crowley and others showed that there were administration issues, technology issues, communication issues, and problems with finding clinical internships sites.[6] Miller and King observed that there were low completion rates with distance learning students, with as many as one-third of the students dropping out before completing the class.[7] Among the cons of online courses, Cuellar listed increased time commitment, cost, and lack of support for online learning and teaching.[8]

Another concern for many researchers has been the academic performance of distance students. Many researchers have attempted to evaluate distance learning courses and programs by comparing distance students to their on-campus counterparts. Bearden, Robinson, and Deis performed a statistical analysis comparing dental hygiene students' grades in online and on-campus nutrition courses and their performance on the national board exams. These researchers found that the distance students and on-campus students performed the same when course averages, pre-course GPAs, and certification scores on the nutrition questions were compared.[9]

In CLS, two research studies were found that compared distance learning students to their on-campus counterparts. One performed by Crowley and others compared distance students' and on-campus students' certification pass rates. The distance students were students who were enrolled in an articulation program for clinical laboratory technicians (CLTs). CLTs possessed previous education and work experience in the clinical laboratory. The researchers found that the pass rate on the national certifying examination was higher with the distance learning students than their on-campus counterparts.[6]

Another study in CLS was performed by Freeman who studied academic performance and learning styles in CLS students enrolled in a distance learning course utilizing interactive video-teleconferencing. Forty students were included in the quasi-experimental research study to determine if learning styles and delivery method had an impact on student academic performance. Academic performance was measured by eight objective-based tests and national certification scores. The researcher found that that there were no significant differences in clinical laboratory scientist students' test scores and the American Society of Clinical Pathology (ASCP) Board of Registry certification scores for the distance learning students as compared to the traditional on-campus students. The researcher also determined that there was no significant difference in examination scores and learning styles. However, it was not clear from the research if the entire program was offered by distance or just one course.[10]

Researchers that have compared certification scores have typically focused their research on certain components of the certification exam or they have only offered one or two of the core curriculum courses by distance. However, a research study performed by Olmsted evaluated five consecutive classes of distance and on-campus dental hygiene students to determine how they performed on the national board examinations. A total of 115 distance students were compared to 105 traditional on-campus students. Olmsted found no significant difference in scores on the national board examination, core curriculum courses, and final grade point averages (GPAs) between the distance and on-campus students. In addition, the researcher also found that there was a strong correlation for both distance learning and on-campus students between GPA scores and national board examination scores.[11]

The academic performance of distance learning students compared to on-campus students has been the focus of many research studies. However, the majority of this research has focused on the comparison of student grades in individual courses and not the comparison of final GPA scores or certification scores of students who had taken their entire program through distance learning to their on-campus counterparts. In addition, there have only been a few researchers that have focused on allied healthcare education and even fewer that have compared distance learning students' academic performance to traditional on-campus students in CLS. The purpose of this study was to determine if there were any differences in academic performance between distance students and on-campus students in CLS and if there were any relationships between age, overall admission GPA, math science admission GPA, final GPA scores, and certification scores within the group as a whole and within the two separate learning environments.

## MATERIALS AND METHODS

The research study was conducted at one academic health sciences university in the eastern United States. The academic "transfer" university required students to have two years of previous college work from an accredited higher education institution.

The sample was ascertained by determining the years that both distance students and on-campus students graduated. The CLS program graduated distance learning students in 1995, 1996, 1997, 1998, 2002, 2004, and 2005. One limitation of this study was that the majority of the students that graduated from the distance program were CLT to CLS articulation students, and the majority that graduated from the on-campus program were CLS students who were not CLTs.

In the traditional on-campus program, the education received was composed of three components. The first was the didactic or lecture component. This component was typically taught concurrently with the second component, which was the student laboratory. The third component was the clinical internship. The first two components, the didactic lectures and the student laboratories, were taught in face-to-face classrooms and student laboratories in a campus setting. The clinical internships were taught in a clinical laboratory at a hospital affiliate.

For the distance learning program, all students received their didactic educational material via distance learning. Non-laboratory trained students had student labs taught at the clinical internship site or a satellite student laboratory facility away from the main campus. The CLT to CLS distance students did not take the student laboratory courses due to previous laboratory training. All students performed their clinical internships at a clinical laboratory. The course work for both the on-campus programs and the distance learning programs were identical.

The researchers used a quantitative causal comparative research design, and after obtaining IRB approval collected the following anecdotal data: gender, age, overall admission GPA, math/science admission GPA, final GPA, and certification score on each graduate. The independent variable was the learning environment, either distance or on-campus. The dependent variable was the academic performance, measured by final GPA scores and certification scores.

Descriptive statistics were performed for gender and a chi-square test was performed to determine if there were any differences in gender between the two groups. Two-sample *t*-tests were performed to determine if there were any significant differences in age, overall admission GPAs, math science admission GPAs, final GPAs, and ASCP certification scores. For ASCP certification scores, the total scores and the scores from the subcategories were compared.

Correlation studies were performed to determine if there were any relationships between age, overall admission GPA, math science admission GPA, final GPA scores, and certification scores with the group as a whole and then within the two separate groups. If a relationship was found, then regression studies were performed.

## RESULTS

There were a total of 155 sets of student data included in the study. Of these 155 sets of data, 113 were on-campus students and 42 were distance students. One set of student data was not available for overall admission GPA and math science admission GPA. Not all students had taken the certification exam at the time this study was performed, so there were only 36 distance students' certification scores and 112 on-campus certification scores included in the study which accounted for 95% of the total sample.

Descriptive statistics for gender revealed that 80% percent of the on-campus students were female and 74% of the distance students were female. The Chi-square test was used to determine if there was any difference in gender between the two groups and this value was 0.61.

Two-sample *t*-tests were performed to determine if there were any significant differences between the two groups for age, overall admission GPA, and math science admission GPA. The mean age of the distance students was 33.88 and the mean age for the campus students was 25.91. The overall admission GPA for distance students was 3.14 and for campus students 3.03. The mean math science GPA for distance students and campus students was 2.93. The t-test values for these constructs are displayed in Table 1.

**Table 1.** *t*-test values for outcomes

| Outcome | On-campus mean | Distance mean | *t*-value |
|---|---|---|---|
| Age | 25.91 | 33.88 | -5.53** |
| Overall GPA | 3.03 | 3.14 | -1.58 |
| M/S GPA | 2.93 | 2.93 | 0.01 |
| Final GPA | 3.49 | 3.53 | -0.58 |
| Cert score total | 495.34 | 523.17 | -1.54 |
| Bld bank cert score | 499.89 | 530.72 | -1.24 |
| Chem cert score | 484.46 | 513.19 | -1.26 |
| Hema sert score | 511.96 | 526.72 | -0.60 |
| Immuno cert score | 502.28 | 511.56 | -0.40 |
| Micro cert score | 506.23 | 540.08 | -1.44 |
| UA cert score | 482.37 | 543.19 | -2.16* |

*$p<0.05$; **$p<0.01$
Abbreviations: bld bank = blood bank; cert = certification; chem = chemistry; hema = hematology; immuno = immunology; micro = microbiology; M/S = math science; UA = urinalysis

Academic performance was measured by comparing the final GPA scores and certification scores for the two groups. The two-sample *t*-test results for these analyses are shown in Table 1. The mean final GPA scores for the distance students and campus students were 3.53 and 3.49, respectively. The distance students' mean certification score of 523.17 was higher than the on-campus students' mean certification score of 495.34. The certification scores were further compared by performing analysis on the subcategories of the examination. The mean certification scores and *t*-test values for the subcategories are also displayed in Table 1.

Correlations were performed to determine if there were any relationships between age, overall admission GPAs, math science admission GPAs, final GPAs, and certification scores. The correlations were first performed with both distance and on-campus students in one group and then correlations were performed within the two separate groups. The correlation value for age and final GPA was 0.03 and for age and certification score it was 0.16. A correlation value of 0.36 was found for both overall admission GPA and final GPA and overall admission GPA and certification score. The correlation value was 0.35 for math science admission GPA and final GPA scores and 0.32 for math science admission GPA and certification scores. The final GPA scores and certification scores had a correlation of 0.62. Upon admission, the student GPAs

**Table 2.** Correlations and descriptive statistics for the entire sample

| Outcome | Age | Overall GPA | M/S GPA | Final GPA | Cert score |
|---|---|---|---|---|---|
| **Age** | --- | 0.072 | -0.056 | 0.033 | 0.162* |
| **Overall GPA** | 0.072 | --- | 0.861** | 0.356** | 0.355** |
| **M/S GPA** | -0.056 | 0.861** | --- | 0.348** | 0.318** |
| **Final GPA** | 0.033 | 0.356** | 0.348** | --- | 0.617** |
| **Cert score** | 0.162* | 0.355** | 0.318** | 0.617** | --- |
| **M** | 28.07 | 3.06 | 2.93 | 3.50 | 502.11 |
| **SD** | 7.89 | 0.38 | 0.46 | 0.35 | 94.96 |
| **n** | 155 | 154 | 154 | 155 | 148 |

*p<0.05; **p<0.01
Abbreviations: cert = certification; M = mean; M/S = math science; n = number; SD = standard deviation

were calculated for overall admission GPA and math science GPA, and this correlation was 0.86. These results are displayed in Table 2.

Regression analysis of the relationships between overall admission GPAs, math science GPAs, and final GPAs with certification scores revealed that an increase in the overall admission GPA of one point led to an increase in 89 points on the certification examination. An increase in the math science admission GPA of one point correlated with an increase in 66 points on the certification exam and an increase in the final GPA of one point led to an increase in 167 points on the certification examination.

The correlation values were similar when the correlations were performed within the two separate groups of distance learning and on-campus students for all of the constructs except age. The correlation value for age and final GPA for campus students was -0.14 and for distance students it was 0.35. The age and certification score correlation for campus students was 0.16 and for distance students it was 0.00.

## DISCUSSION

The descriptive statistics for gender show that there are more females enrolled in both the on-campus and distance programs than males. The Chi-square test reveals that there is no difference in gender between the two groups. However, there is a significant difference in the mean age between the two groups; on average the distance students are older than their on-campus counterparts.

The mean overall admission GPA for the distance students is slightly higher than the mean overall admission GPA for the campus students; however the difference is not significant. The mean math science GPAs for both groups are almost identical, so again the difference between the groups is not significant.

Final GPA scores and ASCP certification scores are a measure of academic performance. The statistical analysis reveals that there is no difference in the mean final GPA scores between the two groups. For certification scores, the distance students slightly outperform their on-campus counterparts, but again the difference is not significant. Analysis of the subcategories of the certification examination show that the distance students score higher than the on-campus students; however, the differences are not significant in any subcategories except for urinalysis. The distance students perform significantly better on the urinalysis subcategory than their on-campus counterparts.

Correlations studies for age, overall admission GPAs, math science admission GPAs, final GPAs, and certification scores for the distance students and campus students combined show that there is no significant correlation between age and final GPA scores. However, there is a significant but weak positive correlation between age and certification scores. There are also moderately significant positive correlations for overall admission GPAs with final GPA scores and certification scores. The same results are found with the math science admission GPAs and final GPA scores and certification scores. A moderate to strong correlation exists between final GPA scores and certification scores. The students' GPAs are calculated for overall admission GPA and math science admission GPA upon admission to the CLS program, and there is a strong correlation between these two values.

Regression analysis of the relationships between overall admission GPAs, math science GPAs, and final GPAs show that an increase in one point for the overall and math science admission GPA scores leads to a significant increase in certification scores. In addition, with an increase in one point on the final GPA scores there is a significant and even larger increase in the certification scores.

Correlations performed for age, overall admission GPAs, math science admission GPAs, final GPAs, and certification scores within the separate groups of distance learning students and on-campus students show similar results when the two groups are combined for all constructs except for age. There are some differences in the relationships between age and final GPA scores and age and certification scores. There is a significant but weak correlation between age and certification scores when both groups are together, however when the campus and distance students are separated there are no correlations between age and certification scores. There is no correlation between age and final GPA scores when the two groups are together, nor is there a correlation between age and final GPA scores for the campus students. However, there is a moderately significant positive correlation between age and final GPA scores for the distance students. It was theorized that the academic performance of older students returning to school would suffer because of lack of computer skills in today's online environments. But that correlation did not emerge in this study.

This study, comparing the academic performance of distance students and on-campus students in CLS, shows that distance students perform academically as well as their on-campus counterparts. These results are similar to what was found by Freeman[10]

and Olmsted.[11] Therefore, the results support the postulate that distance learning programs in CLS can be used successfully to educate clinical laboratory science professionals.

The correlation studies show that there are relationships between previous academic performance and academic performance in the CLS program. These relationships are the same for both the distance and on-campus programs. For this reason, the same admission criteria can be used for both distance and on-campus students in regards to previous academic performance.

As technology grows, distance learning will become more prevalent in higher education institutions. Entire programs are being offered via distance learning and they are created so the distance students never have to come to campus. CLS programs are not an exception to this statement. Future predictions for the clinical laboratory scientists' workforce numbers are dire. There are not enough scientists to fill the vacant positions and the majority of the workforce is over the age of 40. Educators are being pressured to educate more students in fewer programs and with decreased funding. With these types of constraints, distance learning becomes an attractive venue for educating the future professionals. Research such as this can reassure accreditating bodies, program directors, educators, and practitioners that distance learning programs in CLS can successfully educate new professionals. Future collaborative research studies need to be conducted that compare the academic performance of distance CLS graduates across the United States. Expanding graduate data to include more than one CLS program will reveal the true success of distance learning graduates.

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