AN ABSTRACT OF THE THESIS OF

LOY WAYNE YOUNG for the DOCTOR OF EDUCATION

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Title: AN ANALYSIS OF THE COMPARATIVE EFFECTIVENESS OF PROGRAMMED MULTIMEDIA TEACHING AND TRADITIONAL TEACHING OF DRUG INFORMATION TO JUNIOR HIGH SCHOOL STUDENTS

Abstract approved: Redacted for privacy

Dr. Gordon W. Anderson

The central purpose of this comparison was to determine the congruence or difference between two teaching techniques, the programmed multimedia approach and the traditional teaching method as used in presenting drug information to eighth grade students in the Mankato, Minnesota school district. The population sample consisted of 391 students enrolled in four junior high schools. Intact sections of students from each of the junior high schools were used. In each of the participating schools, an equal number of sections were assigned to both the programmed multimedia method as designed by the Lockheed Educational Systems of the Lockheed Aircraft Corporation and the traditional method of teaching.
The following data collected on each student consisted of

1. Pretest score of drug knowledge
2. Intelligent quotient test score
3. Reading comprehension test score
4. Final drug knowledge test score
5. Retention test score

Upon completion of a 15 day instructional program, a drug test constructed by the investigator was administered to determine the drug knowledge obtained by the students of the experimental groups and the students of the control groups. After an interval of five weeks, the drug knowledge test was again administered to determine the amount of drug knowledge retained. Using the test scores and adjusting them to control statistically the variables of pre-drug knowledge, academic potential or intelligence and reading comprehension ability; an analysis of covariance was computed, and the adjusted means were tested with the 'F' test. The Biomedical computer program "BMO4V Analysis of Covariance with Multiple Covariates", was used to analyze the data. Six null-hypotheses were tested. Not only was the effectiveness of the programmed multimedia method compared on the basis of drug knowledge obtained and the drug knowledge retained for the entire population of students, but also the effectiveness for groups of students with varying mental abilities and varying reading comprehension levels was determined.

The following conclusions seem warranted on the basis of the data presented in this study.
1. Although the programmed multimedia approach did produce a slightly greater amount of drug knowledge, as observed in the adjusted mean scores, the evidence indicates there is no significant difference in the effectiveness of the two methods for this population of eighth grade students.

2. The evidence indicates that there is no significant difference in the drug knowledge retained by students taught by these two methods.

3. The evidence indicates that there is no significant difference in the drug knowledge obtained by students who have average or above average mental ability but for students who are below average the programmed multimedia approach was the more effective method.

4. The evidence indicates that for students of varying mental abilities there is no significant difference in the drug knowledge retained through the use of these two instructional methods.

5. The evidence indicates for students who have a reading comprehension level at or above the eighth grade there is no significant difference in the drug knowledge obtained through the use of these two methods of instruction, but for the students who have reading comprehension levels below the eighth grade the programmed multimedia approach was significantly more effective.

6. The evidence indicates that for students who have a reading comprehension level at or above the eighth grade there is no significant difference in the drug knowledge retained through the use of these two method of instruction, but for the students of the public school with reading comprehension levels below the eighth grade the programmed multimedia approach was significantly more effective.

Recommendations were presented on the basis of the findings. Major recommendation related to: (a) conducting similar studies on the elementary and high school levels; (b) developing a study on a long term basis to determine behavioral patterns; (c) providing
materials of the programmed multimedia variety for use by the students of below average mental ability; (d) providing materials of a programmed multimedia type for students who have reading deficiencies.
An Analysis of the Comparative Effectiveness of Programmed Multimedia Teaching and Traditional Teaching of Drug Information to Junior High School Students

by

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AN ANALYSIS OF THE COMPARATIVE EFFECTIVENESS OF PROGRAMMED MULTIMEDIA TEACHING AND TRADITIONAL TEACHING OF DRUG INFORMATION TO JUNIOR HIGH SCHOOL STUDENTS

CHAPTER I

INTRODUCTION

Drug abuse has descended upon the American scene as one of society's leading socio-health problems with the most distressing aspects of the problem being that of teenage experimentation with mind altering drugs. Empirical observation indicates an escalation in teenage drug experimentation. Since early adolescence is frequently characterized by increased curiosity and a strong temptation to experiment, it seems inevitable that many youngsters will try some chemical substances which may alter their behavior and which might ultimately have permanent effects on their personalities.

An important issue confronting schools is their proper role in solving the drug problems of students. Although there is no clear cut consensus of what constitutes a "drug problem", most parents and teachers are interested in measures which may prevent students from experimenting with dangerous drugs.

Prevention of drug abuse is the primary objective of a school drug education program. To realize this goal it is necessary to determine which educational methods are most effective and accepted by the students.
A great deal of misinformation on drugs is being circulated, both through the "teen set" and the so-called "establishment". Accurate information is necessary for both groups. The young adolescent must be supplied with accurate up-to-date data as a prerequisite to the development of his ability to make socially accepted decisions. The adults must keep pace by obtaining drug information to enable them to answer questions from the adolescent.

The allocation of drug education in the curriculum must be resolved. The rapid escalation in the use of these substances by young people in recent years has taken educators by surprise. This situation has left many teachers in "academic darkness" searching for ways and means to increase their own knowledge, as well as to educate students concerning the possible consequences of experimentation with the use of drugs.

We are living in a society that is conditioned to use drugs to relieve pain and discomfort. The child learns this concept from his parents at an early age. Whenever there is illness in the family, a drug is frequently prescribed to relieve the discomfort. Johnson and Westman (48, p. 653) feel that many teenagers are "hurting" psychologically today and naturally look to drugs to "stop their hurting". They also contend that the younger the adolescents who use drugs, the more disturbed they become.
This viewpoint would support the growing evidence that drug education should begin at an early age. In 1967, as an outgrowth of the School Health Education Study, the School Health Education Curriculum Design (70) was developed. This curriculum included provision for drug education to be taught from kindergarten through grade twelve.

In playing a "informational catch-up game", it is necessary to develop programs that will be beneficial, effective, and accepted by the students. Not all students learn equally well by the same manner of teaching. Some learn by reading, some by viewing, and some by listening. Involvement activities, such as role playing and game simulation, along with group interaction, must also be considered. It is through these techniques that the individual has the opportunity to develop a better understanding of himself and others, thereby possibly foregoing the need and use of drugs.
Statement of the Problem

This study is designed to investigate the relative effectiveness of a programmed multimedia approach and traditional teaching in improving the drug knowledge of eighth grade students. More specifically, the study will attempt to determine if the combination of a programmed multimedia approach, such as the one designed by the Lockheed Education Systems of Lockheed Corporation, is more effective and results in a significant difference in learning than is achieved by the traditional teaching method.

The following null-hypotheses are to be tested at the .05 level of confidence:

1. There is no significant difference in the drug knowledge obtained by students who are taught by a programmed multimedia approach and students who are taught by the traditional method.

2. There is no significant difference in retention of drug knowledge by students who are taught by a programmed multimedia approach and students who are taught by the traditional method.

3. There is no significant difference in drug knowledge obtained by students of varying mental abilities (superior, average, below average) who
are taught by the programmed multimedia approach and students who are taught by the traditional method.

4. There is no significant difference in drug knowledge retained by students of varying mental abilities (superior, average, and below average) who are taught by a programmed multimedia approach and students who are taught by the traditional method.

5. There is no significant difference in the drug knowledge obtained by students who are taught by the programmed multimedia approach and students who are taught by the traditional method when the students have a reading comprehension level:
   a. at or above the eight grade level.
   b. below the eighth grade level.

6. There is no significant difference in the drug knowledge retained by students who are taught by the programmed multimedia approach and students who are taught by the traditional method when the students have a reading comprehension level:
   a. at or above the eighth grade level.
   b. below the eighth grade level.

In addition to the above stated hypotheses, three secondary results of the study are possible.
1. The determination of the future use of the Lockheed Drug Decision program in the state of Minnesota.

2. The possible adaptation of programmed materials, simulation games, and role playing activities, not only for drug education but for the other areas in health education.

3. The determination of the types of programs which might be more effective and more acceptable by the students.

Importance and Need for the Study

Drug abuse among students of junior high school age is on the increase as reported by Dr. Sidney Cohen (20) in a speech delivered at the Minnesota Governor's Conference on Drug Abuse. Dr. Cohen's statement is based on observable trends rather than statistics, and indicates a direction rather than a total indictment of younger people as drug users. As evidence of the increase in the use and misuse of drug, California Attorney General Thomas Linch (53, p. 81) states, that juvenile drug arrests have increased 2,000 percent in the last eight years. The California Bureau of Criminal Statistics shows over 15,000 juvenile arrests for drug abuse during the first six months of 1968 compared to 728 arrests for a similar period in 1960. An editorial in Newsweek (28, p. 107) states "The age of U.S.
drug users is dropping rapidly, sometimes reaching down into the elementary school”.

Along with this rapid escalation of drug abuse, increased concern on the part of teachers and parents appears to be developing. Many teachers are finding themselves lacking in knowledge and background experience to cope adequately with the numerous students problems arising in the area of drug abuse.

This increased concern over the drug abuse problem is not limited to the field of education. Industrial organizations, government agencies, and the armed services are also concerned to the point of developing various kinds of educational materials which they hope will adequately inform young people as to the effects of the various drug products. This barrage of new resource material has opened new areas of research for educators. It is necessary to investigate new methods, new programs, and new audiovisual aids, as well as to test and experiment with the many programs now in existence. This research is essential to avoid spending money needlessly on crash programs that may offer no advantages to the learner.

Hopefully, through improved educational methods, students will become better informed about drugs and will be prepared to make socially accepted decisions in regard to the personal use of mind altering chemicals.
The head of the Division of Narcotic Addiction and Drug Abuse of the National Institute of Mental Health, Dr. Sidney Cohen, (21, p. 429) feels that the schools have an important educational role in the area of drug abuse prevention because the schools are partly at fault for creating the feeling of alienation which prompts some students to turn to drugs. Cohen (21, p. 429) states, "Education today is not supplying students with living/learning experiences. Schools neglect emotional and sensory education and do not teach youngsters how to sense or enjoy".

Levy (52, p. 60) further emphasizes the role and the importance of the school in the development of effective programs of drug education when he states:

Society turns more and more to the schools for amelioration of deviant practices and has demanded that schools develope strategies to overcome environmental influences. Schools are looked upon as a shield against a host of evils from venereal disease to alcoholism.

Dearden (26), coordinator of the drug education program at the Griffin Hospital, Derby, Connecticut, voices strong opposition to the manner in which drug education is being conducted in the schools. He emphasizes the importance of student involvement and stresses the need for experimentation to determine the most effective methods to be used. He states:

Until we are willing to listen to students and to each other, and are willing to explore together
those areas of personal concern as they exist in individuals and organizational and administrative operation, our efforts in drug education will be less effective than they could be. In effect we will be bandaging a patient who needs an operation.

The Division of Health and Physical Education of the State Department of Education of Minnesota is interested in research to improve the quality of drug education in the schools. The State Director, Dr. Carl Knutson (See Appendix I, p. 119), realizes the possible values that could be derived from this study and therefore agreed to give the financial support necessary.

Further need for this study is indicated by the lack of research relative to the use of programmed learning in the field of drug education. Nothing is reported on research in health education where the use of multimedia techniques are employed. As results favoring the use of programmed and multimedia techniques are reported in studies in other academic disciplines, it follows that similar results might be forthcoming through further research in the areas of health education.

This investigator is interested in the relationship between methodology and knowledge retention and believes that there is a need for more research. To prevent drug abuse, students need adequate knowledge to enable them to make appropriate decisions in their future life and therefore there is a need to provide methods through which knowledge will be retained for a longer period of time.
Students may develop a more positive attitude about drug education if they enjoy the learning that is provided for them. There is a definite need for health educators to utilize all available resources to find ways of making drug education an enjoyable and meaningful experience. Research is, therefore, essential to determine the types of approaches that are liked best by the students.

The need for effective drug education programs has been felt on local, state and national levels. The State of Minnesota has enacted legislation requiring students who want to be certified as teachers to take a class in drug education. Public funds have been allocated from the Department of Health Education and Welfare to promote drug education through workshops and in-service training for teachers. Industries are producing learning packages, and the schools are being bombarded constantly with new programs, new methods, and new visual aids. Undoubtedly some of these programs are excellent, while others are inferior and noneffective. Only through research is it possible to determine the materials and approaches that are most effective and conducive to learning.

The investigator believes that it is the obligation of health educators to ascertain that the materials and methods that are used in teaching students are the best available. The evidence presented in the preceding discussion serves to substantiate this belief as to the importance and need for this study.
Definition of Terms

In order that there might be clarity, it was considered imperative that certain terms be defined.

**DRUG** - Any chemical that modifies the function of living tissues, resulting in physiologic or behavioral change (47, p. 5).

**DRUG USE** - Where the effects of a drug sought can be realized with minimal hazard, whether or not used therapeutically, legally or as prescribed by a physician (47, p. 5).

**DRUG ABUSE** - Where drugs are taken or administered under circumstances and at doses that significantly increase their hazard potential, whether or not used therapeutically, legally or as prescribed by a physician (47, p. 5).

**SIMULATION TEACHING** - The reproduction of a situation or a set of circumstances to which the learner must respond by making a decision or taking an action.

**SIMULATION GAME** - A form of simulation whereby the players are presented simplified models of real world predicaments in a situation of competition or conflict.

**ROLE PLAYING** - The technique in which the students are cast as characters with the intent to act out life situations by assuming the role of another person.
MULTIMEDIA - The use of several different techniques and/or material aids employed by the teacher, supplemental to the spoken word, with the intent of providing the student with a greater variety of learning experiences.

PROGRAMMED INSTRUCTION - Methods, programs or devices characterized by the controlled presentation of material, the elicitation of appropriate response, guidance with respect to subject matter, and control of the way in which learning proceeds.

LINEAR PROGRAMMED INSTRUCTION - An organizational form through which all material is presented in sequence and by means of alternate choice responses at each step or frame; the readers comprehension is tested by immediately checking for the correct response. The teacher or tutor functions are replaced by wholly or partially automated programs capable of instruction without direct intervention or modification by an outside agency.

TRADITIONAL TEACHING - Teaching in a formal classroom setting with the same teacher for a specified time each day, using primarily lecture method supplemented by films, filmstrips and class discussion.

CONTROL GROUP - The group taught by traditional teaching methods using lecture, films, filmstrips and class discussion.

EXPERIMENTAL GROUP - The group taught by using the programmed multimedia approach as designed by the Lockheed Education
**Fundamental Assumptions**

1. The teacher variables will be minimized by having each of the five participating teachers teach both an experimental and a control group.

2. The main concepts and material covered will be the same for both the experimental and the control groups.

3. The Otis-Lennon Test of Mental Ability is a valid and reliable measure of intelligence.

4. The SRA Reading Test is a valid measurement of reading ability.
Limitations of the Study

1. The study will be conducted using only the eighth grade students of the junior high schools in the city of Mankato, Minnesota.

2. Although a parochial school and public school eighth grade students will be used in the study, no attempt will be made to make comparisons between these two groups.

3. This study will be limited to two methods of teaching; the programmed multimedia method and the traditional method.

4. The study will make no attempt to appraise changes in drug attitudes or practices developing as a result of the two teaching methods that will be compared.
CHAPTER II

REVIEW OF RELATED LITERATURE

Review of literature reveals little research in the area on innovations related to health teaching. In virtually all other areas of education, one can find references to the use of programmed learning, simulation games, role playing and other innovations in curriculum construction and teaching methods. One might assume that some of the findings of similar types of research in other areas, such as social studies and mathematics, would provide a basis for curriculum development in the field of health education. This lack of research in the field of health education and more specifically drug education, make it necessary to rely on articles and studies that have been done in other academic disciplines in reviewing literature germane to this study.

Articles and Studies Regarding Programmed Instruction

Creswell (24, p. 365) stated that of the several educational innovations such as team teaching, programmed instruction, audio-visual aids and television, programmed instruction has more potential for alleviating many of the problems besetting educators today. He points out the following advantages of programmed instruction:
1. Careful programming allows complex steps to be broken into small steps that can be immediately reinforced.

2. Programmed instruction allows each student to progress in each phase of learning at his own individual pace.

3. The individualistic nature of the program allows a child who has been absent for several days to return and take up where he left off without being behind the rest of the class.

Podshadley, (66, p. 887) developed and administered a programmed learning sequence for teaching public health to dental students. He found this method was very effective and that the majority of the students indicated a strong preference for the use of programmed materials in public health classes.

Mathews (56, p. 624) indicated there is little argument as to the efficiency of programmed instruction. He said, "tests on both sides of the Atlantic have shown that learning by this method can be twice as fast and just as effective as teaching by conventional methods".

Bensley (9, p. 1) had the following to say concerning programmed instruction in the field of health education:

Programmed instruction tends to capitalize on the student teacher interaction and at the same time solve the problem of mass education. Most data gathered to date concerning programmed instruction indicates a revelation in the learning of factual information. The techniques on which programmed instruction is founded have been the foundation of teaching for centuries. It, also, provides control over the teaching relationship by demanding interaction between the learner and the material to be
learned. It does this by making appropriate use of
rewards to reinforce correct responses.

Olsen (64, p. 55) cited the following advantages and disadvantages
of programmed instruction:

Advantages:

1. Simplicity and ready accessibility (sic)
2. Student and instructor may shift from one text
to another easily and readily
3. In a classroom, students can refer to the same
page making group presentations less complicated.
4. Texts are relatively inexpensive.

Disadvantages:

1. Material can become outdated
2. Unfamiliar format may distract some students
3. Students and teachers are able to violate the
learning principles by straying away or taking
short cuts
4. Some student may not cover the answers and are
able to move ahead with no guarantee that learning
is taking place

Mayshark (60, p. 6) felt that any innovation in health education,
and this certainly includes programmed instruction, deserves a full
and fair hearing. He indicated that he believes the theory behind
programmed instruction is sound but that it needs to be applied in
the proper way with subject matter that lends itself to programming.

In addition to suggestions for research he stated:

It is unwise to assume that because a programmed
unit has been used with success in a certain subject
area, it naturally will be successful in all areas. It
is necessary for subject specialists to take a serious look at the potential of programmed instruction in their area of specialization.

Fry (32) stated in his book, *Teaching Machines and Programmed Learning*, that he believes that programmed instruction holds the promise of being the primary tool of the new educational technology. Not everyone shows the same enthusiasm, however, as indicated by the following statements by Meyers (57, p. 26):

> It is my contention that programmed learning has failed to do what optimists promised; prepare students for the mastery of appropriate skills and tasks as well as teach critical and deductive thinking. Programmed learning was extensively promoted long before adequate programs had been designed.

In spite of all the drawbacks, however, he concluded that it is a young and growing field and new and better programs are being developed every day; that although programmed instruction will not surpass conventional teaching or be effective with all students, it can effectively complement any program.

These two opposing points of view offer strong evidence to support the importance of research to determine the effectiveness of programmed materials in the schools.

Shevlin (72, p. 704) conducted a study to determine if intrinsically programmed materials and techniques could be effectively used to teach a health unit to secondary school students. Twelve secondary school health education classes, involving 343
students, were divided into matched groups. Branched self-teaching materials on the topic of alcohol education were presented to the experimental group to be studied at home for a three day period without recourse to classroom instruction. The control group was taught the unit utilizing traditional classroom techniques. The results of the achievement test administered at the conclusion of the unit, indicated that branched or intrinsically programmed materials and techniques can be effectively used in the teaching of a secondary health education unit, and in this particular study, the experimental group learned significantly more than the control group.

Three authors, Gibbs, Hunt, and Fahrner (36, p. 320) conducted a study comparing conventional and programmed instruction in bookkeeping. In this study 107 high school students were divided into an experimental and a control group. The groups were evenly matched in terms of I.Q. and pretest scores. The students in the control group were taught in the traditional manner using conventional teaching materials. The students in the experimental group were taught by means of programmed instructional materials. Both groups were given three identical post tests. The scores of the experimental group were significantly greater on all three tests. The study indicated that programmed materials can individualize instruction in the classroom and can be used effectively in homework.
A study conducted by Flynn (30, p. 387) was made to determine the influence of programmed instruction upon learning in Educational Psychology. This study was designed to investigate the influence of programmed instruction upon the learning of identified achievers and underachievers. Four groups of students were used; two experimental and two control groups. One experimental group consisted of students identified as achievers and the other experimental group consisted of underachievers. Likewise, one of the control group was made up of students identified as achievers and the other control group consisted of the students who were the underachievers. The experimental group learned the material by programmed instruction and the control group by lecture-discussion technique. The following results were reported by Flynn:

1. programmed methods of instruction yield significantly greater gains in learning for identified school achievers than regular classroom methods of instruction,

2. while achievers using programmed materials gain significantly more from pre-test to post-test, their self-instructional devices do not result in greater retention,

3. underachievers perform equally as well on achievement measures regardless of teaching method employed,

4. programmed methods of instruction did not produce a greater amount of retention for underachievers than classroom method of teaching, and

5. the amount of time spent by subjects using programmed methods of instruction is significantly less time than the time normally spent by students in the regular classroom, while the resultant learning and retention is similar.
Wood (81, p. 22) conducted a study comparing classes using a combination of programmed materials and teacher-led instruction with classes entirely under teacher direction using common methods of teaching ninth grade geography. Results from this study indicated that students using programmed materials learned significantly more factual information than those under teacher direction at the .05 level. Although there was a tendency for those using the programmed material to score higher, there was no significant difference in pupil ability to apply factual knowledge either to the geographic area being studied or to new but similar situations.

In addition to a report on the articles and studies that have been done using programmed instruction, a search yielded the following programmed materials which are available in the area of health education.

In 1965, William Schwartz (71) produced a programmed book on venereal disease. This manual, called Student Manual on Venereal Disease, was published by the American Association for Health, Physical Education, and Recreation, Washington, D. C. His program is written for junior high students and early high school students.

An extensive effort to produce programmed materials in the field of health education has been made by Behavior Research Laboratories of Palo Alto, California. In 1964 they published the American Health and Safety Series consisting of the following six programmed
text books; first aid, safety, nutrition, personal health, body structure and function, and prevention and care of communicable disease. This series, which is designed for use on the junior high school level, can be used either as a complete course of instruction or as separate units.

A booklet published by the United States Public Health Service titled, Food Borne Disease Investigation (74), presents a salmonellosis investigation which is programmed with the use of pictorial, mathematical, and graphical illustrations.

In 1969, the second edition of Lockheed's Drug Decision Text and multimedia instructional package was produced. The student works first in the text and then views systematically coordinated colored films that supplement and reinforce the material in the programmed text.

No other programmed materials were found in the field of health education.

**Articles and Studies Concerning Game Simulation**

In the programmed multimedia approach used by the experimental group in this study, student involvement is enhanced through the technique of game simulation, and therefore a review of the literature relative to the use of this technique in the classroom seems appropriate.
Robinson (67, p. 107) in 1966 conducted a study of the learning effects of two games with simulated environments and found that games and simulations are more effective than conventional methods in gaining the interest of learners and in motivating the learners to become more involved with learning activities.

The use of games or game therapy is appearing with increasing frequency in educational literature. Nova High School in Fort Lauderdale, Florida is very much involved in the use of games in the classroom. Nova High School now uses about 15 games in science, mathematics and social science classes. Allen (2, p. 62), director of Novas two year Academic Game Project, hopes that the school achievement of the adolescent will be improved by "altering the structure of values and rewards evidenced in many schools". He contends that various problem solving games can be helpful in teaching everything from Mathematics to International Relations. Some Baltimore and San Diego high schools have found that games can help motivate the slow learner, and Allen reports similar uses of games to meet the educational needs of the nonmotivated, under-achieving student. At the same time the (3, p. 82) noted that games are also aimed at the gifted or advanced student.

Kalman Cohen (19, p. 63) considers games to be effective learning aids for the following reasons:
Students get very absorbed in the competitive aspect of the game. More important, the exercises give students an opportunity to practice decision making techniques or approaches studied in the classroom. They force students to live with the consequences of their decisions, an experience hard to get in the classroom.

Carnegie Corporation, recognizing the possible values of games in the field of education, offered a $200,000 grant to John Hopkins University for research in this area. It is under this grant that two of the leading game exponents are working to try and develop games with simulated environments. These two researchers, Coleman and Boocock, (22, p. 64) have this to day:

Games bring the future into the present, allowing the student to play roles in a large differentiated society of which he otherwise hardly gets a glimpse, Games are peculiarly self-discipling, and self-judging, meaning that a player knows he has won or lost by his own actions.

A home economics teacher in Long Island, New York, and a strong advocate of the use of games in the classroom, Mrs. Bernice Ignatoff, (44, p. 48) presents many arguments in favor of simulation games. She contends:

One way to transmit learning is to make a game of the subject under study. Because of the pleasure games engender, they reinforce the learning taking place. The students become anxious to participate, are relating to and with their own peers, and the games allow the slow or shy student to assume another personality and are able to compete with the others.
Ignatoff also believes that games serve to improve poise, group work, spelling, and reading, knowledge of the subject, and concludes her article by claiming that she has found them to be an excellent teaching method.

Conceding that the value of games has yet to be proved, Guetzkow (38, p. 63), nevertheless insists that they are an effective teaching tool. He makes the following statement, "We put individuals into decision making posts so they can experience the reality of decision making."

Hemphill (41, p. 344) reports that the work on simulation as conducted in the hypothetical school district, i.e., Jefferson Township School District, which he developed, demonstrated that game simulation offered a unique process of combining effective and cognitive skill development. As an outcome of his work with simulation, he lists the following strengths:

1. Since simulation presents representation of real situations, the likelihood of desired transfer of learning seems to be much more probable with them than with conventional teaching materials and methods.

2. Simulation materials seem to be ideal for developing an ability to see "the total picture", since the student continually examines specific problems in relationship to their total context.

3. By starting with a representation of real situations, the student will have better opportunities to evolve meaningful relationships between concepts and facts.
4. A weakness of traditional programs is that they deal with what ought to be rather than what is. The use of simulated materials can help to maintain a balance between what ought to be and what is.

5. Simulated materials help a student develop insight about himself, learning scientific concepts, and acquire needed skills.

6. Simulated materials are realistic and at the same time susceptible to the control of the instructor.

Brodbelt (12, p. 176) explains the advantages of simulation gaming as it has been used in the social studies area:

A simulation game combines the properties of games in general with the properties of simulation in general. Essentially, simulation allows the student to live vicariously by presenting simplified models of real life situations. It places the student in a role playing position where he not only assumes a role playing decision making role, but where he must follow procedures and rules to achieve specific objectives.

An article by Jerry (48, p. 81) points out some of the advantages of simulation teaching at the junior high school level. She believes that the importance of methodology at any level cannot be overestimated. Teaching methods must be improved. She feels that the only purpose for change or an innovation in teaching method is to increase the effectiveness of instruction. As she discusses the area of simulation games as a teaching method, she has the following to say:

Simulation teaching is based on the premise that persons do not learn by being taught. They learn by experiencing the consequences of their actions. Games which simulate some aspect of reality are
one way a young person can begin to see such consequences before he faces the real action and the real consequences.

A second premise is that simulation affords the student an opportunity to become involved in a non-threatening activity. If the student makes the wrong response, the mistake and the consequences will be clearly recognized without danger of physical, mental, or social repercussions.

*It Works, Project R-3* (29, p. 7), an example of the development of gaming simulation activities for classroom use, was used in conjunction with the San Jose School District in California. It was developed on the following suppositions;

Students are ready to learn only when they are motivated; motivation is achieved when the performance of an act is positively linked with or made relevant to a reward and when the whole process is socially acceptable; major behavioral changes are made lasting by reinforcing the positive, desired acts that promote cognitive and affective development.

The basis for using gaming simulation in this project was to motivate the students through anticipation and to reinforce their actions through rewards.

According to Bruner (13, p. 94) gaming simulation offers an excellent means for introducing concepts and developing fundamental skills in the young. He contends that the component of play in the gaming method allows tension reduction and is essential for uninhibited and pleasurable learning to transpire.
In spite of all of the positive findings relative to the use of games in the classroom some educators are critical. Charles Lerche (50, p. 64), Dean of the School of International Services at American University in commenting on the reality of the simulation games used in political science stated, "The trouble is that there are only a few situations in real life where there are only a few variables at work. Life situations are far more complex than these games can make them".

After reviewing the literature concerning the use of games and noting the results of studies involving game simulation, enthusiasm is stimulated to investigate this method in the area of health education.

**Review of Role Playing in the Schools**

In the multimedia approach used by the experimental group in this study, role playing is used during the third or last phase of the program. It therefore seems logical to present an overview of how role playing may be used in the classroom as evidenced by a review of literature in this area.

Chesler and Fox (17, p. 12), authors of the book *Role Playing Methods in the Classroom* discovered that many teachers were experimenting with role playing in their classrooms. They found that some were using it as a method for teaching children to look at themselves,
to look at the action of others, and to look at social life in general. They were using it to help diagnose and treat classroom behavior problems, and to give feedback to certain individuals. They found that others were using it to dramatize and illustrate subject matter. It was being used in a great variety of ways and for a variety of purposes but with the goal of making the classroom a real-life laboratory for social and academic learning. The authors feel that role playing has tremendous potential for the usual elementary and secondary school classroom and cite the following advantages:

1. By taking on the role of another person, students can act out their true feelings without the risk of reprisals.

2. Students can examine and discuss relatively private issues and problems without anxiety.

3. By placing themselves in the role of another, students can identify with the real world and the imaginations of other children and adults.

4. This increased opportunity for understanding oneself and others paves the way for behavioral change.

5. Role playing may be used to demonstrate less personal but pervasive problems between and among people, and groups.

No studies were found of research concerning the use of role playing in the classroom. After reading about the opinions of teachers who have employed these techniques, and the popularity of this procedure as expressed by many students, it seems that there is ample evidence to warrant further investigation of the potential of using role playing techniques in the classroom.
After reviewing literature concerning the use of programmed instruction, game simulation, and role playing techniques, and also reviewing the viewpoints expressed relative to the effectiveness of these techniques, there seems to be evidence that they have value when properly used. Although it has not been proved that they teach anything that could not be learned in the traditional classroom, they may serve as motivators, and can be used by creative teachers as effective teaching supplements. The diverse opinions express the need for further research in the use of these techniques as aids to learning for all levels of students. One might apply the following quotation made by Carlson (15, p. 83) to all of these techniques. In this statement he is referring to games, however, it seems applicable to the programmed multimedia methods that are employed by the experimental groups in this study:

> If nothing else, they convey to the student a feeling for the multiplicity of factors that must be considered in decision making, and conceivably they may increase the confidence of young people to deal with real life problems that seem impossibly remote from their own lives.

The concept of simulation teaching and role playing seems to be within the framework of sound educational theory as expressed by some educators today. Taba and Elzey (71, p. 524) indicate that
helping pupils to develop a basis for and a method by which to function is most vital in today's changing world. Baughman and Eberle (7, p. 394) in making the following statement seems to summarize the case for the use of a multimedia approach.

Through group and individual involvement, the learning task will become real and meaningful. Involvement will occur as pupils encounter the problem and discuss it in many of its aspects. Perhaps the greatest value comes from the realistic way in which the learner is individually and emotionally involved in the situation.

**Articles on Drug Education in Schools**

In reviewing the literature on the subject of drug and drug abuse, the majority of articles appear to be concerned with the physiological effects, the mind altering properties, or with the types of treatment being attempted for those who become addicted. Only recently have articles appeared which indicate that public concern in shifting toward the prevention of drug abuse and the techniques and methods of drug education used within the schools.

An article by Johnson and Westman (49, p. 646) points out the need for preventive drug abuse education. They conclude that most teenagers and parents are inadequately informed about drugs and respond positively to an open educationally oriented approach that respects their rights to have access to important knowledge and their ability to handle this knowledge. The health professions and educators
have the responsibility of promoting greater self-awareness and knowledge through a variety of experiences available in the life of the adolescent. Bringing the adolescent into the confidence of adults represents the most significant step that can be taken to minimize the adverse effects of drug abuse.

Leach (51, p. 60), cites many examples of drug abuse occurring in elementary school children in many different areas of the country. These results were from a special survey and leads Dr. Leach to conclude that positive educational programs are needed for teachers, parents and students.

Fort (31, p. 22) states the following:

Education on drugs is grossly inadequate or almost nonexistent, despite laws requiring our school systems to provide instruction in this area. Most information and distorted concepts now come from advertising, graffiti on toilet walls, crash scare lectures and films, and teachers who have no special training in the subject matter, or policemen who have no training in pharmacology, sociology, or medicine.

Why do "teens" turn on with drugs? "Boredom is a major factor in the teen drug experimentation" is a quotation made by the Reverend Tom Murphy (59, p. 61) who operates a house for runaway or displaced youth in Washington, D. C. From his experience with teens, he believes that many of the younger generation feel that society is not going anywhere. They do not like school, the way things are, or the prospects for the future. They see the older
generation using alcohol and tranquilizers, observe that adults are not happy, and decide they do not want to pursue the same way of life.

In the article "Innovations in Drug Education", by Norwalk (61, p. 236), we see a crash program again being proposed. This program was planned by a health committee which was made up of both students and faculty. It consisted of a week of drug emphasis, including speakers, films, and discussions. The purpose as stated was to help students make rational and sound decisions about the use of drugs, to present accurate information, and to present a variety of views about drug use.

Barr (5, p. 60) believes that it is better and more effective to teach respect for all drugs at the primary level than to lecture on the subject in high school.

Probably the best way to contribute to curbing drug influence in your own district, according to Barrins, (6, p. 35) is to establish a district wide education program. She feels it is the obligation of the schools to arm youngsters early in life with knowledge of drugs. "Only education will save the life or the healthy brain of a child who is tempted to experiment. If properly educated in drug dangers, most youngsters will react with reason when the temptation arises."

A clinical psychologist, Donald Wolk (80, p. 667) believes that it is well to consider that the major influence on an individual's
use of drugs is the peer group. He also believes that the prestige of key figures, and the power of group approval, identification, and belonging are tremendous motivating factors. "Emphasis in drug education must be on individual attitudes, social value, changing styles of life and implications for the future."

In an article titled "Drug Addicts and the Schools", written in March, 1971, W. W. Brichman (11, p. 147) writes the following:

The passage of the Drug Abuse Education Act of 1970 provides $58,000,000 for a three year attack on the problem via the classroom. Teachers and counselors will be trained. There will be a growing demand for courses in drug education. A combined, continuing campaign by the entire community is a necessity if children and adolescents are to be spared the dire results of action which effect them irrevocable.

A positive approach to drug education is suggested by Mikeal and Smith (58, p. 452) from the School of Pharmacy, University of Mississippi. They claim that most of the scare tactics, behavior shaming, and taboo labeling which seemed to have been passed off as drug education have in reality constituted feeble and abortive attempts of drug socialization. They likewise feel that the restructuring or present drug education will be a difficult but necessary task, the undertaking of which is the responsibility of every health educator.

In an editorial of the Journal of School Health, (46, p. 453) reference is made to the School Health Study. This is a...
comprehensive health education program based upon sequentially developed behavior objectives in a kindergarten through twelfth grade curriculum. Through this kind of approach the focus of the drug abuse problem is not the substance, but the force motivating their use. Thus the student becomes involved in relevant, meaningful learning situations rather than being told that the drugs are dangerous and illegal. The goal is a young person who's values will enable him to make appropriate decisions in regard to the use of drugs.

Matchett (55, p. 90) conducted a study in a suburban public high school in New Haven, Connecticut in an attempt to clarify the incomplete picture of what sort of adolescent is likely to use drugs. He found that there were two very different categories of drug users in this school. One group was using them more heavily and seemed to fit the stereotype of an individual on the fringe of society. The other group was apparently only experimenting, and were in fact even more secure, inquisitive, and active than their non-using peers.

Pearce (65, p. 83) believes that education must deal with the drug problem within the social and cultural context in which it has developed, and that teacher behavior should attempt to generate communication as a basis for the development of socially constructive behaviors. She cites the following:
It is the responsibility of teachers to show the youth culture that we can value and develop creativity and sensitivity without drugs; that we can investigate the cosmic question without drugs; that we can move into a world of shared beliefs and ideas without drugs; and that perhaps such experiences without drugs may be more enduring than the transience of their drug induced experience.

Grant (37, p. 385) conducted a study of 48 high school seniors in the Baltimore area in an attempt to develop a better drug education program. He concluded that the challenge of shaping health behavior through health education must not be taken lightly or for granted and that the conventional, legal, medical, and educational approaches to drug abuse are not impressive, at least to this group of students.

There is no single answer to this complex problem and solutions are slow to come. There is no better place to start, according to Weinswig (78, p. 62), than with the following three concepts:

1. Drugs with proper use are essential.
2. Drugs are powerful agents.
3. When improperly used, any drug is potentially dangerous.

In summarizing the articles concerning drug education, it is apparent that many authorities agree that there should be a comprehensive program beginning in kindergarten and extending through grade twelve, and that drug education needs to be part of a regular course of study for it to receive the long term emphasis which is essential for the involvement of the student in significant learning.
CHAPTER III

DESIGN OF THE STUDY

Procedures for Selection of Schools

After expressing a desire to have a study conducted concerning the effectiveness of a programmed multimedia method in drug education, the Division of Health and Physical Education of the Minnesota State Department of Education made available to the investigator 200 Lockheed Drug Decision instructional kits. These kits, costing $5.00 a unit, consist of a programmed textbook, introductory and reinforcement films, a simulated drug attack game, and case history role playing activities.

Upon securing confirmation that the needed materials would be supplied, it was necessary to select a school population to be used in the study. The supervisor for the Division of Health and Physical Education, Dr. Carl Knutson, requested that the study be conducted at the eighth grade level. Other factors to be considered were the type of class, the schedule and length of class periods necessary to fit the Lockheed program and the qualifications of the instructional staff. To aid in the selection the following criteria were established:

1. A school district having a direct health instructional program at the eighth grade level.
2. Schools having a coeducational health program with classes scheduled five days a week and the class meeting being fifty minutes in length.

3. Schools in which multiple sections of the health class are taught by the same teacher.

4. Teachers who meet the certification standards to teach health as prescribed by the State Department of Education of the State of Minnesota.

5. Teachers who have a minimum of four years of health teaching experience.

6. Teachers who have attended a recent drug education workshop.

**Procedures Used in Briefing the Teachers**

In an attempt to gain uniformity in the presentation of material, two weeks prior to the beginning of the spring semester a six hour in-service training session was conducted to provide an opportunity for the teachers to become acquainted with the Lockheed materials that would be used by the experimental groups and to discuss the procedures that would be used by the control groups. A representative from the Lockheed educational staff presented instructions on the use of the programmed multimedia materials and the investigator went over the guidelines to be followed in instructing the control groups. The entire day was spent in previewing films, group discussions, and answering questions in regard to the types of student activity to be used by both the experimental and control groups. Additional
follow-up meetings with each of the participating teachers to go over in detail the procedures, films, and other materials available for use by the control groups, were scheduled.

Although each of the teachers had attended a recent drug education workshop and had developed a good background in drug knowledge, the above procedures were followed to assure, insofar as possible, that the same basic information would be presented.

Procedures for Selecting Student Groups

For this study it was necessary to use intact groups of students as previously established by each individual school. In an analysis of the methods used to form the class sections, it was found that no two schools followed the same procedures. One school used an alphabetical system arranging the entire eighth grade class in alphabetical order and then counting down to get the desired number in each section. Various other systems were used by the other schools, but none of the schools made an attempt to arrange the students in homogeneous groups. This procedure resulted in groups of students that were presumed to be heterogeneous, i.e., composed of individuals with varied abilities with diverse economic and cultural backgrounds.

The investigator allowed the participating teachers of each school to designate the sections that would be treated as the
experimental group and the control group. This was done so that exchange of materials would be most convenient for each teacher's schedule.

**Description of Experimental Conditions**

Three hundred and ninety-one eighth grade students from the Mankato, Minnesota community were used in this study. The students were enrolled in health classes of four junior high schools. The data in Table 1 are arranged to show the distribution of students among the four schools. Junior high school I is a parochial school and junior high school II, III, and IV are public school.

The student groups were each given the following treatment:

1. All students were given the Lockheed Drug Knowledge Test as a pre-test to insure that the control group did not possess more drug knowledge than the experimental group or vice versa.

2. The student's mental ability scores were secured from the records. For this purpose, the Otis-Lennon Test of Mental Ability was used. This test also served as a device to determine whether each group was comparable in mental ability, and also to classify the students into groups of "superior" mental ability, "average" mental ability, and
TABLE 1. Student Distribution

<table>
<thead>
<tr>
<th>School Designation</th>
<th>Instructor Designation</th>
<th>Group I Experimental Group</th>
<th>Group II Control Group</th>
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<tbody>
<tr>
<td>Junior High School I</td>
<td>Teacher A</td>
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<td>2</td>
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<td>37</td>
<td>37</td>
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<td></td>
<td>Teacher B</td>
<td>3</td>
<td>4</td>
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<td></td>
<td>39</td>
<td>38</td>
</tr>
<tr>
<td>Junior High School II</td>
<td>Teacher C</td>
<td>1</td>
<td>2</td>
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<td>19</td>
<td>27</td>
</tr>
<tr>
<td>Junior High School III</td>
<td>Teacher D</td>
<td>1</td>
<td>2</td>
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<td>24</td>
<td>20</td>
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<tr>
<td>Junior High School IV</td>
<td>Teacher E</td>
<td>1</td>
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</tbody>
</table>

*Junior High School I is a parochial school.
"below average" mental ability. For this study, the mental ability scores were arranged from the highest to the lowest, and the group was divided into thirds. When this was done, the following ability groups were designated.

1. Superior mental ability = students with 114 IQ and up.

2. Average mental ability = students with 104 to 113 IQ.

3. Below average mental = students with 103 IQ and below.

The above classification was used to fulfill the requirements of the third and fourth hypotheses, i.e., to determine the relative effectiveness of programmed multimedia teaching and traditional teaching for various mental ability groups.

3. Because of the nature of the programmed multimedia program in which the student is required to read in a programmed text book, reading comprehension scores were secured for each student. The Mankato Schools use the SRA Reading Test. Reading comprehension scores were used to eliminate the possibility of the control group having an advantage over the experimental group or vice versa.
The reading comprehension scores were used to fulfill the requirements of hypothesis five and six, i.e., to determine whether programmed multimedia teaching is as effective as traditional teaching in increasing drug knowledge of students whose reading comprehension level is below the eighth grade level and similarly for students whose reading comprehension level is at or above the eighth grade level.

4. Each teacher was assigned a minimum of one experimental group and one control group to teach.

5. The control groups and the experimental groups both received equal amounts of time, and covered the same topic areas. Each class met for a fifty minute period, five days a week for a period of fifteen days.

6. A drug knowledge test, developed by the investigator was administered to all of the students as a post-test upon completion of the course.

7. Five weeks following the completion of the course, the drug knowledge test was again administered to determine the amount of knowledge retained by the students who had participated in the experimental and the control groups.
8. No further retention test were possible due to the ending of the school year.

Description of the Drug Decision Program Used by the Experimental Group

It is felt by the producers of this program that the programmed multimedia approach to learning assures maximum achievement of the specific instructional objectives. The following statements from the Drug Decision manual (29, p. 1) will give the reader a more complete understanding of the program:

Lockheed's Drug Decision instructional package for grades seven through nine is a dynamic, self-contained program that creates in the student an understanding and an awareness of the real problems connected with drug abuse. Authenticated by specialists in education, medicine, and law, the information presented in Drug Decision is based on objective facts—the program does not attempt to preach to the student or to appeal to his emotions. A student who completes the Drug Decision program will have up-to-date facts about drug abuse—recognized as perhaps as the most important and difficult problem facing young people today.

In Drug Decision, the student builds up a store of knowledge about drugs and their uses; but the program allows him to do more—it permits him to analyze and evaluate this kind of information in a variety of simulated problem situations. The immediate result? The student learns about drugs that are abused, their effects on the human mind and body, the psychological needs that people try to fulfill with drugs, the exploitive criminal greed that traffics in this special form of human misery, and the legal system and its penalties for violations of drug laws. And this learning is not passive—Drug Decisions requires the student to function as an active decision maker. He must make decisions to protect
his community from a simulated drug attack, and he must decide on the approach to treatment and rehabilitation of drug users. The long-term result? Armed with comprehensive facts about drug abuse, the student is better prepared to cope with the pressures, the insecurity, the fads, and the frustrations of the teenage culture of which he is a part. The "drug scene" loses some of its glitter when illuminated by facts.

The Drug Decision Program consists of nineteen units which are broken down into the following five phases:

Phase I - Disaster Management: Student reads text and reviews and reinforces by use of films. He sees the escalating infiltration of drugs into the community as a new kind of disaster and learns the methods of detecting, stopping and treating a disaster.

Phase II - Effects of Drugs on Man: The student learns where drugs come from and how they are abused. He studies the medical aspects of the commonly abused drugs.


Phase IV - Drug Attack Game: Student is given opportunity to practice what he has learned.

Phase V - Rehabilitation: Role playing, whereby students act out the story of a drug dependent person who has been committed to a drug rehabilitation center for treatment.

The number of class periods can be either increased or decreased by adjusting the number of units per session. It was determined by the schools involved that 17 days could be allotted to complete this study; fifteen days for the course instruction and two days for the testing procedures. A pre-test was given before taking the course; a post test was given upon finishing the course; and the knowledge
retention test was given five weeks after completing the course.

As one looks at the master schedule (see Appendix II, p. 120) of the Drug Decision Program, one notes various phases of the program and sees that for each group topic area, the student first works in a comprehensive programmed textbook. Upon completion of the assigned material, he then views systematically coordinated color films that supplement and reinforce the material just learned. The films are a single concept idea, with a viewing time of from three to six minutes.

The drug attack game and the case history role-playing activities offer opportunity for students to become actively involved in the decision making process. Through these techniques, the students are called upon to make decisions based on knowledge and attitudes they have formed after completion of the programmed text.

This description of the Drug Decision Program is given to present a clear picture of what the students will be doing during the 17 days they are involved with this study.

Description of the Traditional Method of Teaching as Used by the Control Group

In the traditional teaching carried out by the five participating teachers, it was the concern of the investigator that the same topic areas be covered in all of the groups. This problem was discussed at the in-service training session, and it was agreed that the following
areas be covered:

Topic I  - Introduction and History of Drug Abuse
Topic II - Pharmacological aspects of chemicals and drug abuse
Topic III - Physiological effects and addicting factors
Topic IV - Psychological effects and drug dependence
Topic V  - Legal aspects; Laws and penalties
Topic VI - Treatment and Rehabilitation

These topics compared with the phases that were to be presented to the experimental groups.

The teachers, conducting the classes for the control groups were encouraged to utilize, only, the techniques and materials which they had used the previous semester. Each teacher had at their disposal the same sets of books, pamphlets, film strips, transparencies and other instructional aids. The investigator made certain that films were transferred as needed to insure that each of the groups would receive similar exposure. Every effort was made to handle the control groups in a uniform manner.

Development of Drug Knowledge Test

This study is concerned with a comparison of the effectiveness of using a programmed multimedia approach and the traditional approach in acquiring drug information by eighth grade students. In order to conduct a objective nonbiased investigation, one of the necessary tools is a suitable evaluation instrument (See Appendix III, p. 121).
After conducting a thorough review of the available literature, it was discovered by the investigator that there were no tests available in drug education applicable or suitable for this study. Therefore was necessary to construct an adequate evaluation instrument in the area of drug use and abuse or appropriate content and difficulty, and designed with a reading level specifically for eighth grade students.

In developing and constructing the test, the scope and content to be covered was determined. To do this, the investigator made an extensive review of many books and pamphlets and studied the materials that were available to both the experimental and control groups participating in the study. Having conducted numerous drug education workshops for students and teachers in the past several years, the investigator also had at his disposal a vast collection of up-to-date drug education material in his own personal library. From these materials a multiple choice test was constructed with a reading level applicable to the students in the study.

The multiple choice type of question was used for this test because it is generally well suited to group testing procedures and has the following advantages as cited by Baron (4, p. 209):

1. The number of alternate responses reduces the chances of guessing more than in the case with true-false or matching type questions.

2. The listing of plausible answers stimulates thinking.
3. The limitation of possible answers eliminates ambiguity in scoring; the technique of scoring is not complicated.

Furst (34, p. 117, in his book Constructing Evaluating Instruments, lists the following advantages:

1. The multiple choice item is extremely adaptable. It lends itself to an unusually wide range of uses.

2. The multiple-choice item appears to be relatively free of response sets.

3. It generally provides greater test reliability per item than does the true-false type.

4. It generally can provide more analytic data than the true-false test.

If carefully constructed, the several alternatives on a multiple choice test can provide the instructor with a basis for assessing errors in thinking, whereas judgments of truth and falsity leave him only in the dark on the basis upon which the judgments were made.

In developing of the test, the procedures followed consisted of searching out material in the specified topic areas and forming questions with the main concern being the eighth grade students who are participants in this study.

The test developed contained 45 items. These questions were then checked by a reading expert (See Appendix IV, p. 129) which resulted in the need to revise the vocabulary of the test. After reapplying the Lorge Readability Formula, an average grade level readability score of 7.19 grade level was obtained (See Appendix IV, p. 129).
To determine "face validity" the test was submitted to a group of experts with a variety of experience, who are in contact with drug education in the schools and teacher training programs. These professional experts were solicited to render their opinion as to the content covered, the accuracy of the questions, and the usability of the test. To determine the medical and legal accuracy, the test was also submitted to a medical doctor and the County Attorney. The opinions from this group of experts are included in Appendix V, p. 131.

The test was then administered for a test sample to two eighth grade classes which had completed a course in drug education. The investigator administered this test to these students to insure that the teacher would not be aware of the contents of the drug knowledge test which was to be used later in the study.

Considerable information, such as test reliability, item validity, and degree of difficulty may be assessed by the pretesting process. Through use of the IBM test scoring sheets and the computer data processing equipment, the investigator was able to secure an item analysis of these areas.

Item analysis, is not only the process of examining the entire test, but also that of examining each separate item of the test for the purpose of determining its strong points as well as its flaws.
Determination of Degree of Difficulty

Horracks (42, p. 547) states "An index of item difficulty is used to estimate the percentage of examinees likely to get the item right when it is next used".

A test that is to discriminant effectively between students at various levels of ability in any group must contain items of various levels of difficulty for that group. The very difficult items are necessary to discriminate between the individuals who are the better students and the high achievers. Similarly, some items should be so easy that only the poorer student, the lower achiever, will miss them. Not only must the items discriminate, they must discriminate positively.

In addition to the decision to choose items that discriminate positively, there is a question as to the distribution of difficulties that should be sought. Nunnally, (62, p. 147) points out that "After an empirical try out of items, a good procedure is to choose approximately an equal number of items at each difficulty level in the possible score range. That is if a 40 item test is being constructed with five alternatives for each item, the procedure would be to choose five items with difficulty between 20 and 30 percent, five items between 30 and 40 percent, and so on to five items of 90 and 100 percent.

This process seems to be an arbitrary procedure as Nunnally (62, p. 147) also states "The ideal distribution of difficulty varies in
terms of the use which will be made of the test. Consequently, no "air tight" rule can be given for all situations".

According to Hawks, (40, p. 32) there is general agreement that there should be a range of difficulty from about 5 to 20 percent up to 80 to 95 percent.

In the drug knowledge test constructed by the author for this study, the range of item difficulty extended from 15 percent to 91 percent with the mean average level being 52.4 percent. By establishing an interval grouping of approximately 15 points, the item difficulty distributes in the following proportions.

TABLE 2. Item Difficulty Distribution

<table>
<thead>
<tr>
<th>Difficulty Range</th>
<th>Number of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 to 29 percent</td>
<td>--- 8 items</td>
</tr>
<tr>
<td>30 to 44 percent</td>
<td>--- 9 items</td>
</tr>
<tr>
<td>45 to 59 percent</td>
<td>--- 10 items</td>
</tr>
<tr>
<td>60 to 74 percent</td>
<td>--- 10 items</td>
</tr>
<tr>
<td>75 to 91 percent</td>
<td>--- 8 items</td>
</tr>
</tbody>
</table>

Total 45 items with mean difficulty of 52.4 percent.
Determination of Reliability

Frust (33, p. 212) states, "After tryout of the instrument, it is also desirable to determine the degree of reliability. Reliability refers to the adequacy with which a test samples the defined behavior." The problem of reliability is to estimate the degree to which the sample behavior taken by the evaluation instrument is representative enough to yield results which are typical of the individual's concerned. Van Dalen (75, p. 315) states, "a test is reliable if it consistently yields the same results when repeated measurements are taken by the same subject under the same conditions".

There are three common methods which might be used to estimate reliability; the test-retest, the equivalent form, and the split-test procedure.

For the purpose of this study, the split-test procedure was used. This process consists of dividing the items in a single test into halves, taking the odd-numbered items for the other. This assumes that the two halves represent equivalent samples of the same area. Guttman's formula (39, p. 255) which utilizes the standard deviation of each half of the test was used.

\[
r = 2 \left(1 - \frac{S_o^2 + S_e^2}{S_t^2}\right)
\]

where

\(S_o\) = standard deviation of odd half
\( S_e = \text{standard deviation of even half} \)

\( S_t = \text{standard deviation of the total test} \)

Substituting the following data into the formula the reliable coefficient was .81.

\[
\begin{align*}
S_o & = 3.6 \\
S_e & = 3.5 \\
S_t & = 6.5 \\
R & = 2 \left( 1 - \frac{\left( \frac{12.96 + 12.25}{42.25} \right)}{2} \right) \\
R & = 2 \left( 1 - \frac{\left( \frac{25.21}{42.25} \right)}{2} \right) \\
R & = 2 \left( 1 - .596 \right) \\
& = 2 (.41) \\
R & = .808
\end{align*}
\]

Another method of determining reliability coefficient applied to the sample data received from the drug knowledge test was the Kuder-Richardson Formula 20. This process yielded a coefficient of reliability of .87.

In the use of this formula "r" is obtained by using the upper 27 percent and the lower 27 percent of the group.

Kuder-Richardson Formula 20

\[
\text{KR}_{20} = \frac{K}{K - 1} \left\{ 1 - \frac{2n \sum (W_L + W_H) - \sum (W_L + W_H))}{0.667 \left[ \sum (W_L - W_H) \right]^2} \right\}^2
\]
where

\[ K = \text{number of items} \]
\[ n = 27 \text{ percent of students} \]
\[ WL = \text{lower 27 percent of students} \]
\[ WH = \text{upper 27 percent of students correctly answering items} \]

Kuder-Richardson Formula 20 using sample data:

\[
KR_{20} = \frac{K}{K-1} \left( 1 - \frac{2n}{(WL + WH)} \right) - \frac{(WL + WH)^2}{(WL + WH)}
\]

\[
= \frac{45}{44} \left[ 1 - \frac{2(12)(523) - 8105}{667(194)^2} \right]
\]

\[
= \frac{45}{44} \left( 1 - \frac{4447}{25103} \right) = \frac{45}{44} (0.83)
\]

\[ = .87 \]

**Determination of Item Validity**

According to Adams (1, p. 548), the conventional procedure for computing item validity is to:

1. Rank the answer sheets in order of total score.

2. Select the lowest 27 percent of the test papers, and the highest 27 percent, including a paper above or below 27 percent when the percentages do not yield a whole number. An equal number of papers should be included in each group.

3. For each item count the number of correct answers in the low group and the number of correct answers in the high group.

4. Subtract the number of correct answers in the low group from those of the high group.
5. Divide this difference by the number of papers in either group.

**Formula for Validity Index**

\[
\frac{W_H - W_L}{N} = \text{Validity index}
\]

where

- \(W_H\) = upper 27 percent answering correctly
- \(W_L\) = lower 27 percent answering correctly
- \(N\) = the number of persons in either group

The reader must understand that the validity index secured by different methods such as the bi-serial \(r\) are not comparable and that a validity index, say of .60, does not mean that the item is 60 percent valid. It simply means that an index of .60 describes an item more valid than one with a lower index and one less valid than an item with a higher index. The index of validity is at best a rough measure providing some picture as to whether or not the item discriminates between students who secure high scores on the whole test and those who do not. It is thus a measure of whether a given item "pulls its weight" in the general direction of the other items of the test.

There are several varying forms illustrated in the literature for recording item analysis data. The investigator used two such forms to collect the data.

Furst's (33, p. 312) format for tabulation was followed except that where Furst suggests using the bi-serial \(r\), the author used the
percent difference between the high and low choice. This was
necessary because of the unavailability of the Item Analysis Table.

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Choice high Group</th>
<th>Choice low Group</th>
<th>Item Index</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5</td>
<td>1 2 3 4 5</td>
<td>PH PL PD</td>
</tr>
<tr>
<td>1</td>
<td>0 0 1 11 0</td>
<td>1 0 5 6 0</td>
<td>0.99 0.50 0.49</td>
</tr>
<tr>
<td>2</td>
<td>0 11 0 0 1</td>
<td>4 4 1 2 1</td>
<td>0.99 0.33 0.66</td>
</tr>
<tr>
<td>44</td>
<td>0 0 0 0 12</td>
<td>4 1 0 0</td>
<td>7 100 0.58 0.42</td>
</tr>
<tr>
<td>45</td>
<td>10 0 0 1 1</td>
<td>5 0 1 2</td>
<td>4 0.83 0.41 0.42</td>
</tr>
</tbody>
</table>

The items of the test ranged from a high index value of .82 to
a low of .08 with the overall average of .40. Items number ten,
eighteen, and nineteen, had the lowest positive discriminating power,
but because of the nature of the information required to answer these
questions their inclusion was felt to be important. Another value of
the above tabulation process is to note the attractiveness of alternate
or distractor choices. In analyzing the items, it can be readily
recognized whether or not the distractors are effective.

The second tabulation form used was similar to the form
developed by Ross (66, p. 436).
<table>
<thead>
<tr>
<th>Item No.</th>
<th>Rank order according to discriminating power</th>
<th>W_L</th>
<th>W_H</th>
<th>W_L - W_H</th>
<th>W_L + W_H</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>19</td>
<td>2</td>
<td>7</td>
<td>8</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>10</td>
<td>3</td>
<td>5</td>
<td>6</td>
<td>1</td>
<td>11</td>
</tr>
</tbody>
</table>

This form was utilized not only to note the rank order of item discrimination, but was used in computing reliability using the Kuder-Richardson Formula 20.

Summary of Item Analysis of Drug Knowledge Test Constructed by the Investigator

Drug Knowledge Test

Reading Level, by Lorge Readability = 7.19 grade level
(See Appendix IV, p. 129)

Item Analysis

Degree of Difficulty = Range from 15 to 91 percent Mean being 52.4 and
Reliability = .87 by Kuder-Richardson Formula
Validity = items ranged from a high index value of .82 to a low of .08 with the average of .40.
CHAPTER IV

ANALYSIS OF DATA AND PRESENTATION OF THE FINDINGS OF THE STUDY

Before proceeding to analyze the information and the data collected through this study, it seems appropriate to restate the purpose. The study was conducted to compare the effectiveness of two different methods of presenting drug information to eighth grade students; namely the programmed multimedia approach and the traditional method. The development and construction of a drug knowledge test was deemed necessary to give a valid and objective assessment of the drug knowledge obtained upon completion of a 15 day course of study, and the drug knowledge retained after an interval of five weeks.

The following null hypothesis to be tested are:

1. There is no significant difference in drug knowledge obtained by students who are taught by a programmed multimedia approach and students who are taught by the traditional method.

2. There is no significant difference in retention of drug knowledge by students who are taught by a programmed multimedia approach and the students who are taught by the traditional method.
3. There is no significant difference in drug knowledge obtained by students of varying mental abilities (superior, average, below average) who are taught by a programmed multimedia approach and students who are taught by the traditional method.

4. There is no significant difference in drug knowledge retained by students of varying mental abilities (superior, average, below average) who are taught by a programmed multimedia approach and students who are taught by the traditional method.

5. There is no significant difference in the drug knowledge obtained by students who are taught by a programmed multimedia approach and students who are taught by the traditional method when the students have a reading comprehension level:
   a. at or above the eighth grade level
   b. below the eighth grade level

6. There is no significant difference in drug knowledge retained by students who are taught by the programmed multimedia approach and students taught by the traditional method when the students have a reading comprehension level:
   a. at or above the eighth grade level
   b. below the eighth grade level
Analysis Procedure

The statistical procedures followed in this study were recommended by the Department of Statistics and Computer Science of Mankato State College, Mankato, Minnesota.

It was recognized in scrutinizing the format for this study, that several variables should be considered for control purposes. Because it was necessary to use intact groups from the four participating schools, each with the possibility of uniqueness, the decision was made to use the statistical control of analysis of covariance. This technique, made more usable through the advent of computer programs, is well suited to educational research. It enables the investigator to compensate for several initial differences in the group being studied. Due to the nature of the groups in this particular study, it was necessary to compensate for the covariates of intelligence, reading comprehension, and initial drug knowledge. The analysis of covariance in compensating for the differences between groups, adjust the mean scores obtained in the final calculations.

Upon the completion of the course of study, data and test scores for each individual student within a designated school and section, were recorded and coded on the following type of prepared forms:
TABLE 5. Student Data Form

<table>
<thead>
<tr>
<th>Junior High School</th>
<th>Code 1</th>
<th>Section 1</th>
<th>Code 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td></td>
<td>Programmed Multimedia</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Student Name</th>
<th>IQ</th>
<th>Reading Level</th>
<th>Pre-test</th>
<th>Post-test</th>
<th>Retention test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anderson, W</td>
<td>115</td>
<td>144</td>
<td>18</td>
<td>34</td>
<td>31</td>
</tr>
</tbody>
</table>

Using this information, data processing cards were punched in preparation for computer analysis. Data were placed in the first 16 columns on the cards as follows:

TABLE 6. Computer Program Data Card

<table>
<thead>
<tr>
<th>Column</th>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Programmed Multimedia</td>
</tr>
<tr>
<td></td>
<td>or 2</td>
<td>Traditional</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Junior High School I</td>
</tr>
<tr>
<td></td>
<td>or 2</td>
<td>Junior High School II</td>
</tr>
<tr>
<td></td>
<td>or 3</td>
<td>Junior High School III</td>
</tr>
<tr>
<td></td>
<td>or 4</td>
<td>Junior High School IV</td>
</tr>
<tr>
<td>3 and 4</td>
<td>1, 2, 3</td>
<td>Students</td>
</tr>
<tr>
<td>5, 6, and 7</td>
<td>115</td>
<td>IQ</td>
</tr>
<tr>
<td>8, 9, and 10</td>
<td>132</td>
<td>Reading Comprehension level</td>
</tr>
<tr>
<td>11, 12</td>
<td>15</td>
<td>Pre-test</td>
</tr>
<tr>
<td>13, 14</td>
<td>32</td>
<td>Post-test</td>
</tr>
<tr>
<td>15, 16</td>
<td>30</td>
<td>Retention Test</td>
</tr>
</tbody>
</table>
The analysis of covariance was calculated by use of the Biomedical Computer Program BMDO4V-Analysis of Covariance with Multiple Covariates (27, p. 525) (See Appendix VI, p. 134).

This computer program is designed to compute the analysis of covariance with multiple covariates and unequal treatment group sizes. In this study the treatment group, group one, (programmed multimedia group) and treatment group two (traditional groups) was adjusted for the covariate of IQ scores, reading comprehension level scores, and pre-drug knowledge scores.

Following the computer analysis, the "F-test" was used to determine if the resulting adjusted means were statistically significant at the five percent level of confidence.

The formulated hypotheses offer a variety of ways to interpret the differences between programmed multimedia teaching and traditional teaching methods.

**Analysis of the First Hypothesis:** There is no significant difference in the drug knowledge obtained by students who are taught by a programmed multimedia approach and students taught by the traditional method.

It was decided that before an accurate assessment could be made of the two methods of teaching, an analysis should be made of the parochial school students and the public school students using the post-test scores to determine if there was a significant difference between the groups.
In the analysis of the students post-test scores for the programmed multimedia groups (Table 7a) the adjusted mean score for the parochial school was 25.3795 and for the public schools 26.0187. When computing the "F" test on the adjusted mean scores, F is 1.043. Using one and infinite degrees of freedom, the critical ratio at the five percent level of confidence is 3.84. This indicates there is no significant difference in the two groups of students.

In the analysis of the student post-test scores for the traditional teaching group (table 7b), the adjusted mean score for the parochial school was 24.491 and for the public school was 24.2785. When computing the "F" test on the adjusted mean scores, F is .112. Using one and infinite degrees of freedom, the critical ratio at the five percent level of confidence is 3.84. This indicates there is no significant difference in the two groups of students.

Finding no significant difference between the parochial school groups and the public school groups, it was feasible to use the total population of 391 students in the analysis of the post-test scores.

In the analysis of the student post-test scores of the programmed multimedia group and the traditional teaching group (table 7c), the adjusted mean score was 25.69 and 24.385 respectively. In computing the "F" test at the five percent level of confidence, F is 1.254. Using one and infinite degrees of freedom, the critical ratio is 3.84. This indicates there is no significant difference in the drug knowledge
TABLE 7a. Analysis of Student Groups-Drug Knowledge Obtained—Analysis of Covariance Table  
Post Test Scores of the Programmed Multimedia Group 190 Students.

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>YY</th>
<th>SUM-SQUARES (Due)</th>
<th>SUM-SQUARES (About)</th>
<th>DF</th>
<th>MEAN-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td>1</td>
<td>26.8633</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>188</td>
<td>6199.4805</td>
<td>2963.9882</td>
<td>3235.4923</td>
<td>185</td>
<td>17.4891</td>
</tr>
<tr>
<td>Treatment + Error (Total)</td>
<td>189</td>
<td>6226.3437</td>
<td>2972.6141</td>
<td>3253.7297</td>
<td>186</td>
<td></td>
</tr>
<tr>
<td>Difference for Testing Adjusted Treatment Means ....</td>
<td>18.2374</td>
<td>1</td>
<td>18.2374</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Null Hypothesis: No difference among treatments after adjusting with covariates.

\[ F(1, 185) = 1.043 \text{ NS} \]

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Adjusted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25.3799 parochial</td>
</tr>
<tr>
<td>2</td>
<td>26.0187 public</td>
</tr>
</tbody>
</table>
TABLE 7b. Analysis of Student Groups - Drug Knowledge Obtained - Analysis of Covariance Table
Post test scores of the Traditional Teaching groups 201 students

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>YY</th>
<th>SUM-SQUARES</th>
<th>SUM-SQUARES</th>
<th>DF</th>
<th>MEAN-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td>1</td>
<td>27.7715</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>199</td>
<td>7584.4375</td>
<td>3918.7811</td>
<td>3665.6564</td>
<td>196</td>
<td>18.7023</td>
</tr>
<tr>
<td>Treatment + Error (Total)</td>
<td>200</td>
<td>7612.2090</td>
<td>3944.4565</td>
<td>3667.7526</td>
<td>197</td>
<td></td>
</tr>
<tr>
<td>Difference for Testing Adjusted Treatment Means</td>
<td>2.0961</td>
<td>1</td>
<td>2.0961</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Null Hypothesis: No Difference Among Treatments After Adjusting With Covariates.

\[ F(1, 196) = .112 \text{ N.S.} \]
TABLE 7c. Analysis of Student Groups - Drug Knowledge Obtained - Analysis of Covariance Table
Post test scores for the programmed multimedia group and the traditional teaching group 391 students, total population

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>YY</th>
<th>SUM-SQUARES</th>
<th>SUM-SQUARES</th>
<th>DF</th>
<th>MEAN-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td>1</td>
<td>192.7930</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>389</td>
<td>13838.5527</td>
<td>6883.7043</td>
<td>6954.8484</td>
<td>386</td>
<td>18.0177</td>
</tr>
<tr>
<td>Treatment + Error (Total)</td>
<td>390</td>
<td>14031.3457</td>
<td>7053.8979</td>
<td>6977.4479</td>
<td>367</td>
<td></td>
</tr>
<tr>
<td>Difference for Testing Adjusted Treatment Means</td>
<td>22.5995</td>
<td>1</td>
<td>22.5995</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Null Hypothesis: No Difference Among Treatments After Adjusting With Covariates.

\[ F(1, 386) = 1.254 \text{ NS} \]

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Adjusted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25.695 Programmed Multimedia group</td>
</tr>
<tr>
<td>2</td>
<td>24.385 Traditional teaching group</td>
</tr>
</tbody>
</table>
obtained by the students of these two instructional methods.

**Conclusion:** The first null-hypothesis can not be rejected. We conclude that in this population of eighth grade students there is no significant difference in drug knowledge obtained by students taught by the programmed multimedia approach and the students taught by the traditional teaching method.

**Analysis of the Second Hypothesis:** There is no significant difference in retention of drug knowledge of students taught by the programmed multimedia approach and students taught by the traditional method.

To insure statistical accuracy in analyzing hypothesis two, the investigator compared the retention test score of the students of the various schools to determine if there was a significant difference. In the analysis of the student retention test scores for the programmed multimedia groups of the parochial and public schools (table 8a) the adjusted mean score was 23.5341 and 25.3281 respectively. When computing the "F" test on the adjusted mean scores, F is 8.404. Using one and infinite degrees of freedom, the critical ratio at the five percent level of confidence is 3.84. Since F is within the critical region, this indicates there is a significant difference in the student retention test scores of the parochial and public school groups.
In analyzing the retention test scores of the students in the traditional teaching groups of the parochial and the public school (table 8b), the adjusted mean score was 23.1201 and 23.6190 respectively. When computing the "F" test on the adjusted mean scores, F is .572. Using one and infinite degrees of freedom, the critical ratio is 3.84 at the five percent level of confidence. This indicates there is no significant difference in the retention test scores of the students in the traditional teaching groups.

With the appearance of the significant difference in the student retention test scores of the programmed multimedia groups of the parochial and public schools, the investigator analyzed the public schools to determine if a difference might exist. In the analysis of the student retention test scores of programmed multimedia groups of three public schools (table 8c) when the "F" test is applied to the adjusted mean scores, "F" is .636. This indicates no significant difference in the groups at the five percent level of confidence.

In order to make an accurate comparison of the effectiveness of the two methods of teaching used in this study, the parochial and the public school student groups were analyzed separately.

Analyzing the student retention test scores of the programmed multimedia and the traditional teaching groups within the parochial school groups (table 8d), the adjusted mean score for the programmed multimedia group was 23.135 and for the traditional group 23.755.
When computing the "F" test on the adjusted mean score, \( F \) is .952. Using one and 113 degrees of freedom, the critical ratio at the five percent level of confidence is 3.84. This indicates there is no significant difference in the knowledge retained by the students in the two instructional groups within the parochial school.

In the analysis of the retention test scores of the students in the programmed multimedia group and the traditional teaching method group within the public schools (table 8e), the adjusted mean score was 24.835 and 23.9268 respectively. When computing the "F" test on the adjusted mean scores, \( F \) is 2.440. Using one and infinite degrees of freedom, the critical ratio at the five percent level of confidence is 3.84. This indicates there is no significant difference in the knowledge retained by students in the two instructional groups within the public schools.

**Conclusion:** The second null-hypothesis can not be rejected. We conclude that in this population of eighth grade students there is no significant difference in drug knowledge retained by students taught by the programmed multimedia approach and students taught by the traditional method.
TABLE 8a. Analysis of Student Groups - Drug Knowledge Retained - Analysis of Covariance Table

Retention test scores of the traditional teaching group 201 students

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>YY</th>
<th>SUM-SQUARES (DUE)</th>
<th>SUM-SQUARES (ABOUT)</th>
<th>DF</th>
<th>MEAN-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td>1</td>
<td>.0498</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>199</td>
<td>7099.2939</td>
<td>3176.5544</td>
<td>3922.7396</td>
<td>196</td>
<td>20.0140</td>
</tr>
<tr>
<td>Treatment + Error (Total)</td>
<td>200</td>
<td>7099.3437</td>
<td>3165.1627</td>
<td>3934.1811</td>
<td>197</td>
<td></td>
</tr>
<tr>
<td>Difference for Testing Adjusted Treatment Means</td>
<td></td>
<td></td>
<td></td>
<td>11.4415</td>
<td>1</td>
<td>11.4415</td>
</tr>
</tbody>
</table>

Null Hypothesis: No Difference Among Treatments After Adjusting With Covariates.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Adjusted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>23.1201 parochial group</td>
</tr>
<tr>
<td>2</td>
<td>23.6190 public group</td>
</tr>
</tbody>
</table>

\[ F(1', 196) = 0.572 \text{ N.S.} \]
TABLE 8b. Analysis of Student Groups - Drug Knowledge Retained - Analysis of Covariance Table
Retention test score of the programmed multimedia group 191 students

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>YY</th>
<th>SUM-SQUARES (DUE)</th>
<th>SUM-SQUARES (ABOUT)</th>
<th>DF</th>
<th>MEAN-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td>1</td>
<td>175.2705</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>188</td>
<td>6829.9092</td>
<td>3663.8944</td>
<td>3166.0148</td>
<td>185</td>
<td>17.1136</td>
</tr>
<tr>
<td>Treatment + Error (Total)</td>
<td>189</td>
<td>7005.1797</td>
<td>3695.3427</td>
<td>3309.8370</td>
<td>186</td>
<td></td>
</tr>
<tr>
<td>Difference For Testing Adjusted Treatment Means</td>
<td></td>
<td>143.8222</td>
<td></td>
<td></td>
<td>1</td>
<td>143.8222</td>
</tr>
</tbody>
</table>

Null Hypothesis: No Difference Among Treatments After Adjusting With Covariates

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Adjusted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>23.5341 parochial</td>
</tr>
<tr>
<td>2</td>
<td>25.3281 public</td>
</tr>
</tbody>
</table>

\[ F(1^* 185) = 8.404* \]
Significant at .05 level
TABLE 8c. Analysis of Student Groups - Drug Knowledge Retained - Analysis of Covariance Table
Retention test scores of the programmed multimedia group of the three public junior high schools, 114 student

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>YY SUM-SQUARES (DUE)</th>
<th>SUM-SQUARES (ABOUT)</th>
<th>DF</th>
<th>MEAN-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td>2</td>
<td>134.8652</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>111</td>
<td>4052.3721</td>
<td>2063.7299</td>
<td>108</td>
<td>18.4134</td>
</tr>
<tr>
<td>Treatment + Error (Total)</td>
<td>113</td>
<td>4187.2373</td>
<td>2175.1857</td>
<td>110</td>
<td></td>
</tr>
</tbody>
</table>

Difference for Testing Adjusted Treatment Means 23.4095 2 11.7048

Null Hypothesis: No Difference Among Treatments After Adjusting With Covariates.

Treatment Adjusted Mean
1 26.0390 Junior High 2
2 25.1459 Junior High 3
3 25.0192 Junior High 4

\[ F(2', 108) = 0.636 \text{ N.S.} \]
TABLE 8d. Analysis of Student Group - Drug Knowledge Retained - Analysis of Covariance Table

Retention test scores of the parochial school students, 151 students, Analysis of the programmed multimedia group and the traditional teaching group.

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>YY</th>
<th>SUM-SQUARES (DUE)</th>
<th>SUM-SQUARES (ABOUT)</th>
<th>DF</th>
<th>MEAN-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td>1</td>
<td>0.0137</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>149</td>
<td>5249.2588</td>
<td>3036.3837</td>
<td>2212.8751</td>
<td>146</td>
<td>15.1567</td>
</tr>
<tr>
<td>Treatment + Error (Total)</td>
<td>150</td>
<td>5249.2725</td>
<td>3021.9753</td>
<td>2227.2972</td>
<td>147</td>
<td></td>
</tr>
</tbody>
</table>

Difference for Testing Adjusted Treatment Means

|                  | 14.4221 | 1 | 14.4221 |

Null Hypothesis: No Difference Among Treatments After Adjusting With Covariates.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Adjusted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>23.1356 Programmed Multimedia group</td>
</tr>
<tr>
<td>2</td>
<td>23.7559 Traditional teaching group</td>
</tr>
</tbody>
</table>

\[ F(1, 146) = .952 \text{ N.S.} \]
TABLE 8e. Analysis of Student Groups - Drug Knowledge Retained - Analysis of Covariance Table

Retention test scores of the public school students, 240 students, for the programmed multimedia group and the traditional teaching group.

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>YY</th>
<th>SUM-SQUARES (DUE)</th>
<th>SUM-SQUARES (ABOUT)</th>
<th>DF</th>
<th>MEAN-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td>1</td>
<td>233.2382</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>238</td>
<td>8679.9453</td>
<td>4003.1336</td>
<td>4676.8118</td>
<td>235</td>
<td>19.9013</td>
</tr>
<tr>
<td>Treatment + Error (Total)</td>
<td>239</td>
<td>8913.1836</td>
<td>4187.8214</td>
<td>4725.3623</td>
<td>236</td>
<td></td>
</tr>
</tbody>
</table>

Difference for Testing Adjusted Treatment Means

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>1</th>
<th>48.5505</th>
</tr>
</thead>
</table>

Null Hypothesis: No Difference Among Treatments After Adjusting With Covariates.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Adjusted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>24.8358 Programmed multimedia group</td>
</tr>
<tr>
<td>2</td>
<td>23.9268 Traditional teaching group</td>
</tr>
</tbody>
</table>

F( 1', 235) = 2.440 N.S.
Analysis of the Third Hypothesis: There is no significant difference in the drug knowledge obtained by the students with varying mental abilities (superior, average, below average) who are taught by the programmed multimedia approach and the students taught by the traditional method.

A. Superior mental ability: (IQ 114 and above)

In the analysis of the post-test scores of the students of superior mental ability who were members of the programmed multimedia groups and the traditional groups (table 9a) the adjusted mean scores for the programmed multimedia group was 28.8405 and for the traditional group 28.2349. When computing the "F" test, F is .766. Using one and infinite degrees of freedom, the critical ratio at the five percent level of confidence is 3.84. This indicates that there is no significant difference in the drug knowledge obtained by the two groups of students who have superior mental ability.

B. Average mental ability: (IQ 104 to 113)

The statistics revealed (table 9b) the adjusted mean score for students of average mental ability taught by the programmed multimedia approach and the traditional method was 25.2152 and 26.2369 respectively. When computing the "F" test, F is 1.606. Using one and infinite degrees of freedom, the critical ratio at the five percent level of confidence is 3.84. This indicates that there is no significant difference in the drug knowledge obtained by the two
groups of students who have average mental ability.

C. **Below average ability: (103 IQ and below)**

The statistics revealed (table 9c) the adjusted mean scores for the students of below average mental ability of the programmed multimedia group and the traditional group was 21.914 and 19.917 respectively. Computing the "F" test, F was 6.724, in this case, using one and infinite degrees of freedom, the critical ratio at the five percent level of confidence was 3.84. Since F is within the critical region this indicates a significant difference in the drug knowledge obtained by students of below average mental ability who are taught by the programmed multimedia approach and the traditional method.

**Conclusion:** The third null-hypothesis is rejected. We conclude that in this population of eighth grade students for those who are below average in mental ability the programmed multimedia approach is more effective in the acquisition of drug knowledge.
TABLE 9a. Analysis of Student Groups - Drug Knowledge Obtained - Analysis of Covariance Table
Post test score of students of superior mental ability -- IQ 114 and above -- 132 students.
Analysis of the programmed multimedia group and the traditional teaching group.

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>YY</th>
<th>SUM-SQUARES (DUE)</th>
<th>SUM-SQUARES (ABOUT)</th>
<th>DF</th>
<th>MEAN-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td>1</td>
<td>25.9814</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>130</td>
<td>2648.5342</td>
<td>694,1006</td>
<td>1954.4336</td>
<td>127</td>
<td>15.3892</td>
</tr>
<tr>
<td>Treatment + Error (Total)</td>
<td>131</td>
<td>2674.5156</td>
<td>708.2901</td>
<td>1966.2255</td>
<td>126</td>
<td></td>
</tr>
</tbody>
</table>

Difference for Testing Adjusted Treatment Means  
11.7919  
1  
11.7919

Null Hypothesis: No Difference Among Treatments After Adjusting With Covariates

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Adjusted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>28.84 Programmed Multimedia group</td>
</tr>
<tr>
<td>2</td>
<td>28.234 Traditional Teaching group</td>
</tr>
</tbody>
</table>

F (1, 127) + .766 n.s.
TABLE 9b. Analysis of Student Groups - Drug Knowledge Obtained - Analysis of Covariance Table
Post test scores of students of average mental ability -- IQ 104 to 113 -- 128 students.
Analysis of the programmed multimedia group and the traditional teaching group.

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>YY SUM-SQUARES (DUE)</th>
<th>SUM-SQUARES (ABOUT)</th>
<th>DF</th>
<th>MEAN-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td></td>
<td>1.8799</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>126</td>
<td>3256.1201</td>
<td>831.2292</td>
<td>123</td>
<td>19.7146</td>
</tr>
<tr>
<td>Treatment + Error</td>
<td>127</td>
<td>3258.000</td>
<td>801.4494</td>
<td>124</td>
<td></td>
</tr>
<tr>
<td>(Total)</td>
<td></td>
<td>3258.000</td>
<td>801.4494</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Difference for Testing Adjusted Treatment Means

<table>
<thead>
<tr>
<th>Treatment After Adjusting With Covariates</th>
<th>Adjusted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25.2152 Programmed Multimedia group</td>
</tr>
<tr>
<td>2</td>
<td>26.2369 Traditional teaching group</td>
</tr>
</tbody>
</table>

Null Hypothesis: No Difference Among Treatments

\[ F(1, 123) = 1.606 \text{ n.s.} \]
TABLE 9c. Analysis of Student Groups - Drug Knowledge Obtained - Analysis of Covariance Table
Post test scores of students of below average mental ability -- IQ 103 and lower -- 131 students. Analysis of the programmed multimedia group and the traditional teaching group.

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>YY</th>
<th>SUM-SQUARES (DUE)</th>
<th>SUM-SQUARES (ABOUT)</th>
<th>DF</th>
<th>MEAN-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td>1</td>
<td>145.2266</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>129</td>
<td>3899.6133</td>
<td>1599.9943</td>
<td>2299.6190</td>
<td>126</td>
<td>18.2509</td>
</tr>
<tr>
<td>Treatment + Error (Total)</td>
<td>130</td>
<td>4044.8398</td>
<td>1622.4935</td>
<td>2422.3463</td>
<td>127</td>
<td></td>
</tr>
<tr>
<td>Difference for Testing Adjusted Treatment Means</td>
<td>122.7274</td>
<td>1</td>
<td>122.7274</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Null Hypothesis: No Difference Among Treatments After Adjusting With Covariates

Treatment | Adjusted Mean
-----------|------------------
1          | 21.914 Programmed Multimedia group
2          | 19.9176 Traditional teaching group

\[ F(1, 126) = 6.724^* \]
Significant at the .05 level
Analysis of the Fourth Hypothesis: There is no significant difference in the drug knowledge retained by students of varying mental abilities (superior, average, below average) taught by the programmed multimedia approach and the traditional method.

It was necessary, due to the significant difference found in the student retention test scores between the parochial and the public schools to analyze each of these groups separately. To accomplish this, the two groups of students, public and parochial, were divided into thirds according to the previously established ability groupings.

A. Superior ability parochial school students (IQ 114 and above)

In the analysis of the student retention test scores of this group (table 10a) the adjusted mean score for the programmed multimedia group and the traditional group was 25.924 and 25.918 respectively. In computing the "F" test on the adjusted mean score, F was .000. Using one and 50 degrees of freedom, the critical ratio at the five percent level of confidence was 4.00. This indicates that there is no significant difference in the drug knowledge retained by the two groups of students who have superior mental ability.

B. Superior ability public school students (IQ 114 and above)

In the analysis of the retention test scores of this group (table 10b), the adjusted mean score for the programmed multimedia group and the traditional group was 29.1145 and 27.6346 respectively. In computing the "F" test on the adjusted mean scores, F is 1.641.
Using one and 80 degrees of freedom, the critical ratio at the five percent level of confidence is 3.92. This indicates that there is no significant difference in the drug knowledge retained by the superior students participating in the two instructional methods.

C. Average ability parochial school students (IQ 104 to 113)

In the analysis of the student retention test scores of this group, (Table 10c) the adjusted mean score for the programmed multimedia group and the traditional group was 24.004 and 26.155 respectively. In computing the "F" test on the adjusted mean scores, F is 3.189. Using one and 52 degrees of freedom, the critical ratio at the five percent level of confidence is 4.00. This indicates that there is no significant difference in the drug knowledge retained by the students of average ability participating in the two instructional methods.

D. Average ability public school students (IQ 104 to 113 IQ)

In the analysis of the students retention test scores for this group (table 10d), the adjusted mean score for the programmed multimedia group and the traditional group was 25.2465 and 24.5683 respectively. In computing the "F" test on the adjusted mean score F is .581. Using one and 74 degrees of freedom, the critical ratio at the five percent level of confidence is 3.92. This indicates that there is no significant difference in the drug knowledge retained by students of average mental ability participating in the two instructional methods.
E. Below average ability public school (IQ 103 and below)

In the analysis of the student retention test scores of this group (Table 10f), the adjusted mean score for the programmed multimedia group and the traditional group was 20.3618 and 19.6453 respectively. In computing the "F" test on the adjusted mean score, F was .518. Using one and 83 degrees of freedom, the critical ratio at the five percent level of confidence is 3.92. This indicates there is no significant difference in the drug knowledge retained by the student of below average ability participating in the two instructional methods.

Conclusion: The fourth null-hypothesis can not be rejected.

We conclude that in the six groups analyzed there is no significant difference in the drug knowledge retained by students of varying mental abilities taught by the programmed multimedia approach and students taught by the traditional method.
TABLE 10a. Analysis of Student Groups - Drug Knowledge Retained - Analysis of Covariance Table

Retention test scores of parochial school students of superior mental ability -- IQ 114 and above -- 51 students. Analysis of the programmed multimedia group and the traditional teaching group.

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>YY SUM-SQUARES (DUE)</th>
<th>SUM-SQUARES (ABOUT</th>
<th>DF</th>
<th>MEAN-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td>1</td>
<td>.0723</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>49</td>
<td>1073.6143</td>
<td>603.1882</td>
<td>470.4260</td>
<td>46</td>
</tr>
<tr>
<td>Treatment + Error (Total)</td>
<td>50</td>
<td>1073.6865</td>
<td>603.2603</td>
<td>470.4262</td>
<td>47</td>
</tr>
<tr>
<td>Difference for Testing Adjusted Treatment Means</td>
<td></td>
<td></td>
<td></td>
<td>.0002</td>
<td>1</td>
</tr>
</tbody>
</table>

Null Hypothesis: No Difference Among Treatments After Adjusting With Covariates.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Adjusted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25.9247 Programmed Multimedia group</td>
</tr>
<tr>
<td>2</td>
<td>25.9184 Traditional teaching group</td>
</tr>
</tbody>
</table>

\[ F(1, 46) = .000 \text{ n.s.} \]
TABLE 10b. Analysis of Student Groups - Drug Knowledge Retained - Analysis of Covariance Table  
Retention test scores of public school students of superior mental ability -- IQ 114 and above -- 81 students. Analysis of the programmed multimedia group and the traditional group.

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>YY</th>
<th>SUM-SQUARES (DUE)</th>
<th>SUM-SQUARES (ABOUT)</th>
<th>DF</th>
<th>MEAN-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td>1</td>
<td>59.3213</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>79</td>
<td>2300.7783</td>
<td>320.3937</td>
<td>1980.3846</td>
<td>76</td>
<td>26.0577</td>
</tr>
<tr>
<td>Treatment + Error (Total)</td>
<td>80</td>
<td>2360.0996</td>
<td>336.9633</td>
<td>2023.1363</td>
<td>77</td>
<td></td>
</tr>
<tr>
<td>Difference for Testing Adjusted Treatment Means</td>
<td></td>
<td>42.7517</td>
<td></td>
<td></td>
<td>1</td>
<td>42.7517</td>
</tr>
</tbody>
</table>

Null Hypothesis: No Difference Among Treatments After Adjusting With Covariates.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Adjusted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>29.1145 Programmed Multimedia group</td>
</tr>
<tr>
<td>2</td>
<td>27.6346 Traditional teaching group</td>
</tr>
</tbody>
</table>

F( 1, 76) = 1.641 n.s.
TABLE 10c, Analysis of Student Groups - Drug Knowledge Retained - Analysis of Covariance Table
Retention test score of parochial school students of average mental ability -- IQ 104 to 113 -- 53 students. Analysis of the programmed multimedia group and the traditional teaching group

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>YY</th>
<th>SUM-SQUARES (DUE)</th>
<th>SUM-SQUARES (ABOUT)</th>
<th>DF</th>
<th>MEAN-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td>1</td>
<td>11.8838</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>51</td>
<td>1333.0977</td>
<td>468.9261</td>
<td>864.1716</td>
<td>48</td>
<td>18.0036</td>
</tr>
<tr>
<td>Treatment + Error (Total)</td>
<td>52</td>
<td>1344.9814</td>
<td>423.4479</td>
<td>921.5335</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>Difference for Testing Adjusted Treatment Means</td>
<td>57.3619</td>
<td>1</td>
<td>57.3619</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Null Hypothesis: No Difference Among Treatments After Adjusting With Covariates

\[ F (1, 48) = 3.186 \text{ n.s.} \]
TABLE 10d. Analysis of Student Groups - Drug Knowledge Retained - Analysis of Covariance Table

Retention test scores of public school students of average mental ability -- IQ 104 to 113 -- 75 students. Analysis of the programmed multimedia group and the traditional teaching group.

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>YY</th>
<th>SUM-SQUARES (DUE)</th>
<th>SUM-SQUARES (ABOUT)</th>
<th>DF</th>
<th>MEAN-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td>1</td>
<td>20.3657</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>73</td>
<td>1194.3013</td>
<td>219.1381</td>
<td>975.1632</td>
<td>70</td>
<td>13.9309</td>
</tr>
<tr>
<td>Treatment + Error (Total)</td>
<td>74</td>
<td>1214.6670</td>
<td>231.4077</td>
<td>983.2593</td>
<td>71</td>
<td></td>
</tr>
</tbody>
</table>

Difference for Testing Adjusted Treatment Means 8.0961 1 8.0961

Null Hypothesis: No Difference Among Treatments After Adjusting With Covariates.

Treatment Adjusted Mean

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Adjusted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Programmed Multimedia group</td>
<td>25.2465</td>
</tr>
<tr>
<td>2 Traditional teaching group</td>
<td>24.5683</td>
</tr>
</tbody>
</table>

\[ F(1, 70) = 0.581 \ n.s. \]
TABLE 10c. Analysis of Student Groups - Drug Knowledge Retained - Analysis of Covariance Table

Retention test scores of parochial school students of below average mental ability -- IQ 103 and lower -- 47 students. Analysis of the programmed multimedia group and the traditional teaching group.

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>YY</th>
<th>SUM-SQUARES (DUE)</th>
<th>SUM-SQUARES (ABOUT)</th>
<th>DF</th>
<th>MEAN-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td>1</td>
<td>.5205</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>45</td>
<td>1448.4583</td>
<td>746.8114</td>
<td>701.6469</td>
<td>42</td>
<td>16.7059</td>
</tr>
<tr>
<td>Treatment + Error</td>
<td>46</td>
<td>1448.9788</td>
<td>745.7546</td>
<td>703.2241</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>Difference for Testing Adjusted Treatment Means</td>
<td>1.5773</td>
<td>1</td>
<td>1.5773</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Null Hypothesis: No Difference Among Treatments After Adjusting With Covariates

\[ F(1, 42) = .094 \text{ n.s.} \]
TABLE 10f. Analysis of Student Groups - Drug Knowledge Retained - Analysis of Covariance Table

Retention test scores of public school students of below average mental ability -- IQ 103 and lower -- 84 students. Analysis of the programmed multimedia group and the traditional teaching group.

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>YY</th>
<th>SUM-SQUARES (DUE)</th>
<th>SUM-SQUARES (ABOUT)</th>
<th>DF</th>
<th>MEAN-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td>1</td>
<td>22.9204</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>82</td>
<td>2304.8892 777.7337</td>
<td>1527.1555</td>
<td>79</td>
<td>19.3311</td>
<td></td>
</tr>
<tr>
<td>Treatment + Error (Total)</td>
<td>83</td>
<td>2327.8096 790.6417</td>
<td>1537.1679</td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difference for Testing Adjusted Treatment Means</td>
<td>10.0125</td>
<td>1</td>
<td>10.0125</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Null Hypothesis: No Difference Among Treatments

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Adjusted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20.3618 Programmed Multimedia group</td>
</tr>
<tr>
<td>2</td>
<td>19.6453 Traditional teaching group</td>
</tr>
</tbody>
</table>

F( 1, 79) = .518 n.s.
Analysis of the Fifth Hypothesis: There is no significant difference in the knowledge obtained by students taught by the programmed multimedia approach and students who are taught by the traditional method who have a reading comprehension score at or above the eighth grade level and below the eighth grade level.

A. Students at or above the eighth grade level (96 months and above)

In the analysis of the students post-test scores for the programmed multimedia group and the traditional group (table 11a) the adjusted mean score was 27.1040 and 27.3436 respectively. In computing the "F" test on the adjusted mean scores, $F$ is .208. This indicates that there is no significant difference in the drug knowledge obtained by students who are in the two instructional groups who have a reading comprehension score at or above the eighth grade.

B. Students below the eighth grade level (95 months and below)

In the analysis of the students post-test scores of this group (table 11b) the adjusted mean score for the programmed multimedia group and the traditional group was 21.8958 and 19.9300 respectively. In computing the "F" test on the adjusted mean scores, $F$ is 6.337. Using one and infinite degrees of freedom, the critical ratio at the five percent level of confidence is 3.84. Since $F$ is within the critical region this indicates there is a significant difference in the drug knowledge obtained by students participating in the two instructional groups who have a reading level below the eighth grade level.
Conclusion: The fifth hypothesis is rejected. We conclude that in this population of eighth grade students for those who have reading comprehension scores below the eighth grade level the programmed multimedia approach is more effective in the acquisition of drug knowledge.
TABLE 11a. Analysis of Student Groups - Drug Knowledge Obtained - Analysis of Covariance Table
Post test score of students with reading comprehension at or above the eighth grade level, 260 students. Analysis of the programmed multimedia group and the traditional teaching group.

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>YY (DUE)</th>
<th>SUM-SQUARES (DUE)</th>
<th>SUM-SQUARES (ABOUT)</th>
<th>DF</th>
<th>MEAN-SQUARES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td>1</td>
<td>1.3613</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>258</td>
<td>6675.1426</td>
<td>2149.0293</td>
<td>4526.1133</td>
<td>255</td>
<td>17.7495</td>
</tr>
<tr>
<td>Treatment + Error (Total)</td>
<td>259</td>
<td>6676.5039</td>
<td>2146.6975</td>
<td>4529.8065</td>
<td>256</td>
<td></td>
</tr>
</tbody>
</table>

Difference for Testing Adjusted Treatment Means

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Adjusted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>27.1041 Programmed Multimedia group</td>
</tr>
<tr>
<td>2</td>
<td>27.3436 Traditional teaching group</td>
</tr>
</tbody>
</table>

Null Hypothesis: No Difference Among Treatments After Adjusting With Covariates.

F( 1, 255) = .208 n.s.
TABLE 1b. Analysis of Student Groups - Drug Knowledge Obtained - Analysis of Covariance Table

Post test scores of students with reading comprehension below the eighth grade level, 131 students. Analysis of the programmed multimedia group and the traditional teaching group.

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>YY</th>
<th>SUM-SQUARES (DUE)</th>
<th>SUM-SQUARES (ABOUT)</th>
<th>DF</th>
<th>MEAN-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td>1</td>
<td>160.3701</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>129</td>
<td>3512.1797</td>
<td>1293.7439</td>
<td>2218.4358</td>
<td>126</td>
<td>17.6066</td>
</tr>
<tr>
<td>Treatment + Error (Total)</td>
<td>130</td>
<td>3672.5498</td>
<td>1342.5334</td>
<td>2330.0164</td>
<td>127</td>
<td></td>
</tr>
<tr>
<td>Difference for Testing Adjusted Treatment Means</td>
<td></td>
<td>111.5806</td>
<td></td>
<td></td>
<td>1</td>
<td>111.5806</td>
</tr>
</tbody>
</table>

Null Hypothesis: No Difference Among Treatments After Adjusting With Covariates.

\[
F(1, 126) = 6.337^* \\
\text{Significant at .05 level}
\]

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Adjusted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>21.805 Programmed Multimedia group</td>
</tr>
<tr>
<td>2</td>
<td>19.9300 Traditional teaching group</td>
</tr>
</tbody>
</table>
Analysis of the Sixth Hypothesis: There is no significant difference in the drug knowledge retained by students who are taught by a programmed multimedia approach and the students who are taught by the traditional method who have a reading comprehension score; (a) at or above the eighth grade level and (b) below the eighth grade level.

Students with reading comprehension scores at or above, eighth grade in the parochial schools:

In analyzing the student retention test scores for this group (table 12a), the adjusted mean score for the programmed multimedia group and the traditional group was 24.5520 and 25.7140 respectively. In computing the "F" test on the adjusted mean scores, F is 2.698. Using one and 113 degrees of freedom, the critical ratio at the five percent level of confidence is 3.92. This indicates there is no significant difference in drug knowledge retained by students in the two instructional groups who have reading comprehension scores at or above the eighth grade level.

Students with reading comprehension scores at or above the eighth grade level in the public schools:

In the analysis of the student retention scores for this group (table 12b) the adjusted mean score for the programmed multimedia and traditional group was 26.7443 and 27.6219 respectively. In computing the "F" test on the adjusted mean scores, F is .140. Using one and infinite degrees of freedom, the critical ratio at the
five percent level of confidence is 3.92. This indicates that there is no significant difference in the drug knowledge retained by the students in the two instructional groups who have reading comprehension scores at or above the eighth grade level.

**Students of the parochial school groups with reading comprehension scores below the eighth grade level:**

In the analysis of the student retention test scores for this group (table 12c), the adjusted mean score for the programmed multimedia group and the traditional group was 18.7438 and 17.8217 respectively. In computing the "F" test on the adjusted mean scores, F is .397. Using one and 36 degrees of freedom, the critical ratio of confidence is 4.08. This indicates that there is no significant difference in the drug knowledge retained by students in the two instructional groups who have reading comprehension scores below the eighth grade level.

**Students in the public school groups with reading comprehension scores below the eighth grade level:**

In the analysis of the students retention scores for this group (table 12d), the adjusted mean score for the programmed multimedia groups and the traditional group was 21.5663 and 19.6675 respectively. In computing the "F" test on the adjusted mean scores, F is 4.282. Using one and 93 degrees of freedom, the critical ratio at the five percent level of confidence, is 3.92. Since F is within the critical region, this indicates there is a significant difference in the drug
knowledge retained by students in the two instructional groups who have reading comprehension scores below the eighth grade level.

**Conclusion:** The sixth null-hypothesis is rejected. We conclude that in this population of public school eighth grade students who have reading comprehension scores below their grade level greater drug knowledge is retained through the use of the programmed multimedia approach.
TABLE 12a. Analysis of Student Groups - Drug Knowledge Retained - Analysis of Covariance Table

Retention test scores of the parochial school students with reading comprehension at or above the eighth grade level, 114 students. Analysis of the programmed multimedia group and the traditional teaching group.

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>YY</th>
<th>SUM-SQUARES (DUE)</th>
<th>SUM-SQUARES (ABOUT)</th>
<th>DF</th>
<th>MEAN-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td>1</td>
<td>9.1240</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>112</td>
<td>2779.1572</td>
<td>1251.4463</td>
<td>1527.7109</td>
<td>109</td>
<td>14.0157</td>
</tr>
<tr>
<td>Treatment + Error (Total)</td>
<td>113</td>
<td>2788.2812</td>
<td>1222.7613</td>
<td>1565.5200</td>
<td>110</td>
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</tr>
<tr>
<td>Difference for Testing Adjusted Treatment Means</td>
<td>37.8091</td>
<td>1</td>
<td>37.8091</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Null Hypothesis: No Difference Among Treatments After Adjusting With Covariates.

Treatment 1 Adjusted Mean
24.5520 Programmed Multimedia group

Treatment 2 Adjusted Mean
25.7140 Traditional teaching group

F(1, 109) = 2.698 n.s.
TABLE 12b. Analysis of Student Groups - Drug Knowledge Retained - Analysis of Covariance Table

Retention test scores of the public school students with reading comprehension at or above the eighth grade level, 146 students. Analysis of the programmed multimedia group and the traditional teaching group

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>YY</th>
<th>SUM-SQUARES (DUE)</th>
<th>SUM-SQUARES (ABOUT)</th>
<th>DF</th>
<th>MEAN-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td>1</td>
<td>11.5049</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>142</td>
<td>3738.7178</td>
<td>1001.9797</td>
<td>2736.7381</td>
<td>139</td>
<td>19.6888</td>
</tr>
<tr>
<td>Treatment + Error (Total)</td>
<td>143</td>
<td>3750.2227</td>
<td>1010.7251</td>
<td>2739.4976</td>
<td>140</td>
<td></td>
</tr>
<tr>
<td>Difference for Testing Adjusted Treatment Means</td>
<td>2.7595</td>
<td>1</td>
<td>2.7595</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Null Hypothesis: No Difference Among Treatments After Adjusting With Covariates.

F( 1, 139) = .140 n.s.
TABLE 12c. Analysis of Student Groups - Drug Knowledge Retained - Analysis of Covariance Table

Retention test scores of the parochial school students with reading comprehension below the eighth grade level, 37 students. Analysis of the programmed multimedia group and the traditional teaching group.

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>YY</th>
<th>SUM-SQUARES (DUE)</th>
<th>SUM-SQUARES (ABOUT)</th>
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<tr>
<td>Treatment (Between)</td>
<td>1</td>
<td>13.4142</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error (Within)</td>
<td>35</td>
<td>1135.8832</td>
<td>552.6278</td>
<td>583.2554</td>
<td>32</td>
<td>18.2267</td>
</tr>
<tr>
<td>Treatment</td>
<td>36</td>
<td>1149.2974</td>
<td>558.8057</td>
<td>590.4917</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>Difference for Testing Adjusted Treatment Means</td>
<td>7.2363</td>
<td>1</td>
<td>7.2363</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

Null Hypothesis: No Difference Among Treatments After Adjusting With Covariates.

\[ F(1, 32) = 0.397 \text{ n.s.} \]

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Adjusted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Programmed Multimedia group 18.7438</td>
</tr>
<tr>
<td>2</td>
<td>Traditional teaching group 17.8217</td>
</tr>
</tbody>
</table>
TABLE 12d. Analysis of Student Groups - Drug Knowledge Retained - Analysis of Covariance Table

Retention test scores of the public school students with reading comprehension below the eighth grade level, 94 students. Analysis of the programmed multimedia group and the traditional teaching group.

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>DF</th>
<th>YY</th>
<th>SUM-SQUARES (DUE)</th>
<th>SUM-SQUARES (ABOUT)</th>
<th>DF</th>
<th>MEAN-SQUARE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment (Between)</td>
<td>1</td>
<td>101.1948</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Error (Within)</td>
<td>92</td>
<td>2573.6245</td>
<td>894.4307</td>
<td>1679.1938</td>
<td>89</td>
<td>18.8673</td>
</tr>
<tr>
<td>Treatment + Error (Total)</td>
<td>93</td>
<td>2674.8193</td>
<td>914.8305</td>
<td>1759.9888</td>
<td>90</td>
<td></td>
</tr>
</tbody>
</table>

Difference for Testing Adjusted Treatment Means

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>80.7950</td>
<td>1</td>
<td>80.7950</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Null Hypothesis: No Difference Among Treatments After Adjusting With Covariates.

F( 1, 89) = 4.282 *
Significant at the .05 level

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Adjusted Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>21.5663 Programmed Multimedia group</td>
</tr>
<tr>
<td>2</td>
<td>19.5663 Traditional teaching group</td>
</tr>
</tbody>
</table>
Analysis of Student Opinions

After completing the course, the students who had participated in the programmed multimedia approach were given an opinion questionnaire (produced by the Lockheed educational staff) to determine the students' feelings about drug knowledge and the instruction methods and materials used in this program.

In appendix VII, p. 140, the opinion questionnaire and the item analysis may be reviewed. According to the item analysis, 85 percent of the students felt the Drug Decision Program was interesting and useful. The majority of students (70 percent) indicated they liked the question and answer method of the Drug Decision manual. The activities, such as the Drug Attack Game rated very high. Eighty-five percent felt this game helped them remember facts about drugs.

In the final analysis we see that most of the students involved in the drug decision program felt it to be an interesting and worthwhile program.
CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY

Drug abuse by young people of this country constitutes a major socio-health problem of our society. Determining how to attack this problem is the concern of parents and teachers alike. In the past three years, this problem has escalated to a point where it touches the lives of millions of people each day. Most of the "over thirty" age group have had little or no experience or knowledge about the "world of drugs" and the "drug scene". They, therefore, become "up tight" about the drug problem and in a quandary as to how to inform their young adolescents about drug abuse.

The first step in combating the problem must be one of giving up-to-date facts. In order to be capable of making an intelligent decision when confronted with the pressures to use drugs, a young person must possess knowledge adequate to weigh the pros and cons of the question. The schools, with the many resources available, should be an ideal place for this program to function. Awareness of drugs and chemicals which may be abused should begin in kindergarten and extend through the twelve grades, building on the concept that these products have the potential to be a servant of man, or
they have the potential to make man a slave through their abuse.

The acceptance of drug education as a necessary function of
the school brings with it an obligation to appraise the effectiveness
of the instructional methods.

The purpose of this study was to investigate the relative effectiveness
of a programmed multimedia approach and a traditional method
in improving the drug knowledge of eighth grade students.

The null hypotheses formulated to test this stated purpose were:

1. There is no significant difference in the drug knowledge obtained by students who are taught by a programmed multimedia approach and students who are taught by the traditional method.

2. There is no significant difference in retention of drug knowledge by students who are taught by a programmed multimedia approach and students taught by the traditional method.

3. There is no significant difference in drug knowledge obtained by students of varying mental abilities (superior, average, and below average) taught by the programmed multimedia approach and students taught by the traditional method.
4. There is no significant difference in the drug knowledge retained by students of varying mental abilities who are taught by the programmed multimedia approach and students who are taught by the traditional method.

5. There is no significant difference in drug knowledge obtained by students who are taught by the programmed multimedia approach and students who are taught by the traditional method who have a reading comprehension score at or above eighth grade level and students who have a reading comprehension score below eighth grade level.

6. There is no significant difference in drug knowledge retained by students who are taught by a programmed multimedia approach and students who are taught by the traditional method who have a reading comprehension score at or above the eighth grade level and students who have a reading comprehension score below eighth grade level.

To be able to test the stated hypotheses, an objective test was designed and constructed by the investigator specifically for the eighth grade students participating in this study.

To insure statistical validity, the student's intelligence quotient test scores, reading comprehension scores, and drug knowledge.
pre-test scores were used as covariants in using the Biomedical Computer Program for the analysis of covariance.

The student population numbering 391 eighth grade students from junior high schools at Mankato, Minnesota took part in this study. Of these, 240 students were from three public junior high schools and 151 students were from a parochial junior high school. Intact groups were used in these schools.

To minimize the teacher variables, the participating teachers conducted both the experimental and the control groups. The experimental group used the programmed multimedia instructional package, "Drug Decision", designed by Lockheed Educational Systems. The control group used traditional or conventional teaching methods.

Upon completion of the 15 day instructional program, a drug knowledge test constructed by the investigator, was administered to determine the drug knowledge obtained by the students of the experimental groups and the students of the control groups.

After an interval of five weeks, the drug knowledge test was again given to determine the amount of drug knowledge retained by the students of each group.

Additional investigations were made to determine the effects of varying mental abilities and varying reading comprehension levels upon the drug knowledge obtained and the drug knowledge retained by students in both of the instructional programs.
In order to determine the students feeling about the drug decision program used by the experimental group, an opinion questionnaire, developed by the Lockheed Education Systems of the Lockheed Corporation (see Appendix VII), was administered to those students who had participated in the group using the programmed multimedia approach. In analyzing the responses, it was found that the majority (70 percent) of the students felt that the program was effective, interesting, and worthwhile.

CONCLUSIONS

The statistical process of analysis of covariance using the five percent level of confidence was the method employed to determine whether the programmed multimedia approach was as effective as traditional teaching in the following hypotheses:

Hypothesis Number One:
In analyzing the effectiveness of the two methods of teaching about drugs, the evidence produced by the analysis of covariance indicates that there is no significant difference in the drug knowledge obtained. Although the programmed multimedia approach did produce a slightly greater amount of drug knowledge as observed in the adjusted mean scores, the "F" test results showed, at the five percent level of confidence, a lack of evidence to reject the null-hypothesis.
Therefore, we conclude that in this population using the total 391 eighth grade students there is no significant difference in the effectiveness of the programmed multimedia approach and the traditional methods of teaching in increasing drug knowledge.

**Hypothesis Number Two:**

In analyzing the drug knowledge retained by the students involved in the programmed multimedia approach and the students in the traditional teaching method group, the evidence indicates that for this population of eighth grade students there is no significant difference at the five percent level of confidence in the effectiveness of these two methods.

**Hypothesis Number Three:**

In analyzing the effectiveness of the two methods of teaching about drugs for students with different mental abilities the evidence produced indicates that there is no significant difference in the drug knowledge obtained by students who have average and superior mental ability. For students of below average mental ability, the evidence indicates at the five percent level of confidence that there is significantly more drug knowledge obtained through the use of the programmed multimedia approach. We, therefore,
reject hypothesis number three and conclude that for this population of eighth grade students the programmed multimedia approach is more effective.

Hypothesis Number Four:
In analyzing the effectiveness of the two methods of instruction about drugs, the evidence indicates that there is no significant difference at the five percent level of confidence in the drug knowledge retained by students of different levels of mental ability. The fourth null-hypothesis, therefore, can not be rejected.

Hypothesis Number Five:
In analyzing the effectiveness of the two methods of teaching about drugs, the evidence indicates that for students who have a reading comprehension level at or above the eighth grade level, there is no significant difference at the five percent level of confidence in the drug knowledge obtained. For students who have a reading comprehension score below the eighth grade level, the evidence indicates at the five percent level of confidence that there is significantly more drug knowledge obtained through the use of the programmed multimedia approach. Investigators, therefore, reject the fifth hypothesis.
Hypothesis Number Six:

In analyzing the effectiveness of the two methods of teaching about drugs, the evidence indicates at the five percent level of confidence that for this population of eighth grade students who have reading comprehension scores at or above the eighth grade level, there is no significant difference in the drug knowledge retained. For students who have reading comprehension scores below the eighth grade level, the evidence further indicates that there is significantly more drug knowledge retained by the public school students who were taught by the programmed multimedia approach. The null-hypothesis is therefore rejected as stated.

RECOMMENDATIONS

Based on the data and findings of this study, the investigator offers the following recommendations to health educators and administrators organizing and administering drug education programs.

1. Additional drug studies using the programmed multimedia approach should be conducted to determine the effectiveness of this method at the elementary and high school levels.

2. Scientific studies of the effectiveness of the various drug teaching methods should be developed on a long
term basis to determine the behavioral pattern of these students three or four years hence.

3. Because the programmed multimedia proved to be more effective than traditional teaching for students of below average mental ability, the investigator recommends that schools engaged in the drug instructional programs, make available to these students programmed and multimedia materials of varying kinds.

4. Because the evidence indicates that students of below grade reading comprehension levels do better when using the programmed multimedia approach, than they do in traditional teaching programs, materials of the type used in this programmed multimedia (programmed text, role playing, games) be made available to these students.

5. Because of the nature of the Drug Decision Program used in this study, the investigator recommends it to schools and administrators who do not have qualified personnel to teach drug education.

6. Both types of instruction can be equally effective, but because of the apparent popularity of the multimedia materials, as indicated by the students, the investigator recommends the use of these materials as a supplementary means of disseminating drug information to students.
7. The investigator believes the information produced by this study is of great importance and plans to utilize the findings in the numerous health education teaching method classes and drug education workshops that he conducts.

8. The investigator plans to make the findings known to the members of the Minnesota State Department of Health and Physical Education so they might be guided in recommending teaching methods and materials to school personnel throughout the state.
BIBLIOGRAPHY


50. Lerche, Charles O. Games in the classroom as cited by Elliot Carlson. Saturday Review, April, 1967. p. 64.


July 31, 1970

Mr. Loy Young
991 North West Hayes
Apartment 207
Corvallis, Oregon 97330

Dear Loy:

Drug education has received considerable emphasis during the past two years at local, state and national levels. I am pleased that you are interested in conducting research in this area to determine the effectiveness of various instructional programs.

The State of Minnesota has received a grant from the U. S. Office of Education to conduct inservice education for teachers regarding drug education. Also the State Department of Education has been conducting inservice education programs during the summer on drug education in cooperation with the state colleges. In each instance, we are concerned about various approaches relative to the curriculum and their effectiveness.

Therefore, the Minnesota Department of Education has purchased 400 kits of materials on drug education from the Lockheed Educational Systems titled, Drug Decision. We are concerned about the effectiveness of this programmed approach as compared to a traditional approach at the 6th and 8th grade levels. It would be necessary to pre-test and post-test relative to cognitive and affective domains. The effectiveness of these two approaches would be shared with school administrators and teachers during inservice education workshops. We could involve you and teachers from the selected schools in the conduct of these workshops.

I am looking forward to your involvement in this research project, which is practical and can make a significant contribution to the program.

Sincerely,

Carl Knutson, Ph. D.
Supervisor, Health, Physical Education
Recreation and Safety

CK:1h
## MASTER INSTRUCTIONAL SCHEDULE

For Programmed Multimedia Groups

<table>
<thead>
<tr>
<th>Unit</th>
<th>Activity</th>
<th>Time (Min)*</th>
</tr>
</thead>
</table>
| 1    | Presentation of movie: "Disaster Management"  
Student entries in Drug Decision Manual  
Classroom discussion | 45 |
| 2    | Programmed Text: Drug Definition  
Cartoon No. 1: "Drug Definition"  
Programmed Text: Physical/Physiological Effects of Drugs  
Cartoon No. 2: "Physical/Physiological Effects of Drugs" | 43 |
| 3    | Programmed Text: Behavioral Effects of Drugs  
Cartoon No. 3: "Behavioral Effects of Drugs"  
Programmed Text: Drug Dependence and Tolerance  
Cartoon No. 4: "Drug Dependence"  
Cartoon No. 5: "Drug Tolerance"  
Cartoon No. 6: "Review of Drug Effects" | 40 |
| 4    | Programmed Text: Physiological and Psychological Drug Needs  
Cartoon No. 7: "Drug Needs"  
Programmed Text: Drug Sources  
Cartoon No. 8: "Drug Source"  
Programmed Text: Drug Use  
Cartoon No. 9: "Drug Use" | 28 |
| 5    | Programmed Text: Treatment of Drug Dependence  
Cartoon No. 10: "Medical Treatment"  
Programmed Text: Volatile Chemicals | 30 |
| 6    | Programmed Text: Marijuana  
Movie: "Case Study - Marijuana" | 37 |
| 7    | Programmed Text: LSD  
Movie: "Case Study - LSD" | 35 |
| 8    | Programmed Text: Amphetamines  
Movie: "Case Study - Amphetamines" | 30 |
| 9    | Programmed Text: Cocaine | 25 |
| 10   | Programmed Text: Barbiturates  
Movie: "Case Study - Barbiturates" | 25 |
| 11   | Programmed Text: Heroin  
Movie: "Case Study - Heroin" | 25 |
| 12   | Programmed Text: Drug Laws and Enforcement Agencies  
Movie: "Stopping Drug Abuse" | 25 |
| 13   | Movie: Class Discussion  
"Drug Attack" | 45 |
| 14   | Drug Attack Game | 45 |
| 15   | Drug Attack Game | 45 |
| 16   | Movie: "Rehabilitation" | 45 |
| 17-19| Selected Case Histories of Drug Abuse | 45 per case |

*Times are those of an average-to-fast seventh grade class.*
APPENDIX III

DRUG EDUCATION

Part I: Directions:
Read each of the questions or statements carefully and select from the choices provided the word, statement or figure which best answers the questions or completes the stated fact. Indicate your selection by filling in the proper space on the IBM answer sheet. USE PENCIL ONLY.

1. "Substances that may produce sleep and have a dulling effect on an individual" is the definition of
   1. hallucinogens
   2. an irritant
   3. a stimulant
   4. a depressant
   5. an analgesic

2. According to the federal laws
   1. The dangerous drugs and the hard or narcotic drugs have the same penalties for their illegal possession.
   2. the penalties for the illegal possession of the dangerous drugs are less severe than the penalties for illegal possession of the narcotic drugs
   3. any of the dangerous drugs or narcotic drugs may be prescribed by a doctor
   4. the possession of LSD has penalties of greater severity than for the possession of marijuana
   5. the penalties for selling illegal drugs are less severe than for using these drugs.

3. The term "narcotic" is used medically in reference to
   1. marijuana
   2. barbiturates
   3. cocaine
   4. hallucinogens
   5. opiates

4. "A condition arising from a need to use a drug on a regular basis" is the definition of
   1. drug stimulation
   2. depression
   3. drug dependence
   4. analgesia
   5. euphoria
5. In most cases the person who has taken a large dose of amphetamines will
1. become sleepy
2. develop a state of deep depression
3. stay awake for a long period of time
4. have a distortion of color
5. become violent

6. A substance that depresses body functions is
1. barbiturates
2. mescaline
3. amphetamines
4. LSD
5. cocaine

7. A substance that stimulates body functions is
1. barbiturates
2. alcohol
3. opiates
4. cocaine
5. mescaline

8. "A general feeling of well-being may be produced by drugs" is a definition of
1. euphoria
2. tolerance
3. analgesia
4. dependence
5. hallucination

9. Most of the drugs, such as amphetamines and barbiturates, being abused in Minnesota are believed to have been manufactured in
1. the United States
2. Mexico
3. South America
4. The Orient
5. The Near East

10. The dangerous drugs (barbiturates, amphetamines)
1. are outlawed both legally and medically
2. may be used legally without a doctor's prescription
3. may be used legally only under a doctor's supervision
4. come under legal control through the federal narcotic laws
5. are all mild drugs comparable to alcohol in their effects

11. The most hopeful approach to the solution of the glue and gasoline sniffing problem at present appears to lie in
1. developing better laws with greater punishment
2. better enforcement of existing laws
3. voluntary control by the people selling those volatile substances
4. replacement of volatile chemicals by nonintoxicating solvents
5. the education of children about the dangers of breathing the fumes into the body.
12. In the United States marijuana is most frequently taken into the body by
   1. chewing the leaves
   2. sniffing a powder made from the plant
   3. eating the plant
   4. drinking a tea made from the leaves
   5. inhaling the smoke

13. The odor associated with the use of marijuana is most like the odor of
   1. burning rope or alfalfa hay
   2. alcohol
   3. garlic
   4. decaying fruit
   5. burning wood

14. The effects of marijuana on the system most closely resemble the effects of
   1. heroin
   2. cocaine
   3. strong coffee
   4. ordinary cigarettes
   5. alcohol.

15. The body system most affected by the use of marijuana is
   1. the nervous system
   2. the circulatory system
   3. the digestive system
   4. the respiratory system
   5. the muscular system

16. From among the following effects, the one which fails to occur with the use of LSD is
   1. bad trips
   2. withdrawal illness
   3. hallucination flashbacks
   4. severe depression
   5. suicide

17. A person who takes LSD often continues to take it because
   1. it improves his ability to think
   2. it causes sexual excitement
   3. it creates a feeling which he likes
   4. it brings on a physical need or craving
   5. it improves his ability to be creative
18. From among the following substances, the one substance which is not related to opium is
1. heroin
2. morphine
3. codeine
4. cocaine
5. papaverine

19. If a person is convicted of illegal possession of a narcotic drug
1. the crime would be classified as a misdemeanor
2. the crime would be classified as a felony
3. the death penalty may be imposed
4. the prison term would be less than one year
5. none of the above answers are correct

20. The drug taken on purpose or by accident which causes the most deaths of young adults is
1. LSD
2. heroin
3. amphetamines
4. barbiturates
5. aspirin

21. The drugs that cause physical withdrawal illness
1. are all related to the drugs made from opium
2. are all related to opium or cocaine
3. uniformly cause death on withdrawal
4. come from various chemical families, both narcotic and non-narcotic
5. are all illegal and have no medical use

22. The regular use of heroin
1. is not serious from the standpoint of one's health
2. is almost certain to lead to drug dependence and addiction
3. may be prescribed by doctors for the relief of pain
4. is a very inexpensive habit to maintain
5. may produce lung cancer

23. The most difficult condition of drug dependence for the user to overcome is
1. physical dependence
2. psychological dependence
3. tolerance
4. illness due to a lack of vitamins
5. euphoria
24. The boy's ability to adapt to the effects of a drug so that a person must take a larger and larger dose to get the desired feeling is a description of
1. habituation
2. tolerance
3. addiction
4. dependence
5. withdrawal

25. Marijuana is classified medically as
1. an opiate
2. a barbiturate
3. a stimulant
4. a narcotic
5. a hallucinogen

26. The teenager who uses marijuana may
1. move to the use of heroin
2. have similar effects each time he uses it
3. have greater pressure to use other drugs
4. become physically addicted
5. have freakouts and bad trips

27. Young people who are starting to use drugs most often
1. get their supply from older adult pushers who hand around the schools
2. purchase them at the drug stores
3. get them from the family medicine cabinet
4. get them from a friend or other teenagers who have tried drugs
5. get them from strangers on the street

28. The teenager who experiments with the use of marijuana
1. knows that this practice is legal for adults but illegal for him
2. frequently has been tricked into the use by not being able to recognize the product
3. has usually made this decision knowing many of the risks involved
4. will be ill and have a reaction the first time he uses it
5. knows the strength of the product and how it will affect him

29. A drug used quite often to commit suicide is
1. heroin
2. barbiturates
3. LSD
4. mescaline
5. amphetamines
30. Which of the following drugs would most likely be used by a physician in treating patients?
   1. heroin
   2. marijuana
   3. opium
   4. mescaline
   4. morphine

31. The term "pot" as used in the drug world refers to
   1. alcohol intoxication
   2. a container for carrying drugs
   3. barbiturates
   4. marijuana
   5. a bag of heroin

32. Of the substances listed, the one which is causing the greatest addiction problem for the people of the United States is
   1. heroin
   2. LSD
   3. amphetamines
   4. marijuana
   5. Psilocybin

33. Reefers contain
   1. tobacco
   2. marijuana
   3. opium
   4. heroin
   5. peyote

34. Under the current laws of Minnesota, the penalty for possession of marijuana is a
   1. misdemeanor
   2. felony
   3. the same as for possession of LSD
   4. less severe than the penalty for possession of cocaine
   5. gross misdemeanor

35. The synthetic drug methadone is used in the treatment of
   1. barbiturate addiction
   2. LSD over-dose
   3. heroin addiction
   4. speed addiction
   5. alcoholism

36. Mescaline is classified as a
   1. hallucinogen
   2. stimulant
   3. depressant
   4. analgesic
   5. anythetic drug
37. Every drug is harmful to the individual when it is
1. mixed with coca-cola
2. made by artificial means
3. made from opium
4. purchased as a patient medicine
5. taken in excess

38. Hashish is produced from
1. morphine
2. opium
3. marijuana
4. tobacco and LSD
5. cocaine

39. Amphetamines are often prescribed by doctors
1. to prevent certain illnesses
2. to keep people awake for driving
3. to help a person lose weight
4. to provide relief from pain
5. to reduce blood pressure

40. A person may get a flashback from the use of
1. amphetamine
2. LSD
3. marijuana
4. barbiturates
5. heroin

41. Amphetamine drugs
1. pep you up
2. depress or slow you down
3. make you sleepy
4. reduce fevers
5. relieve pain

42. Drugs purchased on the streets from pushers
1. are in a form that can be identified easily
2. are more likely to cause addiction than prescribed drugs
3. can be considered safe because they are always of high quality
4. are illegal because the seller did not have a license to sell drugs
5. may be dangerous because they are often of unknown strength and purity
43. A person who uses marijuana over a period of time
   1. needs to smoke more and more of the product at one time in order to get a "high"
   2. usually suffers severe withdrawal illness when he stops using it
   3. may become psychologically dependent and need to continue to use it
   4. will develop a high tolerance level for the drug
   5. may develop hepatitis

44. The main reason for finding the teenage heroin user is to
   1. place them in jail for breaking the law
   2. remove them from society to prevent them from getting others to use the drug
   3. notify their parents
   4. put them on probation in order to keep track of them
   5. give them medical treatment and rehabilitate them

45. "Speed" refers to
   1. amphetamines such as methedrine
   2. caffeine
   3. barbiturates such as seconal
   4. stimulants such as cocaine
   5. the quick reaction one gets to an injection of heroin
APPENDIX IV

January 14, 1971

To whom it may concern:

I have applied the Lorge Readability Formula to Loy Young's Drug Education Test and by sampling the test the following Readability scores were arrived at by application of the formula:

7.09  
7.62  
6.88  

21.59

The average grade level readability score is 7.19 over the three samples that were analyzed.

H. B. Dreyer, Director  
Graduate Reading Programs  
Mankato State College
Lorge Formula for Estimating Difficulty of Reading Materials

Basis Data

1. Number of words in the sample
2. Number of sentences in the sample
3. Number of prepositional phrases in the sample
4. Number of hard words in the sample

Computation

For average sentence length:
Divide Item 1 by Item 2

\[ \frac{\text{Item 1}}{\text{Item 2}} \times 0.60 = \text{Value} \]

For ratio of prepositional phases:
Divide Item 3 by Item 1

\[ \frac{\text{Item 3}}{\text{Item 1}} \times 9.55 = \text{Value} \]

For ratio of hard words:
Divide Item 4 by Item 1

\[ \frac{\text{Item 4}}{\text{Item 1}} \times 10.43 = \text{Value} \]

Constant = 1.9892

Add the Value and the Constant
Readability Index =
APPENDIX V

Statement of Jury of Experts

The following statements relate to the face validity of the drug knowledge test developed by the investigator.

Brauer, Harry M. M. D. Director of Student Health Service, Mankato State College, Mankato, Minnesota.
"I have read and examined Loy Young's drug education test and find it very satisfactory from a medical point of view."

Bucher, Charles A. Ph. D. Acting Division Head, Division of Physical Education, Health and Recreation, New York University, New York, N. Y.
"I have referred your test to Dr. Sanford Weinstein who is a professor in the health education area and is also an expert in research. He indicates that your test does have face validity since it does include a good series of questions on drugs."

Clarke, Kenneth S. Ph. D. Professor of Health Science, Mankato State College, Mankato, Minnesota
"I find this test developed by Mr. Young to be comprehensive, discriminatory, and therefore very usable for evaluating cognitive understandings related to current drug abuse problems."

Cobb, Robert S. Ph. D. Professor of Health Science, Department Head, Mankato State College, Mankato, Minnesota
"I have read and evaluated the drug education test designed by Mr. Young and have found it to be valid and objective from the educational point of view."

Cohen, Allan Y. Ph. D. Associate Professor of Psychology and Director of the Institute for Drug Abuse Education and Research, John F. Kennedy University, Martinez, California.
"I have read over Mr. Young's cognitive drug knowledge test and find the answers to the test questions accurate and proper."
Dreyer, H. B. Ph. D. Director of Graduate Reading Programs, Mankato State College, Mankato, Minnesota.

"I have applied the Lorge Readability Formula to Loy Young's drug education test and by sampling the test the following readability scores were arrived at: 7.09, 7.62, and 6.88. The average grade level readability score is 7.19 over the three samples that were analyzed."

Harten, James C. Assistant County Attorney, Blue Earth County, Mankato, Minnesota

"I have reviewed Mr. Young's drug test and find those questions which have legal implication to be correct and accurate in accordance with the present law of the State of Minnesota."

Leach, Glenn C. Ph. D. Associate Professor of Education and Coordinator of Health Education, Wagner College, Staten Island, New York.

"I have reviewed Mr. Young's drug test; this is a good test well thought out and greatly needed at this age level."

Levin, Adeline. Ed. D. Professor of Health Science, Mankato State College, Mankato, Minnesota.

"I have reviewed the drug test developed by Mr. Loy Young and have found it to be:
1. Couched in language that pertains to the grade level for which it was created.
2. Scientifically correct to the best of my knowledge.
3. Covers in depth a great many facts concerning the nature of drugs and their effects."

Montebello, Robert A. Ed. D. Professor of Health and Safety, Department Chairman, Bemidji State College, Bemidji, Minnesota.

"I have reviewed the drug test developed by Mr. Young and find it to be comprehensive in content; accurate and up-to-date. I would recommend it highly as a cognitive test of drug information."

Nolte, Anne E. Ph. D. Professor Health Science, State University College at Brockport, Brockport, New York.

"I have reviewed the cognitive drug test. I would say it is a valid test."
Serdula, George. H. S. D. Professor of Health Education, Director of Health Education, St. Cloud State College, St. Cloud, Minnesota.
"I have reviewed the drug knowledge test and from all the criteria used it appears to be an adequate test to determine the cognitive level of students."

Shaw, John H. Ph. D. Professor and Chairman, Department of Health and Physical Education, Syracuse University, Syracuse, New York.
"I have studied your test and feel it is a valid test of information in the field of drug education for eighth graders. In other words, it has face validity in my opinion."

Willgoose, Carl E. Ed. D. Professor of Education, Boston, University Boston, Massachusetts.
"After reading your new test I would say it has a useful quality about it. From my experience the ordinary seventh and eighth grade student should be able to respond and indicate their level of understanding."
APPENDIX VI
BMD04V
ANALYSIS OF COVARIANCE WITH MULTIPLE COVARIATES

1. GENERAL DESCRIPTION

a. This program is designed to compute analysis-of-covariance information for one analysis-of-variance variable with multiple covariates and unequal treatment group sizes. Cases may be specified by the user as being in certain treatment groups, or cases may be placed in treatment groups by the program in accordance with a specified Boolean expression.

b. Output from this program includes:

(1) List of case numbers, data input, and group designation (optional)
(2) Variable means for each treatment group.
(3) Sums of products matrices for Total, Treatment, and Error.
(4) The inverses of the covariate matrices for Total, Treatment, and Error.
(5) Analysis-of-covariance table with degrees of freedom, sums of squares, mean squares, and F ratio.
(6) Tables of regression coefficients, their standard errors and computed t-values with and without adjustment for groups.
(7) Table of adjusted means and their standard errors.

c. Limitations per problem:

(1) \( v \), number of variables read in. However, no more than 36 variables (including the analysis-of-variance variable) may enter the computation, i.e. \( v + q \leq 36 \). Also see limitations (2) and (6) below. \( 3 \leq n_i \leq 99 \)
(2) \( p \), number of covariates \( 1 \leq p \leq 35 \)
(3) \( t \), number of treatment groups \( 2 \leq t \leq 99 \)
(4) \( n_i \), sample size of the \( i \)th treatment group \( 1 \leq n_i \leq 999 \)
(5) \( N \), total number of cases \( [(t+p+1) \leq N \leq 99,999] \)
(6) \( q \), number of variables added to the original set after transgeneration \( -96 \leq q \leq 32 \)
Example of Job Deck Set-up:

1. SYS
   2. /PROLM
   3. TRNGEN
   4. SAMSIZ
   5. LABELS
   6. CVRSEL
   7. DATA
   8. FINISH

- **System Cards**
- **Problem Card**
- **Sample Size Card(s)**
- **Group Definition Card(s)**
- **Standard Transgeneration Card(s)**
- **Labels Card(s)**
- **F-type Variable Format Card(s)**
- **Covariate Selection Cards(s)**
- **Finish Card**
4. **COMPUTATIONAL PROCEDURE**

Statistical Model:

\[ Y_{ij} = \mu + \alpha_i + \beta_1 (X_{ij1} - \bar{X}_{i1}) + \cdots + \beta_p (X_{ijp} - \bar{X}_{ip}) + e_{ij} \]

Notation:

- \( X_{ijk} \) \((k^{th}\ covariate)\)
- \( Y_{ij} = X_{ij(p+1)} \) \( (\text{Variate}) \)

\( i = 1, 2, \ldots, t \) \( (\text{Treatment groups}) \)
\( j = 1, 2, \ldots, n_i \) \( (\text{Sample size of the } i^{th} \text{ treatment group}) \)
\( k = 1, 2, \ldots, p \) \( (\text{Covariates}) \)
\( m = 1, 2, \ldots, p \) \( (\text{Covariates}) \)
\( a = 1, 2, \ldots, p+1 \) \( (\text{Covariates +1 variate}) \)
\( b = 1, 2, \ldots, p+1 \) \( (\text{Covariates +1 variate}) \)

**Step 1.**

1. \( N = \sum_{i=1}^{t} n_i \) \( (\text{Total number of cases}) \)
2. \( \bar{Y}_{i.} = \frac{1}{n_i} \sum_{j=1}^{n_i} Y_{ij} \) \( (\text{Variate mean for the } i^{th} \text{ group}) \)
3. \( \bar{X}_{i..k} = \frac{1}{n_i} \sum_{j=1}^{n_i} X_{ijk} \) \( (\text{Covariate means for the } i^{th} \text{ group and } k^{th} \text{ covariate}) \)
4. \( \bar{X}_{..k} = \frac{1}{N} \sum_{i=1}^{t} \sum_{j=1}^{n_i} X_{ijk} \) \( (k^{th} \text{ covariate mean, ignoring treatments}) \)
(2) and (3) are printed under the heading VARIABLE MEANS FOR EACH GROUP.

**Step 2. Sums of Squared Deviation**

(1) **TOTAL**

\[
Sxx_{ab} = \sum_{i=1}^{t} \sum_{j=1}^{n_i} X_{ija} X_{ijb}
\]

\[
S_{xyk} = Sxx_{k(p+1)}
\]

\[
S_{yy} = Sxx_{(p+1)(p+1)}
\]

(2) **TREATMENT (Between)**

\[
Txx_{ab} = \sum_{i=1}^{t} \left( \sum_{j=1}^{n_i} X_{ija} \sum_{j=1}^{n_i} X_{ijb} \right)
\]

\[
T_{xyk} = Txx_{k(p+1)}
\]

\[
T_{yy} = Txx_{(p+1)(p+1)}
\]

(3) **ERROR (Within)**

\[
Exx_{ab} = Sxx_{ab} - Txx_{ab}
\]

\[
Exy_{k(p+1)} = S_{xyk(p+1)} - T_{xyk(p+1)}
\]

\[
E_{yy} = S_{yy} - T_{yy}
\]

(1), (2), and (3) are printed under the heading SUMS OF SQUARES AND CROSS PRODUCT MATRIX FOR TOTAL, TREATMENT AND ERROR.
Step 3. Regression Coefficients

(1) Matrices $S_{xx_{km}}$ and $E_{xx_{km}}$ are inverted.

Let $S_{km} = (S_{xx_{km}})^{-1}$, $E_{km} = (E_{xx_{km}})^{-1}$

(2) $B_k = \sum_{m=1}^{p} (E_{km}) (E_{xy_m})$ (ERROR Coefficients)

(3) $A_k = \sum_{m=1}^{p} (S_{km}) (S_{xy_m})$ (TOTAL Coefficients)

(1) is printed under the heading INVERSE OF THE COVARIATES CROSS PRODUCT MATRIX FOR TOTAL AND ERROR.

Step 4. Regression Sums of Squares

(1) ERROR (Within)

$Edue = \sum_{k=1}^{p} B_k E_{xy_k}$

$Eabout = E_{yy} - Edue$

(2) TOTAL

$S_{due} = \sum_{k=1}^{p} A_k S_{xy_k}$

$S_{about} = S_{yy} - S_{due}$

(1) and (2) are printed in the ANALYSIS OF COVARIANCE TABLE.
Step 5. Standard Errors of Regression Coefficients and Computed t-values.

Standard Errors \hspace{1cm} \text{Computed t-values}

\[
\begin{align*}
\text{ERROR:} & \quad SE(B_k) = \sqrt{(\text{Eabout}) E_{kk}} & \quad t_k = \frac{B_k}{SE(B_k)} \\
SE(A_k) = \sqrt{(\text{Sabout}) S_{kk}} & \quad t_k = \frac{A_k}{SE(A_k)}
\end{align*}
\]

These and (1) and (3) from Step 3 are printed in the output under the heading TABLE OF COEFFICIENTS, STANDARD ERRORS AND COMPUTED T-VALUES.

Step 6. Adjusted Means and Standard Errors of Adjusted Means

(1) Adjusted Means

\[
\text{Adj} \left( Y_{i.} \right) = Y_{i.} - \sum_{m=1}^{P} B_m (X_{i.m} - X_{..m})
\]

(2) Standard Errors of Adjusted Means

\[
SE(\text{adj} Y_{i.}) = \left\{ \text{Edue} \left[ \frac{1}{n_1} + \sum_{k=1}^{P} \sum_{m=1}^{P} (X_{i.k} - X_{..k})E_{km}(X_{i.m} - X_{..m}) \right] \right\}^{1/2}
\]

These are printed in the output under the heading TABLE OF ADJUSTED MEANS AND STANDARD ERRORS.
OPINIONS ABOUT THE COURSE

People honestly disagree about how good or bad or how true or false something is. Read each statement in this part, and then DECIDE how much you agree or disagree with it. Mark the answer sheet as follows:

1. Even before we took this course, most of my friends were well-informed about drug effects.

2. Providing people with information about the effects of drugs is an important step in controlling drug abuse.

3. I liked the question and answer method used in the Drug Decision Student Manual.

4. Some of the motion pictures used in this course were too short to really learn anything from them.

5. Most young people already have the information they need about drugs. Courses like this one aren't needed.

6. I understand the dangers and problems a drug user faces much better than I did a month ago.
7. I liked the motion pictures used in this drug course.

8. My classmates in this Drug Decision course really weren't very interested in the subject and were quite bored by the way it was presented.

9. I didn't see any use in spending so much time on all the big words like "physiological need," "hallucination," or "inhalation" to understand the effects of drugs.

10. Trying to decide whether to release drug-dependent people after reading their case histories made the drug problem very real and meaningful to me.

11. The Drug Attack game helped me to remember a lot of facts about drugs.

12. The facts about drugs which we learned in this course are really of no use in making up my mind about drugs.
## Student-Opinion Questionnaire

### Item Analysis

<table>
<thead>
<tr>
<th>Item Number</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Couldn't decide</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
<th>Student response percentage</th>
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<td>56</td>
<td>41</td>
<td>68</td>
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<td>.70 couldn't decide or disagreed</td>
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<td>66</td>
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<td>74</td>
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<tr>
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<td>79</td>
<td>14</td>
<td>9</td>
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<tr>
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<tr>
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</tr>
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</table>

Items 3, 4, 7, 8, 9, 11, and 14 dealt with the drug decision program, materials and activities.