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Effect of a multimedia program on achievement and attitudes of elementary and secondary students

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by

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CHAPTER I. INTRODUCTION

Educators during the last decade have been witnesses to an enlivened thrust toward development of models for evaluation. An awareness of a need for an objective basis for decision-making has been prompted by pressures from both inside and outside the community of professional educators. A concerned public is now asking the question, "Why?", when large sums of the taxpayer's money are funneled into innovative programs in education at all levels. Such concern has provided a much needed stimulus to account for the present system of education. As a result a new breed of educator has evolved, one which has loosed the shackles of tradition and has looked outside the net which formerly enveloped a closed community. Lessons have been borrowed from developments in science, business, and industry in the last half century. Application of these lessons has generated specialists in education working in such areas as systems analysis and operations research, expressions which formerly held connotations only of big business or industry. Comparable management models now exist in education. An important phase of such program management systems has been the program evaluation. This has typically provided the information needed for decision-making.

This investigation is an evaluation of two distinct aspects of a multimedia program which was implemented in the Sibley, Iowa Community School District on February 1, 1968. It is concerned with the degree to which the program has achieved its stated objectives with regard to academic achievement and attitudes of students. The program was designed to conform to a management systems model in which program

evaluation was expected to provide a measure of the degree to which objectives had been achieved and to supply the decision-makers with the information necessary to effect appropriate modifications.

Description of the Program

The program was initially funded by Office of Education Grant No. OEG-0-8-051090-2693 on February 1, 1968 for the amount of $125,000.00. It was officially called the "Exemplary All-Level Instructional Materials Center" and administered as Title III, Elementary and Secondary Education Act, Project No. 68-05109-0. Subsequent grants of $77,000.00 and $160,000.00 have sustained the project through January 31, 1971, when local funding began.

Some local financial support has supplemented the federal Title III funds in developing and equipping instructional materials centers in three units within the school district. A 32' x 60' area featuring fifty reading stations and forty listening stations was equipped for grades K-4 at the Franklin Elementary School. The Middle School Instructional Materials Center was developed to accommodate a school population of 350 students. It occupies two adjoining rooms of Central School and has seating for twenty-nine at carrels, twenty-four at tables and eight in the periodical and microfilm area. This facility serves grades 5-8.

Two main centers have been in operation in the high school which is also located in the Central School building. The High School Instructional Materials Center was designed to serve 330 students plus twenty-six faculty members. The combination High School Satellite Center and Audio Access area has a multiplicity of audio and video devices available

including video tape recording equipment and television monitors. Small branch centers have been placed in some classrooms that are remote from the two main centers; these are located in the art, foreign language, home economics, industrial arts, and vocational agriculture classrooms. Grades 9-12 are served by these centers.

Each of the three units in the district has facilities for the professional staff to prepare and produce learning materials. A supporting staff of clerical help is available to serve both students and teachers.

In addition, a unit of clerical and technical personnel is housed in a separate building which is equipped for large scale production of print and nonprint materials. This building also functions as a bindery for periodicals and houses the office of the project director.

Need for the Study

The objectives of the project were restated by Forbes (10, p. 6) in the final application for funding as they had been stated in each of the previous applications. Four primary objectives were delineated. They were:

1. To improve academic performance through using, in an articulated curriculum with well-developed units of study, media at all grade and ability levels, thus adjusting learning to accommodate individual differences.

2. To expand the use made of all types of media through providing (1) media facilities and (2) inservice teacher training which encourage the multi-media approach (as opposed to the single-text, teacher-lecture methods), thus building a more flexible approach to learning.

3. To encourage teacher-creation of new uses of media through (a) use of the graphic artist's services, (b) teachers' study of literature or creative uses

of media and visits to other schools, and (c) local inservice workshops.

4. To teach students the skills necessary to keep pace with the rapid advance of knowledge thus insuring the ability to make lifelong use of available media centers and libraries and to become informed citizens.

These objectives provided the foci for this evaluation. It was not possible to consider all of the stated objectives and, in fact, it was necessary to restate the objectives with which this study deals in order to generate testable hypotheses. This was accomplished by interviewing the personnel most closely involved with the project in order to more clearly delineate its goals and purposes.

Given the objectives of such a project the need for an evaluation is apparent. It is necessary in order to determine if the project has accomplished what it has set out to do. But even more than this, it should be able to discover areas of strength and weakness. It is information of the latter type that is needed by those people who must make decisions regarding the program.

This investigation came at a time when federal funding of the project was about to expire. The local school board was faced with the problem of deciding what to do with this project into which $360,000.00 of Title III funds had been invested. It was obvious that local millage could not sustain the program at such a high level of support.

Purpose of the Study

Evaluation is the key element in progress and goal realization. It is the pivot about which any program turns and as such it must yield the information necessary to effect appropriate modifications of direction and scope.

This evaluation focused on academic achievement and attitudes. The purposes were to determine the effect of the K-12 multimedia instructional program on the academic achievement of students in the Sibley Community School District and to measure and describe the attitudes of students and professional staff toward the program.

More specifically, the objectives with regard to academic achievement were:

1. To determine if the rate of achievement growth of students has changed significantly since the implementation of the multimedia program.
2. To determine if the rate of achievement growth is significantly different for classes within each of the grade level categories 1-2, 3-8, and 9-12.
3. To determine if the rate of achievement growth of boys is significantly different from the rate of achievement growth of girls within each of the grade level categories 1-2, 3-8, and 9-12.
4. To determine if the rate of achievement growth during the period of the multimedia program is significantly related to the ability of the student.

With regard to the attitudes of students and professional staff, the objectives were:

1. To determine the present attitudes of students and teachers toward the program.

2. To determine if there are any differences in the attitudes of students categorized according to grade and sex.
3. To determine if there is a relationship between the attitudes of members of the professional staff and any of the variables derived from information about the staff member. These variables included teaching experience, educational background, teaching level, age, teaching specialty, sex, and satisfaction with teaching assignment.

The criterion selected to make comparisons of academic achievement was the rate of achievement growth. This was defined to be the slope of the regression line obtained by regressing achievement test scores over a period of successive years on time. The resulting measure would have dimensions of change in academic achievement per year. Such a criterion has the advantage of being more precise than using the academic achievement scores themselves. The reason is that the variability of scores among students at any given time has been removed and only the variation in difference scores remains. The scores from which rates of growth were computed were scores on standardized achievement tests.

The Sibley Community School District administers batteries of standardized achievement tests annually to all students in Grades 1-12. The Stanford Achievement Test is used in Grades 1-2, the Iowa Tests of Basic Skills in Grades 3-8, and the Iowa Tests of Educational Development in Grades 9-12. In addition a form of the Lorge-Thorndike Intelligence Test is administered each year to all students in Grades 1-12.

Four attitude instruments were constructed by this investigator to measure attitude toward the multimedia approach. Three of the measures were directed at student groups in Grades 1-4, 5-8, and 9-12 respectively. The fourth instrument was prepared for use with the professional staff. Details regarding constructing, factoring, scoring, and analyzing responses is given in the third chapter.

In a post hoc study such as this the alternatives for analysis of the achievement data are a function of how much information was recorded at the time the tests were administered. In this case this included the student's name, grade, year, and scores on each scale of the particular standardized test. For the convenience of discussion each scale on each of the three batteries of achievement tests was numbered (see Table 1).

The following sets of null hypotheses were tested with respect to each scale of the indicated achievement test battery and grade levels.

Set 1

Null hypotheses for testing main effects and interactions of the classification variables used to categorize students in Grades 1-2--the criterion measures were computed from SAT scale scores:

1. There was no significant difference in the rate of achievement growth of students before implementation of the multimedia program when compared with the performance of students after implementation of the multimedia program.
2. There was no significant difference in the rate of achievement growth of students classified by class within the pre-

Table 1. Achievement test scales and corresponding scale number code

Grade level	Achievement test	Scale	Scale number
1-2	Stanford Achievement Test (SAT)	Word Reading	1
		Paragraph Meaning	2
		Vocabulary	3
		Spelling	4
		Word Study Skills	5
		Arithmetic	6
3-8	Iowa Tests of Basic Skills (ITBS)	Vocabulary	1
		Reading	2
		Language Skills	3
		Work-Study	4
		Arithmetic	5
		Composite	6
9-12	Iowa Test of Educational Development (ITED)	Background Soc. Stud.	1
		Background Nat. Sci.	2
		Corr. of Expression	3
		Quantitative Thinking	4
		Reading Soc. Stud.	5
		Reading Nat. Sci.	6
		Reading Lit.	7
		General Vocabulary	8
		Composite 1-8	9
		Use of Sources	10

and post-implementation groups.

3. There was no significant difference in the rate of achievement growth of students due to sex of students.

4. There was no significant difference in the rate of achievement growth of students due to the interaction of the pre-post classification variable and sex of students.

5. There was no significant difference in the rate of achievement growth of students due to the interaction of the classes-within-pre-post classification variable and sex of students.

6. There was no significant relationship between the rate of achievement growth of students and the ability of students as measured by the Lorge-Thorndike Intelligence Test.

Set 2

Null hypotheses for testing main effects and interactions of the classification variables used to categorize students in Grades 3-8--the criterion measures were computed from ITBS scale scores:

1. There was no significant difference in the rate of achievement growth of students before implementation of the multimedia program when compared with the performance of the same students after implementation of the program.
2. There was no significant difference in the rate of achievement growth of students due to differences among classes.
3. There was no significant difference in the rate of achievement growth of students due to sex of the students.
4. There was no significant difference in the rate of achievement growth of students due to the interaction of the pre-post classification variable and classes.
5. There was no significant difference in the rate of achievement growth of students due to the interaction of the pre-post classification variable and sex of the students.
6. There was no significant difference in the rate of achievement growth of students due to the interaction of the class and sex variables.
7. There was no significant difference in the rate of achievement

growth of students due to the interaction of the pre-post classification, class, and sex variables.

8. There was no significant relationship between the rate of achievement growth of students and the ability of students as measured by the Lorge-Thorndike Intelligence Test.

Set 3

Null hypotheses for testing main effects and interactions of the classification variables used to categorize students in Grades 9-12--the criterion measures were computed from ITED scale scores:

1. There was no significant difference in the rate of achievement growth of students before implementation of the multimedia program when compared with the performance of students after implementation of the program.
2. There was no significant difference in the rate of achievement growth of students classified by class within the pre- and post-implementation groups.
3. There was no significant difference in the rate of achievement growth of students due to sex of students.
4. There was no significant difference in the rate of achievement growth of students due to the interaction of the pre-post classification variable and sex of students.
5. There was no significant difference in the rate of achievement growth of students due to the interaction of the classes-within-pre-post variable and sex of students.

6. There was no significant relationship between the rate of achievement growth of students and the ability of students as measured by the Lorge-Thorndike Intelligence Test.

There were no available measures of attitudes of students and teachers prior to the implementation of the program. It was decided to measure present attitudes toward the multimedia program. This procedure was expected to expose both favorable and unfavorable aspects of the program. In addition, an analysis of attitude scores was devised to account for some of their variability. Table 2 provides a description of the instruments that were administered to the four groups of subjects.

Table 2. Description of the five attitude inventories

Group to whom the inventory was administered	Number of items	Response format
Grades 1-4	17	Yes-No
Grades 5-8	40	5-option agree-disagree
Grades 9-12	40	5-option agree-disagree
Professional staff	31	5-option agree-disagree

A factor analysis was planned in order to reduce each instrument to a smaller number of factors. This procedure was expected to provide more interpretable scores and to facilitate the subsequent analysis.

The following sets of null hypotheses were tested with respect to each scale of each instrument.

Set 4

Null hypotheses for testing main effects and interactions of the

classification variables used to categorize students in Grades 1-4--the criterion measure was a scale score obtained from the 17-item inventory administered to this group of students:

1. There will be no significant difference in the attitude scale scores of students due to differences among grades.
2. There will be no significant difference in the attitude scale scores of students due to differences among classes within the grades.
3. There will be no significant difference in the attitude scale scores of students due to sex.
4. There will be no significant difference in the attitude scale scores of students due to the interaction of class and sex.
5. There will be no significant difference in the attitude scale scores of students due to the interaction of classes-within-grades and sex.

Set 5

Null hypotheses for testing main effects and interactions of the classification variables used to categorize students in Grades 5-8--the criterion measure was a scale score obtained from the 40-item inventory administered to this group of students:

1. There will be no significant difference in the attitude scale scores of students due to differences among grades.
2. There will be no significant difference in the attitude scale scores of students due to sex.

3. There will be no significant difference in the attitude scale scores of students due to the interaction of grade and sex.

Set 6

Null hypotheses for testing main effects and interactions of the classification variables used to categorize students in Grades 9-12--the criterion measure was a scale score obtained from the 40-item inventory administered to this group of students:

1. There will be no significant difference in the attitude scale scores of students due to differences among grades.
2. There will be no significant difference in the attitude scale scores of students due to sex.
3. There will be no significant difference in the attitude scale scores of students due to the interaction of grade and sex.

Set 7

Null hypotheses for testing main effects and interactions of the classification variables used to categorize members of the professional staff--the criterion measure was a scale score obtained from the 31-item inventory administered to this group:

1. There will be no significant difference in the attitude scale scores of members of the professional staff due to differences among grade levels taught.
2. There will be no significant difference in the attitude scale scores of members of the professional staff due to sex.

3. There will be no significant difference in the attitude scale scores of members of the professional staff due to the interaction of grade level and sex.

The particular classification scheme used in connection with each of the last four sets of hypotheses and the method of factor analysis employed to delineate the scales will be discussed in detail in the third chapter.

All of the sets of hypotheses are contingent upon the assumption that all sources of variation other than those represented in the hypotheses are less plausible in accounting for the systematic variation of criterion scores than are the classification variables defined within each set of hypotheses.

Delimitations

This study has been limited to students and professional staff within the Sibley Community School District. In the case of the investigation of academic achievement it has involved students enrolled as long ago as 1965. All attitude measures were administered to those students and members of the professional staff who were enrolled or employed during the 1970-71 school year.

Inferences from the analysis of the data obtained in this study are valid if made to the particular populations within the Sibley Community School District from which that data was procured. Any inferences made to any other populations of students and professional staffs will be subject to considerably more error. It should be emphasized that this is in keeping with the intent of the evaluation which was to provide

decision-makers in the Sibley district with an objective basis for effecting appropriate decisions.

It is entirely appropriate, however, to apply the strategies employed in this study in the conduct of other evaluations.

CHAPTER II. REVIEW OF LITERATURE

Literature relevant to multimedia programming and project evaluation is cited in this chapter. The most logical partitioning of the information obtained from a review of the literature is: (1) a review of literature pertaining to the rationale and techniques underlying the multimedia approach to instruction and (2) a review of literature related to program and/or curriculum evaluation including the role of evaluation in the systems approach to instruction.

Review of the Rationale Underlying the Multimedia Approach to Instruction

The advent of the implementation of multimedia programs was the development of theories of learning which some practitioners believed were manifested in multiple mode (multimedia) instruction.

Contemporary learning theories lie generally within two broad categories: S-R associationist theory and Gestalt-field theory. Bigge (2, p. 64) distinguishes the philosophical thinking underlying each of them.

> "Since any psychological system rests upon a particular conception of human nature, psychology is deeply involved with philosophy from the very start. The issue among contemporary psychologists is whether man is an active creature of instincts (as exemplified in Freudian or neo-Freudian psychology), an essentially passive creature in a determining environment (as implied in S-R associationism), or a purposive person interacting with a psychological environment (as implied in Gestalt-field psychology). Each of the two latter positions harmonizes with an allied philosophical outlook: S-R associationism with philosophic realism or positivism, and Gestalt-field theory with a systematic relativism, also called pragmatism, experimentalism, or instrumentalism."

The two philosophic camps imply different roles for instruction because they view the learner differently. The S-R associationist, in manifesting the realistic viewpoint of the world as that which is experienced or observed through the senses, advocates a mechanistic theory of learning. He sees the learner as a passive receptor of stimuli and contends that learning starts with irreducible elements and the process of learning consists of combinations of these. Bigge (2, p. 34) states,

> "The thinking underlying modern associationism goes back to Aristotle, who observed that recollection of an item of knowledge was facilitated by a person's associating that item or idea with another when he learned it."

John Locke, a seventeenth century advocate of a form of realism called sense empiricism, is sometimes credited with establishing the basis for associationism. Locke's position was that ideas come to a person only through his senses. The role of a teacher within this philosophy was to develop a systematic instructional program designed to form proper habits in students.

Contemporary extensions of this philosophy have been realized in the neo-behavioristic learning theories of the likes of B. F. Skinner (24). The best known implementation of this general theory has been in the form of Skinner's "teaching machines" (25).

The relativistic philosophy upon which the Gestalt-field theory is based defines psychological reality as that which we make of what comes to us. The resultant learning theory casts the learner in the role of an active participant in the learning process. The learner is viewed as possessing the capacity for processing incoming information. Perception

of input is therefore influenced by the purposes and experiences of the learner and is very much an individual matter. It also infers that the procedures used to perceive an object will affect what the observer "sees".

A very important difference between associationist and Gestalt-field theories exists in the role given to motivation in the learning process. A desire to learn is not an essential ingredient of the behavioristic theory; the learner must only be persuaded to study in order that the opportunity exists for conditioning to take place. In the frame of the field theorist, learning takes place when a person interacts with the learning situation. The motivation required in this case must be a desire to learn. In the context of this study the Gestalt-field theory is very important because attitudes are weighted very heavily in evaluating the product of the multimedia program.

James (18), an early proponent of the psychology surrounding field theory, was also influential in establishing its philosophic base. He is generally credited with popularizing pragmatism, the philosophy that an event can only be judged in terms of its practical consequences.

Variations of the basic tenets of the Gestalt-field theorists have emerged in the last two decades. Probably the most influential of this new breed have been the cognitive-field theorists who have developed what has become known popularly as the psychology of learning. Bigge (2, p. 177) describes it this way:

> "A cognitive-field theory of learning often is called merely field theory. However, since it describes how a person gains understanding of himself and his world in a situation where his self and his environment compose a totality of mutually interdependent, coexisting events, cognitive-field is more truly descriptive of the learning process. Within cognitive-field theory, learning, briefly defined, is a relativistic process by which a learner develops new insights or changes old ones. In no sense is learning a mechanistic, atomistic process of connecting stimuli and responses within a biological organism."

Bruner (4) has been a leading advocate of the importance of insight in the learning process. Intellectual growth is characterized by a hierarchical chain of successively more sophisticated modes of representation of information and an increasing capacity to deal with several alternatives simultaneously. Based on this point of view is his theory of instruction which is principally concerned with how to arrange environments to optimize learning.

Ausubel (1) can also be categorized generically as a cognitive-field theorist. His theory stresses the importance of what he calls an "advance organizer". He specifies the role of the organizer when he states (1, p. 148),

> "The principal strategy advocated in this book for deliberately manipulating cognitive structure so as to enhance proactive facilitation or to minimize proactive inhibition involves the use of appropriately relevant and inclusive introductory materials (organizers) that are maximally clear and stable. These organizers are introduced in advance of the learning material itself and are also presented at a higher level of abstraction, generality, and inclusiveness; ...

He further comments in describing the role of organizer,

> ...the principal function of the organizer is to bridge the gap between what the learner already knows and what he needs to know before he can successfully learn the task at hand."

Whereas Ausubel's theory of learning is in contrast with that of the behaviorists there is some sharing of ideas with regard to the means for accomplishing the ends. Skinner introduced teaching machines as a tool for accomplishing what he called operant conditioning, the learning process whereby a response is made more frequent by reinforcing that response. The rationale for utilizing teaching machines to accomplish that goal is best expressed when Skinner states (25, p. 9),

> "We might say that the human organism is reinforced by any simple gain in competence. When we guarantee a consistent gain by breaking the material to be learned into small steps, we raise the frequency of reinforcement to a maximum and reduce aversive consequences to a minimum. Although these requirements are not excessive, they are probably incompatible with the current realities of the classroom and suggest a need for instrumentation."

The role of the school in this setting is delineated in the following excerpt (25, p. 13):

> "...One of the great sources of inefficiency in modern education is due to our effort to teach a group of students at the same rate. We recognize that this is unfair to the student who is able to move faster, but we have no idea how much damage may be suffered by those who move slowly. There is no evidence that a slow student is necessarily unintelligent, but in our system he quickly falls behind and becomes less and less able to move at the speed adopted by the teacher. With properly designed machines and programs, a slow student free to move at his own normal rate of work may rise to undreamed-of levels of competence."

Teaching machines envisioned by Ausubel are regarded in a different context. Ausubel's position in this regard is depicted when he states (1, p. 158),

> "In sequential school learning, knowledge of earlier-appearing material in the sequence plays much the same role as an organizer in relation to later-appearing material in the sequence. It constitutes a relevant ideational foundation, and hence a crucial limiting condition, for learning the latter

> material when the influence of both verbal ability and general background is held constant. For maximally effective learning, however, a separate organizer should be provided for each unit of material. Thus, sequential organization of subject matter can be very effective, since each new increment of knowledge serves as an anchoring post for subsequent learning. This presupposes, of course, that the antecedent step is always thoroughly consolidated. Perhaps the chief pedogogic advantage of the teaching machine lies in its ability to control this crucial variable in sequential learning."

It is apparent that, although the behaviorist and cognitive-field theorist do not agree in theory, there is considerable agreement that instrumentation can be used to enhance the learning environment. It remains for the researcher to ascertain which, if either, of the two contemporary theories of learning is to be given the greatest credence.

Implementation of the learning theories has been the impetus for development of a new technology in education. This in turn has provided the thrust for new management systems to evolve. The educator is now charged with the responsibility of managing the learning environment. Gagne (11, p. 324), in defining the role of the teacher within the system, says it well,

> "In most conceptions of the educational system, the teacher is the manager of the conditions of learning. What he says to the student comprises the verbal communications and also the verbal stimulus content of the learning situation. What he points to or has the student look at in the surrounding environment becomes a part of the stimulus situation for learning. This managing function of the teacher does not change when the system is made more complex by incorporating certain technological improvements. Providing the student with verbal content by means of books speeds up the whole process of learning, once the skill of reading has been acquired. Using pictures, filmstrips, or motion pictures makes possible the representation of a great variety of objects and events that cannot be directly seen from one

> geographical spot. Records and tape recordings can provide auditory stimulation of languages, music, and other sounds beyond the capabilities of a single teacher. In more complex educational systems, then, the teacher may be aided by a number of gadgets, and also by a number of other people. But the essential function remains one of managing the conditions of learning."

A complex and diverse instructional technology has resulted from efforts to control the learning environment of the student. Heinich (16, p. 222) clarifies the role of instructional technology in instruction when he states, "...instructional technology refers to a systems approach to the entire instructional process."

Educators now speak of "learning packages," "multimedia approach," and "computer-assisted-instruction" as freely as they discussed "modern math" and "discovery learning" a decade ago.

It is also true and indeed unfortunate that considerable jargon has made its way into the language of contemporary education. Consider, for example, the expression "behavioral objectives" (13). Synonomous with it are "instructional objective" (20), "educational objective" (9), and "behavioral goal" (22). All four have been used by different authors to mean the same thing. In any case it refers to a measurable student response and the conditions under which that response is to be obtained. In the management systems model delineation of behavioral objectives is usually one of the early phases.

Management systems is a label borrowed from business and industry to denote the chain of integrated activities connecting the initial statement of objectives with evaluation of the final outcome of an endeavor. The usual model includes feedback mechanisms at preselected stages so as to provide the decision-maker with dynamic input. Such

models in business and industry have become quite sophisticated and have been enhanced by modern mathematical and computer techniques (7). The merits of this approach to decision-making rests with the fact that the information upon which decisions are based is relatively objective. It assumes that the necessary information is accessible and measurable.

Applications of the systems approach to education are becoming more numerous, particularly where instructional media plays a key role. The transition from business and industry has not been accomplished without some problems, however. These problems relate to both the scope of the role assigned to the model and to problems associated with particular steps within the model. It is agreed by practitioners in the field of media that the primary goal of the systems approach is to provide appropriate information for decision-making. It is not at all clear how theory and research should be incorporated, however. Hoban (17, p. 240) points out the gaps that exist between theories in educational media and research in educational media and between theories and research in educational media, on the one hand, and the application of both, on the other hand. His recommendations for improvement are implicit when he states, (17, p. 244),

> "...relevant theories, theory-oriented research on technology of education involved in theory, research, and application will not come to fruition without (a) changes in our ways of thinking about these problems, (b) the development of some mechanisms that will bridge existing gaps, and (c) a more comprehensive concept of the function of research on educational media. Throughout this entire article, there is an underlying bias directing educational research toward educational operations. ...educational research must have a primary use orientation.

Hoban delineates two basic research designs borrowed from the studies of effects of the mass media. The first is a field design after the fact and the second is the experimental design in which hypothesized variables are subjected to systematic control. Commenting on the two types of research he states (17, p. 248),

> "...in field studies...insights into social dynamics develop out of the analysis of the observed behavior in its broad and complex social context; whereas, in experimental research, the insights are essentially a priori requirement of hypothesis formation.
>
> The narrowness of problems investigated by the experimental method, and the likelihood of hypothesis blindness--which diverts attention from the alert observation of a range of behavior to the formalistic analysis of quantified data related only to hypotheses--are sources of criticism of both the experimental method and of the neglect of the field study and other research methodologies."

Practitioners in the use of educational media are the beneficiaries of the redirected emphasis on broader investigative methodologies.

Relatively more reports involving such variations in research methodology have been written in the last two to three years and proportionately more can be expected in the coming years. Impetus for this prolificacy has come, at least in part, from the requirement of federal funding agencies--notably the Office of Education within the Department of Health, Education, and Welfare--that an evaluation be incorporated within the planning of funded projects.

Review of the Role and Strategies of Evaluation in the Management Systems Model

It is the evaluation more than any other feature of the systems approach to instruction that distinguishes the management systems model from older, traditional models for initiating and implementing changes

in education. In fact, the expression "evaluation model" is often used synonymously with management systems model.

It has previously been stated that the evaluation provides the information necessary for the decision-maker to effect appropriate decisions. This is a rather broad statement of purpose. Stake (26, p. 5) provides a less ambiguous statement of purpose when he states,

> "The purpose of educational evaluation is expository: to acquaint the audience with the working of certain educators and their learners. It differs from educational research in its orientation to a specific program rather than to variables common to many programs. It tells what happened. It reveals perceptions and judgments that different groups and individuals hold--..."

Scriven (23) further distinguishes between the roles of evaluation and the goals of evaluation. The expressions "formative evaluation" and "summative evaluation" were coined to distinguish between two roles of evaluation. In general, formative evaluation activities are nonthreatening and potentially influential in modifying the enterprise that is being evaluated whereas summative evaluation refers to activities conducted at the conclusion of a project for the purpose of accounting for that project. The two types certainly are not usually mutually exclusive, however. It would seem that, unless a project was terminated and all of its functions ceased to exist, there must always be ingredients of a formative evaluation within any summative evaluation.

Cronbach (8, p. 675) is less emphatic about the need for summative evaluation when he states,

> "Evaluation, used to improve the course while it is still fluid, contributes more to improvement of education than evaluation used to appraise a product already placed on the market."

An extensive effort to provide a comprehensive model of educational evaluation for decision-making has been developed by the PDK National Study Committee on Evaluation (27). This model identifies four types of evaluation: context, input, process, and product evaluations. Process and product evaluations closely correspond with Scriven's formative and summative evaluations respectively. Context evaluation is intended to serve planning decisions to determine objectives. Input evaluation serves formulating decisions to determine project designs. Both context and input evaluations are pre-implementation procedures. The administering of context and input evaluations infers the participation of an evaluator in the planning and design stages of a project.

The advantage of utilizing an evaluator in the pre-implementation stages of a project rests with the ability of the evaluator to delineate measurable objectives. Whereas most educators now agree that clearly stated behavioral objectives are essential ingredients of any educational evaluation there are differences of opinion regarding the extent to which an evaluation should adhere strictly to the stated objectives. Hansen (15) subscribes to the policy of strict adherence to the stated objectives. Scriven (23) warns against such unbending dogmatism. He notes that objectives are necessarily subjective to begin with and, as such, are subject to the scrutiny of the evaluator. Grobman (12) reinforces Scriven's position by pointing out that a project cannot

anticipate all positive and negative outcomes. Cronbach (8, p. 680) represents a similar position when he states,

> "...An ideal evaluation would include measures of all the types of proficiency that might reasonably be desired in the area in question, not just the selected outcomes to which this curriculum directs substantial attention. If you wish only to know how well the curriculum is achieving its objectives, you fit the test to the curriculum; but if you wish to know how well the curriculum is serving the national interest, you measure all outcomes that might be worth striving for."

A situation of considerable consternation to an evaluator is the post hoc evaluation; that is, an evaluation to be made after the fact. Although by no means hopeless, a request to conduct an evaluation when the project has been completed or is nearing completion tends to degrade the management system and fails to utilize the full potential of the evaluator. Theimer (29) proposed a model for post hoc evaluation and cites an example of its use in the case of the development of a program for a new school in Philadelphia. Compounding the problems facing the evaluator in this instance was the fact that there were no clearly stated objectives for the program. This latter problem was surmounted by conducting a series of interviews with the personnel most directly involved with planning the program in an effort to obtain a consensus of opinion regarding how these people perceived the objectives of the program. In addition, written documents directly related to the program were examined to further clarify perceptions of the objectives. In response to the argument that such research has been "watered down" Theimer asks the question, "Is it better to make decisions based on some information or no information?"

Hammond (14) has studied in depth the problem of evaluation of innovations at the local level and proposes a three dimensional structure for evaluation. The dimensions he suggests are behavior, instruction, and institution. Each dimension is further subdivided: behavior into cognitive, affective, and psychomotor domains; instruction into cost, facilities, method, content, and organization; and institution into student, teacher, administrator, educational specialist, family, and community.

This problem at the state level has also been attacked by the PDK National Study Committee on Evaluation (27, p. 280) in relation to Title III projects. Within this discussion, four evaluator roles were outlined,

1. The evaluator is an information system specialist.
2. The evaluator as a field specialist.
3. The evaluator as an instrument specialist.
4. The evaluator as an interactor.

Among the mechanisms recommended for performance of the roles was the use of "a team of evaluators supported by a state education department to work with local school districts."

Once the role of the evaluator has been clarified it becomes the task of the evaluator to select or devise an appropriate research design and methodology. An evaluation usually cannot meet the specifications of an experimental design and so it becomes necessary to formulate what Wick and Beggs (30) prefer to call an "evaluation design." In this context an evaluation design is not a standard design but is a function of the particular situation in which the evaluation is to be conducted.

Although it is generally agreed that an experimental design is desirable there are some who contend that certain attributes of an experimental design may be justifiably ignored and in some cases intentionally avoided. A case in point is the use of control groups for comparison. Cronbach (8) warns against the risk of tests which may be designed for the experimental curriculum and, therefore, not a valid instrument to be administered to any control group. He advocates, rather, a study to determine the performance of a clearly specified group with respect to important objectives and side effects. Scriven (23) disagrees with Cronbach's position on the nonuse of a control group and argues that the use or nonuse of a control group is a function of each situation. He does agree, however, that a control group study is inadequate as a total approach to the whole of curriculum research.

Wick and Beggs (30) advance the argument against the use of control groups that the control group does not receive direct benefit from the experiment. In addition, the purpose for which it was being used may be invalidated anyway by indirect exposure to the experimental conditions.

There are designs which can survive the arguments against the use of control groups. Grobman (12) suggests that the pre-entry status of a group might be used as a control against the performance of that same group following the change in curriculum. She warns, however, that the two groups must be checked carefully to ascertain that they are in fact the same; normal attrition and additions within any particular group can result in an entirely different group over a period of time. Campbell and Stanley (6) have noted that, even if the group is kept intact, the mere passing of time can be a source of invalidity, that is, uncontrolled

events during this time interval may have an effect of unknown magnitude on the criterion measures.

The plausibility of causal inferences from nonexperimental designs has also been subject to discussion. Blalock (3, p. 3) states that, "...causality can never be proved beyond all doubt no matter what the nature of one's empirical evidence." He points out that, whenever certain information is not given to the experimenter or is not available, certain simplifying assumptions are necessary. Some assumptions will be less plausible than others and will cause the experimenter to run the risk of more error in making causal inference. Despite the risk Blalock (3, p.13) states, "The fact that causal inferences are made with considerable risk of error does not, of course, mean that they should not be made at all."

Campbell (5, p. 213), in advancing a position similar to that of Blalock states, "When we have an evidence of change and wish to interpret it causally, the only relevant threats to that interpretation are other plausible, probable, causal explanations." Field observations are held subject to this same tenet for making causal inferences.

It is interesting to note, as Nagel (21) remarks, that a certain lack of esteem for nonexperimental designs has existed in some quarters in the past but that astronomy and astrophysics, which are nonexperimental sciences, have enjoyed a status comparable with the experimental sciences.

The use of statistical tests to test for differences in nonexperimental designs is generally warranted provided the simplifying assumptions underlying the tests are made clear. Campbell and Stanley (6) suggest a number of "quasi-experimental" designs and appropriate tests of

significance to use with each one. The PDK National Study Committee on Evaluation (27) notes that many statistical techniques are robust with regard to assumptions and encourages their use in evaluation studies. This same group does suggest that nonparametric tests may be more appropriate in situations where assumptions are unreasonable. Wick and Beggs (30) are quick to point out that whether or not differences are meaningful to the practicing researcher in the field should be more important than whether the differences are statistically significant.

Summary

The review of literature has focused on two general topics: (1) the rationale underlying the use of media and the role of media in the instructional process, and (2) evaluation models and techniques.

With regard to the first topic it was noted that the use of media is supported by two different learning theories but for different reasons. The neo-behaviorist or associationist envisions media as an agent for conditioning the learner whereas the cognitive-field theorist expects to utilize a variety of media to accommodate the idiographic learning style of each individual student.

Incorporation of media into the instructional process has given rise to management systems in education. The systems approach is intended to provide a framework within which media can function as part of the overall learning environment. Most management systems models specify behavioral objectives initially and proceed to devise strategies for achieving those objectives within intermediate phases of the model.

Within this model evaluation is given the key role of providing the systems manager with information for deciding between alternate courses of action for implementing the strategies determined by the model.

Evaluation designs are usually not classified as experimental designs. However, it is still considered appropriate to make causal inferences from information obtained through application of nonexperimental designs. It is true that simplifying assumptions must be made in such cases, but as Blalock states (3, p. 21),

> "In practice, even the most carefully designed experiment falls short of the ideal. But departures from the ideal are matters of degree, and therefore so is the plausibility of any simplifying assumptions that must be made."

CHAPTER III. METHOD OF PROCEDURE

Preview and Techniques

The purpose of this study was to determine the effect of a multimedia program on the academic achievement and attitudes of elementary and secondary students in the Sibley (Iowa) Community School District. The scope of the investigation was limited to students and teachers in the Sibley schools.

The structure of the evaluation was two dimensional. It was essentially a modification and reduction of the model proposed by Hammond (14) for evaluation at the local level. The reduced model utilized in this study contained dimensions of "entity" and "behavior." Each dimension was subdivided--the "entity" dimension into student and professional staff divisions and the "behavior" dimension into cognitive and affective domains. This created a model containing four cells (Figure 1), three of which were relevant to this evaluation. The professional staff-cognitive domain cell was not directly focused upon in this study. The three dimensions of "institution," "instruction," and "behavior" in the Hammond model were reduced to the two dimensions of "entity" and "behavior." The instruction dimension was collapsed entirely and the institution dimension became the entity dimension of the new model. In addition, the divisions along the entity axis were condensed to two from the original six--the remaining divisions were those of student and professional staff. Furthermore, this study was concerned with only two of the three divisions of the behavior dimension--they

were the cognitive domain and the affective domain. The psychomotor division of the behavior dimension was deleted entirely. The resultant model was as depicted by Figure 1.

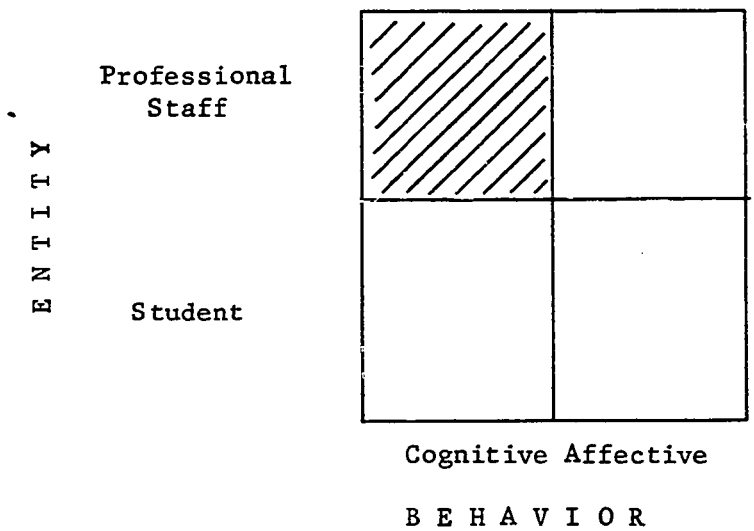


Figure 1. Reduced model for evaluation

This study in no way purports to be a complete evaluation of the multimedia program. It investigates only the limited aspects of the program represented by Figure 2. Whereas the total evaluation did incorporate inspections of the media services by experts in the field, their reports are not included in this account of the study.

In order to clarify the objectives of the program and to provide a viable basis for the evaluation, the project director and school administrators were interviewed. The consensus of this group and the evaluators was to utilize the scores of students on standardized achievement tests as the basis for determining the effect of the multimedia approach on academic achievement. The rationale underlying this

decision was that the particular sets of standardized tests administered in the Sibley schools were chosen because they conformed to the objectives of the Sibley Community School District with regard to academic achievement. It should, therefore, be possible to determine the degree to which academic achievement objectives have been attained by analyzing the standardized test scores.

There had been no attitude measures administered to students prior to the implementation of the multimedia program so no comparison with attitudes at that time was possible. The interview with the administrators and project director revealed that an agreeable course of action would be to measure present attitudes of students and professional staff and then to make comparisons of the attitudes of well-defined groups of students and staff members.

Academic Achievement

Overview

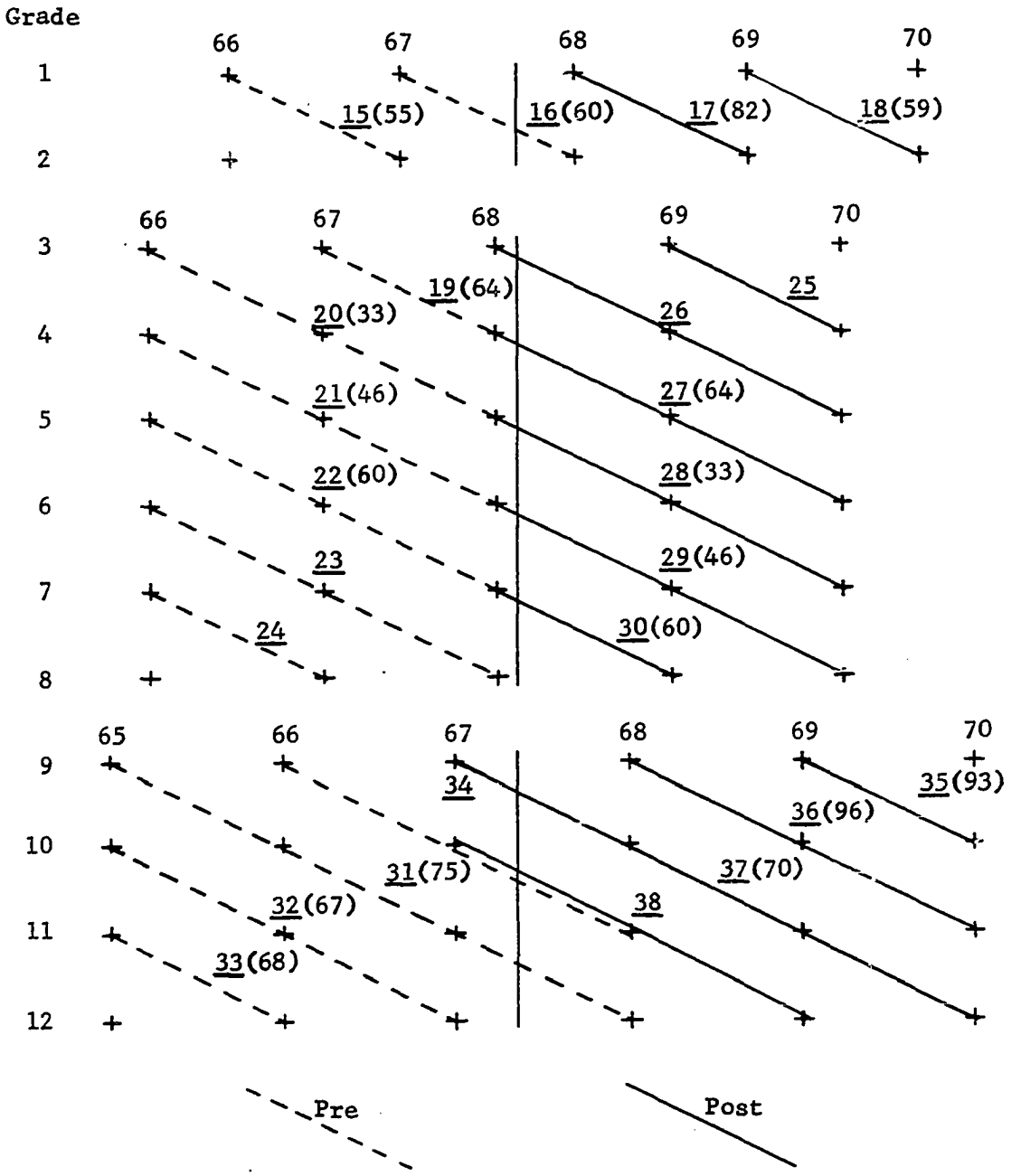
The evaluation of academic achievement fell logically into three parts according to natural groupings formed by the administration of the three different sets of achievement tests. Table 1 in the first chapter depicted the partitioning by grade level and standardized test.

The scores of 928 students over a period of six years were used in this study. The breakdown by grades was: Grades 1-2 (N=256), Grades 3-8 (N=203), and Grades 9-12 (N=469). The disproportionality between number of grades and number of students in those grades was a function of the particular design chosen to analyze the data obtained from each group. A separate design was formulated to accommodate the characteristics

of the data that were unique to each of the three groups.

The criterion chosen to represent the achievement of each student was the rate of academic growth. This quantity was defined to be the gradient of the linear function of time which, according to the least-squares criterion, afforded the best fit to a student's achievement scores over a period of successive years. This procedure condensed a set of sequential achievement test scores for an individual into a single parameter which described that individual's rate of academic growth over the period of time covered by the test scores. This parameter was computed for each student on each scale of the particular achievement test battery appropriate to the student's grade level. Separate rates of academic growth during the pre-multimedia and post-multimedia time periods were computed for those students enrolled during both periods.

Subjects were partitioned into a pre-multimedia group and a post-multimedia group. The point in time separating the two groups was February 1, 1968, the date on which the multimedia program was initiated. Some modifications of this very simple partitioning criterion were necessary to accommodate the different dates of test administration for the three standardized test batteries. Figure 2 illustrates the partitioning scheme that was finally adopted. This configuration reflects a nearly symmetrical distribution of classes on either side of the time at which the program was initiated. Some overlapping across this axis of symmetry was unavoidable. The dotted diagonal lines in Figure 2 connect testing events during the two to three year period prior to the implementation of the multimedia program. The rates of academic growth computed from achievement test scores obtained at those times



[a] + Testing event.

Figure 2. Scheme used to partition students by grade level and class

comprise the set of pre-multimedia criterion scores. Similarly, the solid diagonal lines connect testing events following implementation of the multimedia program and the set of criterion scores computed from those achievement test scores are classified as post-multimedia. Adjacent to each diagonal line and near its mid-point are two numbers, a class number and the number of students in that class. The class numbers were arbitrarily assigned to all classes for which data was available and ranged from 15-38. A class, in the context of this discussion, is an intact group of students for which a complete set of achievement test scores was available. The choice of class numbers was made on the basis of convenience, having originally been assigned because of computer restrictions regarding the numbering of data sets. Since a set of class data was assigned a computer input data set number and because the computer output referenced that class by the same number, it was convenient to continue to refer to the class by the same number in all of the subsequent analyses. All class numbers have been underlined in Figure 2. The number in parentheses immediately following the class number is the number of students in the class. The latter figure is included only for those classes that were eventually included in the sample for analysis.

The rate of academic growth was computed only for those students having a complete set of scores, i.e. a score on each scale of the test battery for each year within the pre- or post-multimedia time periods. For students in Grades 3-8 the completeness criterion was also invoked across the line demarcating pre- and post-multimedia instruction.

Grades 1-2

The Stanford Achievement Test Primary I and Primary II batteries were administered annually in May to first and second graders. The two batteries are not composed of the same set of scales. The Primary II scales corresponding to each of the six Primary I scales were determined by computing the interscale correlations (see Table 3). The resulting correspondence is illustrated in Table 4. The choice of the seemingly unlikely correspondence of the Science and Social Studies Concepts scale of the Primary II battery with the Vocabulary scale of the Primary I battery was made on the basis that each of the two scales correlated highest with the other when all inter-battery correlations involving either of the scales were compared. This correspondence is more reasonable when the nature of the two scales is considered. Each scale is a dictated test measuring understanding of definitions; the Primary I scale being more general than the Primary II scale.

Analysis of variance was used to analyze the criterion scores obtained from the two test batteries. The criterion scores were partitioned into eight groups according to class and sex. The resulting groups are described in Table 5. The model describing criterion scores as a function of the potential sources of variability was:

$$Y_{ijkl} = \mu + \alpha_i + \beta_{j(i)} + \gamma_k + \alpha\gamma_{ik} + \beta\gamma_{kj(i)} + e_{l(ijk)} \quad \text{(Model 1)}$$

where

Y_{ijkl} = criterion score (rate of academic growth)

Table 3. Intercorrelations of scales on SAT Primary I and Primary II batteries; correlations of corresponding scales on the two batteries underlined

		(WR)I	(PM)I	(V)I	(S)I	(WSS)I
Word reading	(WR)I		.73	.39	.65	.64
Paragraph meaning	(PM)I			.34	.60	.73
Vocabulary	(V)I				.30	.39
Spelling	(S)I					.58
Word study skills	(WSS)I					
Arithmetic	(A)I					
Word meaning	(WM)II					
Paragraph meaning	(PM)II					
Science & social studies concepts	(SSS)II					
Spelling	(S)II					
Word study skills	(WSS)II					
Language	(L)II					
Arithmetic computation	(ACp)II					
Arithmetic concepts	(ACn)II					

(A)I	(WM)II	(PM)II	(SSS)II	(S)II	(WSS)II	(L)II	(ACp)II	(ACn)II
.43	.66	.67	.28	.68	.61	.60	.41	.54
.48	.65	.70	.35	.64	.64	.66	.47	.55
.45	.44	.42	.56	.22	.40	.38	.32	.49
.46	.50	.51	.20	.68	.59	.55	.48	.44
.59	.61	.67	.33	.62	.69	.60	.47	.58
	.46	.50	.42	.39	.53	.49	.56	.76
		.81	.40	.62	.63	.60	.40	.61
			.45	.62	.66	.65	.50	.65
				.16	.37	.38	.36	.52
					.62	.67	.54	.51
						.66	.55	.62
							.55	.67
								.61

Table 4. Scales of SAT Primary I and Primary II batteries; correlations of corresponding scales listed on the solid lines connecting the scales

Primary I		Primary II
Word reading	.66	Word meaning
Paragraph meaning	.70	Paragraph meaning
Vocabulary	.56	Science & social studies concepts
Spelling	.68	Spelling
Word study skills	.69	Word study skills
Arithmetic		Language
	.76	Arithmetic computation
		Arithmetic concepts

Table 5. Distribution of subjects in Grades 1-2

	Class			
	Pre-multimedia		Post-multimedia	
	15	16	17	18
Boys	24	25	43	18
Girls	31	35	39	28

μ = overall grand mean

α_i = effect of the i^{th} treatment group

i = 1 for pre-multimedia

i = 2 for post-multimedia

$\beta_{j(i)}$ = effect of the j^{th} class within the i^{th} treatment group

j(i) = 1(1) for Class 15

j(i) = 2(1) for Class 16

j(i) = 3(2) for Class 17

j(i) = 4(2) for Class 18

γ = effect of the k^{th} sex

k = 1 for boys

k = 2 for girls

$\alpha\gamma_{ik}$ = interaction of the i^{th} treatment group with the k^{th} sex

$\beta\gamma_{kj(i)}$ = interaction of the k^{th} sex with the j^{th} class within the i^{th} treatment group.

$e_{l(ijk)}$ = random error associated with the criterion score of the l^{th} subject within the ijk^{th} classification cell.

All effects of this model are considered fixed except for the error which is random. The analysis of variance computed from this model is equivalent to one in which the treatment and classes within treatment factors were considered as a single factor, namely classes. Therefore, inferences drawn from the analysis with regard to differences between the means of the two treatment groups are based upon a comparison of the means of Classes 15 and 16 and Classes 17 and 18, each pair of classes being considered collectively. Tests of significance of all of the hypothesized sources of systematic variation were made by computing the ratio of the

mean square associated with the variable of interest to the error mean square. This ratio was assumed to have an F-distribution with degrees of freedom equal to the degrees of freedom of the numerator and the denominator respectively.

Grades 3-8

The most valid evaluation design of the entire study was applied to an analysis of the performance of students in third through eighth grades. Maturation and intervening history constitute the most critical factors for potentially jeopardizing the validity of the design utilized with this group.

Scores on each of the six major scales of the Iowa Tests of Basic Skills were used to compute a rate of academic growth for each student. The ITBS battery was administered annually in January. Figure 2 depicts the manner in which scores were partitioned into pre- and post-multimedia categories. Only Classes 19, 20, 21, and 22 were considered because only these classes had records of both pre- and post-multimedia performance. Note that Classes 27, 28, 29, and 30 are the same as Classes 19, 20, 21, and 22 respectively.

An additional restriction which further reduced the size of the sample representing these grades was imposed to increase the validity of the design and to allow for the testing of the significance of interaction effects which could not be isolated otherwise. This was the requirement that a complete set of scores (i.e., a score on each of the six scales of the ITBS battery) had been recorded each of the years the student had been in the third through eighth grades during

the period included in this study. This accounts for the relatively small number of students in the sample representing Classes 20 and 21.

Analysis of variance was used to treat the data obtained from the four remaining classes. The criterion scores were partitioned into sixteen cells according to treatment, class, and sex classifications. Table 6 depicts the distribution of subjects within this classification scheme. The model which describes the criterion scores as a function of the potential sources of variability was:

$$Y_{ijkl} = \mu + \alpha_i + \beta_j + \gamma_k + \alpha\beta_{ij} + \alpha\gamma_{ik} + \beta\gamma_{jk} + \alpha\beta\gamma_{ijk} + e_{l(ijk)} \quad \text{(Model 2)}$$

where

Y_{ijkl} = criterion score (rate of academic growth)

μ = overall grand mean

α_i = effect of the i^{th} treatment group

i = 1 for pre-multimedia

i = 2 for post-multimedia

β_j = effect of the j^{th} class

j = 1 for Class 19

j = 2 for Class 20

j = 3 for Class 21

j = 4 for Class 22

γ_k = effect of the k^{th} sex

k = 1 for boys

k = 2 for girls

Table 6. Distribution of subjects in Grades 3-8; the same group of students participated in both pre- and post-multimedia sessions

	Pre-multimedia				Post-multimedia			
	19	20	21	22	19	20	21	22
Boys	40	17	22	34	40	17	22	34
Girls	24	16	24	26	24	16	24	26

$\alpha\beta_{ij}$ = interaction of the i^{th} treatment group with the j^{th} class

$\alpha\gamma_{ik}$ = interaction of the i^{th} treatment group with the k^{th} sex

$\beta\gamma_{jk}$ = interaction of the j^{th} class with the k^{th} sex

$\alpha\beta\gamma_{ijk}$ = 2nd order interaction of treatment, class and sex

$e_{l(ijk)}$ = random error associated with the criterion score of the l^{th} subject within the ijk^{th} classification cell.

All effects in the model are fixed except for the effect of error which is assumed to be random. The model is in correspondence with a 3-way factorial experiment even though each subject was represented in two cells of the distribution matrix (Table 6). The rationale for this model rather than one involving repeated measures was a function of the nature of the criterion scores. Whereas the scores obtained on an achievement test scale on one occasion may very likely be correlated with scores on the same scale on a second occasion, the rates of growth computed from these scores are not likely to be correlated and are essentially independent. Therefore, it is reasonable to consider pre-post classification as an independent factor in a 3-way factorial design.

Grades 9-12

Six classes, three each in pre- and post-multimedia categories, provided the sample from which the analysis of academic performance in Grades 9-12 was conducted. These classes were Classes 31, 32, and 33 in the pre-multimedia group and Classes 36, 37, and 38 in the post-multimedia group (see Figure 2). These two groups were composed of entirely different students.

The criterion measure, rate of academic growth, was computed for each student on each of the ten scales in the ITED test battery. Criterion scores were partitioned into twelve cells according to class and sex. Classes 31, 32, and 33 constituted the pre-multimedia group and Classes 35, 36, and 37 made up the post-multimedia group. The subjects were distributed as indicated in Table 7.

Table 7. Distribution of subjects in Grades 9-12

	Pre-multimedia			Post-multimedia		
	31	32	33	35	36	37
Boys	35	33	38	46	54	51
Girls	40	34	30	47	42	19

The analysis of variance model selected to describe the criterion scores was:

$$Y_{ijkl} = \mu + \alpha_i + \beta_{j(i)} + \gamma_k + \alpha\beta_{ji} + \alpha\gamma_{ik} + \beta\gamma_{jk} + e_{l(ijk)} \qquad \text{(Model 3)}$$

where

Y_{ijkl} = criterion score (rate of academic growth)

μ = overall grand mean

α_i = effect of the i^{th} treatment group

i = 1 for pre-multimedia

i = 2 for post-multimedia

$\beta_{j(i)}$ = effect of the j^{th} class within the i^{th} treatment group

j(i) = 1(1) for Class 31

j(i) = 2(1) for Class 32

j(i) = 3(1) for Class 33

j(i) = 4(2) for Class 35

j(i) = 5(2) for Class 36

j(i) = 6(2) for Class 37

γ_k = effect of the k^{th} sex

k = 1 for boys

k = 2 for girls

$\alpha\gamma_{ik}$ = interaction of the i^{th} treatment group with the k^{th} sex

$\beta\gamma_{kj(i)}$ = interaction of the k^{th} sex with the j^{th} class within the i^{th} treatment group

$e_{l(ijk)}$ = random error associated with the criterion score of the l^{th} subject within the ijk^{th} classification cell.

The effects of this model are all considered fixed except for the error term which is random. The analysis stemming from this model treated the pre-post difference as a difference between the two sets of classes comprising the pre- and post-multimedia groups.

Method of analysis

The analysis of variance for each of the three sets of data just discussed was computed via a regression routine. Sums of squares attributable to each of the sources of variation in each model were extracted via the backward regression technique. This technique computes a regression sum of squares for the full model and a regression sum of squares for a reduced model containing all of the sources of variation except the variable or variables of interest. The difference between the two sums of squares extracted in this fashion is the sum of squares attributable to the missing variable or variables.

Tests of significance were conducted by computing the ratio of the mean square associated with the variable of interest and the residual mean square resulting from regression on the full model. This ratio was assumed to have an F-distribution with degrees of freedom corresponding to the degrees of freedom associated with the numerator and denominator of the ratio. These tests of significance were equivalent to testing all hypotheses except the last one in each of the first three sets of null hypotheses.

The last hypothesis in each set, the hypothesis of no relationship between criterion and intelligence scores, was tested on the basis of the correlations between the two sets of scores for each scale of each test battery. This is equivalent to testing the hypothesis of no correlation between criterion scores and intelligence scores. In this phase of the evaluation only post-multimedia criterion and intelligence scores were used.

Attitudes

Overview

The focus of this phase of the evaluation was to determine and analyze the attitudes of students and professional staff toward the multimedia approach to instruction. It was not possible to determine change in attitude because pre-program measures of attitudes were non-existent. Some information regarding such changes was inherent in the responses to those items on the attitude opinionnaire which alluded to the subjects' perceptions of changes which have occurred as a result of the multimedia program.

A brief description of the attitude opinionnaires was given in the first chapter. The actual instruments used in the study are listed in Appendix A. The items were constructed for the purposes of ascertaining how students and professional staff felt about the learning environment created as a result of implementation of the multimedia program.

The attitude opinionnaires were administered to students and professional staff on January 14 and 15, 1971 in the Sibley schools. With the exception of the instrument administered to Grades 1-4 all instruments employed a 5-option, agree-disagree, Likert-type response format. Subjects were asked to respond on IBM No. 505 answer sheets. These responses and personal information about the subject were subsequently transcribed into IBM cards for further analysis.

The instrument constructed for Grades 1-4 was administered aurally so as to circumvent the obvious problem of nonreaders. A YES-NO response format was used to further simplify the process of administering

the instrument to lower elementary students. The students were asked to respond in YES or NO boxes on the instrument itself. These responses were later keypunched into IBM cards along with personal information about the student.

Treatment of the attitude data was directed at, first, reducing each of the four sets of items to a smaller number of internally consistent and interpretable factors and, secondly, to analyzing the factor scores for differences in the responses of subgroups of each of the four major groups of subjects.

The factors for each instrument were extracted from the interitem correlation matrix according to the principal components criterion and subsequently rotated via a varimax rotation. The criterion for inclusion of an item in a factor was that the item correlate at least .45 with the rotated factor. This process was expected to reduce each of the inventories to a smaller set of factors.

The Spearman-Brown formula was used to compute the reliability of each scale. This formula utilizes the average interitem correlation in yielding a reliability coefficient which reflects the degree to which the responses to items on a scale are internally consistent.

Responses of a student to the items on a scale were summed to obtain a scale score for that student. In the scoring process the responses to some of the items were first reversed if the lowest response to the item also represented the most favorable response. With this scoring technique the maximum possible scale score reflected the most favorable response to each item on the scale. For the 2-option, YES-NO response format the most favorable response to an item was given a weight

of 2 whereas the alternate response was assigned a weight of 1. Similarly, a weight of 5 was given to the most favorable response to 5-option items while 1 was the weight of the least favorable response.

In order to provide a basis for comparing the average scale scores of subgroups within each of the four larger groups an arbitrary "neutral" average scale score was defined. This neutral scale score average was computed by multiplying the weight of a neutral item response (the midpoint of the response options or the average of the two most extreme options) by the number of items on the scale.

Grades 1-4

A total of 330 students in Grades K-4 responded to the 17-item opinionnaire. Even though all items were read to all students in these five grades the responses of kindergarteners proved to be unusable. It was not possible to communicate the necessary instructions to this particular group. This was due in large part to the failure of this evaluator to foresee such a problem and to prepare an appropriate instrument for this group.

A factor analysis of the remaining opinionnaires yielded a single, 10-item factor which was labeled "attitude toward the environment for working and studying." The reliability of this scale was .58.

A scale score for each student was computed and this set of scale scores was subsequently partitioned according to grade, class, and sex. Analysis of variance was used to treat the partitioned data. The model chosen to represent the criterion scores was:

$$Y_{ijkl} = \mu + \alpha_i + \beta_{j(i)} + \gamma_k + \alpha\gamma_{ik} + \gamma\beta_{kj(i)} + e_{l(ijk)} \quad \text{(Model 4)}$$

where

Y_{ijkl} = attitude scale score of the l^{th} subject in the ijk^{th} cell

μ = overall grand mean

α_i = effect of the i^{th} grade

$\beta_{j(i)}$ = effect of the j^{th} class within the i^{th} grade

γ_k = effect of the k^{th} sex

$\alpha\gamma_{ik}$ = effect due to the interaction of grade and sex

$\beta\gamma_{jk}$ = effect due to the interaction of sex and class

$e_{l(ijk)}$ = random error associated with the l^{th} observation in the ijk^{th} cell

$i = 1, 2, \ldots, 4$

$j = 1, 2, \ldots, 13$

$k = 1, 2$

$l = 1, 2, \ldots, n_{ijk}$.

All effects are considered fixed except for error which is random. Tests of significance of each of the effects were conducted by comparing the mean square associated with each term in the model with the error mean square.

Grades 5-8

Three hundred sixty-one students in Grades 5-8 were administered a 40-item attitude opinionnaire. The factor analysis and rotation produced three scales with reliabilities of .80, .61, and .61. The content items

of each scale were examined and the scales interpreted as representing "attitude toward the multimedia approach as an aid to learning," "attitude toward the multimedia approach as an aid to self-help," and "attitude toward the functioning of the media center."

Once again, analysis of variance was used to treat the scale scores which were partitioned according to grade and sex. The model representing the scale scores was:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + \alpha\beta_{ij} + e_{k(ij)} \qquad \text{(Model 5)}$$

where

Y_{ijk} = scale score

μ = overall grand mean

α_i = effect of the i^{th} grade

β_j = effect of the j^{th} sex

$\alpha\beta_{ij}$ = effect due to the interaction of grade and sex

$e_{k(ij)}$ = random error associated with the k^{th} observation in the ij^{th} cell

$i = 5, 6, \ldots, 8$

$j = 1, 2$

$k = 1, 2, \ldots, n_{ij}$.

All effects in this model are considered fixed except for error which is random. Tests of significance of all sources of systematic variation are based upon F-tests using the F-ratio formed from the mean square associated with the effect of interest and the error mean square.

Grades 9-12

The 40-item opinionnaire that was administered to students in Grades 5-8 was modified slightly and given to 345 students in Grades 9-12. Factor analysis and rotation of factors revealed only two factors with satisfactory internal consistency. They were labeled "attitude toward the environment for studying" and "attitude toward the practical utility of the multimedia approach" and possessed reliabilities of .79 and .82 respectively.

The same model as Model 5 was constructed to account for systematic and random sources of variation of scale scores. In this case the range of the subscript "i" was from 9 to 12.

Professional staff

The 31-item teacher attitude opinionnaire was administered to all 58 members of the professional staff; this included school administrators, teachers, and the project director but did not include any clerical or technical personnel. Two factors, "attitude toward the multimedia approach as an aid to teaching" and "attitude toward the practical utility of the multimedia approach," were delineated as a result of the factor analysis and rotation.

Analysis of variance was again used to treat the data. It was first necessary to build a model for attitude scale scores, however, since it was unclear just what attributes of the professional educator would contribute to the variability of attitude scores. For the purpose of building the model some information about each educator was gathered at the time the attitude opinionnaire was administered. The "Teacher

Information" sheet attached to the opinionnaire (see Appendix A) provided the format for obtaining the necessary data.

The intercorrelations of scale scores and teacher attributes were then computed in an effort to reveal those variables that were most closely related (Table 8). A stepwise regression of the scale scores on the independent variables further reduced the number of relevant independent variables to two, sex and teaching level.

Analysis of variance was again used to treat the data. The scale scores were partitioned according to sex and teaching level and were represented by the model:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + \alpha\beta_{ij} + e_{k(ij)} \qquad \text{(Model 6)}$$

where

Y_{ijk} = scale score

μ = overall grand mean

α_i = effect of the i^{th} teaching level

β_j = effect of the j^{th} sex

$\alpha\beta_{ij}$ = effect due to the interaction of teaching level and sex

$e_{k(ij)}$ = random error associated with the k^{th} observation in the ij^{th} cell

$i = 1, 2, \ldots, 4$

$j = 1, 2$

$k = 1, 2, \ldots, n_{ij}$.

Effects are all considered fixed except for error which is random. The ratios of the mean squares associated with the independent variables

Table 8. Matrix of correlations of teacher attributes and attitude scale scores

		1	2	3	4	5	6	7	8	9	10
SCALE IV-1	(1)	1.000									
SCALE IV-2	(2)	.719	1.000								
Teaching experience	(3)	.077	-.155	1.000							
Sibley teaching experience	(4)	.138	.040	.769	1.000						
Educational background	(5)	-.123	-.094	.215	.217	1.000					
Grade levels taught	(6)	-.266	-.153	-.039	-.080	.255	1.000				
Age	(7)	.110	-.091	.902	.739	.164	-.081	1.000			
Teaching specialty	(8)	.060	.125	.076	.062	.070	-.259	-.007	1.000		
Teacher satisfaction	(9)	.080	.079	-.167	-.275	.245	.142	-.177	.064	1.000	
Sex	(10)	.319	.240	.276	.249	-.318	-.297	.334	-.073	.240	1.000

to the error mean square are the bases for determining the significance of each of the three effects.

Method of analysis

The analysis of variance was the primary analytical tool used to treat all of the attitude scale scores. The backward regression technique described previously was used with each of the four sets of data to compute the appropriate sum of squares for each of the sources of variation within each model.

Tests of the significance of the effects of the hypothesized sources of systematic variation are equivalent to testing the null hypotheses listed in Sets 4-7 in the first chapter. There is a one-to-one correspondence of terms in the models with null hypotheses in the sets.

CHAPTER IV. FINDINGS

Overview

The results of this evaluation have been quite varied. This is not unexpected when the scope of the investigation is considered. It should be reiterated that this has been a program evaluation directed at those aspects of the program that have been in correspondence with the objectives of the program.

The evaluation has concentrated on academic achievement and attitudes, the areas given the highest priority by the administrators of the multi-media program.

The classical technique of analysis of variance was used throughout the study to determine the significance of differences of achievement and attitude scores of well-defined subgroups of the total population of students and professional staff. Statistical techniques only serve to call attention to information contained within the phenomena to which they are applied. It is more important to know whether differences in criterion score means are meaningful than it is to know whether they are significantly different statistically. Reporting of statistically significantly differences is necessary in order to focus the attention of the decision-maker who ultimately decides whether the differences are of any practical value. This study reports differences which yield F-ratios that would occur by chance with a probability of less than .10 as statistically significant differences. The relatively high level of significance was chosen because the F-test was a relatively conservative

test owing to the manner in which sums of squares were computed, that is, by subtracting the sum of squares due to regression on a reduced model from the sum of squares due to regression on the full model. This difference is generally devoid of confounded sums of squares and represents the lowest estimate of sums of squares that can be attributed to the variable of interest. It is reasonable, therefore, to set a relatively high level of significance in order to avoid the risk of missing effects that may be of practical interest but would not be isolated by tests of significance at lesser probabilities.

Generally, the findings of this study are favorable to the multimedia instructional approach. Gains in rate of achievement growth have been noted in Grades 1-8, with the high school students as a group holding steady. Responses to the opinionnaire reflect a positive attitude toward the multimedia program by students and professional staff. There is considerable variability in achievement and attitudes among subgroups of the major groups, however. This will be discussed in more detail in the sections that follow.

Achievement

Grades 1-2

The analyses of variance (Table 9) failed to reveal any differences that could be attributed to the hypothesized sources of variation on the word reading, paragraph meaning, and arithmetic scales of the SAT battery.

Significant differences between the pre-post groups and among the classes within the pre-post groups were noted on the vocabulary scale.

Table 9. Analysis of variance of SAT achievement test scores for classes 15, 16, 17, and 18

Source of variation	df	Sum of squares	Mean square	F
SCALE 1--Word reading				
Full model	7	267.24		
Pre-post	1	49.21	49.21	1.12
Classes/pre-post	2	7.32	3.66	<1
Sex	1	78.97	78.97	1.79
Pre-post X sex	1	45.34	45.34	1.06
Classes/p-p X sex	2	69.37	39.57	<1
Residual[a]	248	10930.76	44.08	
SCALE 2--Paragraph meaning				
Full model	7	236.50		
Pre-post	1	80.76	80.76	2.30
Classes/pre-post	2	7.19	3.60	<1
Sex	1	.23	.23	<1
Pre-post X sex	1	4.22	4.22	<1
Classes/p-p X sex	2	33.55	16.77	<1
Residual[a]	248	8944.18	36.06	
SCALE 3--Vocabulary				
Full model	7	2642.67		
Pre-post	1	863.37	863.37	13.03[b]
Classes/pre-post	2	1190.13	595.06	8.98[b]
Sex	1	12.22	12.22	<1
Pre-post X sex	1	120.05	120.05	1.81
Classes/p-p X sex	2	71.68	35.84	<1
Residual[a]	248	16428.39	66.24	
SCALE 4--Spelling				
Full model	7	647.35		
Pre-post	1	26.58	26.58	<1
Classes/pre-post	2	263.26	131.63	4.11[c]
Sex	1	176.09	176.06	5.49[c]
Pre-post X sex	1	.29	.29	<1
Classes/p-p X sex	2	122.18	61.09	<1
Residual[a]	248	7951.65	32.06	

[a]Residual is from the full model.

[b]$p < .01$.

[c]$p < .05$.

Table 9. (Continued)

Source of variation	df	Sum of squares	Mean square	F
SCALE 5--Word study skills				
Full model	7	929.78		
Pre-post	1	390.00	390.00	3.13[d]
Classes/pre-post	2	346.76	173.38	1.39[d]
Sex	1	424.58	424.58	3.42[d]
Pre-post X sex	1	726.62	726.62	5.85[c]
Classes/p-p X sex	2	637.56	318.78	2.57[d]
Residual[a]	248	30814.08	124.25	
SCALE 6--Arithmetic				
Full model	7	197.94		
Pre-post	1	21.87	21.87	<1
Classes/pre-post	2	25.65	12.83	<1
Sex	1	11.22	11.22	<1
Pre-post X sex	1	2.72	2.72	<1
Classes/p-p X sex	2	57.45	28.73	
Residual[a]	248	9863.81	39.77	

[d] $p < .10$.

The pre-post difference favored the post-multimedia group and the superior performance of Class 18, which far surpassed all other classes, accounted for the differences among classes.

Differences on the Spelling scale were significant for the classes and sex variables. Class 16 displayed superiority over the other three classes and the girls outperformed the boys.

Four sources of variation proved to be significant in accounting for variability of criterion measures on the word study skills scale. These were the main effects due to pre-post and sex differences and the pre-post X sex and classes X sex interactions.

The means explaining the significant main effects and interactions are displayed in Tables 10a-c.

Table 10a. Mean scores on the SAT vocabulary scale for students in Grades 1 and 2 partitioned according to the pre-post and classes within pre-post classifications

Class	Pre		Class	Post	
	N	$\bar{X}$		N	$\bar{X}$
Class 15	55	.93	Class 17	82	.72
Class 16	60	.89	Class 18	59	1.48
Totals	115	.91	Totals	141	1.04

Table 10b. Mean scores on the SAT spelling scale for students in Grades 1 and 2 partitioned according to sex and classes within pre-post classifications

		Boys		Girls		Subtotals	
		N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$
Pre	Class 15	24	.68	31	.82	55	.76
	Class 16	25	.84	35	1.21	60	1.05
Post	Class 17	43	.93	39	.96	82	.94
	Class 18	31	.73	28	1.08	59	.90
Subtotals		123	.81	133	1.02	256	.92

The null hypotheses in Set 1 are listed in the same order as the sources of variation are listed in Table 9. Acknowledgement of the existence of a significant main effect or interaction is equivalent to rejecting the null hypothesis regarding that effect. The same relative

Table 10c. Mean scores on the SAT word study skills scale for students in Grades 1 and 2 partitioned according to the pre-post, sex and classes within pre-post classifications

		Boys		Girls		Totals	
		N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$
Pre	Class 15	24	1.35	31	1.53		
	Class 16	25	1.58	35	1.12		
Subtotals		49	1.47	66	1.31	115	1.38
Post	Class 17	43	1.52	39	1.42		
	Class 18	31	1.08	28	1.62		
Subtotals		74	1.34	67	1.50	141	1.41
Totals		123	1.39	133	1.41		

ordering of null hypotheses and sources of variation is consistent throughout this chapter and therefore, need not be explained in future sections.

The correlations of post-multimedia rates of growth with intelligence scores were all significantly different ($p < .05$) from zero and positive (see Table 11). The implications of these relationships are that the more intelligent students are displaying a faster rate of academic growth than are the less intelligent students. It should be emphasized that this is not the same as saying that the more intelligent students obtain higher achievement test scores than do students with lesser intelligence. It does say that the greatest rates of growth, regardless of initial achievement status, are experienced by the more intelligent students.

Table 11. Correlations of SAT rates of growth and intelligence scores

	Word reading	Paragraph meaning	Vocabulary	Spelling	Word study skills	Arithmetic
Intelligence	.41[a]	.39[a]	.26[a]	.26[a]	.24[a]	.50[a]

[a]Significantly different from zero at the .01 level.

Grades 3-8

Significant effects were noted in the analyses of variance of five of the six ITBS scales. The only scale on which performance of all subgroups was relatively stable was the reading scale. The analyses of variance of criterion scores for all six scales are shown in Table 12.

Only one variable was found to account for some variability of scores on the vocabulary scale. The effect due to sex was significant at the .01 level. The performance of girls was superior to that of boys.

The sex factor was also the only factor which accounted for a significant amount of the variability of language skill rates of growth. Once again, the girls topped the boys (Table 13a).

Three effects contributed to the variability of work-study criterion scores. The pre-post and class main effects were significant as well as their interaction. The pre-post difference clearly favored the post-multimedia performance. Table 13b displays the mean rates of academic growth in work study skills and arithmetic for subgroups that differed sufficiently to contribute significantly to the hypothesized explanatory model.

Table 12. Analysis of variance of ITBS achievement test scores for Classes 19, 20, 21, and 22

Source of variation	df	Sum of squares	Mean square	F
SCALE 1--Vocabulary				
Full model	15	8.27		
Pre-post	1	.20	.20	<1
Class	3	2.68	.89	2.28
Sex	1	3.71	3.71	9.50[a]
Pre-post X class	3	2.21	.74	1.89
Pre-post X sex	1	1.70	1.70	4.35
Class X sex	3	4.00	1.33	3.41
P-p X class X sex	3	2.78	.93	2.38
Residual[b]	390	150.77	.39	
SCALE 2--Reading				
Full model	15	10.92		
Pre-post	1	.01	.01	<1
Class	3	.14	.05	<1
Sex	1	.30	.30	<1
Pre-post X class	3	.69	.23	<1
Pre-post X sex	1	.66	.66	1.43
Class X sex	3	1.06	.35	<1
P-p X class X sex	3	.57	.19	<1
Residual[b]	390	181.02	.46	
SCALE 3--Language skills				
Full model	15	7.43		
Pre-post	1	.07	.07	<1
Class	3	.57	.19	<1
Sex	1	.82	.82	2.73[c]
Pre-post X class	3	.46	.15	<1
Pre-post X sex	1	.02	.02	<1
Class X sex	3	1.28	.43	1.43
P-p X class X sex	3	.38	.13	<1
Residual[b]	390	115.84	.30	

[a] $p < .01$.

[b] Residual is from full model.

[c] $p < .10$.

Table 12. (Continued)

Source of variation	df	Sum of squares	Mean square	F
SCALE 4--Work study				
Full model	15	14.34		
Pre-post	1	3.41	3.41	11.38[a]
Class	3	4.70	1.57	5.24[a]
Sex	1	.02	.02	<1
Pre-post X class	3	4.16	1.39	4.63[a]
Pre-post X sex	1	.04	.04	<1
Class X sex	3	.41	.14	<1
P-p X class X sex	3	.27	.09	<1
Residual[b]	390	116.38	.30	
SCALE 5--Arithmetic				
Full model	15	14.26		
Pre-post	1	1.26	1.26	4.06[d]
Class	3	4.16	1.39	4.48[d]
Sex	1	.03	.03	<1
Pre-post X class	3	5.17	1.72	5.54[a]
Pre-post X sex	1	.44	.44	1.42
Class X sex	3	.15	.05	<1
P-p X class X sex	3	.29	.10	<1
Residual[b]	390	120.17	.31	
SCALE 6--Composite				
Full model	15	3.77		
Pre-post	1	.28	.28	1.75
Class	3	1.12	.37	2.32[c]
Sex	1	.05	.05	<1
Pre-post X class	3	.72	.24	1.50
Pre-post X sex	1	.04	.04	<1
Class X sex	3	.25	.08	<1
P-p X class X sex	3	.13	.04	<1
Residual[b]	390	61.87	.16	

[d] $p < .05$.

The same three effects were again found to be significant in accounting for the variability of arithmetic scores and, as before, the pre-post difference favored the post-multimedia performance.

The effect of class was the only effect to yield an F-value exceeding the significance criterion on the composite scale analysis (Table 13c).

Table 13a. Mean scores on the ITBS vocabulary (Scale 1) and language skills (Scale 3) scales for students in Grades 5-8 partitioned according to sex

	Boys (N=108)	Girls (N=90)
Vocabulary	.96	1.00
Language skills	.88	1.01

Table 13b. Mean scores on the ITBS work-study (Scale 4) and arithmetic (Scale 5) scales for students in Grades 5-8 partitioned according to class and pre-post classifications

	Pre			Post			Totals		
	N	Scale 4	Scale 5	N	Scale 4	Scale 5	N	Scale 4	Scale 5
Class 19	64	1.11	1.13	64	.92	.89	128	1.02	1.01
Class 20	33	.86	.99	33	1.15	.96	66	1.00	.98
Class 21	46	.96	.94	46	1.25	1.19	92	1.11	1.07
Class 22	60	.99	.98	60	1.44	1.41	120	1.22	1.20
Totals	203	1.00	1.02	203	1.19	1.12			

Table 13c. Mean scores on the ITBS composite scale (Scale 6) for students in Grades 5-8 partitioned according to class

Class 19 (N=128)	Class 20 (N=66)	Class 21 (N=92)	Class 22 (N=120)
.95	.96	1.03	1.07

All correlations of rate of academic growth with intelligence scores were significantly different from zero except for the work-study scale (see Table 14). The fact that all significant correlations were positive indicates that in Grades 3-8 as in Grades 1-2 the more intelligent students were experiencing the greatest rate of growth.

Table 14. Correlations of ITBS rates of growth and intelligence scores

	Vocabulary	Reading	Language skills	Work-study	Arithmetic	Composite
Intelligence	.15[a]	.14[a]	.19[b]	.07	.25[b]	.26[b]

[a]Significantly different from zero at the .05 level.

[b]Significantly different from zero at the .01 level.

Grades 9-12

The ITED test battery consists of ten major tests or scales. The performance of students on all ten scales was relatively stable across the pre-post treatment interrupt line. The effect of the pre-post classification variable was not significant on any of the ten analyses of variance. In fact, none of the hypothesized sources of systematic variation was able to account for a significant amount of the variability of any of the first five scales (see Table 15).

Differences among classes within the pre-post classifications were significant on Scale 6, Reading Natural Science. Two interactions were also significant in the analysis of rates of growth on this scale. These were the interaction of the pre-post variable and sex and the interaction of classes and sex (Table 16a). While both boys and girls performed less well following implementation of the multimedia program the decline of the boys was especially severe.

Table 16b displays the means that produced the significant interaction of classes and sex on Scale 6, Reading Literature. This points up the differential response of boys and girls in different classes, an effect which remains confounded with effects due to whatever other variables contribute to the uniqueness of a class.

Analysis of Scale 8, General Vocabulary, resulted in significant effects. Classes within the pre and post classifications displayed significantly different rates of growth. The class and sex interaction was also significant as it had been on the two previous scales. The subgroup means which produced the significant effects are shown in Table 16c.

Table 15. Analysis of variance of ITED achievement test scores for Classes 31, 32, 33, 35, 36, and 37

Source of variation	df	Sum of squares	Mean square	F
SCALE 1--Background social studies				
Full model	11	345.96		
Pre-post	1	11.54	11.54	2.07
Classes/pre-post	4	26.81	6.70	1.20
Sex	1	1.82	1.82	<1
Pre-post X sex	1	.44	.44	<1
Classes/p-p X sex	4	30.93	7.73	1.39
Residual[a]	457	2551.48	5.58	
SCALE 2--Background natural science				
Full model	11	86.48		
Pre-post	1	1.21	1.21	<1
Classes/pre-post	4	47.71	11.93	2.29
Sex	1	.44	.44	<1
Pre-post X sex	1	.06	.06	<1
Classes/p-p X sex	4	18.64	4.66	<1
Residual[a]	457	2386.71	5.22	
SCALE 3--Corr. of expression				
Full model	11	104.52		
Pre-post	1	1.11	1.11	<1
Classes/pre-post	4	36.43	9.11	1.89
Sex	1	.06	.06	<1
Pre-post X sex	1	.09	.09	<1
Classes/p-p X sex	4	21.77	5.44	1.13
Residual[a]	457	2208.73	4.83	
SCALE 4--Quantitative thinking				
Full model	11	171.77		
Pre-post	1	3.78	3.78	<1
Classes/pre-post	4	41.00	10.25	1.57
Sex	1	.82	.82	<1
Pre-post X sex	1	.35	.35	<1
Classes/p-p X sex	4	17.59	4.40	<1
Residual[a]	457	2973.88	6.51	

[a]Residual is from full model.

Table 15. (Continued)

Source of variation	df	Sum of squares	Mean square	F
SCALE 5--Reading social studies				
Full model	11	302.69		
Pre-post	1	.12	.12	<1
Classes/pre-post	4	12.08	3.02	<1
Sex	1	4.91	4.91	<1
Pre-post X sex	1	1.62	1.62	<1
Classes/p-p X sex	4	44.83	11.21	1.13
Residual[a]	457	4521.87	9.89	
SCALE 6--Reading natural science				
Full model	11	186.30		
Pre-post	1	20.93	20.93	1.91
Classes/pre-post	4	86.41	21.60	1.97[b]
Sex	1	15.73	15.73	1.44
Pre-post X sex	1	43.79	43.79	4.01[c]
Classes/p-p X sex	4	180.11	45.03	4.14[d]
Residual[a]	457	4994.98	10.93	
SCALE 7--Reading literature				
Full model	11	105.49		
Pre-post	1	3.58	3.58	<1
Classes/pre-post	4	13.72	3.43	<1
Sex	1	3.93	3.93	<1
Pre-post X sex	1	3.74	3.74	<1
Classes/p-p X sex	4	74.04	18.51	2.58[c]
Residual[a]	457	3283.49	7.18	
SCALE 8--General vocabulary				
Full model	11	121.44		
Pre-post	1	6.75	6.75	1.66
Classes/pre-post	4	53.72	13.43	3.30[c]
Sex	1	.57	.57	<1
Pre-post X sex	1	1.83	1.83	<1
Classes/p-p X sex	4	115.86	28.96	7.11[d]
Residual[a]	457	1859.96	4.07	

[b] $p < .10$.

[c] $p < .05$.

[d] $p < .01$.

Table 15. (Continued)

Source of variation	df	Sum of squares	Mean square	F
SCALE 9--Composite 1-8				
Full model	11	93.14		
Pre-post	1	.14	.14	<1
Classes/pre-post	4	10.83	2.71	<1
Sex	1	.51	.51	<1
Pre-post X sex	1	0.00	0.00	<1
Classes/p-p X sex	4	87.86	21.96	7.00[d]
Residual[a]	457	1432.58	3.13	
SCALE 10--Use of sources				
Full model	11	380.65		
Pre-post	1	.59	.59	<1
Classes/pre-post	4	42.49	10.62	1.12[b]
Sex	1	29.62	29.62	3.11[b]
Pre-post X sex	1	.06	.06	<1
Classes/p-p X sex	4	372.79	93.20	9.71[d]
Residual[a]	457	9.60	9.60	

Scale 9 on the ITED is actually a composite of the first eight scales and represents general academic achievement. The only effect great enough to attain significance was that due to the interaction of class and sex (Table 16d).

The tenth scale on the ITED, Use of Sources, measures the capacity of a student for utilizing a variety of sources in his studying routine. The analysis of variance showed that girls experienced a greater rate of growth in this area than did the boys. It also showed that the effect of the the interaction of class and sex was once again significant. The means which illustrate the significant effects are found in Table 16e.

It should be noted that the pre-post classification variable was unable to account for a significant amount of the variability of criterion scores on any of the ten ITED scales. This can be interpreted as meaning

that the multimedia program has not significantly affected the academic achievement of students in high school.

The interaction effect of class and sex, which persisted across the last five scales of the ITED battery, revealed an inconsistent ordering of class-sex subgroups. That is, there was no subgroup which was consistently superior or inferior to all others across all five scales.

Table 16a. Mean scores on the ITED reading natural science scale for students in Grades 9-12 partitioned according to class and sex

		Boys		Girls		Subtotals	
		N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$
Pre	Class 31	35	1.83	40	1.77	75	
	Class 32	33	1.36	34	2.40	67	
	Class 33	38	1.86	30	.48	68	
Subtotals		106	1.69	104	1.60	210	1.65
Post	Class 35	46	.41	47	1.34	93	
	Class 36	54	.76	42	.43	96	
	Class 37	51	.80	19	1.76	70	
Subtotals		151	.67	108	1.06	259	.83
Totals		257	1.09	212	1.33		

Table 16b. Mean scores on the ITED reading literature scale for students in Grades 9-12 partitioned according to class and sex

		Boys		Girls		Subtotals	
		N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$
Pre	Class 31	35	1.00	40	1.49	75	1.26
	Class 32	33	1.59	34	2.03	67	1.81
	Class 33	38	.92	30	2.08	68	1.43
Post	Class 35	46	.43	47	1.15	93	.79
	Class 36	54	.75	42	1.66	96	1.15
	Class 37	51	1.07	19	1.55	70	1.20
Subtotals		257	.92	212	1.62		

Table 16c. Mean scores on the ITED general vocabulary scale for students in Grades 9-12 partitioned according to class and sex

		Boys		Girls		Subtotals	
		N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$
Pre	Class 31	35	1.66	40	1.59	75	1.62
	Class 32	33	1.76	34	1.49	67	1.62
	Class 33	38	1.46	30	2.12	68	1.75
Post	Class 35	46	1.42	47	2.83	93	2.13
	Class 36	54	.84	42	1.62	96	1.18
	Class 37	51	1.21	19	1.39	70	1.26
Subtotals		257	1.34	212	1.91		

Eight of the ten ITED scale rates of the growth were significantly correlated with intelligence scores and were all positive once again (see Table 17). Quantitative thinking and general vocabulary gradients were not significantly correlated with intelligence but were positive. This result reinforces the pattern that has been consistent through all twelve grades, the tendency of the more intelligent student to grow faster academically under the multimedia program than does the less intelligent student.

Table 16d. Mean scores on the ITED composite scale for students in Grades 9-12 partitioned according to class and sex

		Boys		Girls		Subtotals	
		N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$
Pre	Class 31	35	1.89	40	1.89	75	1.89
	Class 32	33	1.82	34	2.19	67	2.01
	Class 33	38	1.38	30	1.56	68	1.50
Post	Class 35	46	.67	47	1.76	93	1.22
	Class 36	54	.85	42	1.29	96	1.04
	Class 37	51	1.28	19	1.45	70	1.32
Subtotals		257	1.25	212	1.70		

Table 16e. Mean scores on the ITED use of sources scale for students in Grades 9-12 partitioned according to class and sex

		Boys		Girls		Subtotals	
		N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$
Pre	Class 31	35	1.98	40	2.51	75	2.26
	Class 32	33	1.45	34	1.82	67	1.64
	Class 33	38	.38	30	1.60	68	.92
Post	Class 35	46	0.00	47	3.00	93	1.52
	Class 36	54	1.53	42	2.20	96	1.82
	Class 37	51	.51	19	1.82	70	.87
Subtotals		257	.93	212	2.26		

Attitude

Initial findings

Before any of the attitude inventories were factored or any of the item responses reversed, all items on all instruments were scored. Table 18 summarizes the average responses to the items on the original opinionnaires. Whereas it is difficult to interpret and summarize the responses to the items considered individually they are no less valid because of it. Even though some of the items were not included in any

Table 17. Correlations of ITED rates of growth and intelligence scores

	Intelligence
Background social studies	.15[a]
Background national science	.14[a]
Corr. of expression	.15[a]
Quantitative thinking	.10
Reading social studies	.25[b]
Reading natural science	.15[a]
Reading literature	.21[b]
General vocabulary	.12
Composite scales 1-8	.29[b]
Use of sources	.23[b]

[a]Significantly different from zero at the .05 level.

[b]Significantly different from zero at the .01 level.

of the factors that were formed by the factor analysis they may certainly be considered separately. The fact that an item does not correlate highly with a factor simply means that it is apparently measuring something other than what the factor is measuring. It is no less worthy of consideration because of it.

It was deemed judicious, however, to attempt to condense the relatively large number of items into fewer factors in order to simplify the interpretation and analysis of the results. This was accomplished according to the factor analysis and rotation scheme outlined in the previous chapter. Table 19 summarizes the resultant factors or scales and Appendix B lists the items in the scales of the four reduced

Table 18. Summary of responses to all items on the attitude measures

Item	Grades 1-4 M.F.R.[a]	Grades 1-4 mean	Grades 5-8 M.F.R.	Grades 5-8 mean	Grades 9-12 M.F.R.	Grades 9-12 mean	Teachers M.F.R.	Teachers mean
1	1	1.00	5	3.76	5	3.16	5	4.02
2	2	1.73	5	3.72	5	3.21	1	1.88
3	1	1.20	5	3.93	5	3.26[b]	5	3.74
4	2	1.83	5	3.38	5	2.88[b]	5	4.14
5	1	1.26	1	2.55	1	2.51[b]	1	1.83
6	2	1.73	5	3.43	5	2.81[b]	5	3.83
7	2	1.62	5	4.09	5	3.40	5	3.22
8	1	1.09	1	2.23	1	2.67	1	1.67
9	1	1.37	5	3.70	5	3.40	5	3.91
10	1	1.34	5	3.27[b]	5	3.20[b]	1	2.81
11	2	1.69	5	2.95[b]	5	2.76[b]	1	2.45
12	1	1.50	1	2.41	1	2.94[b]	5	4.10
13	1	1.03	5	3.10[b]	5	2.69[b]	1	2.24
14	2	1.85	1	3.31[b]	1	3.27[b]	1	2.34
15	1	1.07	5	3.11[b]	5	2.96[b]	5	3.93
16	2	1.74	1	3.31[b]	1	3.35[b]	1	2.10
17	1	1.05	1	2.38	1	2.81	5	3.86
18			1	2.04	1	2.77	5	4.31
19			5	4.36	5	3.66[b]	5	4.07
20			1	2.78	1	3.30[b]	1	2.33
21			5	3.68[b]	5	3.19[b]	1	2.26
22			5	2.06[b]	5	2.63[b]	5	3.83
23			1	2.24	1	2.77	5	3.97
24			1	1.95	1	2.68	1	1.88
25			1	1.84[b]	1	2.36[b]	5	3.60
26			1	3.17[b]	1	3.14[b]	1	2.22
27			1	2.53	1	3.00	1	2.86
28			5	4.34	5	3.23	1	1.95
29			1	1.97	1	2.57	1	2.19
30			5	3.35	5	3.18[b]	5	4.17
31			1	2.24	1	3.39[b]	1	1.97
32			1	1.79	1	2.41		
33			5	3.99	5	3.19		
34			5	3.90	5	3.14		
35			1	2.50	1	2.69		
36			1	2.41	1	2.59		
37			1	1.93	1	2.49		
38			1	2.80	1	2.76[b]		
39			5	3.74	5	2.93[b]		
40			1	1.77	1	2.45		

[a]Most favorable response.

[b]"Unfavorable" average response.

Table 19. Summary of the results of the factor analysis of the four attitude inventories

Inventory	Scale code	Items	Trait measured by the scale
Grades 1-4	I-1	2, 3, 4, 5, 8, 11, 12, 14, 15, 17	Attitude toward the environment for working and studying
Grades 5-8	II-1	1, 3, 4, 17, 18, 19, 28, 29, 32, 40	Attitude toward the multimedia approach as an aid to learning
	II-2	2, 7, 33, 34	Attitude toward the multimedia approach as an aid to self-help
	II-3	16, 21, 24, 36, 38	Attitude toward the functioning of the media center
Grades 9-12	III-1	1, 2, 3, 4, 6, 13, 18, 39	Attitude toward the environment for studying
	III-2	19, 21, 25, 28, 29, 32, 37, 40	Attitude toward the practical utility of the multimedia approach
Teachers	IV-1	1, 3, 4, 9, 17, 18, 19, 22, 23, 30	Attitude toward the multimedia approach as an aid to teaching
	IV-2	5, 8, 12, 13, 16, 20, 28	Attitude toward the practical utility of the multimedia approach

inventories. Summing the responses to all items on a scale yielded a scale or factor score for each subject. Table 20 is a summary of the major characteristics of each of the eight scales along with a brief description of the responses of each of the four groups involved in the study.

Table 20. Attitude scale reliabilities and scoring

Scale	Reliability	No. of items	Maximum possible score	Arbitrary "neutral"[a] average	Actual average	St. dev.	Number of subjects
I	.58	10	20	15	17.21	1.18	330
II-1	.80	10	50	30	39.81	6.76	361
II-2	.61	4	20	12	15.70	3.04	361
II-3	.61	5	25	15	17.22	3.98	361
III-1	.79	8	40	24	24.15	6.28	345
III-2	.82	8	40	24	27.81	6.82	345
IV-1	.97	10	50	30	40.02	11.32	58
IV-2	.91	8	40	24	31.64	8.18	58

[a]"Neutral" averages are computed by multiplying the number of items in a scale by the neutral score for an item.

Grades 1-4

The analysis of variance of scores on the factor labelled "attitude toward the environment for working and studying" failed to reveal any sources of systematic variation (see Table 21). The responses of all of the subgroups implied by the analysis of variance model were relatively stable and favorable toward the multimedia program. Table 22 summarizes the distribution of subjects and mean responses of the subgroups and reveals the homogeneity of responses across all classes and both sexes in the first four grades.

Table 21. Analysis of variance of attitude scale scores for Grades 1-4

Source of variation	df	Sum of squares	Mean square	F
SCALE 1--Attitude toward the environment for working and studying				
Full model	25	49.88		
Grade	3	2.44	.81	<1
Class within grade	9	11.56	1.28	<1
Sex	1	2.94	2.94	2.21(NS)[a]
G X S	3	1.84	.61	<1
S X C/G	9	6.76	.75	<1
Residual[b]	304	406.16	1.33	

[a]NS = Not significant.

[b]Residual is from the full model.

Table 22. Distribution of subjects in Grades 1-4 and mean scores on the reduced attitude scale

		Boys		Girls	
		N	Mean	N	Mean
GRADE 1	Class 1	10	16.71	14	17.22
	Class 2	14	17.29	15	17.47
	Class 3	13	16.85	11	17.73
GRADE 2	Class 4	15	17.27	10	17.10
	Class 5	15	16.46	11	17.45
	Class 6	14	16.93	11	17.09
GRADE 3	Class 7	13	17.70	12	17.84
	Class 8	12	17.09	11	17.64
	Class 9	12	16.58	12	16.75
	Class 10	11	16.91	13	17.31
GRADE 4	Class 11	17	17.36	12	17.92
	Class 12	15	17.00	12	17.67
	Class 13	15	16.80	10	17.50

The average score of 17.31 for all students in Grades 1-4 on the 10-item reduced scale was 2.31 units above the arbitrary neutral average of 15.00.

Grades 5-8

The three sets of attitude scale scores were partitioned according to grade and sex for the analyses of variance (see Table 23).

Table 23. Analysis of variance of attitude scale scores for Grades 5-8

Source of variation	df	Sum of squares	Mean square	F
SCALE 1--Attitude toward the multimedia approach as an aid to learning				
Full model	7	1066.56		
Grade	3	387.49	129.16	2.96[a]
Sex	1	157.76	153.76	3.53[a]
G X S	3	26.95	8.98	<1
Residual[b]	353	15378.01	43.56	
SCALE 2--Attitude toward the multimedia approach as an aid to self-help				
Full model	7	121.70		
Grade	3	46.84	15.61	1.71
Sex	1	11.70	11.70	1.28
G X S	3	10.72	3.57	<1
Residual[b]	353	3214.39	9.11	
SCALE 3--Attitude toward the functioning of the media center				
Full model	7	343.14		
Grade	3	165.46	55.19	3.63[c]
Sex	1	18.62	18.62	1.22
G X S	3	14.99	4.99	<1
Residual[b]	353	5367.13	15.20	

[a] $p < .10$.

[b] Residual is from the full model.

[c] $p < .05$.

The effect of sex was significant in accounting for some of the variability of scores on the scale "attitude toward the multimedia approach as an aid to learning." The responses of girls on this scale were consistently higher than those of boys across all four grades. The mean scale score for all four grades was 39.81, well above the neutral average of 30.00. None of the eight subgroups fell below this arbitrary neutral standard (Table 24a).

The average scale score on the scale labelled "attitude toward the multimedia approach as an aid to self-help" was 15.70, a highly favorable response when compared with the neutral average of 12.00. None of the hypothesized sources of variation had a significant effect.

The average response to the third scale, "attitude toward the functioning of the media center," was also favorable. The mean score of 17.22 was 2.22 units above the neutral standard of 15.00. Analysis of variance revealed that the effect of grade was significant in this instance. Grades 5 and 7 scored higher than Grades 6 and 8; the same trend was noted on the previous two scales but was not great enough to satisfy the criterion of statistical significance. Nonetheless, the fact that it appears in all three cases makes it noteworthy and warrants further investigation (Table 24b).

Mean scores for all eight subgroups are tabulated in Table 24 for the three attitude scales.

Grades 9-12

Scores on the two attitude scales resulting from the factor analysis were partitioned into grade and sex categories. The analyses of variance

Table 24a. Mean scores of students in Grades 5-8 on attitude toward the multimedia approach as an aid to learning

Boys (N=176)	Girls (N=185)
39.05	40.61

Table 24b. Mean scores of students in Grades 5-8 on attitude toward the functioning of the media center

Grade 5 (N=85)	Grade 6 (N=88)	Grade 7 (N=94)	Grade 8 (N=94)
18.17	16.51	17.95	16.30

computed on the two sets of scores revealed a significant grade effect and a significant grade X sex interaction for the second scale, "attitude toward the practical utility of the multimedia approach." Table 25 presents the analyses of variance for both sets of scale scores.

The mean scale score of 24.10 on the scale labelled "attitude toward the environment for studying" just barely exceeded the neutral average of 24.00. This represented the lowest scale mean relative to the arbitrary neutral standard of any attitude scale in this study. In fact, four of the eight subgroups actually scored below the neutral standard.

Closer inspection of the scores leading to the significant grade effect and the significant grade X sex interaction for Scale 2 scores reveals a deterioration in attitudes with increasing grade level (Table 26). The interaction effect is due to the fact that this decline in attitudes is quite rapid for girls while holding relatively stable for boys across the four grades. Despite the decline there are no subgroup means below the neutral average of 24.00. Taken as a group, the boys and girls in

Table 25. Analysis of variance of attitude scale scores for Grades 9-12

Source of variation	df	Sum of squares	Mean square	F
SCALE 1--Attitude toward the environment for studying				
Full model	7	1191.26		
Grade	3	243.04	80.01	2.26
Sex	1	78.54	78.54	2.22
G X S	3	68.55	22.85	<1
Residual[a]	335	12236.97	36.53	
SCALE 2--Attitude toward the practical utility of the multimedia approach				
Full model	7	1848.91		
Grade	3	632.84	210.64	4.99[b]
Sex	1	2.18	2.18	<1
G X S	3	470.85	156.95	3.71[c]
Residual[a]	335	14136.55	42.20	

[a]Residual is from the full model.

[b]$p < .01$.

[c]$p < .05$.

Table 26. Mean scores of students in Grades 9-12 partitioned according to grade and sex on attitude toward the practical utility of the multimedia approach

	Boys		Girls		Subtotals	
	N	$\bar{X}$	N	$\bar{X}$	N	$\bar{X}$
Grade 9	43	27.32	44	31.98	87	29.68
Grade 10	46	24.33	51	30.24	97	27.44
Grade 11	41	26.19	44	28.23	85	27.25
Grade 12	46	26.78	28	26.43	74	26.65

all four grades scored 27.79 on the average.

Professional staff

The two reduced attitude scales which resulted from the factor analysis and rotation possess the highest degree of internal consistency of any of the attitude scales used in this study. This is evidenced in the extremely high reliability coefficients for these scales, and reflects the relative homogeneity of the respondents.

The mean score on the first scale, "attitude toward the multimedia approach as an aid to teaching," was 40.02. This is in contrast with the neutral average of 30.00 and represents a highly favorable attitude.

The analysis of variance based on the sex and teaching level classification scheme did reveal some variability among subgroups, however. The effect of sex was significant in this case and reflects the relatively more favorable attitude of women (see Table 27).

Response to the second scale, "attitude toward the practical utility of the multimedia approach," was favorable for the professional staff as a whole. The mean score of 31.64 was 7.64 units above the neutral average of 24.00. Analysis of variance in this case failed to yield any significant effects among the hypothesized sources of systematic variation. Inspection of Table 28 discloses considerable variability among subgroups nonetheless. An effect of interest, though not statistically significant, is the very low attitude on both scales of the subgroup called "Other Men." This group consists of only three men who could not be classified into one or the other of the three grade level groupings. These are people whose responsibilities overlap

Table 27. Analysis of variance of attitude scale scores for professional staff

Source of variation	df	Sum of squares	Mean square	F
SCALE 1--Attitude toward the multimedia approach as an aid to teaching				
Full model	7	1951.62		
Teaching level	3	487.07	162.36	1.52
Sex	1	861.44	861.44	8.06[a]
TL X S	3	689.87	229.96	2.14
Residual[b]	50	5345.36	106.91	
SCALE 2--Attitude toward the practical utility of the multimedia approach				
Full model	7	543.27		
Teaching level	3	94.65	31.55	<1
Sex	1	60.43	60.43	<1
TL X S	3	282.32	94.11	1.44
Residual[b]	50	3274.13	65.48	

[a] $p < .01$.

[b] Residual is from the full model.

Table 28. Distribution of teachers and mean scale scores in the cells of the age and teaching level classification scheme

	Men			Women		
	N	Scale 1 mean	Scale 2 mean	N	Scale 1 mean	Scale 2 mean
Grades 1-4	3	36.00	31.00	15	43.20	34.20
Grades 5-8	6	42.34	32.50	8	47.13	31.87
Grades 9-12	15	37.33	29.60	4	35.00	30.75
Other	3	23.33	22.00	4	45.75	36.50

grade level categories. It should be noted that with such a small number of subjects the mean score for the subgroup can be biased by the extreme score of only one of the subjects. This is, in fact, the reason for the relatively low score of this subgroup. An inspection of the scale scores for the three subjects disclosed that one of them had responded very unfavorably on both scales.

CHAPTER V. DISCUSSION

This chapter focuses on a discussion of the results of the evaluation and recommendations for improving the multimedia program. It will be based not only on the data collected and analyzed but will also include information obtained through interviews with students and staff and observations of activities and procedures that occurred in the course of the investigation.

Discussion of the Results

The data collected and analyzed in the course of the evaluation reflected positively on the program. Objectives established by the program staff relative to student achievement and attitudes of students were attained to a limited degree. The study disclosed that students performed academically at least as well or better following implementation of the multimedia program than they did before. While this was true for all students on the average there were some rather obvious exceptions when the achievement records of subgroups of the larger groups were examined. The evidence supports the notion that the program had affected some students quite favorably while others had not been able to sustain even their previous levels of academic growth. It was clear that the goal of individualizing instruction had not been attained.

The result that was most difficult to explain was the erratic pattern of academic growth across subject matter areas and grade levels. No subject matter area was consistently affected by the program across all or even most levels. Students in Grades 1 and 2 demonstrated improved

performance in vocabulary and word study skill, those in Grades 3-8 improved in work study skills and arithmetic, and high school students showed no change in any of the academic areas. There was no common effect of the program that permeates all grade levels as far as achievement was concerned.

It appeared that there actually existed three different multimedia programs corresponding to the three school buildings. This was further evidenced in observations of the activities in the three buildings. Aside from some similarity in the hardware among the three sites there was little similarity in the types of activities that were occurring.

It should be pointed out that there was no intent on the part of the program staff to establish similar programs in all buildings. However, it would seem that there should be some subject areas, particularly in the basic skills in Grades 1-8, that would be affected similarly across all grades since the instructional objectives would be expected to be similar across those grades.

Despite the fact that the multimedia program was common across all buildings there was little evidence of cooperative efforts on the part of the staffs of the different buildings to integrate instructional activities between and within buildings.

Multimedia affords an opportunity for a flexibility of instruction that had not previously existed. This flexibility should extend beyond the variety of materials available for students so as to include a greater variety of instructional methods such as team teaching and individualized instruction. As was mentioned previously, the goal of individualizing instruction has a long way to go before it will be realized.

Except for the well equipped resource centers all three of the buildings appeared quite conventionally equipped. Most of the classrooms had six rows of six student desks each with a teacher in the front of the room; hardly any different from the traditional classroom of a decade or even a quarter century ago. The beautiful multimedia equipment was rarely observed in the classrooms during the greater part of the school day.

There was a need to develop greater flexibility in the use of the available resources, time, and space so as to allow students greater opportunity to utilize the facilities that exist for them.

There were some obvious limitations to the flexibility of space in old, traditionally designed school buildings such as those housing Grades 7-12. There was no reason, however, why multimedia materials and equipment could not be made more accessible to students by bringing some of them into the classrooms and providing a schedule for their use.

The differential performance of distinct subgroups of the larger population of students was further accented by the analysis of the scores of subgroups characterized by sex and class. In several academic areas the achievement growth rate of girls far exceeded that of boys. While the difference was statistically significant for only five scales the effect was consistent across almost all scales.

The most pronounced difference occurred on the "Use of Sources" scale at the high school. In this case the difference in growth rates was 1.33 grade equivalent years per academic year. This was a particularly critical result inasmuch as the success of the multimedia program was highly dependent upon the ability of students to use resources independently.

Girls have apparently acquired the necessary skills while the boys have failed to average even a one year gain per academic year.

Coupled with the relatively poor attitudes of boys in high school this effect points up the most serious problem in the multimedia program. The boys were just not impressed with the program. Informal discussions with several of the boys during the course of the evaluation revealed much displeasure with the high school facilities. Apparently the girls have been far more willing to overlook the inadequacies and inconveniences of the building itself and have been able to adapt to the new program more readily.

Variability among classes on the criterion variable again indicated the failure of the program to meet individual or, at least, small group needs. Lest this should seem to be too unfair an indictment it must be remembered that the criterion scores were gradients of achievement scores over time. By using such a measure the past performance or past achievement of a student has been adjusted out so that the measure actually reflects the gain or the value added by the school during the time interval over which the gradient was computed. The design of the study did not permit isolation of the effect of teachers on the growth rate as the teacher variable was confounded with the class variable. It is quite possible that the explanation of the differences among classes resides in a difference among teachers although there was no way that the data could be interpreted so as to validate such a stance unequivocally. It would be more reasonable to assume the posture that the difference among classes was due to differences in the subject matter content of the courses. This would be particularly possible at the high school level where students

were permitted several options in their class schedules. The implications were that either there was a need to alleviate the differential performance of classes by providing more equitable treatment for all classes or that the criterion measures were inappropriate, in which case the testing program needs revision.

The difficulty of the effort to individualize instruction was once again reflected in the relationship that existed between the rate of achievement growth and I.Q. It was consistently true across all twelve grade levels that the rate of growth in most subject areas was positively correlated with I.Q. This indicated that the more intelligent students were experiencing the greatest academic gains thereby inflating the academic gap between the more intelligent and less intelligent students. This effect was not necessarily due to the multimedia program since there was insufficient information available to compute the comparable correlations for those students who were attending school before the program was implemented. Nonetheless the fact that the condition exists now cannot be ignored.

Based on all the achievement information that has been gathered and processed during this evaluation there is good reason to suggest that the program will require considerably more time before it attains its goal of individualized instruction. At least the kind of individualized instruction that has been occurring has not had comparable effects on all students or even on most students. The students that have enjoyed the least success in the program have been the male students and, in particular, the less intelligent male students.

If there was one aspect of the program that can be used as evidence for its success it would have to be the positive affect that students and teachers have toward the program. The attitude scores of each of the three major student groupings, Grades 1-4, 5-8, and 9-12, reflected a favorable disposition by each group on the average. There was some variability among subgroups, however, an indication that all students were not in agreement in their feeling about the program.

Students in Grades 1-4 were more pleased with their multimedia program than either of the other two groups. They were also more uniform in their opinions; no item on the 17-item attitude scale received an unfavorable average response. At least one reason for such positive regard rests with the atmosphere and surroundings in the instructional materials center in the lower elementary school building. This room was by for the most esthetically pleasing of the resource centers in all of the schools. It was roomy, carpeted, well equipped, and well lighted. The students that were observed using the center appeared to be enjoying their surroundings immensely.

The one aspect of the program in Grades 1-4 that was not enthusiastically endorsed was the amount of time teachers had to spend with students. About half of the students felt their teacher did not have enough time to spend with them. However, this apparently presented no serious problems for most of the students inasmuch as nearly all of the 330 students felt they could obtain help in school when they needed it. There were sufficient sources of aid other than teachers to satisfy the needs of most students.

Students in Grades 5-8 actually attended classes in two separate buildings. Seventh and eighth graders were housed in the same building that was used for the high school students although the area they used was distinct from the high school section. Fifth and sixth graders attended classes in a former parochial school about a block from the high school building. All students in Grades 5-8 used the same instructional materials center located in the high school building.

The attitudes of students in the four grades was favorable on the average, although there was more variability in the responses of this group of 361 students than there was among the elementary students. There was evidence of a poorer attitude among boys than among girls with regard to the multimedia approach as an aid to learning. No viable reason for the discrepancy was apparent and was of little concern since the responses of both boys and girls was highly favorable.

An inspection of the responses to individual items on the attitude scale disclosed a few specific areas of discontent. Students felt they did not have as much opportunity to express themselves as they would liked to have had and they felt they did not have sufficient time to study the things they would like to study. This was a reflection of the lack of flexibility of the program as a whole. The instructional materials centers were well equipped and heavily used but the flexibility of the center was reduced to the regiment of the traditional classroom when students returned from the center. Many students felt the center was overcrowded. This was understandable in view of the fact that all 361 students were expected to use a facility that could accommodate

only 50 students at one time. The need certainly exists to expand the center or to incorporate some of the materials into the classrooms, or both.

The spirit of individualization of instruction was again found to be lacking inasmuch as the majority of students still felt they had to keep up with the rest of their class, a symptom of norm-referenced standards rather then self-determined criterion-referenced goals.

The overall attitude scores of high school students were relatively the lowest among the student groups. Despite this fact the average scores were all classified as favorable. However, there was some definite variability on this count. There was a consistent decline in attitude toward the practical utility of the multimedia approach with increasing grade level. The decline was most promounced among the male students although there was a gradual diminution of affection for the program among girls also.

Responses to individual items on the attitude scale helped to focus on the nature of the relatively poor attitude among the high schoolers. A majority of the students indicated that the multimedia approach had not made school more pleasant than it had been before the program began. In fact, they said they did not prefer the multimedia program to the old traditional program. These were students who had experienced the maximum number of years in both traditional and multimedia programs and, therefore, had a more extensive basis for comparing them than any other students.

The complaint of overcrowded centers and too much school work coupled with the opinion that the people who worked in the centers were not very friendly accounted for a good deal of the reason for much of the relative negativism in this group of students. Observations made at the

time of the evaluation visits to the school bear out the fact that the centers were overcrowded. The two instructional materials centers were able to accommodate only about 25 percent of the 343 high school students at any one time. This was incongruent with the plan of the instructional staff to provide sufficient time and resources for students to spend 50 percent of their time on independent study. The problem of overcrowding should be alleviated to some extent with a new high school but even a new school will be able to accommodate only about 33 percent of the expected enrollment of 500 students.

A new school will not necessarily create a better atmosphere between students and the people who work in the centers. Informal interviews with some of the center employees indicated that they spend a good deal of time preparing instructional materials for teachers; certainly an admirable task, but it may be occurring at the expense of limited attention to students in the centers. If this was the case the project director and administrative staff would be well advised to take a long look at the job description of center personnel. It may be necessary to redefine the jobs so that more time is spent attending to student needs.

It was interesting to note that the administrative and instructional staffs of the schools see the multimedia program in a most favorable light. They feel they have become better teachers, are able to help students on an individual basis, and their effectiveness as teachers has been enhanced. In contrast to some of the students in high school they feel that the personnel working in the centers are very helpful. This serves to accent the notion that the center personnel may be oriented too much toward teaching and not enough toward learning.

The discussion to this point has dealt to a large extent with some of the weaknesses of the multimedia program. The intent is to be as constructive as possible by providing information that would be helpful in planning changes in the program. By pointing up deficiencies in the program it is not intended that its strengths be camouflaged, for it has many.

The program has been extremely well organized and directed from its inception due in large measure to the efforts of Elizabeth Forbes. She has demonstrated a talent for organizing and directing a large scale project with flare and energy.

Although the effect of the project on academic achievement has been limited it has at least been a positive effect. The literature in education fails to reveal projects on the scale of the Sibley project that have produced drastic increases in achievement over a time span of only a few years. The full impact and effect of the project may not be realized for some time to come.

The project has succeeded in gaining the affective support of students and staff, a necessary prerequisite to any effective cognitive changes. It appears that the Sibley Public Schools can look forward to more and better things with continued support of the program.

Recommendations

The recommendations for change can be most clearly presented if the framework within which the changes will be made is clearly defined. The educational environment can be described in terms of the configuration of resources, space, and time within which the student exists and with

which he interacts. The role of the educator is to mold the environment so as to optimize desired effects on the student. Therefore, the recommendations are intended to suggest possible alternative configurations of the student's environment so as to increase student achievement and improve student attitudes, the major criteria upon which the evaluation was based.

It is recommended that the job of project director be considered a full-time job and not be encumbered with such tasks as that of librarian and technician. It should be the job of the project director to coordinate the activities of the project staff and to integrate the multimedia program into the instructional program of the schools.

The present project staff should be increased to include an audio visual specialist, someone who will be able to supervise the use of audio visual materials, particularly non-print materials, and will have time to train teachers in their use. It would also be the job of this person to maintain liaison between project staff and instructional staff and to maintain the audio visual equipment.

The jobs of the other personnel need to be redefined with regard to the responsibilities and duties of each so as to avoid the possible overlapping of tasks and to improve overall efficiency.

The program is well endowed with a large quantity of material resources. However, some consideration should be given to the type of materials that are available. There is an abundance of print type materials but not enough non-print materials. A better balance of print and non-print types would increase the flexibility of the program and would provide a greater variety of learning modes for the students. The academic level of the

materials also needs to be expanded. The relatively low achievement growth rate of the less intelligent students may be resolved by providing them with materials that are appropriate to their level and learning style.

The spatial dimension of the educational environment could be modified to affect learning directly and to enhance the efficiency of the instructional process. At the high school and middle school more space is needed in the instructional materials centers in order for them to accommodate all students. If the centers cannot be expanded an alternative would be to provide more multimedia materials in the classrooms thereby making them accessible to students who are turned away from the centers when they are filled to capacity.

The program at the elementary school could also be enhanced by making more materials available in classrooms although the problem is not as acute in this building as it is in the other buildings.

In all of the schools a restructuring of the time dimension has some potential for improving the instructional process by increasing the utilization of the instructional materials. Alterations of the time element only will not likely yield results without changing spatial and resource elements at the same time. More team teaching and teaching aides would go a long way toward providing greater flexibility in the program thus creating an environment in which needs of individuals could be attended.

If the program is to continue to maintain a high level of favorable affect it would be advisable to involve instructional staff and students in planning activities. The relatively poor attitudes of the high school

boys could be resolved if they were permitted to participate in the process of making decisions that affected them.

In review, it is recommended that the multimedia program be maintained at least at its present level of service to students and staff. The entire project staff plus an audio visual specialist should be retained to perform the maintainence function and to facilitate optimum utilization of services and resources. It is further recommended that, if the program is to be improved, more space will be needed in all schools to provide a more flexible learning environment for students. It is also advised that planning decisions incorporate some input from students, particularly at the high school level.

CHAPTER VI. SUMMARY

The purpose of this study was to determine the effect of the multimedia program on the academic achievement and attitudes of students in the Sibley (Iowa) Public Schools at both the secondary and elementary levels. The investigation attempted to ascertain if academic achievement had changed since the implementation of the program and if students and professional staff were favorably disposed toward the program. In order to provide additional relevant information for the program director, school administrators, and the board of education, the effects on achievement and attitudes of such factors as sex and grade level were statistically isolated.

Three commercially available achievement test batteries--Stanford Achievement Tests (Grades 1-2), Iowa Tests of Basic Skills (Grades 3-8), and Iowa Tests of Educational Development (Grades 9-12)--along with the Lorge-Thorndike Intelligence Test provided the necessary cognitive measures for this study. In addition, four attitude opinionnaires were constructed in order to obtain information regarding affective behavior. In order to facilitate analysis and interpretation the attitude tests were factored according to the principal axis factor analysis and the factors were subsequently subjected to a varimax rotation. The eight factors resulting from the factor analyses and rotations of the four tests were labelled and the factor scores for all subjects were computed.

The standardized achievement test scores for each student over a period of two or three years before and since the implementation of the multimedia program were condensed into more precise criterion scores, the

rates of academic growth, by computing the slope of the best-fitting line to the data. The slope computed from SAT and ITBS test scores had dimensions of years of academic growth per calendar year and the gradient calculated from ITED scores was in units of standard score change per calendar year.

Analysis of the information obtained from the seven batteries of tests was formally structured by seven sets of null hypotheses, one set related to each of the test batteries. The first three sets dealt with achievement and the last four were associated with attitudes.

Tests of the significance of hypothesized sources of systematic variation were based on an analysis of variance model. The sum of squares attributable to each of the hypothesized sources of variation was computed via a backward regression technique. The .10 level was chosen as the level of significance because of the relatively conservative estimate of sums of squares obtained by the regression procedure.

Analysis of achievement battery gradients for students in Grades 1-2 resulted in the rejection of the hypothesis of no effect due to type of program in the areas of vocabulary and word study skills. In both cases the difference favored the post-multimedia program. The hypothesis of no effect due to classes was rejected with regard to vocabulary and spelling skills. The effect of the sex variable was great enough to reject the hypothesis of no sex effect in the areas of spelling and word study skills--both differences favored the girls.

Results of the analysis of achievement in Grades 3-8 included rejection of the null hypothesis relative to type of program in the areas of work-study skills and arithmetic skills--in both cases the

performance of students during the post-multimedia period was superior to that recorded during the pre-multimedia period. Hypotheses of no effect due to classes were rejected relative to work-study skills, arithmetic skills, and the composite of all skills. In addition, the hypothesis of no effect due to sex was rejected in the area of language skills--girls again outperformed the boys.

Ten scales comprised the ITED battery of tests. The analysis of variance of the gradients computed from this set of scales resulted in the rejection of the hypothesis of no difference among classes in the areas of reading natural science and general vocabulary and a rejection of the hypothesis of no difference between sexes relative to achievement growth computed from the Use of Sources scale--the trend of female dominance persisted.

Correlations of intelligence with rate of achievement growth during the post-multimedia period were all significantly different ($p < .05$) from zero except for the correlations of intelligence with the ITBS Work-Study scale, the ITED Quantitative Thinking scale, and the ITED General Vocabulary scale. The hypotheses of no correlation were rejected in these three cases. A nonsignificant correlation is regarded as a positive effect of the multimedia program inasmuch as it represents stable academic growth across intelligence levels.

The achievement test scores of a total of 928 students in Grades 1-12 were analyzed within three distinct grade level groupings: Grades 1-2 (N=256), Grades 3-8 (N=203), and Grades 9-12 (N=469). The results showed an increase in achievement growth rates following implementation of the

multimedia program on a total of four subtests of the three achievement batteries across all twelve grades.

First and second grade students gained .13 grade equivalent year per academic year more on the SAT Vocabulary scale and .03 grade equivalent year more on the SAT Word Study Skills scale following implementation than did their counterparts before the multimedia program began. Gains were not consistent across all classes and between sexes; girls tended to experience greater gains than boys.

Students in Grades 3-8 increased their rate of achievement growth by .19 grade equivalent year in Work Study Skills and .10 in Arithmetic--the only subtests among the six ITBS subtests that were affected by the multimedia program. There was variability of growth rates among classes and between sexes within this group also. As before, the girls had the edge over their male counterparts.

None of the academic disciplines tested by the ITED battery was affected at all by the program although the class and sex variability was again present with this group of high school students. The trend of female superiority persisted.

The small number of increases in the rate of achievement growth among all subtests and across all grade levels indicates that the multimedia program had had only limited success in attaining its goal of improving student cognitive growth. The varied growth rates among classes and sexes indicates a differential response to the program among subgroups of the total population of students. The implications are that the program is not meeting the academic needs of individual students uniformly. This notion is also supported by the high positive correlation

between the gradients of achievement growth and I.Q. that were noted at all grade levels relative to most subtests of the achievement test batteries.

Analysis of variance was also used to test the last four sets of hypotheses which were formulated relative to the four groups of subjects to whom attitude opinionnaires were administered. The four groups were: (1) Grades 1-4, (2) Grades 5-8, (3) Grades 9-12, and (4) professional staff.

Scores on the reduced 10-item factor resulting from the factor analysis and rotation of data obtained from Grades 1-4 were analyzed but failed to isolate any statistically significant effects due to grade, class, or sex.

Analysis of variance of the instrument administered by Grades 5-8 did lead to the rejection of the hypothesis of no effect due to sex relative to the attitude scale, "attitude toward the multimedia approach as an aid to learning." The difference in this case indicated that the girls' attitudes were more favorable than were the boys'. The hypothesis of no effect due to grade was rejected in the case of the attitude scale, "attitude toward the functioning of the media center"--the eighth graders were notably less favorably disposed toward the program than were the other three grades.

High school students as a group were the least enthusiastic of the four groups in their endorsement of the multimedia program as reflected by their attitudes toward the environment for studying as it existed within the multimedia program. Analysis of variance of scores on the attitude scale, "attitude toward the practical utility of the multimedia

approach," revealed significant variability among grades and a significant interaction of grade and sex. This, of course, led to a rejection of the hypotheses of no grade effect and no grade and sex interaction.

The professional staff responded generally with favor toward the multimedia program. Analysis of scores on the two attitude scales resulted in a rejection of the null hypothesis relative to the effect of sex on the first scale--the response of women was more favorable than that of men on the scale, "attitude toward the multimedia approach as an aid to teaching."

Results of the analysis of the student attitude scale scores across all twelve grades were consistently favorable toward the multimedia program within each of the following subgroups: Grades 1-4 (N=329), Grades 5-8 (N=361), and Grades 9-12 (N=343). Some variability in attitude scores among classes and between sexes was evidence that students were not unanimous in their endorsement of the program. High school students were generally less favorably inclined than students at the lower grade levels. This was attributed in part to the severe crowding that existed in the high school building.

The attitude of the professional staff toward the multimedia program was extremely positive across all grade levels. Female teachers were somewhat more favorably disposed than their male colleagues and teachers of Grades 5-8 responded more favorably than any of the other staff groups partitioned according to grade level taught.

In summary, the multimedia program achieved its cognitive goals with only limited success but was highly successful in gaining the approval of

students and the professional staff. More space, increased flexibility in the instructional program, and redefinition of the roles of members of the project staff are recommended as vehicles for potentially improving the program.

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APPENDIX A. ORIGINAL ATTITUDE INVENTORIES

GRADES K-4 STUDENT SCALE

MULTI-MEDIA APPROACH

YES	NO	
☐	☐	I FEEL THAT
☐	☐	1. I AM USUALLY ABLE TO FIND HELP IN SCHOOL WHEN I NEED IT.
☐	☐	2. I USUALLY HAVE A HARD TIME FINDING THINGS WHEN I NEED THEM.
☐	☐	3. I LIKE GOING TO SCHOOL!
☐	☐	4. THE CENTER IS TOO CROWDED!
☐	☐	5. I USUALLY HAVE ENOUGH TIME TO STUDY THE THINGS I WOULD REALLY LIKE TO STUDY.
☐	☐	6. I COULD DO AS WELL IN SCHOOL WITHOUT THE CENTER.
☐	☐	7. IT IS EASY TO WASTE A LOT OF TIME IN SCHOOL.
☐	☐	8. THE PEOPLE WHO WORK IN THE CENTER ARE USUALLY READY TO HELP ME WHEN I NEED HELP.
☐	☐	9. I DON'T HAVE TO KEEP UP WITH THE REST OF MY CLASS.
☐	☐	10. I HAVE LEARNED AS MUCH THIS YEAR AS I WANTED TO LEARN.
☐	☐	11. I USUALLY HAVE <u>TOO</u> MUCH WORK TO DO.
☐	☐	12. MY TEACHER USUALLY HAS ENOUGH TIME TO SPEND WITH ME.
☐	☐	13. I LIKE TO USE THE CENTER.
☐	☐	14. SOME OF THE PEOPLE WHO WORK IN THE CENTER ARE UNFRIENDLY.
☐	☐	15. I HAVE BEEN SHOWN HOW TO FIND THE THINGS I NEED IN THE CENTER.
☐	☐	16. I WASTE A LOT OF TIME IN THE CENTER THAT I SHOULD SPEND STUDYING.
☐	☐	17. THE MEDIA CENTER MAKES LEARNING FUN.

THIS QUESTIONNAIRE HAS BEEN DEVELOPED TO HELP OTHERS LEARN MORE ABOUT YOU AND YOUR FEELINGS. YOUR OPINION IS IMPORTANT, SO PLEASE ANSWER THESE QUESTIONS AS HONESTLY AS YOU CAN. DO NOT SIGN YOUR NAME.

IN EACH CASE YOU SHOULD READ THE STATEMENT CAREFULLY AND DECIDE HOW YOU FEEL ABOUT THAT STATEMENT. YOU MAY THINK THE STATEMENT IS CERTAINLY TRUE, SO, YOU MIGHT SAY THAT YOU STRONGLY AGREE WITH THAT STATEMENT. YOU MIGHT, HOWEVER, FEEL THAT THE STATEMENT IS CERTAINLY NOT TRUE. IN THIS CASE YOU MIGHT SAY THAT YOU STRONGLY DISAGREE WITH THE STATEMENT.

IN SOME CASES YOUR FEELING ABOUT THE STATEMENT MAY BE SOMEWHERE BETWEEN THESE VERY STRONG ANSWERS, AND YOU MIGHT JUST ANSWER AGREE OR DISAGREE. IN A FEW CASES YOU MAY FEEL THAT YOU JUST DON'T KNOW ENOUGH ABOUT THE STATEMENT TO MARK ANY OF THESE, OR YOU MAY JUST NOT FEEL EITHER ONE WAY OR THE OTHER----YOU WOULD THEN MARK NO OPINION.

TO MAKE IT EASIER FOR YOU, THESE DIFFERENT POSSIBLE ANSWERS ARE LISTED NEXT TO THE NUMBERS 1, 2, 3, 4, AND 5. YOU SHOULD CHOOSE THE ANSWER YOU BELIEVE BEST DESCRIBES YOUR FEELING AND BLACKEN THE SPACE NEXT TO THE CORRECT NUMBER.

5 I STRONGLY AGREE WITH THE STATEMENT.

4 I AGREE WITH THE STATEMENT.

3 I HAVE NO OPINION ABOUT THE STATEMENT.

2 I DISAGREE WITH THE STATEMENT.

1 I STRONGLY DISAGREE WITH THE STATEMENT.

REMEMBER, THE ONLY CORRECT ANSWER IS THE ONE WHICH ACTUALLY REPRESENTS HOW YOU FEEL ABOUT THE MULTI-MEDIA APPROACH.

DEFINITION OF MULTI-MEDIA

THE TERM MULTI-MEDIA APPROACH MEANS LEARNING FROM A WIDE RANGE OF MATERIALS: BOOKS, TAPES, FILMSTRIPS, RECORDS, ETC. THESE MATERIALS ARE LOCATED IN A CENTRAL MEDIA CENTER (IMC) AND ARE EASILY AVAILABLE.

Grades 5-8 Student Scale

MULTI-MEDIA APPROACH

I feel that

1. I am able to learn faster since the multi-media approach was adopted.
2. since the multi-media approach was started I am better able to work on my own.
3. since the multi-media approach has been adopted, I am better able to study those topics that interest me.
4. attending school has been made more pleasant by the multi-media approach.
5. I have been given more responsibility for my own conduct at school than I can handle.
6. I am more inclined to study now than I was before we had the media center.
7. I am usually able to find help with my school work when I need it.
8. I can't usually find the materials I want when I need them.
9. the equipment I need is usually available.
10. I am more concerned about whether I am learning than whether or not I am keeping up with the rest of my class.
11. I have as much opportunity to express myself as I would like.
12. my study habits haven't improved very much since the multi-media approach was started.
13. I like going to school more now than I did before the multi-media approach was started.
14. the center is overcrowded!
15. when I want to I can usually study without interruption.
16. I am not given enough time to study the things I would really like to study.
17. the multi-media approach to learning isn't satisfactory as far as I'm concerned.

18. I could do as well in school without all of the multi-media materials and equipment.
19. I would like to see the multi-media approach continue in the Sibley schools.
20. it is easy to waste a lot of time in school.
21. the people who work in the center are usually available to help me when I need help.
22. I don't have to keep up with the rest of my class.
23. I have not learned as much this year as I expected to learn.
24. the center is not very well organized.
25. the multi-media approach has slowed me down in school.
26. I usually have too much work to do.
27. my teachers don't have enough time to spend with me.
28. I like to use the center.
29. I have been very disappointed with the multi-media approach.
30. I am satisfied with the progress I have been making in school.
31. I don't like many of the people who work in the center.
32. I can learn everything I would like to learn by using only my textbooks.
33. I have been shown how to find the materials I need in the center.
34. I know how to use the center.
35. I waste a lot of time in the center that I should spend studying.
36. the personnel in the media center are usually too busy to help me.
37. the media center is a waste of money.
38. there is not enough help available for students in the media center.
39. the media center makes learning fun.
40. the media center is a waste of student time.

Grades 9-12 Student Scale

MULTI-MEDIA APPROACH

I feel that

1. I am able to learn faster since the multi-media approach was adopted.
2. since the multi-media approach was started I am better able to work on my own.
3. since the multi-media approach has been adopted, I am better able to study those topics that interest me.
4. attending school has been made more pleasant by the multi-media approach.
5. I have been given more responsibility for my own conduct at school than I can handle.
6. I am more inclined to study now than I was before we had the media center.
7. I am usually able to find help with my school work when I need it.
8. I can't usually find the materials I want when I need them.
9. the equipment I need is usually available.
10. I am more concerned about whether I am learning than whether or not I am keeping up with the rest of my class.
11. I have as much opportunity to express myself as I would like.
12. my study habits haven't improved very much since the multi-media approach was started.
13. I like going to school more now than I did before the multi-media approach was started.
14. the centers are overcrowded!
15. when I want to I can usually study without interruption.
16. I am not given enough time to study the things I would really like to study.
17. the multi-media approach to learning isn't satisfactory as far as I'm concerned.

18. I could do as well in school without all the multi-media materials and equipment.
19. I would like to see the multi-media approach continue in the Sibley schools.
20. it is easy to waste a lot of time in school.
21. the people who work in the centers are usually available to help me when I need help.
22. I don't have to keep up with the rest of my class.
23. I have not learned as much this year as I expected to learn.
24. the centers are not very well organized.
25. the multi-media approach has slowed me down in school.
26. I usually have too much work to do.
27. my teachers don't have enough time to spend with me.
28. I like to use the centers.
29. I have been very disappointed with the multi-media approach.
30. I am satisfied with the progress I have been making in school.
31. I don't like many of the people who work in the centers.
32. I can learn everything I would like to learn by using only my textbooks.
33. I have been shown how to find the materials I need in the centers.
34. I know how to use the centers.
35. I waste a lot of time in the centers that I should spend studying.
36. the personnel in the media centers are usually too busy to help me.
37. the media centers are a waste of money.
38. there is not enough help available for students in the media centers.
39. the media centers make learning fun.
40. the media centers are a waste of student time.

TEACHER INFORMATION

1. Total number of years of teaching experience _____

2. Total number of years of teaching experience in Sibley _____

3. Educational background--use the following code: _____
   1. less than B.A.
   2. B.A.
   3. B.A. + 15 semester hours
   4. M.A. or B.A. + 30 semester hours
   5. B.A. + 45 semester hours
   6. more than B.A. + 45 semester hours

4. Number of years since your most recent educational experience _____

5. Level at which you are teaching--use the following code: _____
   1. K-4
   2. 5-8
   3. 9-12

6. Age _____

7. Area of teaching specialty--use the following code: _____
   1. business or distributive education
   2. English language arts
   3. fine arts
   4. foreign languages
   5. home economics
   6. industrial arts
   7. mathematics
   8. physical education and health
   9. science
   10. social studies
   11. vocational and technical education
   12. other (please specify)

8. Are you teaching at the grade level and/or in the discipline that you prefer? _____

9. Sex--use the following code: _____
   0. Female
   1. Male

TEACHER SCALE

I feel that

1. the multi-media approach has helped me to become a better teacher.
2. I am not very enthusiastic about the multi-media approach.
3. I can usually get the materials I need for my classes when I need them.
4. the personnel working in the centers are very helpful.
5. I would rather teach under a more traditional teaching format.
6. my attitude toward teaching is as good or better now than it has ever been in the past.
7. the amount of material that is available is sufficient for my teaching purposes.
8. the multi-media approach is a farce.
9. the multi-media approach has made it possible for me to do a better job as a teacher than I could under a more traditional format.
10. the multi-media approach doesn't allow enough time for me to prepare.
11. the multi-media approach is too liberal in its handling of students.
12. the multi-media approach should be continued in Sibley.
13. I would like to have more control of students than I have under the present set-up.
14. discipline problems under the present set-up are interfering with my teaching.
15. I am better able to help students on an individual basis than I could under a more traditional format.
16. the media centers are inadequately supervised.
17. my effectiveness as a teacher is enhanced by the multi-media approach.
18. the multi-media approach is a credit to the Sibley Community schools.
19. I have been encouraged to utilize the personnel and materials that are available.

20. the cost incurred in establishing the multi-media approach exceeds its benefits.
21. materials I need for my classes are often not available.
22. resources such as books, films, prints, etc. are easy to locate.
23. services provided by the center personnel are usually satisfactory.
24. much of the equipment that is available is of poor quality.
25. students are well adjusted to the multi-media approach.
26. I have to wait too long for help to make effective use of the media centers.
27. more personnel are needed in the media centers.
28. money could be better spent on materials and equipment for my classroom than to continue spending for the media center.
29. the school is poorly equipped and supplied for implementation of the multi-media approach in my field.
30. I like the multi-media approach.
31. equipment I need for my classes is not available.

APPENDIX B. REDUCED ATTITUDE SCALES

Grades K-4 Student Scale

Multi-media Approach

Yes No I feel that Reliability = .58

___ ___ 2. I usually have a hard time finding things when I need them.

___ ___ 3. I like going to school!

___ ___ 4. the center is too crowded!

___ ___ 5. I usually have enough time to study the things I would really like to study.

___ ___ 8. the people who work in the center are usually ready to help me.

___ ___ 11. I usually have too much work to do.

___ ___ 12. My teacher usually has enough time to spend with me.

___ ___ 14. Some of the people who work in the center are unfriendly.

___ ___ 15. I have been shown how to find the things I need in the center.

___ ___ 17. the media center makes learning fun.

Attitude toward the environment for working and studying.

Grades 5-8 Student Scale

Multi-media Approach

SCALE 1 Reliability = .80

I feel that

1. I am able to learn faster since the multi-media approach was adopted.

3. since the multi-media approach has been adopted, I am better able to study those topics that interest me.

4. attending school has been made more pleasant by the multi-media approach.

17. the multi-media approach to learning isn't satisfactory as far as I'm concerned.

18. I could do as well in school without all of the multi-media materials and equipment.

19. I would like to see the multi-media approach continued in the Sibley schools.

28. I like to use the center.

29. I have been very disappointed with the multi-media approach.

32. I can learn everything I would like to learn by using only my textbooks.

40. the media center is a waste of student time.

SCALE 2 Reliability = .61

2. since the multi-media approach was started I am better able to work on my own.

7. I am usually able to find help with my school work when I need it.

33. I have been shown how to find the materials I need in the center.

34. I know how to use the center.

SCALE 3 Reliability = .61

16. I am not given enough time to study the things I would really like to study.

21. the people who work in the center are usually available to help me when I need help.

24. the center is not very well organized.

36. the personnel in the media center are usually too busy to help me.

38. there is not enough help available for students in the media center.

SCALE 1--Attitude toward the multi-media approach as an aid to learning.

SCALE 2--Attitude toward the multi-media approach as an aid to self-help.

SCALE 3--Attitude toward the functioning of the media center.

Grades 9-12 Student Scale

Multi-media Approach

SCALE 1 Reliability = .79

I feel that

1. I am able to learn faster since the multi-media approach was adopted.
2. since the multi-media approach was started I am better able to work on my own.
3. since the multi-media approach has been adopted, I am better able to study those topics that interest me.
4. attending school has been made more pleasant by the multi-media approach.
6. I am more inclined to study now than I was before we had the media center.
13. I like going to school more now than I did before the multi-media approach was started.
18. I could do as well in school without all the multi-media materials and equipment.
39. the media centers make learning fun.

SCALE 2 Reliability = .82

19. I would like to see the multi-media approach continue in the Sibley schools.
21. the people who work in the centers are usually available to help me when I need help.
25. the multi-media approach has slowed me down in school.
28. I like to use the centers.

29. I have been very disappointed with the multi-media approach.

32. I can learn everything I would like to learn by using only my textbooks.

37. the media centers are a waste of money.

40. the media centers are a waste of student time.

SCALE 1--Attitude toward the environment for studying.

SCALE 2--Attitude toward the practical utility of the multi-media approach.

Teacher Scale

SCALE 1 Reliability = .97

I feel that

1. the multi-media approach has helped me to become a better teacher.

3. I can usually get the materials I need for my classes when I need them.

4. the personnel working in the centers are very helpful.

9. the multi-media approach has made it possible for me to do a better job as a teacher than I could under a more traditional format.

17. my effectiveness as a teacher is enhanced by the multi-media approach.

18. the multi-media approach is a credit to the Sibley Community schools.

19. I have been encouraged to utilize the personnel and materials that are available.

22. resources such as books, films, prints, etc. are easy to locate.

23. services provided by the center personnel are usually satisfactory.

30. I like the multi-media approach.

SCALE 2 Reliability = .97

5. I would rather teach under a more traditional teaching format.

8. the multi-media approach is a farce.

12. the multi-media approach should be continued in Sibley.

13. I would like to have more control of students that I have under the present set-up.

14. discipline problems under the present set-up are interfering with my teaching.

16. the media centers are inadequately supervised.

20. the cost incurred in establishing the multi-media approach exceeds its benefits.

28. money could be better spent on materials and equipment for my classroon than to continue spending for the media center.

SCALE 1--Attitude toward the multi-media approach as an aid to teaching.

SCALE 2--Attitude toward the practical utility of the multi-media approach.