A COMPARISON OF ATTITUDES TOWARD AND ACHIEVEMENT IN
BIOLOGY AND DESCRIPTIVE CHARACTERISTICS BETWEEN
COMMUNITY COLLEGE STUDENTS ENROLLED IN
ALTERNATIVE INSTRUCTIONAL MODES

DISSERTATION

Presented to the Graduate Council of the
North Texas State University in Partial
Fulfillment of the Requirements

For the Degree of

Doctor of Philosophy

by

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Robertson, Carolyn C., A Comparison of Attitudes Toward and Achievement In Biology and Descriptive Characteristics Between Community College Students Enrolled In Alternative Instructional Modes. Doctor of Philosophy (Higher Education), August, 1982, pp. 97, 20 tables, bibliography, 40 titles.

The problem of this study was a comparison of attitudes toward and achievement in biology between students enrolled in an introductory biology course taught using instructional television and as taught at Tarrant County Junior College South Campus in the spring semester of 1982.

Data were gathered using three instruments: a semantic differential to assess attitude, an achievement test keyed to the course objectives, and a student profile information sheet. The data were coded onto computer sheets for processing. Statistical procedures used for analysis of the data included the t-test for related samples, t-test for independent samples, analysis of covariance, and Chi-square analysis of the profile data.

Several findings resulted from this study: There was no significant difference between the pretest mean scores of the two groups on the attitude test; there was no significant difference between the pretest mean scores of the
two groups on the achievement test; the instructional television students in general were more mature than the "on-campus" students, married, worked full-time, attended school part-time, and had completed thirty or more college credit hours prior to enrolling in the introductory biology course; the "on-campus" students were younger than the instructional television students, single, worked part-time and had completed less than thirty college credit hours prior to enrolling in the introductory biology course.

Recommendations included the following: Faculty involved in planning for "on-campus" biology course materials should reassess the organization of those materials; producers of instructional television courses should use the profile (demographic) information obtained in this and other studies when preparing telecourse materials in order that the appropriate target student audience will be served with the telecourse lessons and support materials; a more in-depth study involving other institutions correlating the demographic data with achievement test scores, attitude scores and course grades is recommended.
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CHAPTER I

INTRODUCTION

Educators have long recognized that students differ from each other in learning styles. Many new and innovative instructional designs and techniques have been developed and introduced into the academic arena since the 1950's in an effort to accommodate some of these diverse learning styles. Instructional television, one such method of instruction, began as an attempt to integrate this unique media tool into the traditional classroom setting. Open-circuit television instruction has become a popular method of delivering educational programming to students, and thus provides ready access for educational opportunities to those preferring individualized instruction and to people who would not be able to attend "on-campus" traditionally taught lecture courses.

Tarrant County Junior College District in Fort Worth, Texas, has been involved in open-circuit instructional television since the fall semester of 1973. At that time only two courses, Ecology and Texas State and Local Government, were offered. The large enrollment figures were surprising to those involved in the project. The 783 students enrolled in the two courses, which were offered on a local public television station, demonstrated an interest
by students in the instructional television mode of learning. Course offerings have increased from two to a high of fifteen courses which were offered in the fall of 1981 and spring of 1982.

Tarrant County Junior College does not produce instructional television courses through its Instructional Television (ITV) Center. The ITV Center and the Director are responsible for contacting producers of college-credit ITV courses; arranging for faculty committees to review courses; and must make recommendations concerning academic credibility and compatibility with the "on-campus" college offerings. The ITV Center also leases faculty-approved courses from producers; coordinates broadcast schedules with KERA-TV in Dallas, Texas, the local Public Broadcasting Station; and coordinates faculty assignments to ITV with the campus departments. Lastly, the ITV Center maintains a record-keeping office for ITV students and faculty and operates a testing center for ITV students. A few courses are offered by closed-circuit television which might be more appropriately termed a tape-retrieval method of instruction. The video tapes are kept on reserve in the Learning Resource Centers on each of the three Tarrant County Junior College Campuses for student viewing. When a course is offered on open-circuit television, the video tapes of all the programs are typically kept on reserve in the Learning Resource Centers;
therefore, the ITV Director must work closely with the Learning Resource Centers' staff to provide the needed services to students for tape retrieval.

The total course offerings of the ITV Center since it started in 1973 have included one astronomy course, two biology courses, three business courses, two ecology courses, one economics course, two English courses, one fine arts appreciation course, two government courses, one home economics course, three history courses, one music course which is offered as a radio course, one physical science course, three psychology courses, one religion course, and three sociology courses. Some of these courses are offered every semester while some are offered periodically.

The focus of this study was one of the biology courses, Biological Concepts (BIO 1624). The course, Biological Concepts, is from a television series titled *Introducing Biology* that was developed and produced by Coastline Community College in California. This biology course has been offered for college credit through the ITV Center at Tarrant County Junior College South Campus for six semesters, beginning in the spring semester of 1980, three of which have been via open-circuit television. Biological Concepts contains fifteen lessons in the form of a student handbook, a thirty-minute television program for each lesson, a textbook with readings for each lesson, a
laboratory component for each major unit, and examination questions keyed to the learning objectives for each lesson. There is no prerequisite course for Biological Concepts.

The laboratory manual to accompany *Introducing Biology* was planned, developed, and written by this investigator for Coastline Community College. The course was first broadcast on local public television in January, 1981. During the first semester in which it was offered on open-circuit television for college credit, 232 students in the Fort Worth area enrolled. A total of 537 students have taken the course through the spring semester of 1982 for college credit through either open-circuit or closed-circuit television.

The Instructional Television Center receives inquiries from students, faculty, administrators, and educators from other colleges seeking information about how to take or offer a science course on television. The educators also seek information about the type of students who enroll in the course and whether the students learn as well from an instructional television course as they do from a traditionally taught "on-campus" course. It has been suggested by observers that students who choose to take an ITV course have a profound dislike and negative attitude toward the subject, and therefore, enroll in the ITV course in an effort to have as little personal contact with the subject as possible.
Statement of the Problem

The problem of this study was a comparison of attitude toward and achievement in biology between students enrolled in an introductory biology course taught using instructional television and as taught on the campus of Tarrant County Junior College South Campus.

Research Questions

Answers to the following questions were sought in this study.

1. **Attitude**
   a. Is there a difference between the pretest and posttest "attitude toward biology" scores for the community college introductory biology "on-campus" students?
   b. Is there a difference between the pretest and posttest "attitude toward biology" scores for the community college introductory biology ITV students?
   c. Is there a difference in the "attitudes toward biology" when comparing the attitude pretest scores of community college "on-campus" students and ITV students prior to taking the biology course as determined by a pretest?
   d. Is there a change in "attitudes toward biology" between community college "on-campus" students and ITV students after taking the biology course as determined by an attitude posttest?
2. **Achievement**
   
a. How do the community college "on-campus" students compare to the ITV students on the pretest achievement test scores?
   
b. How do the community college "on-campus" students compare to the ITV students on posttest achievement test scores?

3. What are the recommendations applicable to an administrative unit involved in the decision making process relating to the use of ITV compared to "on-campus" instruction?

In addition to the above stated questions, student characteristics were collected. This information is not dealt with inferentially, but is reported in a descriptive manner. The information should be useful in relation to question three and for future studies, and includes the areas of demographics and other questions.

1. **Demographics**
   
a. Does the mean age of the community college introductory biology "on-campus" student differ from the mean age of the community college introductory biology ITV student?
   
b. Is there a difference in the distribution by sex of the community college introductory biology "on-campus" students compared to community college introductory biology ITV students?
c. Is there a difference in the marital status of the "on-campus" and ITV students when the choices are married, single, divorced, or widowed?

d. Is there a difference in the ethnic group distribution of the community college "on-campus" students compared to ITV students in an introductory biology course if Caucasian/White (Non-Hispanic), Black (Non-Hispanic), Spanish Surnamed Hispanics, Oriental, and Other are the groupings?

e. Is there a significant difference in the "on-campus" and ITV students in relation to the number of college credit hours they are enrolled in for the spring 1982 semester?

f. Is there a significant difference in the level of education between the "on-campus" and ITV groups?

g. Is there a significant difference in current occupational status of the "on-campus" and ITV groups?

h. Do the reasons for enrolling in an introductory biology course differ for "on-campus" and ITV students?

i. Is there a difference in the type of degree being pursued by "on-campus" and ITV students?

j. Do the "on-campus" students differ from the ITV students on the highest level of education they plan to obtain?
2. **Other Questions**

   a. Do the end of the semester course grades compare favorably with the achievement posttest scores for both groups?

   b. Is there a difference between the two groups of students when comparing those students who complete the course and those who do not complete the course?

**Hypotheses**

The following hypotheses were tested.

1. The posttest "attitude toward biology" scores will be significantly higher than the pretest "attitude toward biology" scores for the community college introductory biology "on-campus" students.

2. The posttest "attitude toward biology" scores will be significantly higher than the pretest "attitude toward biology" scores for the community college introductory biology ITV students.

3. The pretest "attitude toward biology" scores for the community college introductory biology ITV students will not be different than the pretest "attitude toward biology" scores for the community college introductory biology "on-campus" students.

4. The adjusted mean of the ITV student group will be significantly higher than the adjusted mean of the "on-campus" student group on the attitude posttest measure.
5. The posttest achievement test mean scores will be significantly higher than the pretest achievement test mean scores for the community college introductory biology "on-campus" students.

6. The posttest achievement test mean scores will be significantly higher than the pretest achievement test mean scores for the community college introductory biology ITV students.

7. The pretest achievement test mean scores for the community college introductory biology ITV students will be significantly higher than the pretest achievement test mean scores for the community college introductory biology "on-campus" students.

8. The adjusted mean of the ITV student group will be significantly higher than the adjusted mean of the "on-campus" student group on the achievement posttest measure.

Definition of Terms

The following terms are defined for this study as they have restricted meanings.

1. **Achievement** is a measure of how well the student has achieved the course objectives.

2. **Achievement test** is a fifty item test comprised of multiple-choice and true-false questions based on the course objectives for a community college introductory biology course.
3. **Acquired attitudes** are inferred states of an organism that are learned and potentially bipolar.

4. **Bipolar adjectives** are adjectives which present meanings that are opposites, such as hot-cold.

5. **Instructional television** is the use of television as a course component in college credit courses.

6. **On-campus students** are students enrolled in a course taught by the traditional methods with an instructor who directs learning activities.

7. **Open-circuit** is the broadcast to the public of instructional television courses by a local television station so that students can receive the ITV programs over television anywhere in the broadcast area.

8. **Posttest** is a test given after treatment or instruction to determine if a change has occurred in the responses.

9. **Pretest** is a test given before treatment or instruction to determine prior knowledge or attitudes toward some subject, object, concept, or idea.

10. **Semantic differential** is a technique designed to measure generalized attitudes utilizing a seven-point scale between bipolar adjectives.

11. **Telecourse** is an instructional course that utilizes the television medium for open-circuit broadcast to students.
Delimitations

This study was restricted to a community college located in the Tarrant County Junior College District in Fort Worth, Texas. It was restricted further to the student population enrolled in the "on-campus" and ITV introductory biology course during the spring semester of 1982. Statistical inference is limited to the Tarrant County Junior College District; however, there is no reason to assume that the student population in this study differs significantly from other community college students in Texas or the United States as a whole.

The study is further restricted to comparisons of variables between the control group and the experimental group and between variables within each group.

Basic Assumption

The assumption was made that the students in both groups had an attitude toward science and biology in particular, and that they responded to the instruments out of this past experience and knowledge.

Significance of this Study

This study is significant in that it focuses on a comparison of the achievements and attitudes toward biology of community college students enrolled in an introductory biology "on-campus" course with direct teacher contact to students enrolled in an introductory biology open-circuit
instructional television course. The study provides answers supported by empirical evidence to such questions as how ITV biology students compare to "on-campus" students in the area of achievement and what are some of the different characteristics of ITV students.

The significance of the study is summarized as follows.

1. It provides rationale and a research design for the evaluation of ITV courses as an effective method of instruction.

2. The study provides recommendations applicable for the administrative unit involved in decision-making regarding the use of open-circuit television instruction comparable to "on-campus" offerings.

3. Characteristics of the students involved in the study are reported. These should form the basis for further studies.

4. The results of this study should be applicable not only to Texas, but to any of those institutions which utilize this specific ITV course.

5. The profiles of students who enroll in the two alternate modes of learning studied during this investigation will provide data to educators that can be used in planning course offerings and marketing efforts to reach the appropriate student population groups.
6. Student profiles should be useful to college counselors in advisement sessions with students in efforts to match a student with the most appropriate mode of instruction for his or her learning style.

7. The results of the achievement in biology by students enrolled in the instructional television course and the "on-campus" course should indicate if either is a more effective method for teaching biology.

8. The effectiveness of modes of instruction for teaching biology can have implications as resources become more restricted and educational administrators consider both costs and benefits in planning for course offerings. The mode that is cost-effective and presents the greatest opportunity for student success would have an advantage in a financial crisis.
CHAPTER II

RELATED RESEARCH

Introduction

The technological revolution has resulted in many changes in the manner that students are exposed to information. The explosive manner in which the body of knowledge has expanded since 1900 has been facilitated by and resulted from that revolution (12, p. 5). Some of the new modes of learning and instruction include Computer Assisted Instruction, Computer Managed Instruction, educational television and radio, programmed instruction, audio-tutorial systems and open-learning laboratories. An attempt was made to limit the related research to those publications and studies which deal specifically with science courses taught by non-traditional methods, comparisons of attitudes and achievement between "on-campus" and ITV students, and characteristics of ITV students.

The Carnegie Commission has used the term "Fourth Revolution" to indicate the trend toward utilization and incorporation of the new instructional technologies into the academic realm (14), and television offers a ready access to a variety of educational experiences for all citizens. The future of this medium in education seems
limited only by the unimaginative and the unwillingness of educators to utilize the medium to its fullest educational potential. New developments increasing the capability of television are noted in cable systems, microwaves, satellites, videodiscs and rooftop dish antennas which extend the possibilities for broadcast and reception (29, pp. 27-28).

History

In 1932, the State University of Iowa became the first institution of higher education to utilize instructional television by using a "scanning disc" system instead of a picture tube. By 1948 four other educational institutions were involved with instructional television including Kansas State College, Iowa State College, American University in Washington, D. C., and the University of Michigan (19).

Two hundred and forty-two channels were designated for use by the educational community as a result of the Federal Communications Commission allocation hearing in 1952. By 1960 there were sixty-two educationally owned television stations broadcasting and twenty-eight were under construction. Twenty-nine years after the first educational television program was broadcast at the State University of Iowa, more than four hundred institutions of higher education in the United States had offered courses for credit via television (19). By 1979, 71 percent of all colleges
and universities surveyed indicated that some use is made of television for instructional purposes; 61 percent use television for instruction—25 percent offer courses via television and 36 percent use television to supplement existing courses (9, p. 1).

The commercial television networks carried the first open-circuit instructional television programs beginning in the early 1950's. "Continental Classroom" and "Sunrise Semester" were attempts to make college-credit courses more accessible to the public (15, pp. 125-130). These first attempts at open-circuit instruction were mostly limited to televised lectures or television instruction as opposed to the more sophisticated instructional television (22, pp. 6-22). The 1950's were years of rapid growth for colleges and universities with teacher shortages occurring and instructional television was an attempt to alleviate these problems by delivering college-credit courses to the student at home or work.

There are approximately sixty broadcast stations operated by forty-two institutions of higher education at present. Notable progress was made toward establishing television as an educational delivery system with such programs as "Electric Company," "Sesame Street," and documentaries (13, pp. 5-12). Several institutions own their own television stations with elaborate production facilities such as the Coastline Community College in California.
which produced the course *Introductory Biology* that will be used in this study. *Introductory Biology* is unique among instructional television series because it was the first ITV series to be awarded an Emmy by the Academy of Television Arts and Sciences.

Other institutions produce and offer college credit courses in cooperation with local public broadcasting stations such as Dallas County Community College District in Dallas, Texas. Tarrant County Junior College District, Fort Worth, Texas, does not produce courses but has participated in consortia with other institutions to co-produce specific courses by furnishing funds and content experts in support of the projects. Institutions offering ITV courses could be divided into two categories, producers and users or users only.

**Reasons for Student Enrollment**

The reasons students enroll in ITV courses are almost as varied as the students themselves. Surveys indicate that some students have employment situations which prohibit attendance at traditionally scheduled classes; mothers with small children find ITV convenient; the mature student may wish to avoid classroom settings where they fear competition from younger students; and, the highly motivated student appreciates the ability to move through a course at his or her own speed. The ITV experience may be the first attempt at college level course work and could
serve as an incentive to pursue additional college work (29, pp. 27-28).

Academic Achievement

As is the case with most new programs, fears and concerns arise and are expressed by the academic community regarding ITV offerings. At every conference, meeting, or workshop related to ITV attended by professionals, questions have been raised as to the academic credibility of ITV courses and whether students learn and achieve as well by instructional television as they do by traditional "on-campus" methods of instruction. Another concern is that ITV courses will draw students away from "on-campus" classes creating a loss in the full-time equivalent enrollments so important for funding and maintenance of faculty and staff positions.

Research studies in the area of educational television have focused, for the most part, on the gain of information by students. Numerous studies have been conducted in the field of science at the elementary and secondary levels including those by Skinner (30), Enders (11), Bickel (3), Amirian (1), Poteet (27), and Champa (5). No significant differences were reported between the achievement of the instructional television students and traditionally taught students. Five studies have been found in the literature relating to science courses and instructional television conducted at the postsecondary level. These include
Bailey's investigation of physics taught on closed-circuit television (2); Croft's study of an introductory physical science course offered by closed-circuit television at Central Connecticut State College in 1966 (7); and investigations by Richter (28, pp. 12-20), Dubin and Hedley (10, pp. 15-17, 27), and Hartman (17, pp. 117-124). All report no significant differences between achievement of students taught in "on-campus" classes when compared to students receiving instruction by television. Studies in other subject areas which support these findings include those of Patty (26), Gross (16), Dallas County (8), and Chu and Schramm (6).

The fact that students can and do learn from television courses has been established and demonstrated in the United States, Great Britain (18, pp. 140-144), and other countries (20, pp. 3-4) by thousands of students. Thus the question is no longer one of whether students acquire knowledge when enrolled in instructional television courses; but it should be one of how the ITV students' achievement compares to the "on-campus" students' achievement at the end of the semester and what are the characteristics of the students enrolling in ITV courses. The latter point is significant to administrators, faculty, and producers of telecourses so that special needs are met if the ITV students have needs and characteristics which differ from those of "on-campus" students.
Attitude

Introductory biology courses are important to the field of biology and other science-related fields because this course usually stands as a prerequisite for all other offerings. The introductory biology course focuses on the basic and traditional subject areas with laboratory experiences which parallel lectures and familiarize the student with the tools upon which the study of biology is based (24, pp. 7-15). An objective of the course is to develop a more positive attitude toward biology and science in general so as to enable students to better understand and utilize the rapidly expanding body of scientific knowledge in their daily lives. It has been demonstrated by Thurstone (31, pp. 6-7) that attitudes can be measured and studies by Maertens (23, pp. 657-662); Osgood, Suci, and Tannenbaum (25); and Bloom (4) support the premise that attitudes can be measured.

Attitude has been defined generally as "the sum total of a man's inclinations and feelings, prejudice or bias, preconceived notions, ideas, fears, threats, and convictions about any specific topic" (31). A study conducted in 1957 reported that students generally have negative attitudes toward science and scientists (32, p. 783). The concentrated effort in the United States to train scientists following the launch of the Russian Sputnik in the 1950's was not reflected on the scientific interest section
of the Kuder Preference Record between 1959 and 1963 in spite of the increasing status given to science, scientists, and science-related careers by the American society (32, p. 784).

Research evidence for the effects of instructional television upon attitude changes toward course material generally reflects that these attitudes can be modified in a favorable direction to about the same degree which they can be modified by "on-campus" or face-to-face instruction (32, pp. 770-788). Kumata (21, pp. 176-185) reported that there were no significant differences between retention of course material by the ITV students as compared to the conventionally taught students, but that he lacked evidence to make definite statements regarding attitude changes toward subject-matter content.

Characteristics of ITV Students

The age, sex, and ethnic origin of a student may also be significant to the developer, faculty, and/or administrator whose decision making involves planning for future course offerings and making projections of future student populations. The literature suggests that the average age of the ITV student is thirty, and that most are full-time housewives or employed outside the home. Most ITV students are Caucasians with more women than men enrolled (33).
Summary

As costs continue to soar in all areas, it is economically expedient to develop new, cost-efficient delivery systems to reach more students and still maintain or increase the quality of college credit and continuing education courses. The far-reaching potential of instructional television to aid in the quest for quality credit and non-credit education for all citizens is apparent; therefore, it is imperative that educators and administrators in higher education study and learn more regarding the achievement and characteristics of ITV students as compared to "on-campus" students.
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This study involved two groups of community college biology students enrolled on the South Campus of Tarrant County Junior College District. The control group consisted of students taking Biological Concepts (BIO 1624) on campus, in traditionally taught classes where an instructor directed and led the learning activities. The experimental group consisted of students taking Biological Concepts (BIO 1624) via open-circuit instructional television, broadcast on KERA-TV, Channel 13, the Public Broadcasting Station which services the Fort Worth-Tarrant County area.

The study focused on questions relating to attitudes toward biology, achievement and characteristics of the two groups. Comparisons were computed between each group of students for each variable and for each group of students between each variable as a pretest and posttest.

Instruments

Three instruments were used in this study: a student profile sheet, a scale to measure attitude toward biology and an achievement test to measure the students' achievement of the course objectives. The student profile sheet
asked for information relating to age, sex, race, current occupational status, previous education, number of hours spent on a job each week, and number of college credit hours enrolled in at present (see appendix A). This information is treated descriptively.

The attitude of the two groups toward biology was measured by using an attitude scale toward biology developed for this specific study using Osgood's Semantic Differential technique. A semantic differential consists of a number of scales, each of which is a bipolar adjective pair, selected from scales developed for particular research purposes plus the concept or concepts to be rated with the scales. The bipolar adjective scales used were seven-point scales which have been identified by Osgood (4). To develop the attitude instrument, a list of twenty polarized adjectives was prepared and distributed to students in introductory-level biology courses during the fall semester of 1981 (see appendix B). The students were instructed to check the ten bipolar adjective pairs which were most appropriate when expressing their attitude toward biology. The ten adjective pairs most often selected by the biology students were used to construct the attitude instrument. This procedure for development of the attitude instrument follows that of Osgood (4), Sims (7), Russell and Hollander (6), Edwards (1, pp. 9-13), Jahoda (2, pp. 306-309), and McKennell (3, pp. 17-36).
Validity and reliability of the semantic differential has been established by Rowan, Cliff, Taylor, and others as reported by Osgood (4). The attitude instrument thus developed was used as the pretest/posttest instrument for attitude assessment in this study during the spring semester of 1982 (see appendix C). The bipolar scales contained seven positions which were marked by the students. The most positive position on each scale was assigned a value of seven, while the most negative position was assigned a value of one. The positions between the most positive and most negative positions were assigned values of six to two. A student's score on any item was the digit corresponding to the scale position checked for that item. A student's attitude score was the sum of the item scores.

The achievement test was developed by this investigator. It was based on the course objectives for the introductory biology course taught "on-campus" and by ITV in the Tarrant County Junior College District. A comparison was made of the syllabi from the "on-campus" control instructors and the ITV instructor to help establish content validity.

A test bank of two hundred questions was developed consisting of multiple-choice and true-false items based on the course objectives. A copy of the test bank was then sent to all instructors involved with instructions that they mark appropriate questions with a cross (x). The
instructors based their decisions regarding the questions suitable for inclusion in the achievement test on the specific course objectives of the introductory biology course. Only those questions marked with a cross (x) by all the instructors were considered for inclusion in the final form of the achievement test which consisted of fifty items. The fifty-item achievement test (see appendix D) was distributed to the instructors involved for final approval to further establish content validity. Each question on the achievement test had a value of two points; therefore, the achievement test score was computed by multiplying the number of correct answers by two.

Population

Tarrant County Junior College District (TCJCD) serves the citizens of Tarrant County, Texas, which includes the large metropolitan area of Fort Worth, Texas, several large suburban areas and the rural communities. The 1980 estimated census figures for Tarrant County reveal a population of 902,400 with the eighteen years of age or above group containing approximately 585,525 (8). The TCJCD has three campus locations. This study was restricted to the South Campus, the oldest of the three campuses. The South Campus had 1851 students enrolled in ITV college credit courses for the spring semester of 1982. There were 159 students enrolled in the "on-campus" introductory biology course and
92 students enrolled in the ITV introductory biology course.

Sample

The total number of students completing the pretests and posttests and registered in ITV biology during the spring semester of 1982 composed the experimental group of this study. The students who enrolled in four "on-campus" introductory biology sections and who completed the pretests and posttests during the spring semester of 1982 composed the control group. The "on-campus" courses were taught by two different instructors using various methods and techniques of instruction. The experience of the "on-campus" instructors as relates to the teaching of the introductory biology course ranged from thirteen to fifteen years with one instructor holding the master's degree and one instructor holding two master's degrees. The ITV instructor holds the master's degree in biology. Neither of the "on-campus" faculty had taught ITV biology sections.

Pretesting and Posttesting

The three instruments used in this study were administered during the second week of classes in January, 1982, to accommodate late registrants. The pretests were administered by this investigator to avoid bias entering into the study due to lack of standardized instructions at the testing periods. The attitude posttests were administered
during the fourteenth week of the semester, again by this investigator to avoid bias due to lack of standardization of testing procedures. "On-campus" students were pretested and posttested at a regularly scheduled class period in the appropriate weeks. ITV students were pretested at orientation and posttested at an "on-campus" laboratory session.

All information gathered was recorded on computer sheets for further processing at the computer center. Statistical measures were computed for each hypothesis using pretest and posttest data which were interpreted. Tables were constructed, data analyzed, and recommendations were made from the results of the study. The information needed to compile the demographic material was collected at the pretesting period.

Design of Study

This study involved two groups of community college students enrolled in an introductory biology course. The control group consisted of "on-campus" students enrolled in an introductory biology course taught by two instructors using various teaching methods and techniques. The experimental group consisted of all students enrolled in the same course via instructional television.

There were two major variables involved in this study—achievement and attitude. Pretests and posttests were administered to both groups on attitudes toward biology and achievement. Comparisons were computed between
each group of students for each variable and for each group of students between each variable.

Biological and attitudinal terms found on the pretest were not defined, thus each student was free to respond to all items without being forced to conform to a specified meaning. This technique limits the study to the student's previous experiences and knowledge on the pretest. The premise was that the ITV students and the "on-campus" students did not differ significantly at the beginning of the study in the areas of experience, knowledge of biology, and intelligence. The only concern of this study was how the two groups compared in achievement and attitude toward biology at the beginning and at the end of the course.

To test the hypotheses in this study the following statistical measures were used: the $t$-test for related samples, the $t$-test for independent samples, analysis of covariance, and Chi-square tests for contingency tables. The .05 level of significance for a one-tailed test was deemed acceptable for each hypothesis.

Procedures for Analysis of Data

The $t$-test for related samples is used when making comparisons between two samples which are related and for which the data is better than ordinal. The pretest and posttest were completed by the same student; therefore, the $t$-test for related samples was used to test whether the
means of the two scores were significantly different for
the hypotheses numbers 1, 2, 5, and 6.

The t-test for related samples follows the formula (5,
pp. 224-227):

\[ t = \frac{\bar{D}}{S_{\bar{D}}} \]

where

\[ \bar{D} = \text{mean of the difference of } M_2 - M_1 \]

\[ S_{\bar{D}} = \sqrt{\frac{\sum d^2}{N(N-1)}} \]

\[ N = \text{number of pairs of scores} \]

\[ \sum d^2 = \sum (D - \bar{D})^2 \]

\[ D = \text{difference between pairs of scores} \]

\[ df = n-1 \]

The t-test for independent samples is appropriate when
comparisons are made between two independent samples and
the dependent variable is quantified so that it yields
better than ordinal data. Mean scores were used to deter-
mine if the two groups were significantly different in
testing hypotheses numbers 3 and 7.

The t-test for independent samples utilizes the
formula (5, pp. 217-220):

\[ t = \frac{M_1 - M_2}{S_{M_1 - M_2}} \]
where

\[ M_1 = \text{mean of the first group} \]

\[ M_2 = \text{mean of the second group} \]

\[ S_{m_1-m_2} = \text{standard error of difference between the means} \]

\[ df = n_1 + n_2 - 1 \]

Analysis of Covariance

The multiple regression approach to the analysis of covariance allows one to study the linear relationship between a set of independent variables ("on-campus" and instructional television groups) and one dependent variable (posttest score). The pretest scores were used as a covariate.

For purposes of this study, the analysis of covariance was calculated using the following formula (5, pp. 351-355) to test hypotheses numbers 4 and 8:

\[
\text{COV} = \frac{SP}{N}
\]

\[ SP_t = \sum_{j=1}^{k} \sum_{i=1}^{n_j} x_{ij} y_{ij} - \frac{T_x T_y}{N} \]

where \( T_x \) and \( T_y \) are the sums of the respective \( x \) and \( y \) measures for both groups

\[ SP_b = \sum_{j=1}^{k} \frac{T_{xj} T_{yj}}{n_j} - \frac{T_x T_y}{N} \]

where \( T_{xj} \) and \( T_{yj} \) are the sums of the \( X \) and \( Y \) measures for the \( j \)th group
\[ SP_w = SP_t - SP_b \]
\[ F = \frac{MS^1_{by}}{MS^1_{wy}} \text{ with } df = (K-1), (N-K-1) \]

Chi-square Tests for Contingency Tables

Chi-square tests for contingency tables are statistical procedures useful for determining whether two measures are related. The data are organized into a contingency table and tested to determine whether classification on the row variable is independent of classification on the column variable. At the predetermined level of significance, the calculated chi-square is compared with the tabled value for the appropriate degrees of freedom. If the calculated value is smaller than the tabled value, no significant relationship between the row and column variables has been determined to exist. The profile data were subjected to the Chi-square analysis technique using the following formula (5, pp. 254-258):

\[ x^2 = \sum \sum \frac{(O_{ij} - E_{ij})^2}{E_{ij}} \]

where \( O \) = the observed frequency for cell in row i, column j,

and \( E_{ij} \) = the expected frequency for cell in row i, column j

degrees of freedom = \((r-1)(c-1)\) where \( r \) = number of rows and \( c \) = number of columns.
Permissions

The permission to conduct this study in the Tarrant County Junior College District was obtained from the district office. Cooperation was obtained from the Dean of Instruction, the Science and Technology Division Chairperson, and the Biology Department Chairperson on the South Campus to use the introductory biology student population in this study. Permission to use the instructional television students as the experimental group was obtained from the South Campus Dean of Instructional Technology and the Instructional Television Director.
CHAPTER III BIBLIOGRAPHY


CHAPTER IV

PRESENTATION OF FINDINGS

This study was conducted during the spring 1982 semester on the South Campus of the Tarrant County Junior College District located in Fort Worth, Texas. A total of 203 biology students completed the pretests, posttests, and profile information sheets. The sample consisted of 133 students enrolled in four "on-campus" introductory biology sections and 70 students enrolled in the ITV introductory biology course.

The information obtained from the five instruments which were administered to each student was coded on computer sheets and processed by the North Texas State University Computer Center. Statistical measures were computed for each hypothesis using the pretest and posttest data. Tables, interpretations and analyses of the data are presented and discussed in relationship to each of the eight stated hypotheses.

Comparison of Attitude Toward Biology of "On-Campus" and Instructional Television Students

Hypothesis 1

The posttest "attitude toward biology" scores will be significantly higher than the pretest "attitude toward
biology" scores for the community college introductory biology "on-campus" students. The semantic differential instrument was used to measure the "on-campus" students' attitude toward biology. The pretest mean, 52.3308, and the posttest mean, 51.7519, are displayed in Table I.

<table>
<thead>
<tr>
<th></th>
<th>Pretest</th>
<th>Posttest</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>52.3308</td>
<td>51.7519</td>
<td>-0.59</td>
</tr>
</tbody>
</table>

A t of -0.59 was found when the t-test for related samples was administered. This t value is not equal to and does not exceed the specified table value for α = .05 with 132 degrees of freedom. The hypothesis was not accepted since there is no significant difference in the two means, which indicates that the "on-campus" students' "attitudes toward biology" did not change between the pretest and the posttest.

**Hypothesis 2**

The posttest "attitude toward biology" scores will be significantly higher than the pretest "attitude toward biology" scores for the community college introductory biology ITV students. The semantic differential instrument
was used to measure the ITV students' attitude toward biology. The pretest mean, 51.2143, and the posttest mean, 53.8143, are displayed in Table II.

### Table II

"ATTITUDE TOWARD BIOLOGY" PRETEST AND POSTTEST MEAN SCORES FOR THE INSTRUCTIONAL TELEVISION STUDENTS

<table>
<thead>
<tr>
<th></th>
<th>Pretest</th>
<th>Posttest</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>51.2143</td>
<td>53.8143</td>
<td>2.37</td>
</tr>
</tbody>
</table>

When the t-test for related samples was employed, a $t$ of 2.37 was found. This value of $t$ exceeds the specified table value for $\alpha = 0.01$ with 69 degrees of freedom. Therefore, the hypothesis as stated was accepted. The findings indicate that the ITV students' "attitude toward biology" increased in a positive direction between the pretest and posttest sessions.

**Hypothesis 3**

The pretest "attitude toward biology" scores for the community college introductory biology ITV students will not be different than the pretest "attitude toward biology" scores for the community college introductory biology "on-campus" students. The pretest mean of the "on-campus" students, 52.3308, and the pretest mean of the
instructional television students, 51.2143, are presented in Table III.

**TABLE III**

"ATTITUDE TOWARD BIOLOGY" PRETEST MEAN SCORES FOR THE "ON-CAMPUS" AND INSTRUCTIONAL TELEVISION STUDENTS

<table>
<thead>
<tr>
<th></th>
<th>On-Campus N=133</th>
<th>Instructional Television N=70</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>52.3308</td>
<td>51.2143</td>
<td>-.75</td>
</tr>
</tbody>
</table>

When the standard \( t \)-test for independent samples was employed, a \( t \) of -0.75 was found. This \( t \) value is not equal to and does not exceed the table value for \( \alpha = .05 \) for 201 degrees of freedom. There is no significant difference between the pretest mean scores for the "on-campus" and ITV students. This indicates that neither group had a higher pretest mean score than the other group. Therefore, neither group at the time the pretests were administered had an acquired attitude toward biology that was more positive or less positive than the other group.

**Hypothesis 4**

The adjusted mean of the ITV student group will be significantly higher than the adjusted mean of the "on-campus" student group on the attitude posttest measure. The statistical results for the attitude toward biology
posttest for the "on-campus" and instructional television students as measured by the semantic differential instrument are presented in Table IV.

**TABLE IV**

"ATTITUDE TOWARD BIOLOGY" POSTTEST ADJUSTED MEANS FOR "ON-CAMPUS" AND INSTRUCTIONAL TELEVISION STUDENTS

(Analysis of Covariance Summary)

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sums of Squares</th>
<th>Degrees of Freedom</th>
<th>Mean Scores</th>
<th>F-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>279.994</td>
<td>1</td>
<td>279.994</td>
<td>3.726</td>
</tr>
<tr>
<td>Within Groups</td>
<td>15029.602</td>
<td>200</td>
<td>75.148</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>15309.596</td>
<td>201</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

After the data was subjected to the analysis of covariance procedure, with the pretest being the covariate, a $F$ value of 3.726 was found. This $F$ value does not exceed the table value at the $\alpha = .05$ with 1 and 200 degrees of freedom. The adjusted mean of the instructional television group was not significantly higher than the adjusted mean of the "on-campus" group for the attitude posttest measure. The hypothesis was not accepted. This means that a comparison of the two groups on the posttest "attitude toward biology" showed no difference. The ITV group did not score higher than the "on-campus" group on the posttest "attitude toward biology" test.
Comparison of Achievement Between "On-Campus" and Instructional Television Students

Research findings cited in Chapter II have shown that instructional television students compare favorably with "on-campus" students. The investigator prepared an achievement test based on learning objectives common to both instructional modes, instructional television and "on-campus" instruction. The hypotheses are restated and appropriate tables of findings and interpretations of the results are presented.

**Hypothesis 5**

The posttest achievement test mean scores will be significantly higher than the pretest achievement test mean scores for the community college introductory biology "on-campus" students. The achievement pretest mean, 44.7970, and the achievement posttest mean, 71.8195, are displayed in Table V.

**TABLE V**

<table>
<thead>
<tr>
<th></th>
<th>Pretest</th>
<th>Posttest</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>44.7970</td>
<td>71.8195</td>
<td>26.72</td>
</tr>
</tbody>
</table>

The t-test for related samples was utilized and a t of 26.72 was found. This t value exceeds the table value
for \( \alpha = .001 \) with 132 degrees of freedom. This \( t \) is highly significant and indicates that the "on-campus" students achieved significantly higher posttest achievement test mean scores when compared to the pretest achievement test mean scores. This indicates that learning took place as measured by achievement test scores on an achievement test based on the course objectives. The hypothesis was accepted.

**Hypothesis 6**

The posttest achievement test mean scores will be significantly higher than the pretest achievement test mean scores for the community college introductory biology ITV students. The pretest mean, 48.8000, and the posttest mean, 79.9429, for the instructional television students' achievement tests are presented in Table VI.

**TABLE VI**

| ACHIEVEMENT PRETEST AND POSTTEST MEAN SCORES FOR THE INSTRUCTIONAL TELEVISION STUDENTS |
| N=70 |
| Pretest | Posttest | t |
| Mean  | 48.8000 | 79.9429 | 20.79 |

When a \( t \)-test for related samples was utilized, a \( t \) of 20.79 was obtained. Since the \( t \) value exceeds the table value for \( \alpha = .001 \) with 69 degrees of freedom, the
hypothesis was accepted. This finding indicates that learning took place as measured by achievement test scores on an achievement test based on the course objectives.

**Hypothesis 7**

The pretest achievement test mean scores for the community college introductory biology ITV students will be significantly higher than the pretest achievement test mean scores for the community college introductory biology "on-campus" students. The achievement pretest was administered to both groups during the second week of the spring 1982 semester. The pretest mean for the "on-campus" group, 44.7970, and the pretest mean for the instructional television group, 48.8000, are reported in Table VII.

**TABLE VII**

<table>
<thead>
<tr>
<th></th>
<th>On-Campus</th>
<th>Instructional Television</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=133</td>
<td></td>
<td>N=70</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>44.7970</td>
<td>48.8000</td>
<td>2.75</td>
</tr>
</tbody>
</table>

When a _t_-test to determine the significant differences between means of independent samples was administered, a _t_ of 2.75 was obtained. This _t_ value does not exceed the
table value for $\alpha = .05$ with 201 degrees of freedom; therefore, the hypothesis was not accepted. The ITV students' pretest achievement test mean scores were not significantly higher than the "on-campus" students' pretest achievement test mean scores. This indicates that neither group had an advantage at the beginning of the course on knowledge of the course content.

**Hypothesis 8**

The adjusted mean of the ITV student group will be significantly higher than the adjusted mean of the "on-campus" student group on the achievement posttest measure.

The statistical results from the achievement posttest for both the "on-campus" and ITV students are displayed in Table VIII. After the analysis of covariance procedure was employed, a $F$ value of 15.677 was determined. This $F$ value exceeds the table value at the $\alpha = .001$ with 1 and 200 degrees of freedom. The obtained $F$ value is highly significant; therefore, the hypothesis was accepted. This indicates that the ITV group was more successful in achieving the course objectives than was the "on-campus" group.
TABLE VIII

COMPARISON OF ACHIEVEMENT POSTTEST FOR "ON-CAMPUS" AND INSTRUCTIONAL TELEVISION STUDENTS

(Analysis of Covariance Summary)

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sums of Squares</th>
<th>Degrees of Freedom</th>
<th>Means Squared</th>
<th>F-ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1781.281</td>
<td>1</td>
<td>1781.281</td>
<td>15.677</td>
</tr>
<tr>
<td>Within Groups</td>
<td>22725.063</td>
<td>200</td>
<td>113.625</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>24506.344</td>
<td>201</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Treatment of Additional Questions

Demographic Variables and Interpretations

Student characteristics including such variables as sex, age, ethnic groups, level of education, number of college credit hours enrolled in, and reasons for enrolling in the introductory biology course were collected for each student at the pretesting session. These questions were compared using absolute frequencies, relative frequencies, and Chi-square statistical procedures. The original questions and/or statements from the student profile instrument have been restated. Tables provide the findings and interpretations of the findings are given.

1. Sex--Is there a difference in the distribution by sex of the community college introductory biology "on-campus" students compared to community college introductory
biology ITV students? A comparison of the distribution for the two groups by sex is presented in Table IX.

**TABLE IX**

A COMPARISON OF THE DISTRIBUTION FOR "ON-CAMPUS" AND INSTRUCTIONAL TELEVISION STUDENTS BY SEX

<table>
<thead>
<tr>
<th>Sex</th>
<th>On-Campus</th>
<th></th>
<th>Instructional Television</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Percentage</td>
<td>N</td>
<td>Percentage</td>
</tr>
<tr>
<td>Male</td>
<td>50</td>
<td>37.6</td>
<td>23</td>
<td>32.9</td>
</tr>
<tr>
<td>Female</td>
<td>83</td>
<td>62.4</td>
<td>47</td>
<td>67.1</td>
</tr>
<tr>
<td>Total</td>
<td>133</td>
<td>100.0</td>
<td>70</td>
<td>100.0</td>
</tr>
</tbody>
</table>

A calculated Chi-square was determined to be 0.26483 with 1 degree of freedom. At the .05 level of probability the determined Chi-square is not significant which means that the distribution of male and female students was not different for either group.

2. Age--Does the mean age of the community college introductory biology "on-campus" student differ from the mean age of the community college introductory biology ITV student? The results of this comparison are presented in Table X.
TABLE X

A COMPARISON OF AGE DISTRIBUTION FOR "ON-CAMPUS" AND INSTRUCTIONAL TELEVISION STUDENTS

<table>
<thead>
<tr>
<th>Age</th>
<th>On-Campus</th>
<th></th>
<th>Instructional Television</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Percentage</td>
<td>N</td>
</tr>
<tr>
<td>Under 17</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>18-22</td>
<td>103</td>
<td>77.4</td>
<td>14</td>
</tr>
<tr>
<td>23-34</td>
<td>22</td>
<td>16.5</td>
<td>31</td>
</tr>
<tr>
<td>35-45</td>
<td>7</td>
<td>5.3</td>
<td>18</td>
</tr>
<tr>
<td>Over 45</td>
<td>1</td>
<td>0.8</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>133</td>
<td>100.0</td>
<td>70</td>
</tr>
</tbody>
</table>

A Chi-square equal to 65.3074 with three degrees of freedom was found. This Chi-square value is significant at the .001 probability level. Of the "on-campus" students, 77.4 percent were in the age bracket of 18-22 years while 80.2 percent of the instructional television students were 23 years of age or older. The ITV group contained seven students in the "over 45" group as compared to one in the "on-campus" group. The ITV student group was generally older than the "on-campus" group.

3. Marital Status—Is there a difference in the marital status of the "on-campus" and ITV students when the
choices are married, single, divorced, or widowed? The findings as related to the marital status for the two groups are reported in Table XI.

**TABLE XI**

A COMPARISON OF MARITAL STATUS PERCENTAGES FOR "ON-CAMPUS" AND INSTRUCTIONAL TELEVISION STUDENT

<table>
<thead>
<tr>
<th>Marital Status</th>
<th>On-Campus</th>
<th>Instructional Television</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Percentage</td>
</tr>
<tr>
<td>Married</td>
<td>21</td>
<td>15.7</td>
</tr>
<tr>
<td>Single</td>
<td>107</td>
<td>80.5</td>
</tr>
<tr>
<td>Divorced</td>
<td>4</td>
<td>3.0</td>
</tr>
<tr>
<td>Widowed</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>Total</td>
<td>133</td>
<td>100.0</td>
</tr>
</tbody>
</table>

A Chi-square value = 69.07851 with 3 degrees of freedom was determined to be highly significant since the calculated value exceeds the table value for $\alpha = .001$. Of the ITV students, 70 percent were married while 80.5 percent of the "on-campus" students were single. Conversely, approximately 21 percent of the ITV students were single while approximately 16 percent of the "on-campus" students were married.
4. **Ethnic Groups**—Is there a difference in the ethnic group distribution of the community college "on-campus" students compared to ITV students in an introductory biology course if the ethnic groups Caucasian/White (Non-Hispanic), Black (Non-Hispanic), Spanish Surnamed (Hispanic), Oriental, and Other are the groupings? A comparison of the ethnic group distribution for the two groups is presented in Table XII.

### TABLE XII

**A COMPARISON OF THE ETHNIC GROUP DISTRIBUTION FOR "ON-CAMPUS" AND INSTRUCTIONAL TELEVISION STUDENTS**

<table>
<thead>
<tr>
<th>Ethnic Groups</th>
<th>On-Campus</th>
<th>Instructional Television</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Percentage</td>
</tr>
<tr>
<td>Caucasian</td>
<td>97</td>
<td>73.5</td>
</tr>
<tr>
<td>Negro</td>
<td>23</td>
<td>17.4</td>
</tr>
<tr>
<td>Spanish Surnamed</td>
<td>11</td>
<td>8.3</td>
</tr>
<tr>
<td>Oriental</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>132</td>
<td>100.0</td>
</tr>
</tbody>
</table>

A Chi-Square value of 7.30465 was determined. Since a Chi-square value equal to or greater than the table value of 7.815 with 3 degrees of freedom was not obtained, there...
is no significant difference between the ethnic group distributions for the "on-campus" and instructional television groups.

5. **College Credit Hours Enrolled In During Spring 1982 Semester**—Is there a significant difference in the "on-campus" and ITV students in relation to the number of college credit hours they are enrolled in for the spring 1982 semester? A comparison of the distribution of the students in the two groups by college credit hours enrolled in is presented in Table XIII.

### TABLE XIII

A COMPARISON OF THE DISTRIBUTION OF "ON-CAMPUS" AND INSTRUCTIONAL TELEVISION STUDENTS BY COLLEGE CREDIT HOURS

<table>
<thead>
<tr>
<th>College Credit Hours</th>
<th>On-Campus</th>
<th>Instructional Television</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (Total)</td>
<td>Percentage</td>
</tr>
<tr>
<td>0-4</td>
<td>2</td>
<td>1.5</td>
</tr>
<tr>
<td>5-8</td>
<td>9</td>
<td>6.8</td>
</tr>
<tr>
<td>9-11</td>
<td>15</td>
<td>11.3</td>
</tr>
<tr>
<td>12-14</td>
<td>62</td>
<td>46.6</td>
</tr>
<tr>
<td>15 or more</td>
<td>45</td>
<td>33.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>133</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>
A Chi-square = 37.05344 was obtained which is highly significant exceeding the table value for .001 with 4 degrees of freedom. The "on-campus" students were enrolled in more college credit hours than were the ITV students. Of the "on-campus" students, 80.4 percent were enrolled in twelve or more college credit hours while 41.4 percent of the ITV students took twelve or more college credit hours. It may be important to note that when considering the fifteen-or-more-credit-hour row, the "on-campus" group had 33.8 percent while the ITV students had 21.4 percent. Of the ITV students, 58.6 percent were taking eleven or fewer college credit hours while 19.6 percent of the "on-campus" group were taking eleven or fewer college credit hours.

6. Highest Level of Education--Is there a significant difference in the level of education between the "on-campus" and ITV groups? A comparison of the distribution of the students in both groups according to the level of education is presented in Table XIV.

A Chi-square = 25.02867 was found. Since Chi-square = 25.02867 exceeds the table value at the .001 probability level for 4 degrees of freedom, a highly significant difference was found between the two groups. The ITV students had attained more college credits than the "on-campus" students. Of the ITV group, 44.3 percent had 60 or more college credit hours as compared to only 19.6 percent of the "on-campus" group. Of the "on-campus" group, 42.8
percent had some high school credits or were high school graduates with less than one year of earned college credit hours. In the ITV group, 12.8 percent were in this last category.

**TABLE XIV**

A COMPARISON OF DISTRIBUTION OF "ON-CAMPUS" AND INSTRUCTIONAL TELEVISION STUDENTS ACCORDING TO LEVEL OF EDUCATION

<table>
<thead>
<tr>
<th>Level of Education</th>
<th>On-Campus</th>
<th>Instructional Television</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Percentage</td>
</tr>
<tr>
<td>Some High School</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>High School Graduate or GED</td>
<td>56</td>
<td>42.0</td>
</tr>
<tr>
<td>1 Yr. College (30 hrs.)</td>
<td>50</td>
<td>37.6</td>
</tr>
<tr>
<td>2 Yrs. College (60 hrs.)</td>
<td>25</td>
<td>18.8</td>
</tr>
<tr>
<td>Bachelor's Degree or higher</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>Total</td>
<td>133</td>
<td>100.0</td>
</tr>
</tbody>
</table>

7. **Current Occupational Status**—Is there a significant difference in current occupational status of the "on-campus" and ITV groups? A comparison of the distribution
of "on-campus" and ITV students according to current occupational status is presented in Table XV.

**TABLE XV**

A COMPARISON OF THE DISTRIBUTION OF "ON-CAMPUS" AND INSTRUCTIONAL TELEVISION STUDENTS ACCORDING TO CURRENT OCCUPATIONAL STATUS

<table>
<thead>
<tr>
<th>Current Status</th>
<th>On-Campus N</th>
<th>On-Campus Percentage</th>
<th>Instructional Television N</th>
<th>Instructional Television Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work, Part-time</td>
<td>71</td>
<td>53.4</td>
<td>16</td>
<td>22.9</td>
</tr>
<tr>
<td>Work, Full-time</td>
<td>14</td>
<td>10.5</td>
<td>38</td>
<td>54.2</td>
</tr>
<tr>
<td>Full-time Homemaker</td>
<td>8</td>
<td>6.0</td>
<td>9</td>
<td>12.9</td>
</tr>
<tr>
<td>Not Employed</td>
<td>40</td>
<td>30.1</td>
<td>7</td>
<td>10.0</td>
</tr>
<tr>
<td>Total</td>
<td>133</td>
<td>100.0</td>
<td>70</td>
<td>100.0</td>
</tr>
</tbody>
</table>

A Chi-square = 54.80255 was determined to be highly significant since the calculated value exceeds the table value for the .001 probability level with 3 degrees of freedom. Of the instructional television students, 90.0 percent (54.2 percent + 12.9 percent - 22.9 percent) were working full or part-time or were full-time homemakers as compared to 69.9 percent (53.4 percent + 10.5 percent + 6.0 percent) of the "on-campus" students. Thirty percent of the "on-campus" students were not employed, while 10
percent of the ITV students were not employed. A higher percentage of the ITV students were employed full-time than were the "on-campus" students, 54.2 percent and 10.5 percent respectively.

8. Reasons for Enrolling in an Introductory Biology Course--Do the reasons for enrolling in an introductory biology course differ for "on-campus" and ITV students? A comparison of reasons for enrolling in an introductory biology course between the two groups is presented in Table XVI.

TABLE XVI

A COMPARISON OF REASONS FOR ENROLLING IN AN INTRODUCTORY BIOLOGY COURSE FOR "ON-CAMPUS" AND INSTRUCTIONAL TELEVISION STUDENTS

<table>
<thead>
<tr>
<th>Enrollment Reasons</th>
<th>On-Campus</th>
<th>Percentage</th>
<th>Instructional Television</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree Requirement</td>
<td>109</td>
<td>82.0</td>
<td>61</td>
<td>87.1</td>
</tr>
<tr>
<td>Course Related to Current or Desired Job</td>
<td>2</td>
<td>1.5</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Elective</td>
<td>6</td>
<td>4.5</td>
<td>4</td>
<td>5.8</td>
</tr>
<tr>
<td>Interested In Subject Area</td>
<td>16</td>
<td>12.0</td>
<td>5</td>
<td>7.1</td>
</tr>
<tr>
<td>Total</td>
<td>133</td>
<td>100.0</td>
<td>70</td>
<td>100.0</td>
</tr>
</tbody>
</table>
A Chi-square = 2.39366 was determined. This Chi-square value does not exceed the specified table value for
\( \alpha = .05 \) with 3 degrees of freedom; therefore, there is no significant difference for enrolling in an introductory biology course for "on-campus" and ITV students. Of the "on-campus" students, 82 percent enrolled in the course because of degree requirements and 87 percent of the ITV students enrolled in the introductory biology course because of degree requirements.

9. **Degree Being Pursued in the Tarrant County Junior College District**—Is there a difference in the type of degree being pursued by "on-campus" and ITV students? A comparison according to degree goals in the TCJCD between groups is presented in Table XVII.

A Chi-square = 17.87157 was obtained which exceeds the specified table value for \( \alpha = .01 \) with 5 degrees of freedom. Sixty percent of the "on-campus" students were pursuing either a one-year certificate or two-year degree at Tarrant County Junior College as compared to 67.1 percent of the ITV students. More "on-campus" students were pursuing occupational programs or two year Associate of Applied Arts and Science Degrees as evidenced by 24 percent compared to 17.1 percent for the ITV students. Fifty percent of the ITV students were working toward an Associate of Arts and Science Degree as compared to 27.8 percent of the "on-campus" group. None of the ITV students indicated
that a one year certificate program was their educational goal while eleven or 8.3 percent of the "on-campus" students so indicated.

TABLE XVII

A COMPARISON OF THE DISTRIBUTION OF "ON-CAMPUS" AND INSTRUCTIONAL TELEVISION STUDENTS ACCORDING TO DEGREE GOALS AT TARRANT COUNTY JUNIOR COLLEGE

<table>
<thead>
<tr>
<th>Degree Goal at TCJCD</th>
<th>On-Campus</th>
<th>Instructional Television</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Percentage</td>
</tr>
<tr>
<td>1 Yr. Certificate Program</td>
<td>11</td>
<td>8.3</td>
</tr>
<tr>
<td>2 Yr. Assoc. of Applied Arts and Sci.</td>
<td>32</td>
<td>24.0</td>
</tr>
<tr>
<td>2 Yr. Assoc. of Arts &amp; Sci.</td>
<td>37</td>
<td>27.8</td>
</tr>
<tr>
<td>Not Working Toward a Degree at TCJC</td>
<td>53</td>
<td>39.9</td>
</tr>
<tr>
<td>Total</td>
<td>133</td>
<td>100.0</td>
</tr>
</tbody>
</table>

10. **Highest Academic Degree**--Do the "on-campus" students differ from the ITV students on the highest level of education they plan to obtain? A comparison of the distribution according to the highest level of education planned between groups is presented in Table XVIII.
A Chi-square value = 2.32281 was found. This Chi-square value does not exceed the specified table value for $\alpha = 0.05$ with 3 degrees of freedom. Therefore, there is no significant difference between the level of educational aspiration for "on-campus" and ITV students. Of both groups, 96 percent aspire to Bachelor Degrees; 48 percent of the "on-campus" group and 43 percent of the ITV group also aspire to achieve a Masters' Degree or above.
Other Questions

Course Grades--Do the end of the semester course grades compare favorably with the achievement posttest scores for both groups? Table XIX depicts the percentage distribution of semester grades and achievement test scores for the community college introductory biology "on-campus" and ITV students.

**TABLE XIX**

A COMPARISON OF PERCENTAGE DISTRIBUTION OF END OF SEMESTER GRADES AND ACHIEVEMENT TEST SCORES FOR "ON-CAMPUS" STUDENTS AND INSTRUCTIONAL TELEVISION STUDENTS N=203

<table>
<thead>
<tr>
<th>Grades/Scores</th>
<th>On-Campus N=133</th>
<th>Instructional Television N=70</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Semester Grades</td>
<td>Test Scores</td>
</tr>
<tr>
<td></td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>A (90-100)</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>B (80-89)</td>
<td>50</td>
<td>38</td>
</tr>
<tr>
<td>C (70-79)</td>
<td>50</td>
<td>38</td>
</tr>
<tr>
<td>D (60-69)</td>
<td>17</td>
<td>12</td>
</tr>
<tr>
<td>F (below 60)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>133</td>
<td>100</td>
</tr>
</tbody>
</table>

Seven or 5 percent of the "on-campus" students scored ninety or above on the achievement posttest while sixteen or 12 percent made a final grade of "A" in the course.
Sixteen or 20 percent of the ITV students scored ninety or above on the achievement posttest while twenty-three or 33 percent of these students received a final grade of "A" in the biology course. Thirty-two or 24 percent of the "on-campus" students scored between eighty and eighty-nine on the achievement posttest as compared to twenty-three or 33 percent of the ITV students. The two groups had similar percentages for final course grades of "B" with 38 percent for the "on-campus" group and 39 percent for the ITV group.

Forty-two or 32 percent of the "on-campus" group scored between seventy and seventy-nine on the achievement posttest compared to nineteen or 27 percent of the ITV group. Seventeen or 24 percent of the ITV group made a final grade of "C" in the introductory biology course as compared to fifty or 38 percent of the "on-campus" group. Nine or 13 percent of the ITV group scored sixty to sixty-nine on the achievement posttest. Thirty-seven or 28 percent of the "on-campus" group scored sixty to sixty-nine on the achievement posttest. Those students receiving a "D" as a final grade in the introductory biology course included three, or 4 percent of the ITV group and seventeen or 12 percent of the "on-campus" students.

Of the ITV students, three, or 4 percent scored below sixty on the achievement posttest as compared to fifteen or 11 percent of the "on-campus" group. No grades of "F" were given in either the instructional television or the "on-campus" introductory biology course.
11. **Other Students**—The total official enrollment in the "on-campus" course was 159 students and 92 in the instructional television course. The sample for this study was defined as all students who completed the pretests, posttests, and profile information sheets. The distribution of the students enrolled in the introductory biology course is presented in Table XX.

<table>
<thead>
<tr>
<th>TABLE XX</th>
</tr>
</thead>
<tbody>
<tr>
<td>A COMPARISON OF THE DISTRIBUTION OF &quot;ON-CAMPUS&quot; AND INSTRUCTIONAL TELEVISION STUDENTS ENROLLED IN THE COMMUNITY COLLEGE INTRODUCTORY BIOLOGY COURSE INCLUDING THOSE COMPLETING AND NOT COMPLETING THE COURSE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>On-Campus Students</th>
<th>Instructional Television Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enrolled</td>
<td>159</td>
<td>92</td>
</tr>
<tr>
<td>Completed</td>
<td>133</td>
<td>70</td>
</tr>
<tr>
<td>Chose Not to</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Participate in</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Withdrew Passing</td>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td>Withdrew Failing</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

A total of twenty-two students did not complete the "on-campus" course with a similar number not completing the instructional television course. Fourteen percent of the "on-campus" students withdrew passing or failing and 24 percent of the ITV students withdrew passing.
CHAPTER V

SUMMARY OF THE FINDINGS, CONCLUSIONS, RECOMMENDATIONS, AND IMPLICATIONS

Summary

This study was designed to obtain information about community college introductory biology students enrolled in instructional television classes and traditionally taught "on-campus" classes. Educational administrators and subject matter specialists express legitimate concerns regarding students and their achievement in instructional television courses. Educators must be aware of the differences which exist between students who generally enroll in an instructional television course and those who enroll in "on-campus" courses in order to make intelligent and economically sound decisions regarding the offering of instructional television courses.

The problem of this study was to compare attitudes toward and achievement in biology between students enrolled in an introductory biology course taught using instructional television and as taught on the South Campus of Tarrant County Junior College District, Fort Worth, Texas.

Three instruments were used to gather data for this study.
1. A semantic differential was used to measure the students' attitude toward biology.

2. An achievement test was used to measure the students' achievement of the course content objectives. The achievement test was prepared from the content of the "on-campus" and instructional television classes participating in this study. Approval for inclusion of each test item was obtained from the instructors assigned to the participating classes.

3. A profile information sheet was completed by each student participating in this study.

The sample for this study consisted of two groups of community college students. The "on-campus" group was comprised of four classes of introductory biology students from one campus of the multicampus district and taught by two instructors. The ITV group consisted of all the students enrolled in the instructional television course through the same campus of the multicampus district. The number of "on-campus" students involved in this study was 133 while 70 instructional television students were involved.

The "on-campus" students completed the attitude toward biology pretest, achievement pretest, and profile information sheet at a regularly scheduled class period during the second week of the semester. The instructional television students completed the attitude toward biology pretest,
achievement test, and profile information sheet at a scheduled orientation session during the second week of the semester. During the fourteenth week of the semester both groups completed the attitude toward biology posttest. The achievement posttest was administered during regularly scheduled testing periods.

The data gathered from the instruments were subjected to one of the following statistical techniques: \( t \)-test for related samples, \( t \)-test for independent samples, analysis of covariance, and Chi-square analysis. There were eight research hypotheses stated to test the difference between the two variables, attitude, and achievement. Of the eight research hypotheses tested, three were found to be significant at the \( \alpha = .001 \) and one was found to be significant at the \( \alpha = .01 \). The findings were discussed under three categories. This chapter presents a summary of the findings, conclusions, implications, and recommendations based on the findings of the study.

**Summary of the Findings and Conclusions**

**Hypothesis 1**

The posttest "attitude toward biology" scores will be significantly higher than the pretest "attitude toward biology" scores for the community college introductory biology "on-campus" students. To test this hypothesis, the semantic differential instrument was used to measure the "on-campus" students' attitudes toward biology. A pretest
mean = 52.3308 and a posttest mean = 51.7519 were calculated. When a \( t \)-test for related samples was administered, a \( t \) of -0.59 was found. This \( t \) value did not exceed the table value for \( = .05 \) with 132 degrees of freedom. The hypothesis was not accepted since there was no significant difference in the two means. This finding indicates that the "on-campus" students' attitudes toward biology did not change over the course of the semester, between the pretesting and posttesting sessions. From this finding it was concluded that nothing occurred during the semester to alter the "on-campus" students' previously acquired attitude toward biology either in a positive or negative direction.

**Hypothesis 2**

The posttest "attitude toward biology" scores will be significantly higher than the pretest "attitude toward biology" scores for the community college introductory biology ITV students. The semantic differential instrument was used to measure the ITV students' attitude toward biology. A pretest mean of 51.2143 and a posttest mean of 53.8143 were calculated. When a \( t \)-test for related samples was employed, a \( t \) of 2.37 was found. This value of \( t \) exceeded the specified table value for \( = .01 \) with 69 degrees of freedom; therefore, the hypothesis as stated was accepted. The findings indicate that the ITV students' attitudes toward biology increased significantly in a
positive direction between the pretest and posttest sessions. From this finding it was concluded that positive attitudinal learning occurred on the part of the instructional television students. This was revealed by an increase of the posttest mean scores in the positive direction, as compared to the pretest attitude toward biology mean scores.

**Hypothesis 3**

The pretest "attitude toward biology" scores for the community college introductory biology ITV students will not be different than the pretest "attitude toward biology" scores for the community college introductory biology "on-campus" students. As measured by the semantic differential instrument, the pretest mean for the "on-campus" students was 52.3308 and the pretest mean for the instructional television students was 51.2143. When a $t$-test for independent samples was employed, a $t$ of 0.75 was found. This $t$ value was not significant for $\alpha = .05$ for 201 degrees of freedom; therefore, there was no significant difference between the pretest mean scores for the "on-campus" and ITV students. This finding indicates that neither group had an acquired attitude toward biology at the time the pretests were administered that was more positive or less positive than the other group. It was concluded that both student groups entered the introductory
biology course with the same acquired attitude toward biology based on this finding.

**Hypothesis 4**

The adjusted mean of the ITV student group will be significantly higher than the adjusted mean of the "on-campus" student group on the attitude posttest measure. The data were subjected to the analysis of covariance procedure and a $F$ value of 3.726 was found. This $F$ value did not exceed the table value at the $\alpha = .05$ with 1 and 200 degrees of freedom. The adjusted mean of the ITV group was not significantly higher than the adjusted mean of the "on-campus" group for the attitude posttest measure, therefore the hypothesis was not accepted. The analysis of covariance procedure permits statistical rather than experimental control of variables. The pretest was the variable to be controlled (the covariate), and the posttest was the criterion variable. After the data were subjected to the analysis of covariance with a non-significant $F$-ratio result, it was concluded that the ITV student group did not acquire a significantly more positive attitude toward biology than did the "on-campus" student group.

**Hypothesis 5**

The posttest achievement test mean scores will be significantly higher than the pretest achievement test mean scores for the community college introductory biology
"on-campus" students. The achievement pretest mean score, 44.7970, and posttest mean score, 71.8195 for the "on-campus" students was subjected to a t-test for related samples. A t of 26.72 was found. This t value exceeded the table value for \( \alpha = .001 \) with 132 degrees of freedom which indicated that the "on-campus" group achieved a significantly higher posttest achievement test mean score as compared to the pretest achievement test mean score. The hypothesis was accepted as stated. From this finding it was concluded that learning took place as measured by achievement test scores on an achievement test based on the course objectives.

Hypothesis 6

The posttest achievement test mean score will be significantly higher than the pretest achievement test mean scores for the community college introductory biology ITV students. The pretest mean, 48.800, and the posttest mean, 79.9429, for the instructional television students' achievement test were used in a t-test for related samples. A t of 20.79 was obtained which exceeded the table value for \( \alpha = .001 \) with 69 degrees of freedom. From this finding it was concluded that learning took place as measured by achievement scores on an achievement test based on the course objectives.
Hypothesis 7

The pretest achievement test mean scores for the community college introductory biology ITV students will be significantly higher than the pretest achievement test mean scores for the community college introductory biology "on-campus" students. The achievement pretest mean for the "on-campus" group, 44.7970, and the pretest mean for the ITV group, 48.8000, were used in a t-test for independent samples. A t of 2.75 was obtained. This t value did not exceed the table value for $\alpha = .05$ with 201 degrees of freedom; therefore, the hypothesis was not accepted. The ITV students' pretest achievement test mean scores were not significantly higher than the "on-campus" students' pretest achievement test mean scores. As a result of this finding, it was concluded that neither group had an advantage over the other group at the beginning of the course on knowledge of the course content.

Hypothesis 8

The adjusted mean of the ITV student group will be significantly higher than the adjusted mean of the "on-campus" student group on the achievement posttest mean. The analysis of covariance procedure was employed using the achievement pretest as the covariate to test Hypothesis 8. A F value of 15.677 was obtained which was significant at the $\alpha = .001$ with 1 and 200 degrees of freedom. The obtained F was highly significant; therefore, the hypothesis
was accepted as stated. From this finding it was concluded that the instructional television group achieved the course objectives with more success than the "on-campus" students.

Implications

1. Comparisons were made of the attitude toward biology of the "on-campus" and ITV students. The semantic differential was used as a pretest at the beginning of the semester and as a posttest at the end of the semester. The ITV group exhibited a significant increase of 2.6000 in their mean score, while the "on-campus" students' mean score declined, though not significantly by 0.5789. The students were instructed to mark the attitude instrument in relation to the concept "biology." Factors such as instructor, time of day, and previous experience were not investigated. The ITV students had minimal contact with the instructor.

2. The ITV students attained a significantly higher mean score on the posttest achievement test than did the "on-campus" students participating in this study. The following are proposed as possible explanations for the higher achievement mean score of the ITV student group.

a. The textbook, student handbook, telelessons, and laboratory manual were developed as one coordinated learning package. The materials are highly organized with specific learning objectives for each lesson.
b. The student handbook used in the ITV course contains written exercises for each unit, along with posttest questions for each lesson.

c. The ITV students completed ten detailed laboratory reports through the semester which were graded, corrected, and returned to the student. Laboratory subjects in the "on-campus" course and the ITV course complement the course objectives and subject areas. "On-campus" students do not complete detailed laboratory reports for grading but do take short (10 to 15 question) exams each week over the previous week's material.

d. The ITV student may have gained skill in answering objective questions from the posttest material in the student handbook.

The implication here is that "on-campus" instructors may need to reassess the organization and preparation of course materials utilized by "on-campus" students.

3. The profile information revealed that the ITV students were generally white females ranging in age from 23 to 45 years of age. The "typical" ITV student was married, worked full-time, attended school part-time, and had completed 30 or more college credit hours. By contrast, the "on-campus" students were generally white females ranging in age from 18 to 22 years of age. The "typical" "on-campus" student was single, employed part-time, attended college on a full-time basis, and had earned less
than thirty college credit hours. The ITV students were generally older, part-time students pursuing full-time careers. This information should be applicable to producers of telecourses in order that course materials be developed to accommodate the learning style and lifestyle of the potential instructional television student.

Recommendations

The following recommendations seem to be in order, based on the data assembled and analyzed in this study.

1. Community college instructors and administrators should give consideration to offering the introductory biology telecourse in an "open-circuit" format, "closed-circuit" format, or "individualized learning" package in order that students have more alternatives in terms of individual learning styles. Also community colleges should continue to offer the introductory biology course in traditional "on-campus" classes.

2. Producers of instructional television courses should undertake to complete achievement comparison studies between "on-campus" and instructional television students as new courses are developed so that potential users can make judgements relating to the offering of instructional television courses based on experimental evidence.

3. "On-campus" and instructional television instructors should participate in planning and organizing course materials for the traditionally taught classes because both
groups can contribute expertise to the planning and organizing functions. Likewise, "on-campus" instructors and instructors with instructional television experience should participate in planning and organizing course materials for the instructional television courses for the same reasons.

4. Community college administrators should capitalize on the expertise of the instructional television instructors in planning new courses, expanding existing facilities, and support services to students and in the recruitment of instructors for instructional television course offerings.

5. The information obtained from the profile data suggests an in-depth study involving correlation of demographic data with achievement test scores, attitude scores, and course grades.

6. Another study should be conducted with other groups of "on-campus" and ITV students utilizing a different instrument to assess achievement because a different instrument could possibly produce different results.

7. Other college-credit biology courses should be developed for instructional television since the introductory biology course is an effective method of instruction to accommodate the varied learning styles and instructional mode preferences of students.
APPENDIX A
STUDENT PROFILE

In order to obtain background information on biology students, your answers to the following questions are being requested. It is very important to us to have this information so that we may better understand and serve our students. Please mark all answers in the optical scanning area on the answer form provided using a #2 pencil.

Please enter your social security number on the special answer sheet.

1. Sex:
   A. Male
   B. Female

2. Age:
   A. Under 17
   B. 18-22
   C. 23-34
   D. 35-45
   E. Over 45

3. Marital Status:
   A. Married
   B. Single
   C. Divorced
   D. Widowed

4. Race:
   A. Caucasian/White (Non Hispanic)
   B. Black (Non-Hispanic)
   C. Spanish Surnamed Hispanic
   D. Oriental
   E. Other

5. How many college hours are you enrolled in this semester?
   A. 0-4
   B. 5-8
   C. 9-11
   D. 12-14
   E. 15 or more
6. Highest level of education:
   A. Some high school
   B. High school graduate or GED
   C. 1 year college (30 hours)
   D. 2 years college (60 hours)
   E. Bachelors degree or higher

7. Current occupational status:
   A. Work part-time
   B. Work full-time
   C. Full-time homemaker
   D. Not employed

8. What were your reasons for enrolling in this course?
   A. Course required for degree
   B. Course relates to current or desired job
   C. Elective course
   D. Interested in the subject area

9. What degree are you working toward in the Tarrant County Junior College District?
   A. 1 year Certificate program
   B. 2 year Associate of Applied Arts and Sciences
   C. 2 year Associate of Arts and Science
   D. I am not working toward a degree

10. What is the highest degree which you plan to work toward some day?
    A. Certificate--1 year program
    B. Associate Degree--2 year program
    C. Bachelors Degree--4 year program
    D. Masters Degree or higher
    E. None of the above
APPENDIX B
We would like to enlist your help in the construction of an attitude scale toward biology. The purpose of the scale we are developing is to measure meanings of certain things to various people by having them judge them against a series of descriptive scales. The descriptive scales take the form of polarized adjectives, such as:

    good ___: ___: ___: ___: ___: ___: ___: bad

The following is a list of polarized adjectives. Please select 10 pairs that you think would be appropriate for an attitude scale toward biology by placing a check in the space provided.

  1. boring - interesting
  2. confusing - clear
  3. irrelevant - relevant
  4. worthless - valuable
  5. meaningful - meaningless
  6. pleasant - unpleasant
  7. beneficial - harmful
  8. important - unimportant
  9. interesting - boring
 10. complex - simple
 11. vague - precise
 12. distinct - vague
 13. ordered - chaotic
 14. positive - negative
 15. good - bad
 16. purposeless - purposeful
ATTITUDE TOWARD BIOLOGY

The purpose of this instrument is to measure your attitude toward biology. This instrument measures the meanings of certain subjects to various people by having them judge them against a series of descriptive scales. The concept to be judged is Biology, and you will find a set of scales beneath the concept—Biology.

Place a check mark in the appropriate space, as shown in the examples below, based on your feelings of how closely the concept Biology is related to either end of the scale.

Very Closely Related

Fair X: ___: ___: ___: ___: ___: ___ Unfair

or

Fair ___: ___: ___: ___: ___: ___: X Unfair

Quite Closely Related

Strong ___: X: ___: ___: ___: ___: ___ Weak

or

Strong ___: ___: ___: ___: ___: ___: X: ___ Weak

Be sure that you check every scale, do not omit any; and never place more than one check mark on a single scale. Some of the items may seem familiar, as if you had read them before. This will not be the case, so do not look back and forth through the items. Do not try to draw parallels between the scales. Mark each scale as a separate and independent judgement. Work at a fairly high speed, do not worry or puzzle over the individual scales. It is your first impression, the immediate "feeling" about each scale, that is wanted. However, please do not be careless, because it is your true impressions that are desired.

Thank you for your cooperation.
<table>
<thead>
<tr>
<th></th>
<th><strong>BIOLOGY</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Complex                       : Simple</td>
</tr>
<tr>
<td>2</td>
<td>Important                     : Unimportant</td>
</tr>
<tr>
<td>3</td>
<td>Boring                        : Interesting</td>
</tr>
<tr>
<td>4</td>
<td>Clear                         : Confusing</td>
</tr>
<tr>
<td>5</td>
<td>Harmful                       : Beneficial</td>
</tr>
<tr>
<td>6</td>
<td>Meaningful                    : Meaningless</td>
</tr>
<tr>
<td>7</td>
<td>Purposeless                   : Purposeful</td>
</tr>
<tr>
<td>8</td>
<td>Good                          : Bad</td>
</tr>
<tr>
<td>9</td>
<td>Negative                      : Positive</td>
</tr>
<tr>
<td>10</td>
<td>Pleasant                      : Unpleasant</td>
</tr>
</tbody>
</table>
1. The portion of the nervous system that integrates sensory information and motor function is the 
   a. central nervous system. 
   b. peripheral nervous system. 
   c. nerve.

2. The brain is an organ of the 
   a. central nervous system. 
   b. peripheral nervous system.

3. Myelin acts to 
   a. speed the rate of nerve impulse conduction. 
   b. physically carry the impulse along a neuron. 
   c. house the nucleus of a neuron. 
   d. block normal synaptic function.

4. The nerve cell fibre that conducts impulses away from a cell body is 
   a. myelin. 
   b. dendrite. 
   c. axon. 
   d. synapse. 
   e. ganglion.

5. A nerve is 
   a. a collection of cell bodies found outside the central nervous system. 
   b. the same as a neuron. 
   c. a group of neurons wrapped in connective tissue. 
   d. composed only of axons and cell bodies.

6. Nerve tracts consist of 
   a. bundles of neurons in the brain and spinal cord. 
   b. ganglia. 
   c. bundles of neurons in the peripheral nervous system.
7. A nerve impulse is the movement of
   a. transmitter substance along a neuron.
   b. sodium ions out of and potassium ions into a neuron.
   c. myelin along the length of a neuron.
   d. sodium ions into a neuron and potassium ions out of the neuron.

8. The space between neurons is termed the
   a. synaptic cleft.
   b. vesicle.
   c. enzyme.
   d. transmitter substance.
   e. effector.

9. In a reflex arc, the element that begins the reflex by sensing the stimulus is the
   a. interneuron.
   b. effector.
   c. efferent neuron.
   d. afferent neuron.
   e. receptor.

10. The neuron that conducts impulses away from the central nervous system is called
    a. an interneuron.
    b. an effector.
    c. an efferent neuron.
    d. an afferent neuron.
    e. a receptor.

11. The central nervous system is composed of the
    a. brain and spinal cord.
    b. brain and peripheral nerves.
    c. spinal cord and peripheral nerves.
    d. brain, spinal cord, and peripheral nerves.

12. The brain and spinal cord are protected by
    a. cerebrospinal fluid.
    b. cranium and vertebrae.
    c. both a and b above.
13. The portion of the brain that contains centers that control respiration rate, heartbeat rate, and blood pressure is the
   a. thalamus.
   b. cerebrum.
   c. cerebellum.
   d. medulla.

14. The part of the brain that controls the pituitary gland and its secretion of hormones is the
   a. thalamus.
   b. medulla.
   c. cerebellum.
   d. hypothalamus.

15. The portion of the brain that functions in reasoning, thinking, interpreting the senses, and initiating motor movements is the
   a. thalamus.
   b. cerebrum.
   c. cerebellum.
   d. medulla.

16. The portion of the brain that coordinates body movements is the
   a. thalamus.
   b. cerebrum.
   c. cerebellum.
   d. medulla.

17. In experiments with animals, it has been found that destruction of the cerebellum affects
   a. sense perception.
   b. pulse rate.
   c. predictive function and coordination.
   d. aggressive behavior.

18. Brain research techniques include
   a. destruction of specific areas of animals' brains and observation of their behavior.
   b. electrical stimulation of the brain.
   c. chemical stimulation of the brain.
   d. all of the above.
19. An example of a drug that increases the activity of the central nervous system is
   a. alcohol.
   b. a barbiturate.
   c. an amphetamine.
   d. morphine.

20. The minimum amount of stimulus that a receptor cell must receive before it can react is called the
   a. dolor.
   b. threshold.
   c. response.
   d. base.

21. The sensation a person experiences from a stimulus results from an impulse reaching the
   a. receptor.
   b. brain.

22. The two categories of sensory receptors are the somatic receptors and special senses.
   a. true
   b. false

23. The sense of position of the body parts results from
   a. somatic receptors.
   b. special senses.

24. The sense of smell results from
   a. somatic receptors.
   b. special senses.

25. The many scattered sensory receptors located directly beneath the skin are sensitive to the
   a. internal environment.
   b. external environment.
   c. neither a nor b.

26. Receptor cells collect information to send along the correct pathway in order to be interpreted by the
   a. brain.
   b. spinal cord.
   c. eyes.
   d. skin.
27. Sometimes you can feel a light pain coming from your finger and other times, a severe pain coming from the same area. This difference in intensity of pain is probably caused by

a. different kinds of impulses going through neurons to the brain.
b. more neurons conducting impulses to the brain.
c. Both a and b are correct.
d. Neither a nor b is correct.

28. The senses most associated with the skin are

a. smell, pressure, touch, warmth, and cold.
b. balance, pain, pressure, and touch.
c. pain, pressure, touch, warmth, and cold.
d. proprioception, warmth, cold, and touch.
e. balance, smell, pressure, touch, and pain.

29. Motion is sensed chiefly in the

a. proprioceptors.
b. stretch receptors.
c. semicircular canals.
d. utricles.

30. The retina

a. brings nourishment to the retina.
b. protects the eye's contents.
c. contains the light receptor cells.
d. transforms light into nerve impulses.

31. The shape of the lens is changed by the

a. iris.
b. cornea.
c. vitreous humor.
d. ciliary muscle.

32. Rods

a. move the lens, focusing light on the retina.
b. detect color.
c. detect light at low intensities.
d. change the shape of the iris.
e. form aqueous humor.
33. Vitamin A is necessary for
   a. proper color vision.
   b. proper hearing sensitivity.
   c. proper low-light vision.
   d. formation of vitreous humor.

34. Depth perception is made possible by
   a. slightly different images being detected by each eye.
   b. exactly the same image being detected by each eye.
   c. the left eye detecting only images on the left side and the right eye detecting only images on the right side.
   d. using only one eye at a time when looking at an object.

35. The structure that controls the amount of light entering the eye is the
   a. iris.
   b. lens.
   c. cornea.
   d. ciliary body.

36. The clear watery fluid located in the anterior (front) chamber of the eye is called
   a. aqueous humor.
   b. vitreous humor.
   c. choroid.
   d. ciliary body.

37. The outer ear includes
   a. only the visible portion of the ear.
   b. the visible ear and the canal that ends with the eardrum.
   c. the visible ear, eardrum, and ear ossicles.
   d. the visible ear, eardrum, ear ossicles, and semicircular canals.

38. The organ of Corti is
   a. involved with balance.
   b. the portion of the cochlea that contains hair cells.
   c. another name for the oval window.
   d. the same thing as the auditory nerve.
39. Conduction deafness can be caused by
   a. measles.
   b. arsenic.
   c. immobile earbones.
   d. prolonged exposure to loud, high-frequency sounds.

40. The oval window
   a. is the first place middle ear vibrations are converted to fluid movement in the cochlea.
   b. stops echo formation in the cochlea.
   c. conducts sound through the middle ear.
   d. determines the pitch of a sound.

41. The loudness of sound is detected by the
   a. location of hair cells bent.
   b. number of hair cells bent.
   c. amount of endolymph moved.
   d. extent that the round window bulges.

42. Sound waves are conducted from the tympanic membrane to the oval window of the cochlea by the
   a. organ of Corti.
   b. hair cells.
   c. hammer, anvil and stirrup.
   d. eustachian tube.

43. The autonomic nervous system contains the
   a. cranial and spinal portions.
   b. peripheral and spinal portions.
   c. parasympathetic and sympathetic portions.
   d. None of the above is correct.

44. The autonomic nervous system innervates
   a. digestive organs.
   b. blood vessels.
   c. body muscles such as the biceps.
   d. all the above.
   e. only a and b of the above.
45. The autonomic nervous system is
   a. entirely involuntary.
   b. entirely voluntary.
   c. basically involuntary but sometimes can be voluntarily controlled.
   d. basically voluntary but a few portions are involuntary.

46. Parasympathetic and sympathetic systems perform
   a. the same functions.
   b. antagonistic functions.
   c. the same functions sometimes and antagonistic functions at other times.

47. The heart rate increases during
   a. sympathetic stimulation.
   b. parasympathetic stimulation.

48. Stomach contractions increase during
   a. sympathetic stimulation.
   b. parasympathetic stimulation.

49. During the "fight-or-flight" response
   a. the heart rate increases.
   b. rate of urine formation decreases.
   c. blood is shunted from the intestines.
   d. the bronchioles dilate.
   e. all of the above.

50. During the "fight-or-flight" response, the heart rate
   a. increases.
   b. decreases.
   c. is not altered.
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