COMPARISON OF STUDENT SUCCESS IN DIFFERENT TECHNOLOGY-BASED CLASSROOMS

Gregory L. Schwab
Indiana State University

ABSTRACT

Department of Aerospace Technology faculty questioned whether students were benefiting from the new technology that came with the opening of a new state-of-the-art classroom facility. The purpose of this quasi-experimental study was to compare scores of students using advanced technology course delivery methods with the scores of the students using the older course delivery methods as measured by overall class final scores. Two groups of students were presented identical lessons, one via traditional methods delivery. The other group received instruction using all classroom technology options available. The same instructor provided instruction to both groups. The results of the study support the alternative hypothesis in that there was a statistically significant difference at the .05 level between the students' mean grades using the two different course delivery methods at the two facilities. Students who received the same teaching materials but using the newer technology showed a statistically significant higher score as compared to those students who competed the same course work using the traditional methods.

INTRODUCTION AND BACKROUND

Nature of the Problem

The problem at Indiana State University (ISU) was that the Department of Aerospace faculty questioned whether the students were benefiting from the new technology that came with the opening of a new state-of-the-art classroom facility. Because data were not available to determine if a difference exists in student performance based on teaching the same Aerospace Technology (AST) course in using two different course delivery methods, the department chair requested a comparison of student performance. The department chair recommended teaching AST 305, Air Transportation, to two different groups using different delivery methods, to gather the data.

Purpose of the Study

The purpose of this study was to compare scores of students who completed AST 305 using modern delivery methods with the scores of the students who completed AST 305 using traditional methods, as measured by overall final class scores. The two classes were identified as AST 305A and AST 305B. The study was designed to determine whether the course delivery style correlated with students' level of performance. The data also provided a better understanding of the implications of technology in the classrooms to the faculty members.

Literature Review

The review of literature addressing technology in the classroom revealed that the state of current knowledge as related to technology in classrooms is rapidly evolving. Studies (Ehrmann, 1998; Knoke, 1997) show a strong influence of rapidly evolving technology on society and theories that lean toward including technology in the workplace (Gadbow & Hannah, 1998) as well as in education (Benjamin, 1989).

Although there are many examples of various uses of technology, these have not been sufficient to constitute a revolution in education (Ehrmann, 1998). According to Ehrmann, the most important barriers to using technology to help teachers expand the minds of their students have largely been economic barriers. Zuga (1994) argues that studies have been skewed in favor of curricular rather that economic realities. However, Zuga also supports that properly implemented, technology can have a positive effect on student success.

Even with the technology available, teachers seemed uncertain as to how to move forward and capture the imagination of students. Ehrmann (1998) disclosed several important concepts that should be addressed while fielding

technology for the classroom. First, technology alone does not determine learning outcomes. Ehrmann argues that learning outcomes are influenced by choices that faculty, students, and others make about the organization of teaching and learning, including those about content. Second, Ehrmann's study showed that it is difficult and sometimes impossible to evaluate local uses of technology by comparing learning outcomes. His study showed that the use of technology often involves changes in the goals of the program and thus in how student learning is assessed. Of particular interest to this study, is the discovery that some teaching and learning practices do cause improvement in learning outcomes.

Workplace Trends Pushing Technology into the Classroom

Poole (1998) argued that only about 22% of people entering the labor market possess the technology skills required for 60% of the new jobs by the year 2000. Her analysis includes Department of Education statistics stating that 59% of all students are utilizing computers in the classroom. Her study asks for clarification and further study to determine if schools are exposing and preparing students for their technological future.

Knoke (1997) found similar results, adding that technologies will allow anyone to work directly with anyone else and to work in a completely redefined marketplace. Many students entering this workforce should be prepared to deal with the rapidly evolving workplace. This challenge is compounded in that the human evolves much more slowly than technology and must constantly adapt. Judy and D'Amico (1997) suggested private sector competition might best be able to adapt students to the technology challenges of the near future.

There are strong arguments for educators to better prepare students for a lifetime of change that can be introduced through technology-assisted classrooms. Boyett (1996) discusses some key factors facing the 21st century workforce. He feels that tomorrow's workers will be more likely to log-on instead of punch a time card. Since the new technology will allow work from any location, many workers will be less inclined to be physically at an office. These workers are known as telecommuters. Telecommuting has grown as much as 20% per year with no short-term end in sight.

Hines (1994) suggests that there is little point in resisting the technology thrust in higher education. Education will simply fall into the demands of society. Properly guided by trained mentors, however, the teacher can become more of a facilitator and coach. Teachers will serve as the primary conduit of change for the student and will orchestrate the students' needs within the information world.

Losyk (1997) describes the younger student attending classes as Generation X. This generation has faced unique challenges growing up while the field of technology has rapidly evolved. However, demonstrated student attitudes toward technology in educational settings have been mixed. Waetjen (1985) asserts the goal of technology is to promote the field of study and expand the comprehension of the student in a broad way. To achieve this goal, students must be prepared to understand, control, and use technology in productive and effective ways.

Implementation of Computer Technology in Higher Education

Implementation of a course, program, or degree utilizing computer technology as a whole or as a component should not be rushed. Green (1997) points out that on too many campuses, great thinkers have come forward with good ideas, but most campuses fail to ensure a strategic plan is in place before jumping into the latest craze.

The government has implemented numerous incentives to encourage technology in classrooms. Former President Clinton awarded $43 million in grants to train teachers to use technology in classrooms. It is hoped the grants will be used to improve teacher training by using consortia universities in state and local school districts (Ganley, 2000).

A classic study (Baldridge & Okimi, 1982) pointed to strategic planning as being a key element to developing programs that fit the university's mission and purpose. Cohen (1998) points out that faculty members seem to behave as though they still have a prominent role in the

student's education. Cohen warns that if students do not accept and embrace the technology classroom, the classroom of the new century may not look all that different from the last.

METHODOLOGY

The research question for this quasi-experimental study was: "Will there be a significant difference in the final class score for students completing the course in AST 305B using advanced course delivery methods as compared to students enrolled in the same course in AST 305A using the traditional methods?"

The course used in this study was AST 305, Air Transportation. The same instructor using the same course materials in both class sessions, taught the course. Course materials included handouts and industry videos. The two course sessions were identified as AST 305A (traditional methods) and AST 305B (new technology methods).

The course delivery style of the classes was dependent upon the technology used in that class. Traditional instruction methods included utilizing classroom blackboards, overhead transparencies, and video presentations using a portable videocassette recorder and television. New technology methods included maximizing the use of the available master instructor computer console that permits the use of overhead computer presentations via the Internet, computer-based programs such as Microsoft PowerPoint, Excel, and real-time presentation of news, weather, or other information via television cable.

Research Hypothesis

The research hypothesis for this study was: "There is a significant difference in the final class scores between students who will complete the course using the new technology methods as compared to students who complete the same course using traditional methods." The research hypothesis was based upon teaching AST 305, Air Transportation. The dependent variable for this study was defined as the average final course grades and the independent variable for this study was the two teaching methods used in the classroom.

The research design was selected as the problem-solving method to acquire data on which to base management decisions. The researcher provided the same lectures and handouts to both class sessions. The instructional delivery system used by the instructor varied by class. AST 305A delivery presentations involved using the chalkboard, handouts, and overhead transparencies. AST 305B delivery allowed the integration of the Internet, overhead movie projection, and computer-based software programs and real-time presentation of news, weather, or other information via television cable. The independent variable for the study was the two teaching methods used in the facility classroom as measured by the dependent variable of the average final course grades.

Procedures

The data for this study were gathered by following specific procedures. First, the students were informed of the study during the first period of class. All students were provided a research consent form that specifically stated students would be allowed the opportunity to withdraw from the study at any time. Second, the original class was divided into two separate classes (AST 305A and AST 305B) and each class was provided the same lecture material throughout the course. Class lecture materials included handouts, worksheets, video presentations, and course tests. Third, a series of three comprehensive tests were administered throughout the 16-week course. No effort was made to "teach the test" to either class. Scores were carefully tabulated as the course proceeded, to ensure data integrity. Students in both sessions were provided status sheets that stated their progress in the course. Scores for each test were of equal value at 100 points each. Fourth, the data collected were evaluated using Microsoft Excel statistical software package. The results compared the class averages, mode and frequency. The results were tabulated and then analyzed to provide a comparison between AST 305A and AST 305B.

The population for this study was all-current and future students enrolled in classes at ISU Department of Aerospace Technology. The

intact sample group for this study included those students enrolled in AST 305, Air Transportation, during the fall 2001 semester. When the students registered for classes, they had no advance knowledge as to which delivery method they would be exposed. Thus, the population had no advance knowledge as to which treatment they would receive. Students were advised about the study on the first day of class and asked to sign the study consent form. All students agreed to the study and signed the provided consent forms.

The measurement that was used to measure the dependent variable was the average final course scores received for the comprehensive tests given throughout the 16-week fall semester of 2001. All tests that were given in this study were developed using a standardized instructor test bank (Wells, 1998). The tests were composed of multiple-choice and true/false questions. The questions on each test only addressed subject areas previously covered within the select chapters.

The experimental and control groups were treated as follows: both groups were provided the same lectures and course materials. The control group (AST 305A) was taught using traditional delivery methods such as the blackboard and overhead transparencies. The experimental group (AST 305B) was taught using the same lessons but using a delivery method that utilized state-of-the-art technology-based equipment such as computer interface presentations (Microsoft PowerPoint, Excel) and the Internet for real-time news, weather, or other information via television cable.

Scoring and Data Presentation

Scoring and data presentation for this study was limited to the comprehensive tests administered throughout the 16-week semester. The results compared the class averages, mode, and frequency of the AST 305A and AST 305B students' performance. Each 50-question test was scored with 2 points for each correct answer. Once tabulated, the data for the study were presented in descriptive tables and narrative text.

Data Analysis

The null hypothesis for this study was: "There is no statistically significant difference in mean scores in the required course at the .05 level between the two groups (AST 305A and AST 305B) receiving instruction in using two different delivery methods."

The alternative hypothesis for this study was: "There is a statistically significant difference in mean scores at the .05 percent level between the two groups (AST 305A and AST 305B) receiving instruction in two different facilities using two different delivery methods."

The level of significance for this study was at the $p < .05$ level. The null hypothesis would be rejected if there were a less than 5% probability of obtaining the observed difference by chance.

The two-tailed region of rejection for the null hypothesis is if the level of significance is greater than .05. The critical area under the curve that contains the values of the statistic and will allow for the rejection of the null hypothesis at an alpha level of .05.

A two-tailed t-test for independent samples was used for statistical test measurement. This t-test was selected because it is the appropriate statistical test to measure the differences between the control group and the experimental group to test the null hypothesis (McMillian & Schumacher, 1997).

The two-tailed t-test for independent samples used to determine the inferential statistic was the two-sample assuming equal variances. This test was selected to support the null hypothesis that there is no statistically significant difference in mean scores in the required course at the .05 level between the two groups (AST 305A and AST 305B) receiving the two different instruction methods.

The following assumptions were considered for this study: One, all students were enrolled to fulfill a graduation requirement and intended to graduate. Two, the learning environment was conducive to enhance better student performance. Three, the test questions selected from the standardized instructor master test bank reflected appropriate questions to ask for material covered.

The following limitations were inherent in this study: this study was tailored only to the class in the fall semester of 2001 at ISU. This study was not designed to allow application to

other similar institutions. Issac and Michael (1997) suggest the researcher should always consider the impact of external validity upon a study. This study can only be generalized to similar settings and conditions that took place during the study. Because no provisions were made to determine participants' technical abilities, the outcomes may not generalize to similar outcomes at other similar institutions.

RESULTS

The purpose of this study was to compare scores of students who completed AST 305 using modern delivery methods with the scores of the students who completed AST 305 using traditional methods, as measured by overall final class scores. The research question for this study was: "Will there be a significant difference in the final class score for students completing the course in AST 305B using advanced course delivery methods as compared to students enrolled in the same course in AST 305A using the traditional methods?"

Study enrollment consisted of 17 students in AST 305A and 23 students in AST 305B. Students were similar in that all attended classes were required as part of the student's degree. Other similarities included 95 percent male populations in each course section. Population differences between the classes were a factor of student preferences on class times as well as students that withdrew from class after the study began. Original enrollment consisted of 20 students in AST 305A and 24 students in AST 305B. Several students withdrew from AST 305 (in AST 305B, one student and in AST 305A, three students). Since all students voluntarily withdrew from this study prior to completing any tests, their data were deleted from this research.

The evaluation data were analyzed with a two-tailed, independent t-test, which compared the student's mean grades in the two classes based upon three in-class exams. The independent t-test was selected as the appropriate statistical procedure to test for differences between the two independent groups in the study because each respondent participated in only one of the two groups. The results of the t-test data showed that there was a statistically significant difference at the $p < .05$ level between the students' mean grades at the two facilities ($t(38) = 2.09$, $p<.05$ two-tail, critical value = 2.02).

Table 1 depicts the AST 305A student population and course test score results from tests 1-3 as well as their cumulative score for the entire course. The same instructor dispersed these tests throughout the 16-week semester. The students were exposed to the same course materials as AST 305B with the delivery style presentation differing because AST 305A (control group) was delivered using the traditional style.

The mean score for AST 305A was 206.82 with a standard deviation of 18.50. The final mode score for AST 305A was 196 with individual scores ranging from 166-236. The final mode score was only achieved by two students, indicating a wide set of scores by the class as a whole.

A review of the mode scores for AST 305A tests 1-3 reflects some variation throughout the course. Test 1 had 8 students scoring different modes, indicating no clear pattern with scores ranging from 42 to 82. Test 2 produced a mode result of 70 (4 students) with scores ranging from 52 to 76. Test 3 produced a two-mode result of 76 (4 students) and 72 (4 students) with scores ranging from 64 to 84. Students improved their scores with the passage of the class. Class test averages improved from 64.8% (test 1) to 66.7% (test 2) to 75.2% (test 3). The root cause of this improvement was not part of the present research. However, it could have been a function of low-technology preferences, students adjusting to low-technology instruction more quickly over time, or a problem with the sampling.

Table 1

Course Test Scores for AST 305A

Student Number	Test 1	Test 2	Test 3	Total Score
1	72	62	76	210
2	80	62	78	220
3	58	70	78	206
4	58	52	74	184
5	70	70	64	204
6	60	58	72	190
7	74	74	84	232
8	62	70	76	208
9	82	62	82	226
10	56	64	66	186
11	56	68	72	196
12	72	76	76	224
13	42	52	72	166
14	60	70	72	202
15	78	76	82	236
16	46	74	76	196
17	76	74	80	230

Note. Test scores were totaled to compare course mean scores with AST 305B.

Table 2 depicts the AST 305B student population and course test score results from tests 1-3 as well as the their cumulative score for the entire course. These tests were dispersed throughout the sixteen-week semester. The students were exposed to the same course materials as AST 305A but with different delivery styles. AST 305B (experimental group) was delivered using the newer technology.

The mean score for AST 305B was 221.13 with a standard deviation of 22.62. A review of the mode scores for tests 1-3 reflects some variation throughout the course. Test 1 had a mode score of 68 with scores ranging from 54 to 88. Test 2 produced three mode results of 66 (3 students), 80 (3 students) and 82 (3

students) with a range of 52 to 88. Test 3 produced a mode result of 74 (5 students) with a range of 58 to 94.

The final mode score for AST 305B was 232 with the range from 184-252. The final mode score of AST 305B was 56 points higher than the final mode score of AST 305A (196 points). It appears that, while modes were higher in AST 305B, the students did not experience an improvement in their scores with the passage of the class. Test averages remained relatively stagnant from 74.6% (test 1) to 72.5% (test 2) to 73.9% (test 3). As is evidenced by these scores, AST 305A did better on test 3 than AST 305B, but not significantly so.

Table 2

Course Test Scores for AST 305B

Student Number	Test 1	Test 2	Test 3	Total Score
1	76	78	94	248
2	88	82	74	244
3	68	64	66	198
4	84	82	80	246
5	66	52	66	184
6	80	62	74	216
7	84	84	84	252
8	86	74	72	232
9	72	80	80	232
10	82	80	70	232
11	88	86	74	248
12	68	88	76	232
13	74	68	70	212
14	56	66	70	192
15	54	62	64	180
16	80	82	86	248
17	82	80	74	236
18	70	66	70	206

(table continues)

Table 2 (Continued)

Student Number	Test 1	Test 2	Test 3	Total Score
19	78	76	74	228
20	72	66	58	196
21	64	58	72	194
22	78	68	72	218
23	68	64	80	212

Note. Test scores were totaled to compare course delivery styles with AST 305A.

Table 3 shows the descriptive statistics to ascertain characteristics and gather the facts of the different classes. The descriptive statistics provide support and development of the inferential statistics.

A summary of the descriptive statistics for the study is reported in Table 3. As reported in Table 3, the course grades of the students in AST 305B were higher than the course grades of the students in AST 305A. These data depict the study population of 40 with the mean and standard deviation of each class. AST 305A scored 206.82 with a standard deviation of 18.50. AST 305B scored 221.13 with a deviation of 22.62.

Table 3

Means and Standard Deviations for the Students' Grades

Condition	n	Descriptive Statistic
AST 305A	(17)	
M		206.82
SD		18.50
Variance		377.52
AST 305B	(23)	
M		221.13
SD		22.62
Variance		511.57

Note. Table 3 indicates that there was a difference between the two delivery methods. These data show AST 305A mean scores 15.89 points lower than AST 305B mean scores. Table 3 also depicts the variance level. This level reflects the relatively close results spread of the class score. t-Test for two-sample assuming equal variances can be reviewed in Appendix A.

Table 4 depicts the inferential statistics for this study. The two-tailed, independent t-test for two-samples assuming equal variances was selected, as the appropriate measurement

because the null hypothesis assumed there would be no statistically significant difference in mean scores in the required course at the .05 level between the two groups (AST 305A and AST 305B) receiving instruction using two different course delivery methods.

Table 4

Inferential Statistics for the Students' Grades using t-test for Independent Samples

	AST 305B	AST 305A
Mean	221.13	206.82
Hypothesized Mean Difference	0	
df	38	
t stat	2.09	
P(T<=t) two-tail	0.04	
t Critical two-tail	2.02	

Note. As reported in table 4, the inferential statistic analysis reflects a mean score of 206.8 for AST 305A and 221.1 for AST 305B. The complete t-Test for two-sample assuming equal variances can be reviewed in Appendix A.

These data reflect the total 40 observations (17 for AST 305A and 23 for AST 305B). The test result t-statistic is 2.09, which is greater than the critical value of 2.02 with 38 degrees of freedom at the alpha level of .05. The t-value of 2.09 falls in the central region (t-+/-2.02). The level of .04 is less than the level of significance of $p<.05$. Thus, limiting the possibility of a type I error except by chance occurrence because the probability of a type I error is equal to the alpha level. These data reflect a difference between AST 305A and AST 305B ($t(38) = 2.09$, $p<.05$ two-tail, critical value = 2.02). The t-test used to determine the inferential statistic was the two-sample assuming equal variances. This test was selected to support the null hypothesis that there is no statistically significant difference in mean scores in the required course at the .05 level between the two groups (AST 305A and AST 305B) receiving instruction in two delivery methods.

The results as determined by descriptive analysis, reported in Table 3 indicate, AST 305A scored 206.82 with a standard deviation of 18.50. AST 305B scored 221.13 with a deviation of 22.62. The course grades of the students in AST 305B were higher than the course grades of the students in AST 305A.

As reported in table 4, the inferential statistical analysis reflects a mean score of 206.8 for AST 305A and 221.1 for AST 305B. Inferential statistical analysis as determined by a two-tailed t-test for independent samples assuming equal variances indicated the test result t-statistic is 2.09, which is greater than the critical value of 2.02 with 38 degrees of freedom at the alpha level of .05. The t-value of 2.09 falls in the central region (t-+/-2.02). The level of .04 is less than the level of significance of $p<.05$. The possibility of a type I error is limited because the probability of a type I error is equal to the alpha level of .05. These data are significant and serve to reflect a difference between AST 305A and AST 305B ($t(38) = 2.09$, $p<.05$ two-tail, critical value = 2.02).

DISCUSSION

The results of this study did not support the null hypothesis in that there was a statistically significant difference at the .05 level between the two groups. The t-test used to determine the inferential statistic was the two-sample assuming equal variances. This test was selected to support the null hypothesis that there is no statistically significant difference in mean scores in the required course at the .05 level. Inferential statistical analysis as determined by a two-tailed t-test for independent samples assuming equal variances indicated the test result t-statistic is 2.09, which is greater than the critical value of 2.02 with 38 degrees of freedom

at the alpha level of .05. The t-value of 2.09 falls in the central region (t-+/-2.02). The level of .04 is less than the level of significance of p<.05. The possibility of a type I error is limited because the probability of a type I error is equal to the alpha level of .05.

The results of the study indicated support of the alternative hypothesis because the t-value of 2.09 falls in the central region (t-+/-2.02). The level of .04 is less than the level of significance of p<.05.

The results of this study support the work of Zuga (1994) that shows that properly implemented, technology can have a positive effect on student success. Poole (1998) professed that students who receive computer classroom training are more successful in the workplace. However, Hines (1994) suggests educational institutions must resist the temptation to jump into technology classrooms without a well thought out strategic plan. His studies revealed students become frustrated and bored easily when technology is thrown at them without a firm grasp on the purpose or direction. In addition, Losyk (1997) suggests that the students might be more skilled at computer technology than the educational institutions that attempt to implement new technologies.

CONCLUSIONS

The results of the study support the alternative hypothesis in that there was a statistically significant difference at the .05 level between the students' mean grades using the two different course deliver methods at the two facilities ($t(38) = 2.09$, $p<.05$ two-tail, critical value = 2.02). These data served to answer the research question in that there was a difference between the final grades mean test for students completing the course that were exposed to the newer technology delivery style as compared to students enrolled in the same course using the traditional methods. The students who participated in the course using the traditional course delivery methods (AST 305A) did not do as well as the students who participated in (AST 305B), the course using the advanced delivery methods.

Therefore, the null hypothesis, that there was no significant difference between the mean scores in the required course at the .05 level between the groups (AST 305A and AST 305B) receiving instruction using two different course delivery methods, can be rejected. The inferential statistics support acceptance of the alternative hypothesis because the inferential data indicated there was a statistically significant difference in mean scores at the .05 percent level between the two groups (AST 305A and AST 305B) receiving instruction in two different course delivery methods.

The literature review directly supported this study to determine if using technology in the classroom would result in improving student performance. Researchers (Hines, 1994, Poole, 1998, Zuga, 1994) found somewhat similar results in their studies. The addition of this research adds data to the growing evidence that implementation of technology is having a positive impact on student success.

Implications

The results of this study might infer faculty and administrative authorities in higher education should consider a quicker implementation of advanced delivery styles so that students are better prepared to enter the workforce. They also suggest faculty members should become prepared to use such technology before it becomes available. This study was designed to aid the decision-making process by providing data that did not previously exist. The data provided by this study should be used to stress the importance of using advanced technology options where available.

Since AST 305B did do slightly better than AST 305A, this study can only infer that the use of technology might improve other students exposed to the advantages of having technology in the classroom. However, the results of this study do not necessarily mean better scores in AST 305B were a function of what was tested. The correlation of the data from this study does not necessarily imply cause. As Losyk (1997) argued, many other factors can influence student performance, such as prior background, motivation, time of day classes are attended, or even sex of the student.

RECOMMENDATIONS

Several recommendations were drawn from this study. First, the data in this study suggest that students tend to perform better when utilizing the newer technology delivery style. This research should be presented to other departments at the university so that those departments considering implementation of advanced technology in the classroom might consider the findings of this research.

Second, special effort should be made to inform faculty members about the results of this study, which suggests students do perform better when exposed to the advanced course delivery methods. Third, a follow-up study to access which delivery styles students might prefer and what, if any, differences there are among students who might prefer one method to another may contribute additional answers to questions about technology in the classroom.

REFERENCES

Baldridge, J. V., & Okimi, P.H. (1982, October). Strategic planning in higher education. *AAHE Bulletin. 6,* 15-18.

Benjamin, S. (1989, March). An ideascape for education: What futurists recommend. *Educational Leadership,* 8-13.

Boyett, J.H. (1996). Twenty-first century workplace trends. *Horizon Home* [on-line], Retrieved September 14, 2001 from the World-Wide-Web: http://sunsite.unc.edu/horizon/gems/listarchive/96list/0097.html.

Cohen, A.M. (1998). *The shaping of American higher education: Emergence and growth of the contemporary system.* San Francisco, CA: Jossey-Bass.

Ehrmann, S.C. (1998). The flashlight project: Tools for monitoring the progress of our hopes and fears about technology in education. *The Technological Horizons in Education Journal,* 23-31.

Gadbow, N.F., & Hannah, S.A. (1998). *Book of readings: Societal factors affecting education.* [Course materials]. Fort Lauderdale, FL: Programs for Higher Education, Nova Southeastern University.

Ganley, S. (2000, June 9). Education Department Awards $43-Million to support technology in the classroom. *The Chronicle of Higher Education,* A30.

Green, K.C. (1997, October). Think twice and businesslike about distance education. *AAHE Bulletin, 3-6.*

Hines, A. (1994, January-February). Jobs and infotech: Work in the information society. *The Futurist,* 9-13.

Isaac, S., & Michael, W.B. (1997). *Handbook in research and evaluation: For education and the behavioral sciences.* San Diego, CA: Edits/Educational and Industrial Testing Services.

Judy, R.W., & D'Amico, C. (1997). *Workforce 2020.* Indianapolis, IN: Hudson Institute.

Knoke, W. (1997). *Bold new world: The essential road map to the twenty-first century.* New York, NY: Kodansha International.

Losyk, B. (1997, March-April). Generation X: What they think and what they plan to do. *The Futurist,* 33-44.

McMillian, J.H., & Schumacher, S. (1997). *Research in education: A conceptual introduction.* (4th ed). New York, NY: Harper Collins.

Poole, J.J. (1998, December). Schools have their computers, now what? *The Technological Horizons in Education Journal,* 60-61.

Waetjen, W.B. (1985). Technological literacy reconsidered. *Journal of Technology Education, 4(*2), 5-11.

Wells, A.T. (1998). *Instructor's test bank: Air transportation.* (4th ed). Belmont, CA: Wadsworth Publishing Company.

Zuga, K. (1994). *Implementing technology education: A review and synthesis of the literature.* Columbus, OH: ERIC Clearinghouse on Adult, Career, and Vocational Education.

Appendix A

t-Test: Two-Sample Assuming Equal Variances

t-Test: Two-Sample Assuming Equal Variances

	AST 305B	AST 305A
Mean	221.1304348	206.8235294
Variance	511.5731225	377.5294118
Observations	23	17
Pooled Variance	455.1336654	
Hypothesized Mean Difference	0	
df	38	
t Stat	2.096691851	
P(T<=t) one-tail	0.021365509	
t Critical one-tail	1.685953066	
P(T<=t) two-tail	0.042731017	
t Critical two-tail	2.024394234	