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ABSTRACT

In this study the achievement of eighth grade mathematics students who produced their own visual learning materials on topics in the curriculum was compared with eighth graders who did not have this opportunity. Two groups of eighth grade mathematics students were assumed to be equivalent due to their random selection and their comparable I.Q. and pre-test scores. The students in the experimental group were allowed to produce their own filmstrips on various topics in the mathematics curriculum. A post-test showed that students in the experimental group did not learn more than those in the control group. However, observation showed that the filmstrip project did have a strong interest and motivational value. The poorer and the brighter students both became more involved with their projects than did the middle third of the group. (JK)

THE EFFECT OF STUDENT-PRODUCED FILMSTRIPS ON MATHEMATICS ACHIEVEMENT IN GRADE EIGHT

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CHAPTER I

INTRODUCTION

> "We have harnessed our technology to reach the moon, we must now harness technology to teach our children," said Congressman John Brademas (D-Ind.) in an address keynoting the 30th National Convention of the National Audio-Visual Association in Chicago. . . . You, therefore, have a great stake in understanding that educational technology goes far beyond equipment to include the shaping of the most effective strategies of instruction for millions of American children.[1]

The Indiana legislator clearly indicated the need for research into various applications of technology. He felt that there should be research aimed at developing new and advanced educational strategies which incorporate modern technology.[2]

Perhaps the idea of having students write and produce their own filmstrips for added motivation and educational enrichment is one such strategy. Students would carefully study a concept, then view it creatively, and plan and produce a visual presentation. Such a method could provide an added reason for the slower learner to learn and could challenge the creative ability of the more advanced learner.

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[1]"Brademas Urges Application of Technology to Education," Educational Media (September, 1969), 6-7.

[2]Ibid.

The filmstrips could then be added to the available resources of the school so that students who do not understand a given concept could use them for further learning.

The Problem

Statement of the Problem

The problem of this investigation was to determine the relationship between student planned and produced filmstrips and mathematics achievement in the eighth grade.

Hypothesis

There will be a significant difference in the achievement of eighth grade mathematics students who produce their own visual learning materials on topics in the curriculum as compared to eighth grade mathematics students who do not have this opportunity.

Null Hypothesis

There will be no significant difference in the achievement of eighth grade mathematics students who produce their own visual learning materials on topics in the curriculum as compared to eighth grade mathematics students who do not have this opportunity.

Definitions

Visual learning materials.--Colored 35mm filmstrips made by the two-frame technique and capable of being shown on standard 35mm filmstrip projectors.

Topics in the curriculum.--Topics selected by the students from among those which are studied in the eighth grade curriculum. They range from multiplication concepts to simple geometry and introductory algebra. (See Appendix)

Story board.--A layout of the pictures which comprise a film or filmstrip.

Half-frame camera.--Any camera which takes still pictures of 18mm x 24mm on 35mm film. These pictures are half the size of those of a standard full-frame camera.

Full-frame camera.--Any standard sized 35mm camera, taking pictures of 36mm x 24mm.

Two-frame technique.--A method of making filmstrips with a full-frame camera by copying two flat pictures onto one frame.

Justification

The study may be helpful in the field of instructional media as it could lead to a relatively inexpensive motivational device that could at the same time provide relatively inexpensive resource materials. This device could be economically feasible in most contemporary schools.

Student-produced filmstrips might be good tools for teaching varicus mathematical concepts and topics.

Student-produced filmstrips might provide outlets for individual differences in understanding, ability, creative thought and learning style in mathematics.

Assumptions and Limitations

1. Intelligence can be measured.

2. Mathematics achievement can be measured.

3. Increased motivation leads to increased learning.

4. There was no Hawthorne effect.

5. There were no group differences, other than those created by having the students produce their own filmstrips, that would affect the study.

6. Differences in the mathematical learning achievement of the two classes involved in the study were attributed to the extra learning opportunity of the experimental group.

7. The control group met at a different time of day than the experimental group. It was assumed, however, that the academic effects of the time of meeting would be small and not contribute significantly to the mathematics achievement results.

The study took place over a period of four months starting September 1972. The children were all students in the same school and had the same teachers in all subjects. They received similar instruction except that the students in the experimental group were given the opportunity to make their own filmstrips. They were permitted to work on their projects during class time and in study halls if they so desired.

Chapter Two investigates previous studies dealing with filmstrips and audio-visual techniques.

CHAPTER II

THE REVIEW OF RELATED LITERATURE

The tools of audio-visual technology have been used in many applications. Many schools have radios, television sets, overhead projectors, tape recorders, movie projectors, slide projectors, filmstrip projectors, and video-tape recorders for teachers to use to help strengthen the curriculum. Educators seem to have recognized that audio-visual aids can be a useful tool in teaching.

> Audio-visual enrichment of the curriculum as a teaching method stimulates thinking, quickens creative imagination and helps the child become oriented to the materials which are presented to him. . . . Audio-visual aids . . . help develop and increase personal understanding and appreciation of the areas of learning which they humanize and enrich.[1]

Chandler and Cypher imply that filmstrips, a form of audio-visual aid, are of educational value.

John Zuckerman in 1954 attempted to predict film effectiveness by pre-release testing. He had a control group view a film. An experimental group viewed a filmstrip which was composed of choice frames selected from a story board of

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[1]Anna Curtis Chandler and Irene F. Cypher, _Audio-Visual Techniques for Enrichment of the Curriculum_ (New York: Noble and Noble Publishers, Inc., 1948), pp. 6-8.

the same film. The filmstrip also used the film's original sound track. A twenty-six item multiple choice test used to check gains of knowledge revealed that there were no statistically significant differences between the effectiveness of the two methods. He concluded that the filmstrip could be used to predict reliably the effectiveness of the film, implying that both are equally effective media.[1]

Ronald McBeath and James Finn of the University of Southern California studied the relative effectiveness in factual learning of (1) a captioned filmstrip, (2) a captioned filmstrip with narration, (3) a sound filmstrip, and (4) a filmograph (made by photographing still pictures on motion picture film). The study tested the hypothesis that the filmograph could teach more effectively than the other media. A population of 558 sixth grade students revealed that no one method was statistically superior and that "the students did learn by each of the four methods."[2] This research supports the belief that students can learn by using different types of filmstrips.

The idea of students or teachers making their own

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[1]John V. Zuckerman, "Predicting Film Learning by Pre-Release Testing," Audio-Visual Communications Review, II (Winter, 1954), 49-56.

[2]Ronald J. McBeath and James D. Finn, A Comparative Study on the Effectiveness of the Filmstrip, Sound Filmstrip and Filmograph for Teaching Facts and Concepts (Educational Resources Educational Center, Number Ed. 003-574, 1961), p. 12.

filmstrips has been suggested and tried. Textbooks on audio-visual procedures in teaching often have sections dealing with teacher- or school-made filmstrips and slides.

> You will be repaid many times for the effort you exert in preparing home-made teaching films. Their chief value is that they are made to illustrate and clarify your own specific subjects and lessons . . .
> The wide-awake instructor will find many subjects, manipulative skills, general information, and learner attitudes peculiar to his own situation that could be converted and illustrated in filmstrips for more effective teaching. Slide films and filmstrips are applicable to any school or occupational training need.[1]

G. Howard Poteet, of Essex County College, apparently believed that the idea of making a filmstrip would also apply to student-made filmstrips and that such filmstrips would, in fact, be even more valuable. His rationale was that:

> Illustrating the story with 35mm slides makes the story (and the process of decoding symbols that we call reading) come alive for the students. It just might be one way of involving youngsters who were well on their way toward dropping out of a school world that they tend to see as totally unrelated to their own real world.[2]

He goes on to say that "words often remain meaningless without concrete experience." He believed that a student-made filmstrip would tend to relate to the life and interest of the maker and hence have meaning to him. In his

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[1]Kenneth B. Haas and Harry Q. Packer, Preparation and Use of Audio-Visual Aids (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1967), pp. 39-40.

[2]G. Howard Poteet, "Getting to See 'Homer Price,'" Audio-Visual Instruction (November, 1970), 38-39.

experience the students were more interested, more highly motivated and their learning had seemingly been increased when students made their own productions.[1]

Catherine M. Williams suggested that student production of materials should be an integral part of the curriculum.

> In schools where a high value is placed on the development of attitudes, critical thinking, interests, and appreciations, as well as on the acquisition of information and skills, student production of materials is an integral part of the learning experience. This work provides students with the experience in organizing ideas and communicating them to their classmates, their parents or in an assembly program to the entire school.[2]

The ability to organize ideas and to communicate them is a measure of the value of a child's education. The student, by producing his own filmstrips, gains experience in organizing and communicating his own ideas.

Albert Kozeliski and Lawrence L. Kavich claimed that the educational wave of the future was in the individualization of teaching aids and that there would be a growing demand in the school years to come.

> The scope of instructional possibilities is limitless. Individuals or small groups may use self-produced filmstrips for teaching slow learners, gifted students, retarded children, and small or

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[1]Ibid.

[2]Catherine M. Williams, Learning From Pictures (Educational Resources Information Center, Number Ed. 024-272, 1968), pp. 103-104.

large classes at the elementary, secondary or adult level. . . .[1]

The idea of handmade visual learning materials is certainly not a new one. At the same time "lantern slides" first became popular as an educational tool, Eastman Kodak and others sold kits to make one's own slides. Today, one can easily produce his own filmstrips and can choose among four different methods:

1. Directly applying a presentation to blank film.
2. Taking pictures with a half-frame camera.
3. Copying flat pictures by the two-frame technique.
4. Having slides sent out to be professionally made into filmstrips.

The first three of these methods are economically feasible for school use. The advantages and disadvantages of each will be discussed.

Drawings can be directly applied to clear acetate strips or to cleaned film. Using this method, costs are kept to a minimum. Any clear acetate can be cut into strips of the proper width and length. Old scrap 35mm film can be easily cleaned with bleach. Presentations are then applied to these strips with a felt-tipped pen.

In discussing the making of filmstrips on blank

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[1] Albert Kozeliski and Lawrence L. Kavich, "Self-Produced Filmstrips May Be the Answer," Audio-Visual Instruction (April, 1968), 370.

acetate, Philip James, an art teacher, felt that,

> Making filmstrips . . . provides a good preliminary or alternate activity to film making. The projected image is there, the passage of time can be controlled from frame to frame and a sequence of events can be portrayed.

As to the educational value he felt that,

> By allowing the students to feed their own strips through the projector, as they develop their ideas, you allow for instant motivation and immediate reinforcement of successful techniques.[1]

One also can develop a curriculum around the filmstrip, as eighth grade English teacher Hazel Smith has done. She had the students involved in planning the plot lines, drawing the story cards, assembling the story board and in writing a script. She then permitted the students to put their presentation onto the strip. She reported that the students were highly motivated.[2]

The main advantage of this method is that it is inexpensive; however, one must consider one serious drawback: students must confine their presentation to an extremely small space because the size of the filmstrip is approximately 3/4 inch by one inch. The author believes that this method greatly stifles the desire to make a well thought-out presentation.

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[1] Philip James, "Making Filmstrips," School Arts (February, 1969), 22-23.

[2] Hazel Smith, "A Teacher's Experience with Student Hand-Made Filmstrips," Audio-Visual Instruction (November, 1969), 83-84.

In a discussion about self-produced filmstrips, Kozeliski and Kavich felt that a half-frame camera, such as those found in the Japanese Olympus Pen series, was the most advantageous for making filmstrips.[1]

As the standard size for the modern filmstrip is half-frame, it would appear to be most advantageous to take pictures with such a camera. Using a half-frame camera, one can make a filmstrip incorporating live action, drawings and photographic "tricks" such as stop-action and double exposures. This method could be used in teaching English, social studies, science and mathematics, wherever there is a need to show events from the real physical world.

There is one major drawback when making filmstrips in this manner. There is the increased possibility of one frame being out of focus, poorly exposed or poorly positioned. This would entail cutting the bad frame out and splicing the remaining ends together. It is possible to do this, but the results are usually far from satisfactory.

Half-frame cameras are not the only solution to making quality color filmstrips.

> One frame of a full-frame camera can be pictorially reproduced into two pictures to accommodate a half-frame projector. Only photographs of art work and the like (other still objects) can be photographed, however.[2]

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[1]Kozeliski and Kavich, 370.

[2]<u>Ibid</u>.

A great deal of creativity in design and explanation can be graphically produced on cards which can in turn be made into filmstrips by the two-frame technique. In making filmstrips about mathematics, the two-frame technique is devoid of problems for all practical purposes. This was the method chosen for this study.

Most of the 35mm cameras owned by amateurs and schools are the full-frame type. This kind of camera generally offers greater utility, usefulness and versatility than other types of cameras. Using a full-framed camera to make filmstrips is not difficult and there are several publications which present an excellent explanation of how to make filmstrips using a full-framed camera.[1]

The author wanted a quality filmstrip, feeling that a more prestigious, more professional filmstrip would have greater appeal to critical eighth graders. The two-frame technique was the most feasible from an economical point of view.

Professional quality filmstrips can also be made by selecting choice slides and having them processed by a reputable laboratory.[2] The quality of the filmstrip and its

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[1] A Simple Wooden Copystand for Making Title Slides and Filmstrips, Publication T-43 (Rochester, New York: Eastman Kodak Company, n.d.); Producing Slides and Filmstrips, Kodak Audiovisual Data Book S-8 (Rochester, New York: Eastman Kodak Company, 1970).

[2] R. Dwight Wilhelm, "Our Gang Wants to Make a Filmstrip," Audio-Visual Instruction (April, 1968), 366-367.

content can be made as professionally as desired, but cost factors of this method make it impractical for each student to make his own filmstrip.

Each of the four methods of making filmstrips produces different results. For the purposes of this study the spontaneity of making filmstrips on acetate, the professional quality of "jobbing out" a filmstrip, and the versatility of the half-frame camera were sacrificed for the practicality of using a full-frame camera.

In the available literature, studies about filmstrips and student involvement in the production of filmstrips have made claims for the motivational value of student-made filmstrips. The idea of student involvement in making filmstrips has been suggested and tried. However, there appears to be little statistical evidence that such a project would indeed motivate students to increased achievement in mathematics.

CHAPTER III

METHODOLOGICAL DESIGN

Population and Sample

The study took place in the Brennan Middle School in Attleboro, Massachusetts. Attleboro is located in Bristol County in Eastern Massachusetts, bordered on the southwest and west by the State of Rhode Island. It is 32 miles from Boston, 12 miles from Providence and 197 miles from New York City. Its population of some 33,000 and area of some 23 square miles make it one of the larger cities in the region.

Attleboro is an industrial center with manufacturing being the largest source of employment. Some 82 per cent of the working population are employed in the manufacturing of jewelry, electrical machinery and in the primary metals industry. The mean family income in 1965 was $8,626, which was slightly higher than that of Bristol County as a whole.[1]

There are fourteen public schools and three parochial schools in Attleboro. Of the public schools, there are ten elementary schools, three junior high schools and one

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[1] Chamber of Commerce of the Attleboro Area, Attleboro Facts, Data supplied by local officials and Massachusetts Department of Commerce and Development (Attleboro, Massachusetts: April, 1972), pp. 2-5. (Mimeographed.)

combination trade school and high school. A majority of the schools were built at the beginning of the century and are overcrowded.

Brennan Middle School, completely occupying its available site of approximately two acres, is in the middle of a residential area with its front facing a major highway. The building was begun in 1912 with additional renovations in 1939, 1951, 1968, 1971, and 1972. It originally served as the senior high school. With the construction of the new high school, Brennan is now being used as a middle school, housing students in grades six through nine. According to Englehardt, Englehardt and Leggett, educational consultants, Brennan Middle School has twenty-six classrooms and a functional capacity of 702 pupils.[1] Present enrollment is 855 pupils in four grades. There are special facilities for art, music, physical education, home economics, business education and typing. There are also wood and metal shops and a reading laboratory. The school has a part-time teacher for English as a Second Language (Attleboro has a large Portuguese population) and a part-time teacher for the students with learning disabilities.

The classes are heterogeneously grouped. The graduating seventh grade class was randomly divided by the

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[1]Englehardt, Englehardt and Leggett, Educational Consultants, School Building Needs (Purdys Station, New York: By the authors, November, 1965).

principal into three groups of equal number and assigned to one of three teaching teams. The Guidance Office then divided these groups into four departmentalized classes while trying to identify personality conflicts among the students. Randomness of the two groups involved in the study was evidenced by the equivalence of the mean IQ scores as measured by the Otis-Beta Test for Mental Maturity, administrated on October 15, 1971. The mean scores for the experimental and control groups were both approximately 103.

Children with diagnosed learning disabilities and children taking English as a Second Language were excluded from the study in both the control and experimental groups. There was one girl who had a schedule change and consequently was not included in the final analysis.

Null Hypothesis

There will be no significant difference in the achievement of eighth grade mathematics students who produce their own visual learning materials on topics in the curriculum as compared to eighth grade mathematics students who do not have this opportunity.

Hypothesis

There will be a significant difference in the achievement of eighth grade mathematics students who produce their own visual learning materials on topics in the curriculum as compared to eighth grade mathematics students who do not have this opportunity.

Description of the Research Design

The experimental group consisted of 20 eighth grade mathematics students and the control group consisted of 16 eighth grade mathematics students. Both groups were taught by the same teacher. They were assumed to be equivalent due to their random selection and equivalent mean IQ's. In addition, a t-test comparing their scores on the mathematics pre-test found these groups to be concurrent at the .90 level. A t-test was also used to compare the achievement results in mathematics on the post-test for the two groups. A .05 level of significance was sought.

The experiment was begun at the beginning of the school year 1972 by the administering of the pre-test to both groups. The California Arithmetic Test was used and the grade placement equivalent of the subjects was found.

An equivalent form of this test was administered as a post-test for the two groups at the end of the experiment. The California Arithmetic Test is a standardized test with a reported reliability coefficient of .94.[1]

After the completion of the pre-test, the students in the experimental group were told of the opportunity to

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[1]Ernest W. Tiegs and Willis W. Clark, Manual--California Achievement Tests, Complete Battery (Monterey, California: California Test Bureau, 1963), p. 8.

prepare their own filmstrips on any topic in the eighth grade curriculum. The teacher read a list of topics and the children were encouraged to make their own filmstrips after they had been instructed on how to produce filmstrips by the two-frame technique. They were permitted to use class time and study hall time to work on their project. They were also permitted to use the resource center facilities should they be desired.

Both groups were treated as similarly as possible throughout the experiment. New materials and information were introduced to both groups on the same day. Both groups went on field trips on the same day to the same places. Regular classroom instruction in mathematics for both groups was a form of Individually Prescribed Instruction using the materials published by the Continuous Progress Laboratories. The students used multi-level textbooks (covering grades six through eight). The students in both groups were permitted to work individually or in small groups.

An equivalent form of the California Arithmetic Test was administered as a post-test to the two groups after the entire experimental group had been involved in at least one filmstrip production. The experiment was conducted over a period of four months.

Data Gathering Instruments

Otis Quick-Scoring Mental Ability Test--Beta Test[1]

On October 15, 1971, the students in the control and experimental groups were administered the Otis Quick-Scoring Mental Ability Test, Beta Test, Form CM. The mean intelligence quotient scores on this test were used as a preliminary check for randomness of the two groups.

The Otis-Beta is a simple IQ test that can be easily administered to large groups, hence its popularity in schools in the United States. As with most tests of mental ability, the scores are not definitive. With group tests, such as the Otis-Beta Quick-Scoring Test, the scores are even less conclusive.

The Mean Correlation Index between the Otis-Beta and the Stanford Achievement Test, Form J, is approximately .74. The Reliability Coefficient is relatively high. A comparison of Odd vs. Even Items for Form CM, as corrected by the Sperman-Brown Formula, yields a Reliability Coefficient of .87, for eighth graders.

For the purposes of this study the results on the Otis-Beta were assumed to be sufficiently accurate to test initially for the equivalence of the two groups.

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[1]Arthur S. Otis, Otis Quick-Scoring Mental Ability Tests, Manual of Directions for Beta Test (New York: Harcourt Brace and World, Inc., 1954).

California Achievement
Test, Arithmetic[1]

Equivalent forms of this test were used as the pre-test and post-test for this study. A comparison was made on the mean student scores based on a grade placement scale. This grade placement scale represented the average achievement of students at designated chronological ages having, for grade eight, a median IQ of 101.

> The units throughout the grade placement scale indicate as accurately as possible the meaning of test scores for individuals of average intelligence and typical chronological age at each grade classification based upon empirical data.[2]

The test is divided into two parts: Arithmetic Reasoning and Arithmetic Fundamentals. These two parts are combined to find a student's Grade Placement Equivalent. In testing for validity, the two parts, when compared with the Stanford Achievement Tests, Advanced, using a Pearson product-moment correlation corrected for range and for attenuation, yield correlation coefficients of .99 and .96, respectively. Reliability Coefficients for the two parts using the Kuder-Richardson Formula 21 are .84 and .93 and for the total arithmetic achievement test, .94.[3]

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[1]Ernest W. Tiegs and Willis W. Clark, Manual--California Achievement Test, Complete Battery, Junior High Level (Monterey, California: California Test Bureau, 1963).

[2]*Ibid.*, p. 43.

[3]*Ibid.*, p. 8.

The California Achievement Test has had wide acceptance in the United States since 1934. In the author's opinion this time-proven test was ideally suited for the purposes of this study.

Chapter Four deals with the statistical analysis of the results on these tests given to both the experimental and control groups.

CHAPTER IV

ANALYSIS OF THE DATA

Quantitative data was collected on the students' Intelligence Quotient scores and on the students' Grade Placement Equivalents at the beginning and at the end of the experiment.

Intelligence Quotient Scores

The Otis-Beta Quick-Scoring Test of Mental Maturity was administered to the students a year prior to the study as part of the regular testing program of the school's Guidance Department. The mean scores were found to provide a preliminary check on the randomness of the two groups. Because of the inherent limitations to group intelligence tests, the results were not considered to be conclusive.

Table 1 reveals that the students in both groups had mean Intelligence Quotients of 103.4 and 102.6 respectively. Hence the two groups of students appeared to be equivalent and "typical." (See Appendix)

Grade Placement Equivalents, Pre-test

The California Arithmetic Test, Form W, was administered to the students at the beginning of the study. A t-test was conducted on the Grade Placement Equivalent Scores of the students in the two groups.

The mean Grade Placement Equivalent Scores on the pre-test for the students in the two groups were 7.62 and 7.60, as shown in Table 2, supporting the equivalence of the two groups. (See Appendix)

While the student composition of both groups was heterogeneous, the range in scores of the students in one of the groups was 1.5 grade levels higher than that of the students in the other group.

The standard deviations also appeared to differ slightly. The test for F, however, revealed that the null hypothesis of variance homogeneity cannot be rejected at the .05 level.

A t-test on the Grade Placement Equivalent Scores at the beginning of the experiment found the two groups to be equivalent at the .90 level as shown in Table 2. One group was then chosen, at random, to be the experimental group and was given the added opportunity to produce their own filmstrips. The other group became the control group for the study.

Grade Placement Equivalents, Post-test

The California Arithmetic Test, Form Y, was administered to the students at the end of the study. A t-test was conducted on the Grade Placement Equivalent Scores of the students in the two groups.

The mean Grade Placement Equivalent Scores on the post-test were 8.59 for the students in the Experimental Group and 8.50 for the students in the Control Group. It would appear that in the four months of this study, the students planning and preparing their own visual learning materials did achieve slightly better than those students not given that opportunity. The t-test on the Grade Placement Equivalent Scores, however, revealed that this difference was not significant. As shown in Table 3, the sought level of significance of .05 was not attained. (See Appendix)

Therefore, the results of the scores of the students on the post-test revealed that there was no significant difference in the mathematics achievement of eighth grade students who plan and prepare their own filmstrips on topics in the curriculum as compared to an equivalent group of eighth grade mathematics students not given this opportunity.

CHAPTER V

SUMMARY AND CONCLUSIONS AND RECOMMENDATIONS

Restatement of the Problem

Is there a relationship between student-produced filmstrips and mathematics achievement in the eighth grade?

Description of the Procedures

Two groups of eighth grade mathematics students were assumed to be equivalent due to their random selection. A comparison of the mean IQ's of the students in the two groups supported this assumption; a t-test on the student pre-test scores on the California Arithmetic Test also supported this assumption.

Regular classroom instruction for both groups was a form of Individually Prescribed Instruction. The students in the experimental group were given the added opportunity to produce their own filmstrips on various topics in the curriculum. They had the option to use class time and study hall time to work on their projects. Once produced, the filmstrips became part of the regular classroom learning resources.

After every student in the experimental group had been involved in the production of at least one filmstrip, both groups were administered an equivalent form of the California Arithmetic Test. This served as the post-test for the study.

Findings

The students in the Experimental Group became very involved in their projects and they became quite anxious to see their work in actual filmstrip form. Almost all were pleased with and proud of the finished product. In preparing the filmstrips, the students were not given any set guidelines concerning a topic, content or organization. Most chose to make their filmstrip on a small aspect of a unit they had recently completed, i.e., "Addition of Fractions" and "How to Multiply and Reduce Fractions." A few chose to provide a short review of a whole unit and had filmstrip titles such as "Integers" and "Decimal with Deci."

The projects seemed to have their greatest appeal among the students in the upper third and lower third of the class. Their filmstrips demonstrated the greatest amount of effort, thought, and creativity.

Most of the students, in preparing their filmstrips, consulted textbooks or some type of resource material. This provided them with a good understanding of the topic and at the same time gave them a few ideas concerning how to approach the topic.

The filmstrips themselves were generally well planned, beginning with an introduction explaining the importance of the topic and how it is used, then having a detailed section dealing with the actual computational procedures, and ending with a short quiz with the answers. The students found these quizzes extremely helpful. Occasionally someone would start the period by going directly to the test items on a filmstrip to practice and study the sample problems. The filmstrips were used both to reinforce a concept that a student had already started to learn and to provide the student with a quick review of a given topic, especially just prior to taking the final unit examination. When asked, most of the students thought that the project was worthwhile.

Conclusions

The null hypothesis--that giving students the opportunity to plan and produce their own filmstrips on topics in the curriculum does not affect mathematics achievement in Grade 8--was accepted. The hypothesis--there would be a significant difference in the achievement of eighth grade mathematics students who produce their own visual learning materials on topics in the curriculum as compared to eighth grade mathematics students who do not have this opportunity--was rejected at the .05 level of significance.

The related literature indicated that student-produced filmstrips might have a strong motivational and interest value and might be valuable in helping to develop the thinking skills of the students involved. As reported in the findings, observations tended to support this belief. The students indicated that they enjoyed what they were doing and that they felt that the time was well spent.

This study has demonstrated that the opportunity to produce filmstrips on topics in the curriculum did not appear to hamper the mathematics achievement of the students involved. They learned equally as well as those students not given the opportunity. There is also the possibility that additional skills and lessons were learned while the students were involved in their projects.

As in any study of this nature, the limitations such as the subject matter, the size and nature of the sample, and the length of the experiment must be considered when drawing conclusions. This study involved a limited number of eighth grade mathematics students and was conducted over a period of four months. The conclusions drawn may be considered valid only insofar as these limitations are recognized. A similar study using students in a different grade or subject matter or one conducted over a longer period of time might result in different conclusions.

Recommendations for Further Investigations

With the trend in education today being toward the recognition of different learning styles for different students, there appears to be a need for research into new approaches to learning.

This study investigated one type of strategy--student-produced filmstrips--and its effect upon academic achievement. It was noted in the course of this investigation that (1) the students appeared to enjoy learning more when involved in making filmstrips and (2) the poorer students and the more exceptional students became most involved with their projects. This suggests the need for a large-scale investigation that differentiates between students of different abilities and that recognizes attitudinal as well as academic differences. Such a study would help classify the effectiveness of one potentially useful teaching strategy.

APPENDIX

TABLE 1.--A Comparison of the Mean IQ Scores of the Students in the Experimental and Control Groups as Measured by the Otis-Beta Quick-Scoring Mental Ability Test, October 15, 1971

Experimental Group	Control Group
126	125
118	124
114	114
114	111
113	107
113	101
113	101
111	101
107	101
105	101
104	101
101	94
100	93
100	91
97	91
97	86
91	
86	
85	
73	
2,068	1,642

$n_1 = 20$

$\bar{X}_1 = \frac{\Sigma X}{n_1}$

$\bar{X}_1 = \frac{2068}{20}$

$\bar{X}_1 = 103.4$

$n_2 = 16$

$\bar{X}_2 = \frac{\Sigma X}{n_2}$

$\bar{X}_2 = \frac{1642}{16}$

$\bar{X}_2 = 102.6$

TABLE 2.--Test for t to Find a Significant Difference Between the Experimental and Control Groups Using the Pre-test Grade Placement Equivalent Scores on the California Arithmetic Test, Form W, September 26, 1972

Experimental Group			Control Group		
X_1	$X-\bar{X}$	$(X-\bar{X})^2$	X_2	$X-\bar{X}$	$(X-\bar{X})^2$
9.8	2.2	4.84	11.3	3.7	13.69
9.7	2.1	4.41	10.1	2.5	6.25
9.3	1.7	2.89	8.5	.9	.81
8.9	1.3	1.69	8.3	.7	.49
8.4	.8	.64	8.0	.4	.16
8.3	.7	.49	7.9	.3	.09
8.3	.7	.49	7.6	.0	.00
8.1	.5	.25	7.6	.0	.00
7.7	.1	.01	7.2	- .4	.16
7.5	- .1	.01	7.0	- .6	.36
7.4	- .2	.04	6.8	- .8	.64
7.2	- .4	.16	6.6	-1.0	1.00
7.0	- .6	.36	6.5	-1.1	1.21
7.0	- .6	.36	6.2	-1.4	1.96
7.0	- .6	.36	6.0	-1.6	2.56
6.4	-1.2	1.44	6.0	-1.6	2.56
6.2	-1.4	1.96			
6.2	-1.4	1.96			
6.0	-1.6	2.56			
6.0	-1.6	2.56			
152.4		27.48	121.6		31.94

$n_1 = 20$

$$\bar{X}_1 = \frac{\Sigma X_1}{n_1} = 7.62$$

$$s_1^2 = \frac{\Sigma(X-\bar{X})^2}{n_1-1} = 1.446$$

$n_2 = 16$

$$\bar{X}_2 = \frac{\Sigma X_2}{n_2} = 7.60$$

$$s_2^2 = \frac{\Sigma(X-\bar{X})^2}{n_2-1} = 2.129$$

$$F_{15,19} = \frac{s_2^{\ 2}}{s_1^{\ 2}} = \frac{2.129}{1.446} = 1.472 \qquad p > .05$$

$$df = n_1 + n_2 - 2 = 20 + 16 - 2 = 34$$

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\left(\frac{\Sigma X_1^{\ 2} + \Sigma X_2^{\ 2}}{n_1 + n_2 - 2}\right)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} = .0451$$

$p > .90$

TABLE 3.--Test for t to Find a Significant Difference Between the Experimental and Control Groups Using the Post-test Grade Placement Equivalent Scores on the California Arithmetic Test, Form Y, January 24, 1973

Experimental Group			Control Group		
X_1	$X-\bar{X}$	$(X-\bar{X})^2$	X_2	$X-\bar{X}$	$(X-\bar{X})^2$
11.0	2.4	5.76	11.8	3.3	10.89
10.7	2.1	4.41	11.8	3.3	10.89
10.7	2.1	4.41	11.5	3.0	9.00
9.4	.8	.64	9.5	1.0	1.00
9.4	.8	.64	8.7	.2	.04
9.0	.4	.16	8.7	.2	.04
8.9	.3	.09	8.6	.1	.01
8.8	.2	.04	8.4	- .1	.01
8.6	.0	.00	8.0	- .5	.25
8.6	.0	.00	7.9	- .6	.36
8.4	- .2	.04	7.5	-1.0	1.00
8.4	- .2	.04	7.1	-1.4	1.96
8.2	- .4	.16	6.9	-1.6	2.56
7.9	- .7	.49	6.9	-1.6	2.56
7.8	- .8	.64	6.7	-1.8	3.24
7.1	-1.5	2.25	6.0	-2.5	6.25
7.1	-1.5	2.25			
6.9	-1.7	2.89			
6.4	-2.2	4.84			
163.3		29.75	136.0		50.06

$n_1 = 19$

$$\bar{X}_1 = \frac{\Sigma X_1}{n_1} = 8.59$$

$$s_1^2 = \frac{\Sigma(X-\bar{X})^2}{n_1-1} = 1.653$$

$n_2 = 16$

$$\bar{X}_2 = \frac{\Sigma X_2}{n_2} = 8.50$$

$$s_2^2 = \frac{\Sigma(X-\bar{X})^2}{n_2-1} = 3.337$$

$$F_{15,18} = \frac{s_2^{\ 2}}{s_1^{\ 2}} = \frac{3.337}{1.653} = 2.019 \qquad p > .05$$

$$df = n_1 + n_2 - 2 = 19 + 16 - 2 = 33$$

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\left(\frac{\Sigma X_1^{\ 2} + \Sigma X_2^{\ 2}}{n_1 + n_2 - 2}\right)\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} = .1706$$

$p > .05$

TABLE 4.--Topics in the Eighth Grade Curriculum That the Children Were Permitted to Select From for Their Filmstrip

Basic Operations:	Addition
	Subtraction
	Multiplication
	Division
	Properties of Real Numbers
	Closure Properties
Roman Numerals, Exponents, Scientific Notation	
Rational Numbers:	Basic Operations with Fractions
Decimals:	Basic Operations with Decimals
	Converting Decimals
Proportions and Per Cents	
Integers:	Basic Operations with Integers

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