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A STUDY
TO COMPARE THE EFFECTIVENESS OF
TELETECHNET DISTANCE EDUCATION WITH
TRADITIONAL CLASSROOM EDUCATION
AMONG OLD DOMINION UNIVERSITY
INDUSTRIAL TECHNOLOGY GRADUATES
1998 – 2000

A Research Paper

Presented to the Graduate Faculty of the
Department of Occupational and Technical Studies,
Old Dominion University

In Partial Fulfillment
of the Requirements for the
Master of Science Degree

By

Robert J. Cartwright

March 31, 2002

SIGNATURE PAGE

This research paper was prepared by Robert J. Cartwright under the direction of Dr. John M. Ritz in OTED 636, Problems in Occupational and Technical Studies. It was submitted to the Graduate Program Director as partial fulfillment of the requirements for the degree of Master of Science in Occupational and Technical Studies.

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Research Advisor and
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Date: 4-2-02

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CHAPTER I

INTRODUCTION

Distance education is not new. Since Isaac Pitman started teaching shorthand by correspondence in 1849, students have been able to acquire new knowledge and skills with little or no need to sit in a traditional classroom. In 1934, the State University of Iowa began some televised course broadcasts (www.gospelcom.net/bakersguide/timeline.html, 2000), and in 1971 the Open University in the United Kingdom admitted its first students to degree programs that were largely based on television broadcasts (www.open.ac.uk/about/, 2000). Today, distance education is used increasingly in all spheres of education and training and is supported by a wide variety of media, from the printed word to interactive, virtual classrooms.

Old Dominion University in Norfolk, Virginia, offers a number of programs that are delivered solely by distance education. Indeed, it is possible for a student to qualify for a degree from Old Dominion without ever having set foot on the University's campus. An example is the Bachelor of Science (BS) degree in Occupational and Technical Studies; students earn their degrees by completing the first two years of coursework at a community college, the remaining coursework being provided by the University, primarily through the TELETECHNET distance learning system. TELETECHNET courses are broadcast from the Old Dominion campus, and received at community college or other remote sites, using audio and video technologies that give students

opportunity to interact with the instructor and with each other. The question arises: is such remote instruction as effective as that provided in a traditional classroom?

The BS degree in Occupational and Technical Studies allows for a range of emphases, one of which is Industrial Technology. Industrial Technology courses are offered both by TELETECHNET and in a traditional classroom setting on the University campus, thereby allowing direct comparison of academic achievement of the two methods. Such comparison is the focus of this study.

STATEMENT OF THE PROBLEM

The problem of this study was to compare the academic achievement of Old Dominion University Industrial Technology majors who have completed their studies using conventional classroom instruction with those who have used TELETECHNET distance education instructional methods.

HYPOTHESIS

The following hypothesis guided this research:

H₀: Among Old Dominion University Industrial Technology majors, there was no significant difference in academic achievement between those students who had been taught by conventional means and those that had used TELETECHNET distance education.

BACKGROUND AND SIGNIFICANCE

“Research studies have been quite consistent in finding that distance learning classrooms report similar effectiveness results as reported under traditional methods.”

(www.usdla.org.04_research_info.htm, 2000). This statement from the United States Distance Learning Association (USDLA), although in agreement with the hypothesis of this study, provides no supporting evidence to show that distance learning and traditional methods are, in fact, similarly effective. Nor does it indicate under what circumstances comparisons have been conducted. However, the Industrial Technology program at Old Dominion University provided an ideal situation for comparison; students in both distance education and traditional classes were taught identical material, completed identical examinations, and had identical requirements for submission of assignments. By comparing the grades awarded to the students, a true comparison of the effectiveness of the two learning environments was possible.

As Galbraith (1990, p. 389) pointed out, “Technology lets us do many things but does not ensure that they are the right things or that they are done well”. Technological progress has allowed Old Dominion to provide modern distance learning facilities; in turn, these have provided students remote from the campus with access to the same lectures, and lecturers, that were enjoyed by their on-campus colleagues. By comparing the performance of distance education and on-campus students, this study has attempted to show that Old Dominion University has “done the right things” and that it has done them equally well for all its students. Such validation of distance education would give

credence to the methods employed and enhance confidence in their suitability for future courses and programs.

LIMITATIONS

The study was subject to the following limitations:

- a. Only those students graduating from the Old Dominion University Industrial Technology program for the Bachelor of Science degree in Occupational and Technical Studies between fall 1998 and fall 2000 were considered.
- b. Assessment of academic achievement was limited to awarded grades and cumulative major grade point average.
- c. On-campus classes were not necessarily taught, nor graded by the same instructor as their corresponding off-campus classes.

ASSUMPTIONS

It was assumed that:

- a. Televised electronic instruction was as effective as that provided in the traditional classroom.
- b. A comparison of the grades awarded to students provided a valid comparison of the effectiveness of the type of instruction that they had received.

PROCEDURES

Grades awarded to Industrial Technology majors in those areas that were common to TELETECHNET and on-campus courses, and cumulative grade point average, were

obtained from Old Dominion University records. The raw grade data were grouped into sub-specialties (Technical Content, Supervision, and Business Cognate) and the results of the TELETECHNET and on-campus students compared; grade point average data were similarly compared. The significance of any relationship was tested by statistical method.

DEFINITION OF TERMS

The following terms are defined to ensure a common understanding between readers and the researcher:

- a. Distance Learning/Education. As defined by The United States Distance Learning Association, distance learning is: “The acquisition of knowledge and skills by mediated information and instruction.” (USDLA, 2000). The terms Distance Learning and Distance Education are taken to be synonymous.
- b. TELETECHNET. TELETECHNET is a distance learning system used by Old Dominion University that comprises broadcast television (one-way, lecturer to student) and two-way audio.
- c. Industrial Technology. Industrial Technology is a field of study designed to prepare technical and/or technical management-oriented professionals for employment in business, industry, education, and government. (NAIT, 2000, p. 1)
- d. Academic Achievement. For the purpose of this study, academic achievement is defined by the grade awarded.

- e. On-campus Student. An Old Dominion University undergraduate student, majoring in Industrial Technology, who has taken all relevant upper level courses by attending class at the Old Dominion campus.
- f. Off-campus student. An Old Dominion University undergraduate student, majoring in Industrial Technology, who has taken all relevant upper level courses via the TELETECHNET distance learning system.

OVERVIEW OF CHAPTERS

In Chapter I the concept of distance learning was introduced; the question was posed as to whether the instruction provided by the TELETECHNET distance learning system was as effective as that provided in the traditional classroom. The question was to be answered by this study, which sets out to compare the academic achievement, among Industrial Technology majors, between TELETECHNET and traditional students.

Chapter II provides a review of literature associated with distance learning (both in general and TELETECHNET in particular), with Industrial Technology, and with other research in this field. Chapter III describes the methods of data collection and how the data were analyzed. Chapter IV discusses the findings arising from the data analysis and, finally, Chapter V provides a summary of the study, its conclusions, and its recommendations.

CHAPTER II

REVIEW OF LITERATURE

This review of literature is presented in three sections. The first addresses distance education in general and the Old Dominion University TELETECHNET system in particular. The second describes the Industrial Technology curriculum at Old Dominion. Finally, the third section discusses previous research that has compared the effectiveness of distance education with traditional classroom methods.

DISTANCE EDUCATION

BACKGROUND

Willis (1994, p. 5) suggests that the first providers of distance education were itinerant wanderers delivering information by word of mouth, a practice that was only changed by the invention of writing and, more irrevocably, of printing. Although Gutenberg developed his printing press in the 15th century (Volti, 1995, p. 177), it was not until 1840 that Pitman started his correspondence courses. This four hundred-year difference can be attributed to the fact that there was, in the meantime, no practicable way of transporting large amounts of correspondence. Pitman was able to capitalize on the 1840 introduction of the Uniform Penny Post (www.lutterworth.com/lp/titles/penny.htm, 2000), itself made feasible only by the development of regular rail services in the United Kingdom (www.charmec.chalmers.se/railtech/history.html, 1999).

It is evident, then, that distance education is dependent on a practicable medium for transferring information between teacher and student. At first the medium was print, delivered by postal services, and correspondence courses still play a significant role in distance education throughout the world (Willis, 1994, p. 109). However, technological developments in the 20th century have greatly facilitated the growth of distance education systems which make use of electronic media, ranging from radio broadcasting in the 1930s, through television, to the interactive, networked computer systems available today.

The gulf between correspondence-based distance education and those systems that utilize some form of interactive telecommunication is so great that a categorization system that separates the two has been proposed (Harry, John, & Keegan, 1993, p. 41). The proposal is based on the characteristics of correspondence based systems, namely that the student is not only separated from the teacher physically, but also separated from the teacher in time, and learns independent of contact with either teacher or with other students. In this context, correspondence systems are not limited to those which utilize only print; for instance, video tapes or even live broadcasts that do not permit interaction are included in this category. In comparison, interactive telecommunications based distance education can deliver simultaneous broadcast instruction from a host site to distant sites that can be supplemented by live audio and/or video interaction between teacher and students, and between the students themselves (Harry et al, p. 40). It follows that the characteristics required of distance education students using correspondence-type systems need not

necessarily apply to those using interactive telecommunications based instruction; these characteristics include maturity, high motivation, and extraordinary commitment (Souder, 1993, p. 50).

The categorization system referred to above further subdivides telecommunications based systems into five sub-categories, depending on the degree of interaction made possible (Harry et al., p. 41). The sub-categories are:

- Two-way voice link, two-way video (full-motion): highest interaction
- Two-way voice link, two way video (freeze frame)
- Two way voice link, one-way video (full motion)
- Two way voice link, one-way video (freeze frame)
- Two way voice link only: lowest interaction

The TELETECHNET system used by Old Dominion falls into the middle sub-category.

TELETECHNET

Old Dominion University's TELETECHNET system comprises four components. The primary instructional component is the satellite broadcast of video and audio, usually from the main campus, which is received at 50 remote sites. These are located throughout Virginia and as far afield as Washington. This one-way live broadcast, classified as *synchronous* (Willis, p. 170), is supplemented by two-way telephone links that enable students at all sites to talk not only to the instructor but also to each other – a form of *teleconferencing* (Willis, p. 137). The third component of the system is the use of e-mail: students at remote sites submit assignments to the instructor by this medium.

The final component is the express delivery of paperwork (returned homework, examination papers, etc.) between the Old Dominion campus and the remote sites.

Students attending TELETECHNET classes on the University campus use a broadcast studio that has been modified to serve also as a traditional classroom. The instructor, of course, uses the same classroom, but his picture, his words, and the images of the visual aids that he uses, are synchronously broadcast to the remote sites as he works. In this scenario, the TELETECHNET system provides all students, be they on-campus or at remote sites, identical instruction: all see and hear exactly the same lectures, have exactly the same access to the instructor, and complete exactly the same assessment processes. However, the majority of on-campus students, although taking the same courses (same course number, same material, and same assignments) as TELETECHNET students, do so in a traditional classroom quite separate from the TELETECHNET system. Furthermore, the instructor that teaches the TELETECHNET classes does not necessarily teach these on-campus students. Nevertheless, for the purposes of this study, all on-campus students were grouped together, regardless of the type of class they attended.

INDUSTRIAL TECHNOLOGY

Although not accredited, the Old Dominion University degree requirements for Industrial Technology follow the guidelines laid down by the National Association of Industrial Technology (NAIT) for baccalaureate degree programs (NAIT, 2000, p. 2). That is, the program:

- Is designed to prepare management-oriented technical professionals,

- Includes at least the junior and senior years of a baccalaureate program, with appropriate lower division course work from Old Dominion or from associated community colleges or technical institutes.
- Prepares students for technical management positions in areas such as industrial planning, production, supply, product market research, and technical sales.

DEGREE REQUIREMENTS

The Old Dominion University Catalog for 2000 – 2002 describes the BS degree in Occupational and Technical Studies, Industrial Technology emphasis, as a 120-hour program designed to prepare students to enter industry as supervisors or technical managers or trainers. Requirements for graduation include a minimum cumulative grade point average of 2.00 overall and in the major, 120 credit hours, passage of the Exit Examination of Writing Proficiency, and completion of Senior Assessment. The detailed degree requirements are listed in Table 1 (Lower Division General Education), Table 2 (Technical Content), Table 3 (Supervision), Table 4 (Business Cognate), and Table 5 (Upper Division General Education).

Old Dominion students undertaking an off-campus degree in Industrial Technology typically complete the lower level requirements at a community college or similar center of learning before going on to complete the upper level requirements with Old Dominion by TELETECHNET. On-campus students, having completed the lower level requirements on-campus, undertake the same upper level classes as their off-campus

colleagues. However, it should be noted that some distance learning or other transfer students may have developed a specialized technical background, compared with on-campus students who have a generalized technical background from the courses listed at Table 2. Such specialized background could have been gained from other classes for which they have been granted credit in the Industrial Technology program; the approved specialist technical areas are listed at Table 6.

Table 1 – Lower Division General Education

Subject	Credit Hours
Written communication	6
Oral communication	3
Mathematics	6
Foreign Language	0-6
Computer skills	3
Fine and performing arts	3
History	3
Literature	3
Philosophy	3
Natural Science and technology	11
Social science	3

Table 2 – Technical Content

Subject	Credit Hours
OTS 111 – Drafting and design	3
OTS 221 – Industrial materials	3
OTS 231 – Materials and process technology	3
OTS 241 – Energy systems: basic electricity	3
OTS 242 – Energy systems: electronic communication	3
OTS 243 – Energy and power	3
OTS 321 – Manufacturing technology	3
OTS 323 – Production technology	3
OTS 351 – Communication technology	3
OTS 370 – Technology and society	3
OTS 382 – Industrial design	3

Table 3 - Supervision

Subject	Credit Hours
OTS 202 - Supervision of personnel	3
OTS 402 - Training methods	3
OTED 400 – Instructional design and development	3
PSYC 303 – Industrial/organizational psychology	3
COUN 343 – Human service counseling methods	3

Table 4 – Business Cognate

Subject	Credit Hours
ACCT 201 – Principles of accounting	3
MGMT 325 – Principles of management	3
MGMT 340 - Human resources management	3
MKTG 311 – Marketing principles and problems	3
Approved business electives	9

Table 5 – Upper Division General Education

Subject	Credit Hours
Option A	Approved minor, 12 – 24 hours; also second degree or second major.
Option B	Cluster, 9 hours. (3 hours may be in the major area of study, e.g. Impacts of Technology or Business Ethics)
Option C	International certificate, 12 hours.

Table 6 – Approved Technical Areas

Information Systems Technology
Networking
Microcomputer Specialist
IST Applications Development
Mechanical Technology
Electronic Technology
Pulp and Paper Technology
Printing Technology
Environmental Protection
General Engineering Technology
Drafting and Design
Electronics Analyst
Electronics Equipment Servicing Consumer Electronics Industrial Electronics
Precision Machining Technology

OTHER RESEARCH

The previously quoted USDLA statement, that “Research studies have been quite consistent in finding that distance learning classrooms report similar effectiveness results as reported under traditional methods” is, in fact, supported by numerous studies. For example, Sounder (1993) examined the relative effectiveness of distance education in three Management of Technology master’s degree programs. Sounder taught the same course at the Georgia Institute of Technology (GaTech), at the University of Alabama in Huntsville (UAH), and at the National Technological University (NTU). Traditional delivery modes were used at GaTech (13 students) and UAH (20 students); distance delivery utilizing satellite-broadcast television was used at NTU (24 students) (pp. 38-39). The study found that, as measured by examinations, term papers, and homework assignments, distance learners performed as well or better than traditional learners (p. 50).

MacFarland (1999) examined the matriculation status of all fall term 1993 students at the Fischler Graduate School of Education and Human Services, Nova Southeastern University. Data on 1,584 campus-based students and 2,602 distance education students showed that, for master’s-level and educational specialist students there was no significant difference between the two groups regarding frequency of successful matriculation. It is interesting to note, however, that for doctoral students, the on-campus group performed significantly better.

Although not a study of effectiveness, Bisciglia's work (1999), which examined attitudes toward TELETECHNET by comparing Old Dominion students on-campus with those at remote sites, is of interest. Bisciglia examined 238 students, 200 of whom took TELETECHNET classes at remote sites whilst the remaining 38 took the same classes in the campus studio. Six separate classes were involved and 36 sites, including the campus studio. The remote sites, which represented all types (community colleges, businesses, hospitals, and learning centers), were located in Virginia, North Carolina, Indiana, and Washington.

In comparing TELETECHNET with other forms of distance education, Bisciglia (p. 11) quotes Keegan (1986, pp. 74 – 78), who said of distance education that "The learner must act as an independent agent and rely on himself rather than structure from the teacher." and that ". . . as the individual moves further away in distance, as well as increasing the level of autonomy, the student will need to have a greater degree of self-motivation." As Bisciglia (p. 14) points out, these comments are not necessarily applicable to TELETECHNET, which allows for little independence: the distant student is required to attend class at the same time, and to submit assignments by the same due date, as the students attending the class in the campus studio. Although Bisciglia's results (p. 73) showed that students at remote sites had a more positive attitude to distance learning than those in the studio, he also established (p. 78) that, as far as motivation to do well was concerned, there was no significant relationship with where students attended class. With regard to the last point, however, it would be prudent to take heed of Bisciglia's note of caution: all the students that he studied were "non-traditional learners" (i.e., they were all

over 25 years old), and their responses to the motivation question may have included bias (they perhaps did not want to admit to poor motivation).

SUMMARY

Distance education depends on some form of delivery medium, which can range from the exchange of printed materials, through broadcast television, to fully interactive computer-based systems. The nature of the medium dictates the style of learning and the more interactive systems replicate, rather than replace, the traditional classroom. Old Dominion University's TELETECHNET is one such interactive system and it is used in the Industrial Technology classes that are the focus of this study. Research has already shown that there appears to be little difference in educational effectiveness between interactive distance learning and the traditional classroom. Chapter III of this report will describe the methods and procedures used to gather and analyze the data used to compare the effectiveness of TELETECHNET and traditional classroom instruction among Industrial Technology students at Old Dominion.

CHAPTER III

METHODS AND PROCEDURES

This chapter describes the methods and procedures used in this descriptive study. The population under study is identified, the design of the instrument used and the methods of data collection are described, as is the type of statistical analysis performed.

POPULATION

The population under consideration in this study consisted of 36 Old Dominion University students that graduated from the Industrial Technology program for a BS degree in Occupational and Technical Studies between Fall 1998 and Fall 2000 inclusive. Of the 36, 17 attended most upper-level classes on-campus while 19 attended similar classes at remote sites using the TELETECHNET distance learning system.

INSTRUMENT DESIGN

The instrument used in this study was designed to establish the statistical difference between the grades earned by two groups of students, all of whom undertook the same classes related to the Industrial Technology major. One group, the off-campus students, took most classes via the TELETECHNET system whilst the second group, the on-campus students, took comparable classes at the Old Dominion Norfolk campus. Not all of the classes listed in Chapter II as being required for the BS degree in Occupational and Technical Studies (Industrial Technology emphasis) were available via the

TELETECHNET system during the period under consideration. Consequently, it was possible to directly compare only those classes listed at Table 7.

Table 7 – Classes Compared in the Study

Subject Area	Designator	Subject
Technical	OTS 351	Communications technology
Technical	OTS 370T	Technology and society
Supervisory	OTS 402	Training methods
Supervisory	OTED 400	Instructional design and development
Supervisory	PSYC 303	Industrial/organizational psychology
Supervisory	COUN 343	Human service counseling methods
Business	MGMT 325	Principles of management
Business	MKTG 311	Marketing principles and problems

METHODS OF DATA COLLECTION

Using Old Dominion University records, individual subject grades from the classes listed at Table 7 and students' overall grade point averages were collected for Industrial Technology students that graduated between Fall 1998 and Fall 2000 inclusive. These were accessed by the research advisor from the University's student records; the identities of the students were kept confidential.

STATISTICAL ANALYSIS

Grades for all students from the applicable classes were separated into two sub-groups: those awarded to on-campus students and those awarded to off-campus students. Within each sub-group, the grades were divided into the three subject areas: technical, supervisory, and business. The average (mean) grade in each subject area was then calculated for both on-campus and off-campus students. These subject area statistical means for on-campus and off-campus students were then compared, using t-tests, to establish the statistical significance of any difference. Similarly, the mean overall grade point averages (GPA) of on-campus and off-campus students were calculated and the significance of any difference was again established by applying the t-test.

SUMMARY

This chapter established that the population under consideration in this study consisted of 36 students, of whom 17 were considered on-campus and 19 off-campus. The classes that were compared in the search for any statistically significant difference between on- and off-campus student performance were identified. The data used were described as grades and grade-point-averages collected from Old Dominion University records. Finally the statistical method used was identified as the comparison of means by t-tests. In Chapter IV, the statistical analysis of data will be pursued and the subsequent findings presented.

CHAPTER IV

FINDINGS

This chapter describes the data collected and the statistical analysis performed on the data in attempting to answer the problem of the study. The problem was to compare the academic achievement of Old Dominion University Industrial Technology majors who have completed their studies using conventional classroom instruction with those who have used TELETECHNET distance education instructional methods.

DATA

The grade data that were collected from University records are shown below in Tables 8 to 11. Table 8 contains data for the technical subject area, Table 9 data for the supervisory subject area, and Table 10 data for the business subject area. Table 11 contains data relating to overall GPA. The data are shown in the form of numerical grades; letter grades were converted to numeric values using the same equivalence as that used by Old Dominion University to calculate GPA, as follows:

<u>Grade/Equivalent</u>	<u>Grade/Equivalent</u>	<u>Grade/Equivalent</u>	<u>Grade/Equivalent</u>
A = 4.0	B+ = 3.3	C+ = 2.3	D+ = 1.3
A- = 3.7	B = 3.0	C = 2.0	D = 1.0
	B- = 2.7	C- = 1.7	D- = 0.7

Table 8 – Data for the Technical Subject Area

On-campus Grades		Off-campus Grades	
OTS 351	OTS 370	OTS 351	OTS 370
4.0	4.0	4.0	3.0
2.3	3.0	3.7	4.0
4.0	4.0	4.0	4.0
3.7	3.3	4.0	3.0
3.7	4.0	4.0	4.0
3.7	4.0	4.0	4.0
3.7	3.3	4.0	4.0
3.0	2.0	3.7	4.0
2.0	2.0	3.7	4.0
3.0	4.0	4.0	4.0
4.0	3.7	4.0	4.0
3.3	4.0	4.0	4.0
2.3	3.0	4.0	4.0
3.0	4.0	3.7	2.0
3.7	4.0	3.7	4.0
3.3	4.0	4.0	4.0
		3.7	4.0
		4.0	3.0
		3.7	
$\Sigma = 52.7, n = 16$	$\Sigma = 56.3, n = 16$	$\Sigma = 73.9, n = 19$	$\Sigma = 67.0, n = 18$
Combined $\Sigma = 109.0, n = 32, \text{mean} = 3.41$		Combined $\Sigma = 140.9, n = 37, \text{mean} = 3.81$	

Table 9 – Data for the Supervisory Subject Area

On-campus Grades				Off-campus Grades			
OTS 402	OTED 400	PSYC 303	COUN 343	OTS 402	OTED 400	PSYC 303	COUN 343
4.0	2.7	2.7	3.3	4.0	1.7	1.7	2.7
4.0	3.3	3.0	3.0	4.0	3.7	3.3	3.7
4.0	4.0	4.0	3.7	4.0	2.7	3.3	3.7
4.0	3.0	3.7	3.7	4.0	3.7	3.3	4.0
3.0	3.0	3.0	4.0	4.0	3.7	4.0	3.3
4.0	3.0	2.7	2.7	4.0	3.7	3.0	3.3
4.0	2.7	3.0	1.3	4.0	4.0	3.0	4.0
4.0	2.0	3.0	1.7	4.0	3.3	4.0	4.0
3.0	0.7	1.3	2.7	4.0	2.7	2.7	3.3
3.0	2.7	2.3	2.3	4.0	2.0	4.0	4.0
3.0	2.3	2.0	3.0	4.0	4.0	3.7	3.3
3.3	3.7	1.7	1.7	4.0	3.0	3.0	3.7
3.0	2.7	2.7	3.3	4.0	2.7	3.3	3.0
4.0	3.3	2.7	3.0	4.0	3.3	3.7	3.7
4.0	2.3	3.7	3.0	2.0	3.7	2.7	3.0
	3.7	3.3	3.7	4.0	2.7		3.0
				3.0	3.0		3.3
				4.0	2.0		
				4.0	3.7		
					3.3		
$\Sigma = 54.3,$ $n = 15$	$\Sigma = 45.1,$ $n = 15$	$\Sigma = 44.8,$ $n = 16$	$\Sigma = 46.1,$ $n = 16$	$\Sigma = 73.0,$ $n = 19$	$\Sigma = 62.6,$ $n = 20$	$\Sigma = 48.7,$ $n = 15$	$\Sigma = 59.0,$ $n = 17$
Combined $\Sigma = 190.3, n = 63, \text{mean} = 3.02$				Combined $\Sigma = 243.3, n = 71, \text{mean} = 3.43$			

Table 10 – Data for the Business Subject Area

On-campus Grades		Off-campus Grades	
MGMT 325	MKTG 311	MGMT 325	MKTG 311
3.0	3.0	2.0	1.0
4.0	2.7	2.0	3.3
2.3	2.7	3.0	3.7
3.0	3.0	3.0	3.7
1.0	1.0	3.0	3.3
3.3	3.3	4.0	2.7
2.0	2.3	2.0	2.0
2.3	1.0	1.7	3.0
3.0	1.0	3.0	4.0
2.0	2.3	4.0	2.7
1.0	2.0	2.3	3.0
3.0	1.7	2.0	3.0
0.7	1.3	2.0	3.3
2.0	4.0	2.0	2.7
2.7	3.0	1.7	2.3
3.0		3.0	2.7
		3.3	4.0
		2.0	2.7
$\Sigma = 38.3, n = 16$	$\Sigma = 34.3, n = 15$	$\Sigma = 46.0, n = 18$	$\Sigma = 53.1, n = 18$
Combined $\Sigma = 72.6, n = 31, \text{mean} = 2.34$		Combined $\Sigma = 99.1, n = 36, \text{mean} = 2.75$	

Table 11 – Grade Point Averages

On-campus Grades	Off-campus Grades
3.55	2.31
2.62	3.53
3.86	3.27
2.86	3.61
3.11	3.43
2.41	3.74
3.17	3.27
2.60	3.21
2.49	3.16
2.20	4.0
2.35	3.02
2.57	3.43
2.95	3.20
2.10	3.53
2.11	2.67
3.25	2.85
3.36	3.00
	3.77
	2.89
$\Sigma = 47.56, n = 17, \text{mean} = 2.80$	$\Sigma = 61.89, n = 19, \text{mean} = 3.26$

ANALYSIS OF THE DATA

Within each subject area, and for overall GPA, the differences between the mean grades for on-campus and off-campus students were calculated. It was noted that for all three program subject areas, and for overall GPA, the mean grades achieved by the on-campus students were lower than those achieved by off-campus students. It was necessary to determine whether these differences were statistically significant. The differences were therefore tested for statistical significance using the t-test. In each case, the value of t

was calculated using the formula:

$$t = \frac{m_1 - m_2}{\sqrt{\frac{(\sum d_1^2 + \sum d_2^2) (n_1 + n_2)}{(n_1 + n_2 - 2) (n_1 \times n_2)}}$$

where: $m_1 - m_2$ represents the difference between the means.
 d_1, d_2 represent the differences between individual grades and the respective means.
 n_1, n_2 represent the number of grades in each sample

As this study was based on a null hypothesis, the two-tailed t-test of significance was used.

TECHNICAL SUBJECT AREA

The difference between the means (3.41 for on-campus students and 3.81 for off-campus students) was 0.4; this yielded a calculated value of t of 3.08. The two-tailed t-test tables, entered with 67 degrees of freedom ($n_1 = 32, n_2 = 37, \text{degrees of freedom} = 32+37-2 = 67$), yielded t values of 1.671 at the 95% confidence level and 2.39 at the 99% confidence level.

SUPERVISORY SUBJECT AREA

The difference between the means (3.02 for on-campus students and 3.43 for off-campus students) was 0.41; this yielded a calculated value of t of 3.42. The two-tailed t-test

tables, entered with 132 degrees of freedom ($n_1 = 63$, $n_2 = 71$, degrees of freedom = $63+71-2 = 132$), yielded t values of 1.658 at the 95% confidence level and 2.358 at the 99% confidence level.

BUSINESS SUBJECT AREA

The difference between the means (2.34 for on-campus students and 2.75 for off-campus students) was 0.41; this yielded a calculated value of t of 2.05. The two-tailed t-test tables, entered with 65 degrees of freedom ($n_1 = 31$, $n_2 = 36$, degrees of freedom = $31+36-2$), yielded t values of 1.671 at the 95% confidence level and 2.39 at the 99% confidence level.

OVERALL GPA

The difference between the means (2.80 for on-campus students and 3.26 for off-campus students) was 0.46; this yielded a calculated value of t of 2.875. The two-tailed t-test tables, entered with 34 degrees of freedom ($n_1 = 17$, $n_2 = 19$, degrees of freedom = $17+19-2$), yielded t values of 1.69 at the 95% confidence level and 2.44 at the 99% confidence level.

SUMMARY

This chapter restated the problem of the study, which was to compare the academic achievement of Old Dominion University Industrial Technology majors who have completed their studies using conventional classroom instruction with those who have used TELETECHNET distance education instructional methods. The data collected for

the study were tabulated by subject area (technical, supervision, and business) and overall GPA; in each, means grades for both on-campus and off-campus students were calculated. The differences between each set of means were determined and t-tests were conducted to establish the statistical significance of the differences.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY

Distance education is well established as an alternative to traditional classroom instruction. However, to assess the relative effectiveness of distance education it is necessary to compare its results with those achieved in the traditional classroom. Old Dominion University offers some of the classes in its Industrial Technology BS program by both methods, providing an opportunity for direct comparison. Therefore, the problem of this study was to compare the academic achievement of Old Dominion University Industrial Technology majors who have completed their studies using conventional classroom instruction with those who have used TELETECHNET distance education instructional methods.

Eight classes in the Industrial Technology program are offered by both conventional classroom instruction and by the TELETECHNET distance learning method. The grades achieved in these classes by students that graduated from the Industrial Technology program between Fall 1998 and Fall 2000 inclusive were compared, as were the students' overall GPA. The eight classes were grouped into three subject areas – technical, supervisory, and business - and the average (mean) grades achieved in each area by on-campus and off-campus students were determined. The significance of any difference in

the means was established by means of t-tests. The mean overall GPA of both on-campus and off-campus students were similarly compared.

CONCLUSIONS

The findings of the study were analyzed with the aim of verifying the hypothesis that guided the study. That hypothesis was:

H₀: Among Old Dominion University Industrial Technology majors, there was no significant difference in academic achievement between those students who had been taught by conventional means and those that had used TELETECHNET distance education.

TECHNICAL SUBJECT AREA

In the technical subject area, the calculated value of t exceeded the value tabulated for the 99% confidence level. The difference between the means was therefore statistically significant and the hypothesis, that there was no significant difference between on-campus and off-campus students, was rejected with 99% confidence. It was therefore concluded that, in the technical subject area, those students that completed their studies using the TELETECHNET distance education instructional methods achieved significantly better academic results than those that experienced traditional classroom methods.

SUPERVISORY SUBJECT AREA

In the supervisory subject area, the calculated value of t exceeded the value tabulated for the 99% confidence level. The difference between the means was therefore statistically significant and the hypothesis, that there was no significant difference between on-campus and off-campus students, was rejected with 99% confidence. It was therefore concluded that, in the supervisory subject area, those students that completed their studies using the TELETECHNET distance education instructional methods achieved significantly better academic results than those that experienced traditional classroom methods.

BUSINESS SUBJECT AREA

In the business subject area, the calculated value of t exceeded the value tabulated for the 95% confidence level. The difference between the means was therefore statistically significant and the hypothesis, that there was no significant difference between on-campus and off-campus students, was rejected with 95% confidence. It was therefore concluded that, in the business subject area, those students that completed their studies using the TELETECHNET distance education instructional methods achieved significantly better academic results than those that experienced traditional classroom methods.

OVERALL GPA

In the context of overall GPA, the calculated value of t exceeded the value tabulated for the 99% confidence level. The difference between the means was therefore statistically

significant and the hypothesis, that there was no significant difference between on-campus and off-campus students, was rejected with 99% confidence. It was therefore concluded that, considering overall GPA, those students that completed their studies using the TELETECHNET distance education instructional methods achieved significantly better academic results than those that experienced traditional classroom methods.

ACCEPTANCE OR REJECTION OF THE HYPOTHESIS

The results of the study indicate that the hypothesis can be rejected with 95% confidence in the business subject area; in the technical and supervisory subject areas, and for overall GPA, the hypothesis can be rejected with 99% confidence. It is therefore concluded that, among Old Dominion University Industrial Technology majors, those that completed their studies using the TELETECHNET distance education instructional methods achieved significantly better academic results than those that experienced traditional classroom methods.

RECOMMENDATIONS

This study examined only a small sample of students. Furthermore, it took no account of the educational backgrounds of the students, nor their motivations. In addition, accurate comparison of on-campus and off-campus student achievements was made difficult because of an important variable that was not taken into account: that is that comparable classes were not necessarily taught, nor graded, by the same instructor. It is therefore

recommended that further study be directed to this problem, if possible without the limitations to which this study was subject.

Despite its limitations, the study gave strong indications that students using the TELETECHNET distance learning methods achieve better academic results than their counterparts using traditional classroom methods. It is therefore recommended that Old Dominion University continue to deliver classes using the TELETECHNET system. It is further recommended that the Department of Occupational and Technical Studies at Old Dominion University continue to recruit students into the Industrial Technology program and provide for the education of these students by televised distance education methods

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