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THE PROBLEM: ITS BACKGROUND AND DEFINITION

Introduction

In recent years, science and its applications have received increased attention in most business, industrial, political, and educational circles. Particularly since the launching of the Russian Satelite, Sputnik, a growing awareness has developed concerning the relationship of science to the world leadership position of the United States.

Many educational leaders recognize the need for adapting the program of public education to the needs of the current decade of political, scientific, and military growth. They are also aware of the acute shortage of competent science teachers in our public schools and are constantly looking for ways and means of improving the quality of science instruction and the total science curriculum. A new and rapidly developing instructional medium is the use of television to obtain the greatest maximum effectiveness from a superior science teacher by enabling the teacher to reach a

much larger body of students, to supplement and enrich the program as it now exists, or to substitute for the teacher. "Television presents a new, flexible, and inexpensive means of illustrating a lesson."[1]

Stoddard makes the following statement concerning the use of television and its relationship to education:

> The powerful new gadget, television, has become an intimate part of most of the homes of the land. Through it the lives of children are being enriched or debased, depending on one's point of view. At least, their lives are being affected. The average child spends about as much time seeing and hearing television programs as going to school. Television has probably done more to promote common learnings or a common cultural climate among our people generally than all the educational forces of the past.[2]

A huge expenditure of time, effort, and money is invested in the field of television. How can educational leadership make the best use of this investment? Since the principal means of formal education is classroom instruction, it is highly appropriate to compare the effectiveness of television teaching with the conventional classroom approach to classroom teaching.

Background of the Problem

In April of 1951, the Fund for Adult Education, an

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[1]Franklin Dunham and Ronald R. Lowdermilk, Television in Our Schools, U. S. Office of Education Bulletin No. 16 (Washington: U. S. Government Printing Office, 1952), p. 33.

[2]Alexander J. Stoddard, Schools for Tomorrow: An Educator's Blueprint (New York: The Fund for the Advancement of Education, 1957), p. 27.

independent organization established by the Ford Foundation, made its first grant of money to educational television for the creation of the Joint Committee on Educational Television which brought together educators and specialists to cooperate on legal and technical problems connected with the acquisition of television channels for use by educational institutions. In January of 1956, the Joint Committee on Educational Television was changed to the Joint Council on Educational Television.

The "Box Score" on the progress of the educational use of television channels on August 1, 1956, was as follows:[1]

Channels finally reserved for educational use	258
Applications for licenses filed with the Federal Communications Commission	51
Construction permits granted	43
Stations on the air	25

In January of 1957, the Oklahoma City Public Schools began a limited schedule of television instruction. This program was increased in the fall of 1957 by a financial grant from the Ford Foundation. The program, as it now exists, consists of instruction at the senior high level in chemistry, physics, geology, second year algebra, trigonometry, and solid geometry. In addition to the senior high school subjects, an enrichment program is offered to the

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[1]William Y. Elliot (ed.), Television's Impact on American Culture (East Lansing, Michigan: Michigan State University Press, 1956), p. 286.

elementary schools. For the purpose of evaluation, six secondary and four elementary schools have been designated as pilot schools.

Need for the Study

Since television is a comparatively new medium to be used for formal education, research in the area of educational television has been limited. Though there have been investigations dealing with the size of viewing audiences, size of television receivers, programming, and the many other problems connected with educational television, research related to instructional effectiveness of this medium is practically non-existent.

On a broad basis, there is need for television experimentation at all levels and in all areas of education. Much careful research is needed to determine where television fits into the total educational pictu..

One of the specific and mos. ..portant areas to be explored is that of measuring the effectiveness of television as a teaching tool.

Elliot reported that progress in educational television research has advanced to the stage where the answers to two major questions are needed: the first concerns the extent to which television is now used at all levels of education and the variety of subjects in which it is being utilized, the second pertains to the effectiveness of teaching by television as compared to the conventional classroom

approach and that evaluation of effectiveness herein should include results achieved with students at different scholastic aptitude levels.[1]

A need, therefore, arises from the use of television to determine the effectiveness of this medium in the teaching of science, namely, physics. The results of this study should be of immediate value to the Oklahoma City Public Schools. The findings of this study, however, when combined with other studies which have been completed, and those in progress or in the planning stage, should hold significant implications for the improvement of teaching in American secondary schools.

Statement of the Problem

The purpose of this study was to determine the comparative effectiveness of television teaching, television teaching supplemented by a certificated physics teacher, and conventional classroom teaching by a certificated physics teacher in the learning of physics facts and principles by senior high school students. The experiment was carried out so as to test the following null hypotheses: (1) there is no significant difference in the learning of physics facts and principles by high school students who are taught high school physics by the conventional teaching method, television teaching supplemented by a physics teacher, and those

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[1] Ibid., p. 286.

taught entirely by television; (2) there is no significant difference in learning of physics facts and principles by high school students that is assignable to the interaction between levels of scholastic ability and these teaching methods.

Major Assumptions

The following assumptions were made in the study:

1. That the ACE Psychological Examination for High School Students was an appropriate instrument to use for the establishment of the three experimental teaching method groups.

2. That the Cooperative Physics Test for College Students measured the achievement of physics facts and principles by high school students enrolled in senior high school physics.

Limitations of the Study

The three teaching method groups of the study were limited to those students enrolled in senior high school physics at Harding High School, Oklahoma City, Oklahoma during the fall semester of 1957-1958. This included 63 members of the twelfth grade class.

The evaluation of the subjects' achievement in senior high school physics was limited to the difference in the raw scores made on the pretest and posttest using the Cooperative Physics Test for College Students-Mechanics, Form F and

Form C, respectively. This test, though designed for college freshmen, was deemed suitable since it measured achievement in the mechanics unit of physics and no other acceptable test could be found which was designed for high school students to measure achievement in this one unit. This test was designed to measure achievement in terms of facts and principles of mechanics and did not presume to measure other significant learning outcomes.

Review of Selected Related Literature

Research related to the evaluation of television as an enrichment aid or as a teacher substitute has been extremely limited due to the newness of this medium in educational circles, but that which has been done has been categorized by Dunham and Loudermilk as follows:

1. Can children learn from television viewing?
2. Is the amount of learning from television affected by the size of the viewing group?
3. How does television compare with the printed page in promoting learning?
4. What possible harmful effects does television viewing have on children's eyesight, reading-interest, and attitudes?[1]

This study was primarily concerned with the effect of television on achievement in high school physics. Therefore, the references to research are confined to the first and third categories above, namely, investigations of the

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[1]Dunham and Lowdermilk, op. cit., p. 16.

effect of television on learning. Much of the reported research was not done under regular public school instructional conditions and that which did concern itself with formal education chiefly involved college students.

In 1951, Iowa State College conducted an experiment in the teaching of clothing construction by television. A twice weekly series of half-hour programs were telecast for five weeks. Enrollment was encouraged through advance publicity and involved sending in name, address, and certain other information. Based on the enrollments, a stratified random sample of 420 respondents was drawn for personal interviews. The sample was further classified into four groups: (1) TV instruction only, (2) TV instruction plus encouragement from the county home economist, (3) TV instruction plus a supplementary booklet, and (4) TV plus booklet plus encouragement from the home economist. Interviews were completed for 364 out of 420 in the sample. The reported findings, based upon the percentage of the sample indicating various levels of interest, showed that there was little appreciable difference between the four teaching methods tested.[1]

Rock, Duva, and Murray report on a research project conducted by the Office of Naval Research concerning the effectiveness of learning by the use of television, kinescopes,

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[1]"Make a Dress--TV" (Ames, Iowa: Agriculture Extension Service, Iowa State College, 1951). (Duplicated.)

and conventional classroom method. Naval Air Reservists at three different stations received instruction by means of television. Reservists in another three stations received instruction by kinescopes while those in the three remaining stations were taught in the conventional classroom by local instructors. Approximately 40 men were at each station making a group of 100 to 120 men receiving instruction under any one condition. Two series of eight lessons were given, one a refresher course for officer pilots and the other a basic training course for enlisted men. Pretests and posttests were used in the experiment to determine the achievement of the subjects. Based upon achievement the following findings were reported: (1) Eighty per cent of the comparisons showed TV as effective as or better than local instructors, (2) Seventy-five per cent of comparisons showed recordings or kinescopes as effective as or better than local instructors, (3) In no comparison was the kinescope superior to the live TV programs, although in 82 per cent of the comparisons, kinescopes were equal to live TV.[1]

Rock, Duva, and Murray reported on a second study in which 3000 Army Reservists were given a series of eight one-hour telecasts concerned with different phases of an Army division's operations in an encounter. Subjects ranged

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[1]Robert T. Rock, Jr., James S. Duva, and John E. Murray, The Effectiveness of Television Instruction in Training Naval Air Reservists, Technical Report SDC 476-02-S2 (Port Washington, New York: Office of Naval Research, April, 1951), p. 43.

in rank from private to colonel. A pretest and posttest was administered to measure achievement. They found that all grades of officers and enlisted men made higher scores on the test questions after the telecasts than they did before the telecasts. On retention tests, officers retained 85 per cent of newly learned material over a period of six weeks while enlisted men retained 65 per cent of newly learned material in the same period.[1]

Allen reported on an experiment which was done to explore the feasibility of teaching Quartermaster Corps subjects via television using low-cost methods. A course of four hours was selected and telecast to ROTC students. Forty-seven students received the instruction via television and 60 students received the instruction through the regular classroom method. Out of a possible posttest score of 32, the regular classroom students scored 27.7 and the TV students 26.5. No tests of significance were applied to the data.[2]

Anderson and Vander Meer conducted an experiment to see how TV instruction on certain computational skills with

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[1]Robert T. Rock, Jr., James S. Duva, and John E. Murray, A Study in Learning and Retention, Technical Report SCD 476-02-S2 (Port Washington, New York: Office of Naval Research, April, 1951).

[2]M. R. Allen, "Quartermaster Training Command Educational-Television Study" (Fort Lee, Virginia: Quartermaster School, Quartermaster Training Command, June 4, 1956). (Duplicated.)

the slide rule compared with the ordinary classroom method. Five classes of high school sophomores ranging in number from 21-26 were used in the experiment. Each student was given the California Test of Mental Maturity and Stanford Achievement Test on advanced arithmetic before the class started. Two matched groups were selected on the basis of these two tests. There were 41 in each group, 23 boys and 18 girls in the non-TV group and 24 boys and 17 girls in the TV group. When the final examination scores were compared between the TV and non-TV groups, there was no significant difference. Also, there were no significant differences when the two groups were broken down by sex or grouped by intelligence test scores.[1]

Husband, in 1954, reported on a study which compared the learning which took place under four different reception conditions. The four groups were TV at home, studio class, kinescope class, and normal class on the campus of Iowa State College. Husband did not report on the number of subjects actually used in the study nor did he report on any statistical treatment of the reported findings that the TV at home group did better than the TV in studio and the normal campus groups. The kinescope group did the best of all.[2]

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[1]George R. Anderson and A. W. Vander Meer, "A Comparative Study of the Effectiveness of Lessons of the Slide Rule Presented via Television and in Person," The Mathematics Teacher, XLVII (1954), p. 326.

[2]R. W. Husband, "Television versus Classroom for Learning General Psychology," American Psychologist, IX (1954), pp. 181-183.

Research using Army basic trainees was carried out by Kanner, Runyon, and Desiderato to determine the differences between television and regular instruction for basic training courses, differences between kinescopes and regular instruction, differences between high and low aptitude basic trainees on learning through television and regular instruction, and the effects of kinescopes review on retention compared with effects of no further training on retention for high and low aptitude trainees. Two hundred trainees took part in the experiment. The findings for the television and regular instruction method showed that there were no significant differences between the mean scores of both groups. No significant differences could be found between television and regular instruction on high aptitude groups but for the low aptitude groups television was superior to regular instruction. In comparing the kinescope method and regular instruction no significant differences were found.[1]

Shimberg reported on research conducted on the effects of television teaching in the learning of home nursing. Three experimental groups were used in the experiment: TV only, TV plus practice session, standard classroom groups which were taught without TV. The two TV groups received

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[1]Joseph H. Kanner, Richard P. Runyon, and Otelle Desiderato, Television in Army Training: Evaluation of Television in Army Basic Training, The George Washington University Human Resources Research Office Technical Report 14 (Washington: The George Washington University, November, 1954), p. 10.

13 half-hour programs twice a week and the classroom group attended seven two-hour sessions composed of lectures, demonstrations and supervised practice. Effectiveness was measured by comparisons between groups both on a battery of pretests and a similar battery of posttests. There were 77 subjects in the TV only group, 43 in the TV plus practice group and 217 in the classroom group. Television instruction was found to be as effective as classroom instruction in teaching facts about home nursing. Students taught by TV did almost as well on the performance test as those taught in the classroom although total time spent was less for the TV students. No differences were found between the TV-only and the TV-plus practice groups.[1]

Williams, in 1954, reported on an experiment in which 108 undergraduates at the University of Toronto were divided into four groups such that each group contained an equal number of high, average, and low students. Each of these groups were arbitrarily assigned to a medium of learning lecture, TV, radio, and reading mimeographed copies of the lecture. An examination consisting of 19 multiple-choice questions and an essay type question to be answered in 200-300 words was administered immediately after exposure as a measure of learning. Analysis of variance and "t" tests

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[1]B. Shimberg, "Effectiveness of Television in Teaching Home Nursing," Research Bulletin, No. RB-54-19 (Princeton, New Jersey: Educational Testing Service, August, 1954). (Duplicated.)

were run only on the multiple choice part of the examination. The analysis of variance showed that the media used made a significant difference in the amount learned. TV was generally superior to radio, radio was superior to reading, and there was no significant difference between reading and the lecture audience. Among the three academic ability groups, the TV low ability group did as well as the average radio group. The largest difference occurred in the high ability group where the TV group was much superior to the radio and reading groups.[1]

Carpenter and Greenhill reported in 1955 on a study made at Pennsylvania State University in which three classes, the second part of an introductory course in chemistry, general psychology, and the psychology of marriage, were used for testing purposes. In the chemistry and general psychology courses, control groups which did not receive TV instruction were utilized. The experimental group in both of these courses received instruction in one of two ways--either the members of the group viewed the lectures on a television receiver, or they were in the TV originating room. The psychology of marriage course was set up so that comparisons could be made only between those receiving instruction via TV and those receiving instruction in the TV originating room. No control group was involved. For the chemistry

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[1]D. C. Williams, "Mass Media and Learning--An Experiment," Explorations, III (1954), pp. 75-82.

course, there were 240 students in the experimental groups and two control groups of 100 students each.

The 240 students in the experimental groups were equally divided for TV viewing and for the TV originating room. The general psychology classes had 40 students each and the psychology of marriage classes had 30 students each. In general chemistry and general psychology the findings showed that there were no significant differences between mean scores on the measurement of learning variable of the control, TV receiving and TV originating room groups. In the psychology of marriage course there were no significant differences between mean scores of the two groups involved.[1]

Evans, Roney, and McAdams performed an experiment at the University of Houston in 1955 to determine the effectiveness of television instruction in two college level courses, biology and psychology. In the biology course, two groups of 78 subjects matched for college class, grades, and sex were used in television and non-television sections. In the psychology course, comparisons were made between 96 subjects in an on-campus lecture section, 30 subjects enrolled in a television plus campus-discussion section, and 17 subjects enrolled in a third section utilizing television plus

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[1]C. R. Carpenter and L. P. Greenhill, An Investigation of Closed Circuit Television for Teaching University Courses, Instructional Television Research Project Number One (University Park, Pa.: Pennsylvania State University, July 31, 1955), p. 12.

correspondence work. The findings were that no significant differences existed among the groups in the psychology sections or between the two groups of biology students.[1]

Ulrich conducted an experiment in 1955 to find out whether eighth grade students retained more by a television kinescope of a straight lecture, or of the same lecture with visual aids handled by the lecturer, or of the same lecture with visual aids flashed on a screen. A sample of 40 eighth grade classes in the Chicago school system were randomly assigned to the three experimental treatments and the control group. In addition to the posttest used, a retention test containing the same items was administered 30 days following the experiment. An analysis of variance of the data revealed significant differences among the four groups on both the immediate and delayed posttests. All three experimental groups did better than the control group for both tests. There was a significant difference among the three experimental groups on the immediate posttest but not on the delayed test.[2]

Pasework reported in 1956 of a study performed at Michigan State University to ascertain the effectiveness of

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[1]R. T. Evans, H. B. Roney, and W. J. McAdams, "An Evaluation of the Effectiveness of Instruction and Audience Reaction to Programming on an Educational Television Station," Journal of Applied Psychology, XXXIX (1955), pp. 277-279.

[2]John H. Ulrich, An Experimental Study of the Acquisition of Information from Three Types of Recorded Television Presentations (Ph.D. dissertation, State University of Iowa, 1955).

television as a medium in teaching typewriting. Forty-four students were split into two classes, one to receive television instruction and the other to receive conventional instruction. The two groups were matched on ACE scores. The results of the study were that the television students typed significantly faster than conventional students on a timed test at the conclusion of the course and they also typed with less mean errors but this difference was not statistically significant.[1]

In 1956, Tannenbaum reported on a study performed at the University of Illinois Medical School in which 356 students in a basic physiology course were divided into two groups, equated on the basis of mid-term grades. One of the groups received instruction through television and the other received the instruction in the conventional manner. Three 50-minute lectures were given on consecutive days and the groups were tested one week after the last lesson. Analysis of variance was used to test for significant differences and it was found that differences did not exist at the .05 level of confidence, but did exist at the .07 level. This difference was in favor of the television group.[2]

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[1]William R. Pasework, The Effectiveness of Television as a Medium of Learning Typewriting (Ed.D. dissertation, New York University, 1956), p. 92.

[2]P. H. Tannenbaum, "Instruction through Television: An Experimental Study" (Urbana, Illinois: Institute of Communications Research, University of Illinois, 1956). (Duplicated.)

The only research found which dealt directly with the subject area of this study was reported by Willis in 1956. It was a report of an experiment conducted during the last two weeks of May, 1956, in the Chicago school system which involved a comparison of instruction in algebra and physics. Nineteen schools were used in algebra and 24 schools in physics. Each school had sections receiving television instruction and regular classes receiving the same units of instruction without television. The number of students involved was not given in the report, nor was the type of evaluation instrument. An analysis of the data showed that there were no significant differences between television and non-television students in both algebra and physics.[1]

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[1]B. C. Willis, "Evaluation Report of the Two Week Experiment of Direct Teaching on Television" (Chicago: Public Schools, 1956). (Duplicated.)

CHAPTER II

PROCEDURE IN EXPERIMENTAL DESIGN

Design of the Experiment

This study was designed to investigate differences in achievement in mechanics, a unit in the elementary senior high school physics course offered at Harding High School, Oklahoma City, Oklahoma. The teaching methods used in this study were television only, television supplemented by a physics teacher, and the conventional classroom procedure.

The effects of these different teaching methods were determined in terms of achievement in the mechanics unit of physics as measured by the difference between performance on pretest and posttest.

Selection of Subjects and Placement in Teaching Method Groups

The subjects were 63 students regularly enrolled in physics during the fall semester of 1957-58 at Harding High School, Oklahoma City, Oklahoma. None of the students had previously taken course work in physics. Each student had four semesters of high school algebra and two semesters of plane geometry. All of the students had either completed

one semester of trigonometry or had enrolled in this course simultaneously with the course in physics.

At enrollment time all subjects were assigned to physics and a study hall during the two class periods from 12:20 p.m. to 2:25 p.m. This provided for more ease in transferring the students from one section to another in the process of equating and randomly assigning them to the three teaching methods, since one physics class was scheduled from 12:20 p.m. to 1:20 p.m. and two were scheduled from 1:25 p.m. to 2:25 p.m.

The American Council on Education Psychological Examination for High School Students, hereafter referred to as ACE, was given to all subjects. Their raw scores were arranged in descending order from high to low. The top three subjects were randomly placed among the three teaching method groups, the next three subjects were counted off and randomly placed among the three teaching method groups, and this process was continued until all subjects were randomly assigned to a teaching method group. This resulted in 21 subjects for each teaching method group. This randomization procedure provided the basis for obtaining the same proportion of students with a similar scholastic aptitude in each of the three teaching method groups.[1] With this procedure each teaching

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[1]E. F. Lindquist, Design and Analysis of Experiments in Psychology and Education (Boston: Houghton Mifflin Company, 1956), pp. 121-155.

method group provided a control on each of the others.

Because of the time at which the television lesson in physics was given and the time alloted for this experiment, the design did not provide for replication.

The Instructional Situation

The three teaching method groups, composed of an equal number of students drawn by chance from each of the comparable scholastic aptitude levels, were taught the mechanics unit in senior high school physics for 60 minutes each day from September 6, 1957, to January 10, 1958.

The three teaching method groups were assigned to classrooms on the second floor of the science department of Harding High School which were equally equipped with laboratory furniture, student desks, and other equipment. The rooms were equally lighted in the same manner and both were provided with blackout blinds in order to provide for adequate television reception.

The same teacher taught the conventional teaching method group and the television supplemented by teacher teaching method group. She possessed an Oklahoma science teaching certificate and was certified by the Oklahoma State Department of Education to teach physics in high school. There was no certified teacher with the television teaching method group but classroom atmosphere was maintained by a teacher who assumed no part in the instructional program other than routine management duties.

The two teaching method groups that used television in the instructional program were provided with identical 21 inch RCA television receivers.

The three teaching method groups were taught in such a manner that it was possible for all to use the same textbook,[1] the same assignments, and they were administered the same examination.

The Instructional Methods

The three teaching method groups of physics students received instruction in the mechanics unit of the physics course as follows:

Television Teaching Method Group.--Teaching method group A, the television teaching method group, received instruction in physics by television from September 6, 1957, until January 10, 1958. This instruction was provided five days per week in sessions of 30 minutes each. The television lesson was followed by student discussion of points missed in the telecast and points not completely understood. If the students did not believe the discussion period was needed, a supervised study period was used to prepare the next day's assignment. This procedure was followed for four days per week with laboratory experiments or demonstrations performed by the students on the fifth day. In order that

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[1]Charles E. Dull, H. Clark Metcalfe, and William O. Brooks, Modern Physics (New York: Henry Holt and Company, Inc., 1955).

the student might know in advance the content of each television lesson, the television studio provided him with an outline of the mechanics section in physics which gave the content of the lesson, the assignments, and the experimental data sheet for his experiments.

This section met regularly Monday through Friday from 1:25 p.m. to 2:25 p.m. in the all-purpose science room of Harding High School.

Television Supplemented by Teacher Teaching Method Group.--Teaching method group B, the television supplemented by teacher group, differed from teaching method group A in that the discussion period which followed the television lesson was led by the regular physics teacher at Harding High School who also taught the conventional teaching method group. The laboratory experiments were supervised by the teacher and on occasions the teacher performed the demonstrations. The 30 minutes which followed the television lesson were used by the teacher in not only clarifying concepts presented by the television lesson but in supplementing the television instruction with additional explanations and examples, with demonstrations not presented in the television lesson, and with a question and answer period.

This teaching method group met regularly Monday through Friday from 1:25 p.m. to 2:25 p.m. in the regular physics classroom at Harding High School.

Conventional Teaching Method Group.--Teaching method

group C, the conventional teaching method group, differed from groups A and B in that it received no television instruction nor instruction from any other type of audio-visual material or equipment. All of the instruction was provided by the regular physics teacher at Harding High School utilizing the lecture, class discussion, demonstration, and laboratory techniques and procedures. Assignments for group C were the same as those for group A and group B.

This teaching method group met regularly Monday through Friday from 12:20 p.m. to 1:20 p.m. in the regular physics classroom at Harding High School.

The Evaluation Instrument

Following the assignment of subjects to the teaching method groups and equating them, as described previously, all subjects were given the pretest, the Cooperative Physics Test for College Students-Mechanics, Form F. This test was administered separately to each teaching method group carefully following the formal "Directions for Administration."

All subjects were given the posttest on January 10, 1958, the day following the last lesson on the mechanics unit of physics. The instrument used to measure the gains or losses against the pretest was the Cooperative Physics Test for College Students-Mechanics, Form C. The formal "Directions for Administration" were followed as in the administration of the pretest. The only additional remark to

the students was to the effect that the test constituted a check on achievement.

The difference score for the study was obtained by subtracting the raw score made by each student on the pre-test from his corresponding raw score on the posttest.

CHAPTER III

PRESENTATION AND ANALYSIS OF DATA

This study was concerned with the achievement of physics facts and principles in the mechanics unit of physics for high school students as measured by the difference between pretest raw scores and posttest raw scores when each of three comparable student groups were taught by different teaching methods.

The primary statistical treatment of the difference between pretest and posttest raw scores in learning physics-mechanics facts and principles was an analysis of variance. The analysis of variance technique was chosen because it provided a means for testing the system as a whole and it provided a more powerful statistical technique than could otherwise be employed.

Guilford[1] points out that the requisite assumptions underlying the analysis of variance are that the contributions to variance in the total sample must be additive, observations within sets must be mutually independent, and

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[1]J. P. Guilford, Fundamental Statistics in Psychology and Education (New York: McGraw-Hill Book Company, Inc., 1956), p. 282.

that homogeneity of variance between groups of data must exist. He also states that the first two assumptions are properties of random sampling.

Since the design of this study provided for random sampling, the first two basic assumptions underlying analysis of variance were satisfied and in order to check the homogeneity of variance between groups of data, Bartlett's Test of Homogeneity of Variance[1] was computed from the data in Table 1. The obtained Chi Square of 9.01 fell between the .05 and .01 level of confidence, therefore homogeneity of variance could not be assumed satisfied but the heterogeneity of variance is not marked. Lindquist has made the following statement concerning the assumption of homogeneity of variance:

> The safest generalization that we can make is that the assumption of homogeneity of variance is practically never satisfied in educational and psychological experiments, but that in most instances the heterogeneity is not marked. Fortunately, the form of the sampling distribution of the mean square ratios is not very markedly affected by moderate degrees of heterogeneity of variance, and hence, the F-test may still be satisfactorily used in many experimental situations.[2]

An analysis of variance was computed for the differences obtained between the raw scores made on the pretest, Cooperative Physics Test for College Students-Mechanics,

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[1]Allen L. Edwards, Experimental Design in Psychological Research (New York: Rinehart and Company, Inc., 1950), p. 298.

[2]Lindquist, op. cit., pp. 77-78.

TABLE 1

DIFFERENCES BETWEEN PRETEST AND POSTTEST RAW SCORES FOR THE MECHANICS UNIT IN HIGH SCHOOL PHYSICS FOR THE THREE TEACHING METHOD GROUPS

Subjects	Method Group A	Method Group B	Method Group C
	Difference	Difference	Difference
1	17	12	14
2	19	12	14
3	5	12	15
4	23	18	19
5	10	12	18
6	11	11	17
7	17	15	19
8	7	13	14
9	10	9	11
10	17	23	13
11	18	13	14
12	15	12	7
13	11	13	15
14	8	22	14
15	13	15	18
16	- 6	16	17
17	16	18	12
18	21	28	19
19	12	27	16
20	16	15	12
21	18	13	17
Means	13.24	15.67	15.00
S.D.	6.06	5.07	2.99

Form F, and the posttest, Cooperative Physics Test for College Students-Mechanics, Form C. The summary of this analysis is presented in Table 2.

An examination of Table 2 indicated that there were no significant differences between the teaching method groups

TABLE 2

ANALYSIS OF VARIANCE OF DIFFERENCES IN ACHIEVEMENT MADE BY THREE TEACHING METHOD GROUPS OF HIGH SCHOOL PHYSICS STUDENTS

Source of Variation	Sum of Squares	df	Mean Square	F*
Between Methods	66.12	2	33.06	1.47
Between Subjects	668.60	20	33.43	1.49
Methods x Subjects	897.88	40	22.45	
Total	1632.60	62		

*Not significant at the .05 level of confidence.

or between subjects. The obtained F between the teaching method groups was 1.47 which was not statistically significant at the .05 level of confidence. This indicated that the difference between the pretest and posttest means was due to chance. Therefore, it was concluded that any one of the three teaching methods employed in this study was just as effective in teaching the facts and principles of the mechanics unit of high school physics as either of the other two teaching methods when the effectiveness was measured by the difference between the pretest and posttest raw scores.

The obtained F of 1.49 between subjects was not statistically significant at the .05 level of confidence. This indicated that the difference between the pretest and posttest means for the subjects was due to chance. It was concluded that the means of the subjects were not signifi-

cantly different in terms of achievement of facts and principles of the mechanics unit of the high school physics course when measured by the difference between the pretest and posttest raw scores.

Since both F ratios proved to be insignificant, the hypothesis of no difference between methods and subjects could not be rejected. If real differences did exist, the F test failed to show them.

One of the purposes of this study was to determine whether or not the three teaching methods employed had the same relative effects at all scholastic ability levels, that is, to determine if there was any interaction between teaching methods and levels. By the term interaction is meant those variations which exist and are not attributable to either the teaching method or the scholastic ability level but may be attributed to the joint effects of both acting together.

In order to test for interaction, a within group or more than one observation for each cell is required. It was realized that the design of the experiment did not provide for the replication or the within group required; therefore, since no significant differences were found with respect to teaching methods, it was possible to pool the subjects of each of the three teaching method groups. The pooled subjects were placed into three levels, upper, middle, and lower scholastic ability levels, according to percentile scores on

the ACE. The subjects were assigned by percentiles in order to place them on a proportional basis.

The upper scholastic ability level consisted of subjects from the 99th down to the 85th percentile of ACE. The middle scholastic ability level consisted of subjects from the 85th down to the 60th percentile. The lower scholastic ability level consisted of subjects at the 60th percentile and below. These cut-off points were used in order to assign an approximate equal number of each scholastic ability level to the three teaching method groups. Also, by using those respective cut-off points, there was no duplication of percentiles in any two levels. The process just described provided for the necessary within group. It should be noted here that the group of subjects enrolled in this physics course was not a typical group of senior high school students because the nature of the course tends to attract only the more able students and the majority of students scored above the 50th percentile.[1]

The procedure used in forming the scholastic ability level groups provided for 21 subjects at the upper level, 24 subjects at the middle level, and 18 subjects at the lower scholastic ability level.

The differences between pretest and posttest raw scores, as measured by the Cooperative Physics Test for

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[1]See Appendix B.

College Students-Mechanics, Form F and Form C, respectively, presented in Table 1 were used to calculate the means and standard deviations of the upper, middle, and lower scholastic ability level for each of the three teaching methods. The means and standard deviations are recorded in Table 3.

TABLE 3

MEANS AND STANDARD DEVIATIONS FOR THE THREE TEACHING METHOD GROUPS AND THE THREE SCHOLASTIC ABILITY LEVELS ON THE ACHIEVEMENT OF PHYSICS FACTS AND PRINCIPLES AS MEASURED BY THE DIFFERENCE OF RAW SCORES ON THE PRETEST AND POSTTEST

Subjects	Group A		Group B		Group C	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Upper Level	14.57	5.70	13.14	2.29	16.57	2.06
Middle Level	12.38	4.06	15.00	4.93	13.25	2.57
Lower Level	12.83	8.16	19.50	5.64	15.50	2.59
All Subjects	13.24	6.06	15.67	5.07	15.00	2.99

For testing interaction, the analysis of variance was computed using the method presented by Lindquist[1] in his teaching method by scholastic ability levels design. The summary of this analysis is presented in Table 4.

According to Table 4, the obtained F ratio between teaching method groups of 1.31, between scholastic ability levels of 1.18, and for the interaction between teaching

[1]Lindquist, op. cit., pp. 121-155.

TABLE 4

ANALYSIS OF VARIANCE OF DIFFERENCES IN ACHIEVEMENT BY THREE TEACHING METHOD GROUPS OF HIGH SCHOOL PHYSICS STUDENTS

Source of Variation	Sum of Squares	df	Mean Square	F*
Between Methods	66.12	2	33.06	1.31
Between Levels	59.90	2	29.05	1.18
Methods x Levels	139.10	4	34.78	1.33
Within Subgroups	1367.48	54	25.32	
Total	1632.60	62		

*Not significant at the .05 level of confidence.

methods and scholastic ability levels of 1.33, were not statistically significant at the .05 level of confidence. This indicated that the differences between the means were due to chance and were not attributed to the teaching methods, the scholastic ability levels, or the interaction between the teaching method and the scholastic ability levels.

Since the necessary data were available, it was desired to statistically test the relationship which existed, if any, between the raw scores on the pretest and the difference on the pretest raw scores and the posttest raw scores within each of the scholastic ability levels. By the term relationship is meant the comparison between the raw scores made on the pretest by the subjects within each of the scholastic ability levels and the differences for each of the

subjects. In order to test this relationship, the Pearson-Product Moment[1] coefficient of correlation was calculated. The results are presented in summary form in Table 5.

TABLE 5

COEFFICIENT OF CORRELATION BETWEEN THE PRETEST RAW SCORES AND THE DIFFERENCE BETWEEN THE PRETEST AND POSTTEST RAW SCORES FOR THE THREE SCHOLASTIC ABILITY LEVELS

Level	df	Calculated r
Upper	20	-.17
Middle	23	-.27
Lower	17	-.76*

*Significant at the .05 level of confidence.

It was evident from Table 5 that no statistically significant relationship existed between the pretest and difference score for the upper and middle scholastic ability levels. The calculated correlation for the lower scholastic ability level of -.76 was significant at the .05 level of confidence which indicated that those subjects within the lower intelligence level who scored high on the pretest made low gains on the posttest, while those who made low scores on the pretest made high gains on the posttest.

[1]Henry E. Garrett, Statistics in Psychology and Education (New York: Longmans, Green and Co., 1948), p. 292.

Theoretical Considerations

The results of this experiment indicated that no significant differences existed among the three groups. These results seem to corroborate the findings of Willis[1] in the only other study similar to this one concerning physics, although his study covered only a period of two weeks. An attempt will be made here to report on factors which may have been responsible for the results of the current study.

At the outset of the experiment every effort was made to condition the students viewing television to the new learning medium. For the first six weeks of the experiment, the students appeared to view closely and concentrate on the television presentation. Television seemed to be a novelty; but as time passed, the novel effect disappeared and the students seemed to become bored with the day-to-day television lesson taught by the same instructor without audio assistance from any other person. This appeared to create an atmosphere of monotony. From boredom many of the students ceased to listen or concentrate on the television lesson, and it became necessary to provide the students with additional background on the reasons for originally placing them in the television class. For the remainder of the experiment, the students were very cooperative in viewing the television

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[1]Willis, op. cit.

lessons. It is believed that this external motivation may be partially responsible for the results of the experiment.

The entertainment impact of television may have had a bearing on the performance of the students viewing television. The professional manner of opening each telecast with station identification, theme music, television lesson title flashed on the screen, and the introduction of the instructor by the announcer resembled commercial television so closely that it seemed extremely difficult for the students to divorce educational television from entertainment television. Due to this factor, the students attempted to discover elements of the entertainment field in the television lessons. When the students failed to find this element, confusion and boredom resulted and some of the students became mild behavior problems. Perhaps it is this factor which caused television to lose its ability to motivate the students.

The students viewing television might have done much better if they had felt themselves a part of the telecast. They frequently would remark that the television instructor did not appear to be talking to them. Many times their questions would go unanswered because the instructor could not anticipate the many and frequent questions by high school students.

The television students seemed to develop the skill of manipulating the apparatus in performing laboratory

experiments as well as the conventional students. This was probably due to the visual contact with the apparatus in the television lesson. Television seemed to be very effective in teaching the skill of performing laboratory experiments.

Summary

On the basis of the analysis of the data presented in this chapter, the hypothesis of no difference between the means of students under the three teaching methods was accepted. It was concluded that no statistically significant differences in the means could be traced to the individual teaching methods. The hypothesis of no difference between methods and subjects could not be rejected. If real differences did exist, the statistical analysis failed to show them. The hypothesis of no interaction between teaching methods and scholastic ability levels was also accepted. That is, no method worked better for any one scholastic ability level than it did for any other one, as measured by the means of the difference between the pretest raw scores and the posttest raw scores.

CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

This study was designed to investigate three methods of teaching senior high school physics in an attempt to determine the extent to which each method affected the academic achievement of the students. One teaching method group was taught by television only, one teaching method group was taught by television supplemented by a physics teacher, and the other teaching method group was taught by the same physics teacher utilizing conventional classroom techniques and procedures. The time of the study was from September 6, 1957, to January 10, 1958.

This particular study was designed to test the null hypotheses: (1) there are no significant differences in the learning of physics facts and principles by students who are taught the mechanics unit of high school physics by the conventional teaching method, television teaching supplemented by a physics teacher, and those taught entirely by television; (2) there are no differences in learning of physics facts and principles by students who are taught the mechanics

unit of high school physics that are assignable to the interaction between scholastic ability levels and the teaching methods.

The subjects were 63 students regularly enrolled in physics during the fall semester of 1957-58 at Harding High School, Oklahoma City, Oklahoma. The subjects were randomly assigned to the three teaching methods on the basis of scholastic ability level. This resulted in 21 subjects for each teaching method group.

Prior to the instructional period, all subjects were given the American Council on Education Psychological Examination for High School Students and a pretest in physics, the Cooperative Physics Test for College Students-Mechanics, Form F. At the close of the experiment the posttest, the Cooperative Physics Test for College Students-Mechanics, Form C, was administered. The difference between the pretest raw score and the posttest raw score provided the basis for comparison of the achievement of physics facts and principles in the three teaching method groups.

At the conclusion of the study, the achievement of physics facts and principles as measured by the difference in the pretest raw scores and the posttest raw scores in the mechanics unit of high school physics was very close. In the analyses of variance which were performed, the calculated F value between teaching methods, between scholastic ability levels, and for the interaction of the teaching methods and

scholastic ability levels was not statistically significant at the .05 level of confidence.

Conclusions

From the results of this investigation the following conclusions were made:

1. Under the conditions provided for the experiment, none of the teaching methods proved to be superior in the teaching of high school physics.

2. There were no statistically significant differences between teaching methods and levels of ability within the groups. If real differences did exist, the statistical analysis failed to show them.

3. On the basis of this study, it was concluded that there was no interaction between teaching methods and scholastic ability levels.

4. There was no relationship between the pretest raw score and the difference between pretest raw score and posttest raw score for the upper and middle scholastic ability levels.

5. There was a high degree of disassociation between the pretest raw scores and the posttest raw scores for the lower scholastic ability level; that is, those who scored high on the pretest made low gains on the posttest, and those who scored low on the pretest made high gains on the posttest.

Recommendations

There are many aspects of physics instruction that were not included within the scope of this study. Other studies might well be concerned with:

1. Discovering the effect of the three methods used in this study upon learning outcomes other than achievement of facts and principles in senior high school physics.

2. Determining whether other teaching methods are superior to the three used in this study in teaching physics facts and principles to senior high school physics students.

3. Determining the relationship between teaching methods and class size in the achievement of certain learning outcomes in high school physics.

4. Applying techniques similar to those used in this study to the teaching of other courses in the secondary education curriculum. If these techniques should be employed, it is recommended that an attempt be made to control the factors discussed under Theoretical Considerations in Chapter III.

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APPENDICES

APPENDIX A

PHYSICS PRETEST AND POSTTEST RAW SCORES AND DIFFERENCES BETWEEN THEM FOR THE THREE TEACHING METHOD GROUPS

Levels	Subjects	Method Group A			Method Group B			Method Group C		
		Pre-test	Post-test	Difference	Pre-test	Post-test	Difference	Pre-test	Post-test	Difference
Upper Level	1	11	28	17	6	18	12	6	20	14
	2	6	25	19	6	18	12	3	17	14
	3	17	22	5	8	20	12	3	18	15
	4	16	39	23	11	29	18	1	20	19
	5	14	24	10	4	16	12	7	25	18
	6	8	19	11	3	14	11	3	20	17
	7	12	29	17	1	16	15	0	19	19
Middle Level	8	14	21	7	1	14	13	5	19	14
	9	6	16	10	7	16	9	12	23	11
	10	9	26	17	3	26	23	3	16	13
	11	6	24	18	5	18	13	2	16	14
	12	5	20	15	4	16	12	3	10	7
	13	10	21	11	0	13	13	2	17	15
	14	13	21	8	7	29	22	5	19	14
	15	10	23	13	18	33	15	1	19	18
Lower Level	16	18	12	- 6	5	21	16	0	17	17
	17	5	21	16	3	21	18	8	20	12
	18	3	24	21	4	32	28	3	22	19
	19	2	14	12	1	28	27	5	21	16
	20	2	18	16	4	19	15	2	14	12
	21	2	20	18	6	19	13	5	22	17

APPENDIX B

ACE RAW SCORES AND PERCENTILES FOR THE THREE TEACHING METHOD GROUPS

Levels	Subjects	Method Group A		Method Group B		Method Group C	
		ACE Raw Score	ACE Percentile	ACE Raw Score	ACE Percentile	ACE Raw Score	ACE Percentile
Upper Level	1	147	99	143	98	138	98
	2	134	97	137	98	136	97
	3	133	97	132	96	132	96
	4	133	97	120	91	130	96
	5	126	94	120	91	122	92
	6	122	92	112	86	119	91
	7	120	91	112	86	114	87
Middle Level	8	110	85	108	83	107	82
	9	109	84	107	82	100	74
	10	107	82	103	78	100	74
	11	97	70	98	72	97	70
	12	95	68	98	72	96	69
	13	92	63	96	69	94	66
	14	92	63	95	68	93	65
	15	91	62	93	65	92	63
Lower Level	16	87	56	89	59	87	56
	17	82	50	88	57	85	54
	18	82	50	87	56	84	53
	19	76	41	82	50	71	34
	20	74	38	76	41	70	32
	21	64	24	58	18	61	21

APPENDIX C

APPLICATION OF BARTLETT'S TEST OF HOMOGENEITY OF VARIANCES FOR THE THREE TEACHING METHOD GROUPS

Method Group	n	34	s^2	log s^2
Group A	21	20	36.7236	1.56495
Group B	21	20	25.7049	1.41010
Group C	21	20	8.9401	.94841
Total	63	60	71.3089	3.92346

Bartlett's Test of Homogeneity formula is given below:

$$\chi^2 = (2.3026/C)\,(n-1)\,[\Sigma(r)\,(\log s^2/r) - \Sigma \log s^2]$$

where:

2.3026 = the constant needed because common logarithms are used instead of Napierian logarithms.

n = the number of subjects in any one group.

r = the number of groups involved.

s^2 = the square of the standard deviation.

C = the correction factor, $1 + \frac{r + 1}{3r(n-1)}$.