Summer 8-1-1963

An Investigation of a Junior High School Mathematics Laboratory through Team Teaching Procedures

Lloyd Don Stacy
Central Washington University

AN INVESTIGATION OF A JUNIOR HIGH SCHOOL MATHEMATICS LABORATORY THROUGH TEAM TEACHING PROCEDURES

A Research Paper

Presented to

the Graduate Faculty

Central Washington State College

In Partial Fulfillment

of the Requirements for the Degree

Master of Education

---

by

Don Stacy

August 1963

ACKNOWLEDGMENT

Grateful acknowledgment is extended to Dr. Gerald L. Moulton for his assistance and encouragement in directing the writing of this paper and to Dr. D. Daryl Basler and Mr. Reino Randall as committee members.

THIS PAPER IS APPROVED AS MEETING THE PLAN 2 REQUIREMENT FOR THE COMPLETION OF A RESEARCH PAPER.

Gerald L. Moulton

FOR THE GRADUATE FACULTY

TABLE OF CONTENTS

CHAPTER I

INTRODUCTION

The magnitude of influence that modern mathematics has generated throughout many school systems is responsible for a dynamic impact upon current curriculum changes. It may be accurately stated that recent advances in the field of instructional mathematics has created an imperative need for improved teaching procedures and curriculum changes. Harold Gores, former Newton, Massachusetts superintendent of schools prefers to generalize the changes in curriculum as:

> An atmosphere in which teachers and department heads--the people who work directly with students--are encouraged to weigh standard practices, to test new ways of teaching, to risk error without fear of reprisal, and if it happens their work fails, to win praise for trying (14:55).

To assume the responsibility of a progressive instructor in the fast-changing world of modern mathematics, does require the adopted philosophy of complete flexibility incorporated into every realm of classroom instruction. Mathematics offers a fascination to many students because of its opportunities for creation, discovery, and utilization. It continually grows rapidly, motivated by intellectual curiosity and practical applications. Even at the junior high level, students can be encouraged to formulate mathematical questions and conjectures which can be tested and perhaps settled; they can be channeled into developing systematic attacks on mathematical problems even though perhaps the problems do not have routine or immediately determinable solutions.

Instructional leaders must be aware of required changes in the presentations of new curriculums, if they expect to meet the challenge that presents itself when totally new programs are inaugurated. It is certainly logical thinking to--we must develop a sensitive awareness of numerous practices, both proven and experimental, which would provide maximum effectiveness in classroom presentations. If the students are expected to react in a highly stimulated fashion through the facilities of a totally new, fresh approach to mathematics, then instructors themselves must be held responsible for the development of this interest through completely revised approaches of curriculum innovations.

It is with this brief background thinking that all justification of changes in curriculums seem evident by proof of need. This is further emphasized in the foreword of the S. M. S. G. Mathematics for Junior High School as they state:

> One of the prerequisites for the improvement of the teaching of mathematics in our schools is an improved curriculum--one which takes account of the increasing use of mathematics in

> science and technology and in other areas of knowledge and at the same time one which reflects recent advances in mathematics itself (13:1).

I. THE PROBLEM

<u>Statement of the problem</u>. The purpose of this study was to plan the initial developments of a junior high school mathematics laboratory. The developments include the implementation of team teaching procedures involving a demonstration unit establishing a modern mathematics approach to the teaching of geometry.

<u>Importance of the study</u>. Since the close of World War II there has been an increasing interest and study in the field of mathematics. The traditional methods of teaching have been proven outmoded. No longer can we be satisfied with rote learning of mathematics as we have had in the past. There is now more emphasis on discovery and creative mathematic explorations within the classroom with a development of new methods and procedures (10:see introduction).

Mathematics cannot be taught by formula alone--as was done in the early 1900's when 90 per cent of our nation's population was engaged in farming or other unskilled labor. "During the past three decades there has been a gradual movement in the elementary school away from instruction based upon the acquisition of facts and on the rote learning of techniques" (3:8). This was especially true in fields such as the language arts, social studies, and science. It was not true, however, in the field of mathematics. It has been only recently that this change in approach--searching for patterns in relations and on learning by discovery--has reached the mathematics curriculum. This is now true at various levels of our school curriculums. Now there is a change of emphasis away from that of studying mathematics as a way of doing something, to the study of mathematics as a way of thinking (15:7).

The new mathematics has played a key role in the development of the complex technological world that we live in today--one which takes account of the increasing applications for mathematics in electronic computations, nuclear energy, rocketry and space travel. The changes now taking place in mathematics are so extensive that they are often described as a "revolution." A revolution not in the strict sense of the word but in that the implementation of this reform has been so rapid.

> The 20th century has been the golden age of mathematics; since more mathematics, and more profound mathematics, has been created in this period than during all the rest of history. This century has seen the introduction and development of pure-mathematic subjects such as abstract algebra, topology, measure theory, general theories of integration, and functional analysis, including the theory of Hilbert space (3:8).

The so-called "revolution" in mathematics now in progress requires a clear reviewing of the curriculum we now have under the traditional mathematics program. If we are to improve the teaching of mathematics in our schools we must have an improved curriculum --a curriculum which will place mathematics in its proper place in relation to the culture and to the ever-accelerating pace of change of our modern world.

> Clearly it is not enough to teach children the computational rules for solving the problems they encounter now and to assume that these rules will be adequate for the problems they will be confronted with even ten or twenty years from now. There is no way of predicting what those problems will be or what rules will be needed to solve them. Children, from their first experiences with mathematics, must understand the concepts basic to the structure of mathematics so that they will be able to use these concepts to create the rules needed to solve the increasingly complex problems of the future (12:20).

This paper will attempt to show the value of a mathematics laboratory as one systematic device in teaching the mathematical concepts that are adequate for the needs of our time.

II. DEFINITION OF TERMS USED

Mathematics Laboratory. A laboratory, according to Webster, was originally the workroom of a chemist. A more comprehensive definition describes it as a place devoted to experimental study in any science. Mathematics has not been generally regarded as a laboratory science, and hence there are numerous versions of what constitutes a mathematics laboratory. Perhaps the most common interpretation is: "a classroom which contains an abundance of specialized mathematics equipment and materials, and where frequent use is made of the laboratory method of teaching" (8:14).

Team teaching. There are only a few definitions of team teaching available, and none of them say quite the same thing. Taken together, however, they suggest that team teaching is certainly more than a group of teachers who have amiably agreed to work together; it is offered in summary as:

> In effect, authorities suggest that team teaching take various forms, but whatever its variations it is essentially a way of organizing the instructional program which is applicable at either secondary or elementary level. Teams may work "vertically" through the school, i.e., at all grade levels in a single subject or closely related subjects, or they may work "horizontally," i.e., at one grade level but in several subjects. For example, all teachers of language arts may work as a team with all pupils from grades seven through twelve. Even a small team has a leader, and many large teams have a hierarchy of levels that bestows different titles on its members--"senior teacher," "regular teacher," "master teacher," and "intern." The heart of it seems to be an almost precedented kind of unity: members of the team plan together, collaborate constantly, communicate without restraint, and shape sincerely and selflessly. Working together they can revise procedures and revamp programs to meet the educational needs of their pupils. In a sense the movement toward team teaching may be considered something of a revolt against the organizational restrictions of the past and a sharp reminder to all and sundry that the purpose of school administration is to serve the educational processes, not to control it. One project director says: "We are questioning the status quo (4:53).

III. REVIEW OF RELATED LITERATURE

The Mathematics Laboratory

The mathematics laboratory is relatively extensive in assumptions, but basic research on the subject is limited. Since the entire laboratory project is of an experimental nature, and regarded by the writer as a pilot program, direct quotations from experts in the related field are offered as justifying the proof of need. Lawrence P. Bartnick, author of Designing the Mathematics Classroom, states:

> Basically a room which is thoroughly and intelligently equipped, which has ample storage and display space, and which is sound in its other physical features, will qualify as a laboratory. This is true not only because of the equipment and facilities present, but also because of the way they are used (2:25-27).

Howard F. Fehr states in an article entitled, "The Place of Multisensory Aids in the Teacher Training Program": "Laboratory teaching is one answer to giving reality to mathematics without the loss of its abstract and theoretical aspects." He feels that every topic in elementary or secondary mathematics can be exemplified and put to work in a mathematics laboratory, although he realizes that for teachers there is the problem of additional training in the use of multisensory aids in instruction. In a laboratory which is used to create a spirit of research and discovery can be found all the measuring instruments, as well as material for constructing simple instruments; calculating devices of all sorts, such as the abacus, the slide rule, and the modern calculating machine; geometrical models; surveying and astronomical instruments; charts and globes; and any additional devices that can be used to illustrate mathematical principles.

Emil J. Berger in his article, "A Guide to the Use and Procurement of Teaching Aids for Mathematics," relates: "Every mathematics department should have a mathematics workroom--a room adjacent to at least two classrooms, accessible to the hallway, and equipped with materials, tools, and a worktable. Here students could work on projects, meet in committees, or receive individual help" (6:141-144).

Harlan Pafford, Head, Mathematics Department, Marion High School, Marion, Virginia, states his opinions regarding planned stages of a mathematics laboratory in his own school department as: "The individual student cannot become familiar with separate items of mathematics equipment, he cannot develop an ease in handling them nor can he learn the many uses of such items unless he has the opportunity to practice and experiment with them. This practice is possible only when adequate laboratory space is provided and enough separate pieces of equipment for individual work are at hand. Inquisitiveness can be encouraged when space and equipment are available for the pupil to enlarge upon his imaginative ideas. Mathematical concepts can be studied in the classroom, but modern teaching methods demand an opportunity to test ideas in the laboratory" (8:141).

A group of local administrators and instructional leaders from the Wilmington High School, Wilmington, Delaware, anticipated that the mathematics laboratory in their new high school would not only deal with standard academic and general mathematics instruction and procedures, but also that a more creative type of activity would be introduced so that students would actually construct models and materials to demonstrate mathematical processes and forms of mathematical significance. After almost two years of experience with the laboratory, these mathematics teachers now report that both of the anticipated intents are being realized. As the possibilities of the laboratory have been explored, an improved attitude toward mathematics has been noted and more individual needs have been satisfied (8:144).

In trying to cope with the frustration felt by students enrolled in general mathematics, Valley High School in Albuquerque, New Mexico, installed four mathematics laboratories. It was intended that students would gain a better understanding of mathematics and would find the subject so interesting that they would want to complete more than one or two years of mathematics study. Valley High furnished its students with specially designed desks in the laboratories; desks that have easel tops for convenience, and offer a wide working space. Desk tops are patterned with the polar and rectangular coordinates and are made of a material which allows the students to draw directly on the desks without damage. Each lab is equipped with special venetian blinds to help ensure optimum performance from the audio-visual equipment. The reference library, designed for both students and teachers, is shared by the four laboratories. This library has proved to be the nucleus of the mathematics areas (8:143).

Out of this survey of related literature a brief but enriched statement which both summarizes and amplifies the major point, is: "Mathematics should be no less a challenge to the slow learner and the student of average mathematical ability than it is to the talented--a challenge that arises from interest." (6:40)

Team Teaching: A Look Into the Background

Under related literature involving team teaching and its ramifications, Harvard University's "SUPRAD," School and University Program of Research and Development, claims the preliminary stages of team teaching was begun at Franklin School in Lexington, Massachusetts, in 1957 (4:8). More changes have been made in the curriculum of the junior high school during the past five years than during any other similar period since the junior high school was first established.

Although numerous changes are being made in the curriculum of the junior high school, they are being directed primarily toward the more able pupils--the upper eight to ten per cent. Consequently, as one visits junior high schools today, one finds many honors classes, accelerated classes, and enrichment classes. These classes are usually found in the modern foreign languages, in mathematics, and in science. The quality of the instructional program can be improved only if we find more effective ways for teachers and pupils to work together in learning situations (5:7).

To the fullest extent possible, subject area teachers develop activities and experiences for pupils in their classes that not only will promote the achievement of objectives for their particular courses, but also use the work and study in other areas to enrich and reinforce on-going activity. In one sense, good schools always have encouraged a form of team teaching.

The article "Team Teaching" by R. H. Anderson in the March issue of the National Education Association, relates some of the essentials of the team teaching processes:

> In team teaching, many teachers will recognize certain processes of co-operative endeavor which are frequently found in good schools. Varieties of informal, co-operative teaching have probably existed for some time. Specifically, a teaching team is a group of several teachers (usually between 3 and 6) jointly responsible for planning, carrying out, and evaluating an educational program for a group of

children. At present there are about 100 communities throughout the U. S. engaged in one form or another of team teaching; hundreds of other communities are known to be planning toward it. Research in the status of team teaching is complicated by the fact that the term "team teaching" is being used very broadly: Many of the arrangements now labeled as "team teaching," some believe, should be given a name such as "co-operative teaching," "collaborative teaching," or the like.

The essential ingredients of team teaching are not only co-operative and collaborative in the planning and presentation of the program, but also the assignment of specific leadership and responsibility (with the accompanying prestige and recognition) to career-oriented teachers of superior training and competence. Though team teaching is new in a certain sense, it is actually an outgrowth of other trends and movements in this and other centuries, rooted particularly in previous systems of deploying personnel and arranging the pupils' daily programs (1:52-54).

Forerunners

One important and recent forerunners of team teaching is the Bay City, Michigan, study, involving the use of teacher aides. Although the team idea does not necessarily involve the use of non-professional assistants, Bay City opened the way to a fresh understanding of the multitude of routine but time-consuming tasks for which teachers are held responsible and to new insights into ways pupils can be grouped and taught.

Example Plans

As mentioned earlier with regard to Lexington, Massachusetts being the center of perhaps the first experimental plan for team teaching in 1957, their program began in the elementary school. The Lexington Plan consists of three teams operating, each having a team leader. Each team teaches two grades. In each team, characteristically, the pupils spend the day in a succession of varying-sized groups, and all six teachers have at least some responsibility for each child (1:52-54).

The Norwalk Plan. The Norwalk, Connecticut, Plan, inaugurated in 1958-59 consists of four elementary schools with teams of three members: the team leader, a co-operative teacher, and the teacher aide. Each of the original teams is working with about 75 to 80 pupils at a single grade level and in spaces equal to three standard classrooms.

The Evanston Plan. Evanston, Illinois, was among the first full-time high schools to become involved in using teacher teams. Fourteen different courses involve 55 teachers and 14 instructional aides in teaching teams, which provide instruction for 2600 students. The teams are small as three and as large as nine. Students assemble for large group presentations in groups ranging from 68 to 130. Such large group instruction embraces about one-half of the regular class time and may often include use of a closed-circuit T. V. or a presentation by a talented member of the community.

Jefferson County Plan. The Jefferson County School District R-1 has implemented perhaps the largest team teaching project found in existence in the United States. Located in Colorado, it involves 7 high schools, approximately 3000 students, 50 teachers, and 9 clerks. It has included a wide variety of experiments touching every curriculum area during its three years of existence as one of the staff utilizations of National Education Association research projects. Basically, the team consists of four persons: the team leader, two qualified teachers, and a clerk. There have been experimental teams which have included specialists (such as a librarian or guidance counselor), students, and community consultants. Most teams concentrate upon one subject area, but inter-disciplinary teams have been tried. Grouping procedures and schedule modifications take many different forms and teachers are encouraged to develop new teaching materials and techniques to fit the new methods of organization. The following are the specific hypotheses which were proposed and tested for the Jefferson County Plan:

(1) Teaching teams produce better results in the educational development of pupils than teachers working singly with regular classes. (2) Better results in pupils' educational development are produced with a schedule which is modified for more efficient utilization of staff than with a regular schedule. (3) It is economically feasible to use team

teaching and schedule modification in secondary schools. (4) The opportunities for varied pertinent learning experiences are provided better in situations using team teaching and schedule modification than in regular classes.

In summarizing the reported plan, the authors Johnson, Lobb, and Swenson stated: "Data thus far are incomplete and tentative, but there is at least sufficient evidence to justify further exploration and development of team teaching organization" (7:79-93).

Supporting Summarizations

The School and University Program of Research and Development, Harvard University, has listed these major supports of the total team teaching program:

> It is good organization. As a plan of organizing for instruction, it preserves the virtue and avoids the weakness of both the self-contained classroom and its opposite number, departmentalized instruction; it makes it possible to have every subject taught by a specialist, yet it preserves the interrelatedness of subject and learning. It makes the most strategic use of each teacher's knowledge and skill, accommodates different levels of teacher responsibility and competence.
>
> The pupil profits. The pupil, having the academic advantage of being taught each subject by a teacher strong in that particular subject, is more likely to find scholarship attractive, to be challenged to work to capacity. His interests, abilities, and needs are more likely to be discovered when he is taught by two or more teachers working closely together than when he is taught by one teacher working more or less alone; and the flexible grouping and regrouping that characterizes many team teaching programs provides more realistically

for pupil differences than straight "ability" grouping. The quality of instruction that a pupil receives during any one term or school year does not depend on the competence of a single teacher!

The staff profits. The teacher receives more professional stimulation when he works on a team than when he works in isolation--there is better communication among staff members, more motivation for continuous curriculum improvement, more co-operative planning. Because the team places a premium on unusual ability and skill and on exceptional qualities of leadership, it encourages teachers to grow professionally.

The school profits. There is more opportunity for flexible schedules and efficient use of space, materials, and equipment; in other words, the administration is encouraged to respond to changing needs rather than to be restrictive. Well-qualified teachers are more likely to be attracted to the school. Because the team has room for different levels of teaching ability, it makes it easier for the school to raise teachers' salaries to professional skill and leadership; easier, too, to provide inservice training for inexperienced teachers (4:58).

It seems very apparent to this writer that of all the developments which could come from team teaching at least one of the most important is the improvement in the quality of teaching through a greater amount of individual instruction given to the students and the enrichment of the program. The team approach may certainly allow a teacher a greater opportunity to assist the gifted student as well as the less academic student.

IV. METHODS AND PROCEDURES

The writer has attempted to review related literature that shows the value of mathematical laboratories as a meaningful approach to mathematics instruction. To re-define the math laboratory as "a classroom which contains an abundance of specialized materials, and where frequent use is made of laboratory method of teaching," an academic description of same may be offered as the laboratory approach to the teaching of mathematics provides for independent investigation and experimentation for both individuals and groups. Students discover mathematical facts and concepts through the manipulation of objects, through the design and construction of models, through studious inquiry and testing of hypotheses, through the application of theory, and through reading and discussion. An advantage of the laboratory method of teaching is that it is equally applicable to a modern or a traditional program of mathematics instruction. (Most of the activity with the laboratory approach so far has been at the secondary level.)

Physical Description

A physical description of the mathematics laboratory to be incorporated next year is listed as: an eighteen-hundred square foot classroom which includes special student "carrels" installed on conventional desks and tables permitting individual privacy. The carrels are eighteen inches in height, enclosed on three sides, and are removable and portable, with respect to the placement installations. Large portable room dividers permitting partitioning of group divisions within grade-level or group-level sections will be used extensively. The functional purpose of the entire laboratory centers around the complete flexibility of furniture arrangement, with special regard for grouping both individually and collectively.

Groupings and Scheduling

The proposed operational plan involving grouping includes six groupings, using selective criteria such as Iowa Basic mathematics placement results, composite results from the total listings of Iowa Basic Skills tests, I. Q. test scores, grade achievements, and teacher recommendations pertaining to each individual student. The teacher recommendations may be used as a replacement criteria for student selection in groupings, or serve as additional information in individual assignment classes.

At the present time, with probable future revisions, the six selected groups are listed as:

(1) Algebra Class

(2) Advanced Mathematics Class

(3) High Core Group

(4) Average Core Group

(5) Low Core Group

(6) Low Group

Application of Selected Criteria and Hypothetical Schedule

As of the present stages of development, the criteria listed, Iowa Basic Skills results, semester grade achievements, I. Q. test scores, and teacher recommendations, have formulated the basis for the designated groupings. The writer wishes to emphasize that these six-grouped sections undoubtedly will be subject to some regrouping; it is impossible at this time to permanently assign students into divided classifications. This laboratory program demanded initial selection of students for assignment purposes, but it is obvious that during the year there will be fluctuations within these six areas.

The sample schedule found on the following page will also require modification during the incoming school year. Administration problems of the total academic program, with regard to separate classroom assignments, will dictate any necessary scheduling changes. As of now, all students are being processed for subject and classroom designations in all of their other subjects first, with the idea in mind that they will undertake their mathematics during some time of the day when best suited to their needs of scheduling. The whole philosophy in mind here is "maximum flexibility" of scheduling.

HYPOTHETICAL SCHEDULE

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
1	8th Grade Algebra Class, Programmed Algebra Class, and Adv. Math Class, and 7th Gr. Algebra Preparatory Group (53)	8th Grade Algebra Class, Programmed Algebra Class, and Adv. Math C. and 7th Gr. A1 Group (53)	8th Grade Algebra Class, Programmed Algebra Class, and Adv. Math Class, and 7th Gr. A1 Group (53)	8th Grade Algebra Class, Programmed Algebra Class, and Adv. Math Class, and 7th Gr. A1 Group (53)	8th Grade Algebra Class, Programmed Algebra Class, and Adv. Math Class, and 7th Gr. A1 Group (53)
2	ACTIVITY PERIOD (open for some students)	ACTIVITY PERIOD (It is assumed that some students will be able to use this period for needed class study time in the mathematics laboratory, or any other subject.)	ACTIVITY PERIOD	ACTIVITY PERIOD	ACTIVITY PERIOD
3	High Core Group and Average Core Group (48)	High Core Group and Average Core Group (48)	High Core Group and Average Core Group (48)	High Core Group and Average Core Group (48)	High Core Group and Average Core Group (48)
4	8th Grade Low Core and 7th Gr. Adv. Core (41)	8th Grade Low Core and 7th Gr. Adv. Core (41)	8th Grade Low Core and 7th Gr. Adv. Core (41)	8th Grade Low Core and 7th Gr. Adv. Core (41)	8th Grade Low Core and 7th Gr. Adv. Core (41)
	LUNCH	LUNCH	LUNCH	LUNCH	LUNCH
5	8th Grade Low Group (45)	8th Grade Low Group (45)	8th Grade Low Group (45)	8th Grade Low Group (45)	8th Grade Low Group (45)
6	7th Grade High Core and 7th Gr. Low Groups (54)	7th Grade High Core and 7th Gr. Low Groups (54)	7th Grade High Core and 7th Gr. Low Groups (54)	7th Grade High Core and 7th Gr. Low Groups (54)	7th Grade High Core and 7th Gr. Low Groups (54)
7	7th Grade Ave. Core and 7th Gr. Low Core Groups (57)	7th Grade Ave. Core and 7th Gr. Low Core Groups (57)	7th Grade Ave. Core and 7th Gr. Low Core Groups (57)	7th Grade Ave. Core and 7th Gr. Low Core Groups (57)	7th Grade Ave. Core and 7th Gr. Low Core Groups (57)

Schedule is based on 298 students, divided into six groups for each grade level (7th and 8th). Number of students in each period is indicated in parentheses.

Materials Used

The following description of materials serves as basis for the course of study for each of the six groups.

Algebra class. Textbook: "Contemporary Algebra, Book One," Smith, Lankford, and Payne, Harcourt, Brace, and World, Inc. "Algebra I," TEMAC programmed materials, Encyclopedia Britannica Press, Inc. Major units for intended coverage are fundamental laws and operations, equations and inequalities, signed numbers, operations with algebraic expression, equations and problem solving, graphing linear equations and inequalities, pairs of linear equations, special products and factors, factions, equations with fractions, ratio, proportion, and variation, roots and radicals, and a brief introduction to quadratic equations. Some of the students of the algebra class will be assigned TEMAC programmed materials using "Algebra I" by Encyclopedia Britannica Press, Inc. An authoritative definition of a TEMAC programmed program is given in the materials as:

> A TEMAC program begins, first of all, with sound content. This content is broken down into small sequential segments or frames. The frames are carefully organized to give students a step-by-step comprehension, along with sufficient review, of the subject matter covered.
>
> Working independently, students read, then fill in the blanks in a series of statements. These statements have been systematically developed to bring out the understanding of one concept, and provide the basis for the next concept. By using the movable masking device, sliding down the page revealing

the next sequence, students check immediately the accuracy of their response through each step of the learning process.

They proceed in this way through to the end of the program, with time out periodically for group discussions, tests, additional help for slow students and enrichment activities for bright ones.

The students' progress can be checked at all important stages in the program through the results of TEMAC tests. TEMAC tests are available in separate booklets or as sample tests in the teacher's guide (14:54-56).

Advanced Mathematics Class. Textbooks: "Mathematics for Junior High School, Volumes I and II; Parts I and II, School Mathematics Study Group, Yale University Press, and "Modern Mathematics for the Junior High School," TEMAC programmed materials, Encyclopedia Britannica Press, Inc. Major units for intended coverage are: S. M. S. G. materials: nature of mathematics (including history), numeration, whole numbers, non-metric geometry, factoring and primes, the rational number system, measurement, area, volume, weight and time, equations, scientific notation, decimals, the metric system, real numbers, and constructions of geometric forms on a limited basis. TEMAC's "Modern Mathematics for the Junior High School," just released last spring for publication, is defined by the publisher as:

> a multi-track program designed for use as an eighth-grade mathematics course or as a seventh-grade course for students with a modern mathematics background. The

> program has three types of frames: 1) basic concept frames in which the usual methods of arithmetic are logically developed from the meanings of the operations and of the numbers; 2) computation frames which are primarily remedial frames in which the basic techniques of working arithmetic problems are stressed; 3) enrichment frames in which the student is led through rigorous proofs of ideas that have been intuitively presented. Average students do the basic frames where necessary and those enrichment frames of which they are capable; slower students do basic frames and computation frames; bright students do basic frames and enrichment frames (14:54-56).

High Core Group. Textbooks: "Modern Mathematics for Junior High School," Rosskopf, Morton, Hooten, and Sitomer; Silver Burdett Company. Major units of intended coverage are: properties of whole numbers, ratio and proportion, analyzing per cent, analyzing geometric forms, measures, new numbers: positive and negative, equations and inequalities, graphs: equations and inequalities, introduction to statistics, plane geometry (demonstration unit used) and some basic investigations into elements of trigonometry. Also intended for the High Core Group is some usage of the previously described TEMAC, new "Modern Mathematics" materials, and TEMAC's "Arithmetic of the Whole Numbers," which is a course for teaching the four basic arithmetic operations with whole numbers, and "Whole Numbers and Numerals," which is a course for developing the arithmetic of whole numbers, stressing the basic properties of whole numbers and of positional systems of numeration.

Average Core Group. Textbooks: "Modern Mathematics for Junior High School," Silver Burdett Company, and "Growth in Arithmetic," Clark and Smith, World Book Company. The current plan for the average core group is to master the traditional course of study as prescribed by World Book's "Growth in Arithmetic," and then, according to the individual achievement, progress on to Silver Burdett's "Modern Mathematics" for advanced work in a contemporary approach. This procedure will undoubtedly demand careful screening by the instructors involved.

Low Core Group. Textbook: "Growth in Arithmetic," World Book Company, together with supplementary remedial materials of the traditional approach to be used as needed. The intended plan for the low core group is to offer a slowed-down version (not watered down) of the same traditional mathematical presentation as offered the average core group. Some remedial practices in lower grade textbook material is anticipated in this grouping.

Low Group. Textbooks of a definite remedial nature are expected within this group; however, as with all low groups, there will be some students capable of performing at a level which would not challenge them if allowed to continue all year at the same pace. It is planned that some fresh approach be at least experimented with involving a "touch" of modern mathematics, which even if only meant introducing something as basic as "one-to-one correspondence," would still provide some interest motivation for these academically unfortunate youngsters.

The Team Teaching Approach

In order to cope more adequately with the vast growth of knowledge, to find more efficient and productive methods for providing an educational program which meets the needs of all pupils, and to improve instruction at all levels, team teaching has entered the scene as one of many diversified approaches. Perhaps one of the most effective methods of operation regarding team teaching procedures is the "teacher specialist approach." This approach involves teams of teachers each teaching his own specialty, i.e., the area he knows best. The teacher specialist is given adequate help from well-qualified certificated teachers who have considerable work and training in the particular area of study. The basic idea in this approach is the use of teacher abilities and talents where they can do the most to provide an optimum educational program for all pupils. In the teacher specialist approach, films or television media can be used to provide the lesson by the specialist. In most instances where this is done, large groups of pupils are involved, and classroom teachers then join the team to provide further experiences for pupils. Speaking in general descriptions of team teaching, however, one of the most accurate and illustrative definitions of the team teaching process is offered by Robert Marsh in his article "Team Teaching--New Concept?"

> Team teaching, while new to education, is not new to our society. A form of this has been used since the late 1700's by our churches. Sunday mornings throughout the U. S. people go to church. The congregation divides into small discussion groups called Sunday schools. The Sunday school teacher, usually a layman, discusses the lesson with the class. Afterwards, the different classes meet together to hear the minister deliver the sermon for that Sunday.
>
> This same method, but in reverse order, can be applied to our schools today. Large student classes are organized to receive knowledge that is common to every student. This may be in the form of a lecture, a guest speaker, or some type of audio-visual material. These large classes are then divided into smaller groups to discuss the material that has been presented.
>
> The students are under the direction of a teaching team instead of a single instructor. The team consists of two to four members who are jointly responsible for the teaching of large groups of students and for the learning activities in small groups. Making up the teams are the following people: team leader, team member, one or two teacher aides.

In summarizing, Mr. Marsh offers these advantages in behalf of team teaching:

(1) The class has an opportunity to hear well-prepared lectures and see demonstrations by superior teachers.

(2) Time can be spent working with the gifted child as well as the slow learner or on an individual basis.

(3) Absence of one teacher will not disrupt the class.

(4) Outside guests would be more willing to speak before large groups.

(5) More time can be given to teachers for preparation of lessons.

(6) The teacher is relieved of much of the routine clerical burden.

(7) In some cases an additional classroom will be made available by combining teachers.

The writer of this paper was impressed by Mr. Marsh's comments on team teaching; with special regard for his mention of "additional classrooms made available by combining teachers." This is exactly what is planned for next year in the proposed experimental laboratory.

The Use of Team Teaching in the Mathematics Laboratory

As of now, the mathematics program next year will consist of two instructors, remaining in the laboratory as a team for the full day. It is planned through the scheduling procedures that while one instructor is conducting a group presentation, the other would be free for at least part of the period to work individually with the students, and what is thought to be *the* most important function of the total program, released time for developing, implementing, and evaluating small seminar groups. These seminar groups will be structured only in the content area; the *manner* in which students select to participate will be based largely upon their own decisions of how they wish to actually function in the small groups. To further clarify: the students who are capable and qualified for being assigned in one of the seminar groups should certainly deserve the privilege of having provided for them a permissive atmosphere. The approach used will, it is believed, lend itself to greater communication between instructor and student.

A distinct advantage should be apparent during the incoming school year; the students themselves, both on an individual level and small group seminars, will obviously receive a greater amplification and enrichment of modern mathematics materials, some of which will be entirely new to them, through the team teaching approach. It is quite obvious that if a teacher can be released part time from the lecture-type presentations which have dominated our present instructional structure, he certainly will function more effectively with students who need, desire, and strive for a greater understanding of mathematical concepts.

CHAPTER II

SUMMARY

The increasing contribution of mathematics to the culture of the modern world, as well as its importance as a vital part of scientific and humanistic education, has made it essential that the mathematics in our schools be both well selected and well taught.

> If the schools now and in the future are to meet the growing demands for an educated people for solving problems, keeping abreast with growing knowledge, and maintaining world leadership for peace, educators must give serious thought and attention to the most important task facing education today--organization of an educational program backed by a highly qualified teaching team, for bringing about the optimum development of all pupils everywhere (44:55).

The purpose of this study was an attempt to show the value of team teaching through the facilities of a mathematics laboratory at the junior high school level, which involves a modern mathematics instructional materials program. One of the most important values in the modern mathematical approach is placing major emphasis on the understanding of basic mathematical ideas which are sometimes hidden within computational techniques. Computation is an important part of mathematics and it must be taught, but it should be taught after the child understands the underlying mathematical ideas.

The writer of this paper has structured the philosophy of the laboratory into four major areas: (1) to determine the status of the problem area; (2) to undertake improvement; (3) to evaluate the status of the program; and (4) to develop suggested recommendations for future study and improvement.

With these four objects-in-point strongly in focus next year, both from instructor and student viewpoint, it may well be stated that the desired goals presented in this study will demand the utmost ingenuity, imagination, and flexibility in the presentation of teaching material and in the use of personnel and facilities. It is sincerely desired that this mathematical laboratory program will produce maximum meaningful learning. Students learn only that which they can understand--things into which they gain an insight. All learning is related to previous learning, and this indicates that curriculum materials should be designed for the maturity and experience levels of the various learners.

This closing statement is offered as a symbolic philosophy which could be adopted as a strengthening guideline to an instructor's realm of instruction:

> Mathematics should be no less a challenge to the slow learner and the student of average mathematical ability that it is to the talented--a challenge which arises from interest (6:415).

BIBLIOGRAPHY

BIBLIOGRAPHY

1. Anderson, R. H., "Team Teaching With Examples of Projects," National Education Association Journal, 50:52-54, March, 1961.

2. Bartnick, Lawrence P., "Designing the Mathematics Classroom," The Mathematics Teacher, 50:25-27, May, 1957.

3. Britton, Leonard Moscato, "Greater Cleveland Mathematics Program," Administrator's Guide, Science Research Associates, Inc. Preliminary Edition, p. 8, 1963.

4. Dean, Stuart E., "Team Teaching: A Review," School Life, 44:5-8, September, 1961.

5. Gruhn, William T., "What Is New In Junior High School Education?" National Association of Secondary School Principals, 44:7, February, 1960.

6. Hatwood, Hollie E., "Enrichment For All!" School Science and Mathematics, 62:415, May, 1963.

7. Johnson, R. H., M. P. Lobb, L. G. Swenson, "An Extensive Study of Team Teaching and Schedule Modification in Jefferson County, Colorado, School District R-1," National Association of Secondary School Principals, 44:79-93, January, 1960.

8. Klutz, Marguerite, "The Mathematical Laboratory--A Meaningful Approach to Mathematics Instruction," The Mathematics Teacher, 61:141-144, March, 1963.

9. Marsh, R., "Team Teaching: New Concept?" The Clearing House, 35:496-499, April, 1961.

10. May, Lola, "Major Concepts of Elementary Modern Mathematics," John Colburn Associates, Inc., 1962.

11. Morton, M. S., "Approaches to Team Teaching," National Association of Secondary School Principals, 44:89-92, October, 1960.

12. Price, G. Baley, "Progress in Mathematics," The Educational Digest, 27:20, February, 1962.

13. School Mathematics Study Group, "Mathematics for Junior High Schools," 1:Part I, Yale University Press, 1961.

14. Shapin, J. T., "Team Teaching," Saturday Review, 44:54-56, March 20, 1961.

15. Thorburn, Tina, and John Dye, Key Topics in Mathematics, Science Research Associates, Inc., 1962.

16. U. S. Department of Health, Education, and Welfare, "The Leadership Role of State Supervisors of Mathematics," Bulletin: Office of Education, 1:48-53, 1962.

A P P E N D I X

A SUGGESTED TEAM TEACHING GUIDE FOR INTRODUCING A UNIT IN GEOMETRIC ANGLES THROUGH THE APPLIED USE OF AERIAL NAVIGATION

Introduction

The stimulating influence that aviation has generated throughout every corner of the world, is responsible for a revolutionary impact upon societies of both complex and primitive nature. Advanced technology has given peoples of the world a modern vehicle capable of transporting men, equipment, and their ideas through aerial pathways at fantastic rates of speed, and as a result extended the power of aviation into the social, economic, and political forces of modern environments.

As frequently illustrated in the past, science and inventions have accelerated ahead of social adjustments in societies. The invention of the aircraft as well as the discovery of atomic energy have tendencies to produce a period of "social lag," since aviation can be related as to having influenced events, conditions of life, and transformed old patterns of social living. Each social, scientific, and economic area in which education deals, every objective of education has been affected. It is imperative that education does not ignore the vital role that aviation plays in its affect upon our societies. Education in aviation can help reduce the social lag.

It is with this background introduction, that the writer of this paper feels a definite need for a more stimulating approach to the teaching of junior high school geometry. The following demonstration unit can be successfully used on a team teaching basis, and can help to provide a highly motivated introductory unit in the presentation of a junior high school geometry unit.

Explanation and Limitations of Unit

This specifically created unit involves the introduction of angles, which is a sub-division of a regular course in junior high school geometry. Because of the nature of the materials used, it lends itself capably to a team teaching approach. One instructor presents the traditional background information concerning a general introductory overview. This provides the opportunity for the second and perhaps third member of the team to concentrate on the direct correlation between basic aerial navigation and its close relationship to the study of angles. Some familiarization in aeronautical chart reading and basic principles of aerial navigation will furnish the teachers with adequate preparation for such a presentation. It is emphasized that a technical knowledge of navigation and flying is not imperative for the teachers involved in this instructional unit.

The suggested unit is limited to the study of angles; it is one of the phases of a complete geometry unit, which is usually taught as a divisional section from the mathematics course of study. A working knowledge and use of lines, points, and space is imperative in the study of angles, and is included in the unit as basic related information. As previously stated, a general introductory overview of geometry is recommended first, allowing the transition into this unit to be made at the discretion of the instructor.

Purpose

The purpose of the unit is to amplify, strengthen, and enrich the students understanding of the importance of angles; their definitions, identifications, measurements, and construction. It is believed that the particular approach offered here provides a higher motivating technique as compared to traditional methods of introduction.

Materials

Aside from the basic tools required by students studying geometry; a compass, legibly calibrated protractor, ruler or yardstick, and medium-hard pencils, the only special items required are sectional or regional aeronautical charts, available at a nominal charge from the United States Department of Commerce, Coast and Geodetic Survey Office, or local flight school operators at thirty cents each. Obsolete, unusable charts for actual navigation purposes, are available free of charge from the Geodetic Survey Office. For purposes of instruction, these aeronautical charts should all be from the same geograhical area, such as the sectional chart used in this unit entitled Seattle.

Suggested Teaching Procedure

Dependent upon available time, teachers' interest and planning, and the nature of desired achievements, the material offered here can and should be adapted and/or modified according to variable conditions. The five major areas of desired learnings, listed on the following pages, serve as a guide for the teacher, and no attempt is made in the sample exercises to cover all of these listings. This is a matter of instructor selection. It is recommended, however, that the following outline be considered as providing a good background for the students in the study of angles, with related areas of lines, points, and space, focusing upon the idea that a totally different approach does generate greater student enthusiasm, interest, and learning.

Basic Outline of Desired Learnings

I. Definition of Geometry

II. Classification and Vocabulary of Angles

- A. Define angle
- B. Naming parts of an angle
    1. sides, arms, or rays
    2. vertex
    3. inside region
    4. outside region

C. Naming and constructing types of angles

1. 90 degree or right
2. acute
3. obtuse
4. straight
5. reflex
6. supplementary
7. complementary
8. adjacent
9. central
10. corresponding

III. Measurement of Angles

A. Define protractor

B. Review degree, minutes, and seconds

C. Review longitude and latitude identification

D. Define arc, ray, radius, diameter, circumference

E. Record proper methods of angle measurement

F. Define complete revolution

IV. Classification and Vocabulary of Lines

A. Define line

B. Naming and constructing types of lines

1. vertical
2. horizontal
3. oblique
4. straight
5. broken
6. curved
7. parallel
8. perpendicular
9. intersecting
10. segment
11. reference line

V. Define and Demonstrate Relationships between Points, Space, and Lines

<u>Chart familiarization</u> For the purpose of the instructional information contained in this suggested unit guide, all exercises and related information refers specifically to the sectional aeronautical chart labeled Seattle. A review discussion of longitude and latitude with respect to degrees, minutes, and seconds should serve as a beginning of chart familiarization. The instructors involved should work with any individuals who need a review of longitude and latitude insuring a thorough understanding of how positions are located on the charts by using the coordinates of longitude and latitude.

From this point on, the demonstrative relationship between geometric angles and aerial navigation becomes a series of planned exercises.

The following sample exercises are offered as examples, illustrative of a planned series of material determined by instructor selection, to be performed by the students.

Aeronautical Chart Exercises

I. Directional Orientation

   A. Locate north, south, east, west

   B. Familiarize additional points; northeast, southeast, southwest, northwest

II. Airport Locations

   A. From the airport directory listed on the back of the chart, find the following airports:

      1. Seattle
      2. Tacoma

3. Olympia
4. Ellensburg
5. Yakima
6. Spokane
7. Pangborn Field (Wenatchee)
8. Astoria
9. Kelso
10. Paine Field

B. Measure carefully from above the distances between adjacent pairs of airports beginning with Seattle, using the statute mile scale in the lower left side of the chart. Record the distances.

III. Construction, Identification, and Measurement of Angles

A. Construct straight lines between any two or three airports that form the following angles using the center airport as the vertex:

1. acute
2. obtuse
3. straight
4. reflex

B. Measure carefully the degrees found within these angles and record.

C. Find and name three airports on the chart which form true 90 degree angles.

D. Construct a hypothetical flight path originating from Ellensburg airport, flying first to the north, then turning west, changing direction next to south. You may choose any airport within these directional limits.

1. measure and record the total distance of your flight
2. identify, measure, and record the angles formed by this flight path

E. Five airplanes depart on separate flight paths departing from Yakima. One flys to Seattle, one to Ellensburg, one to Spokane, one to Astoria, and the fifth plane proceeds to Sunnyside.

1. measure and identify all angles formed by the flight paths of the five planes.

2. identify all supplementary and complementary angles by referring to the different airport locations

As previously mentioned, this represents a small portion of the magnitude of possibilities available through the correlative studies of geometric units and aerial navigation. The previously listed exercises can be expanded into a complete study demonstrating practically every phase of geometry. This, of course, is entirely dependent upon the instructor or instructors involved.

Summary

The airplane is perhaps the present-day climax in the development of transportation, and because of it the scope of human association has been tremendously extended. What will its affect be upon our society, upon the development of our relations with other nations- indeed, upon maintaining our independence and security? These are the questions which education must help to answer. Through the imperative and functional demands of new educational experience, pupil achievement in the fundamental skills will be stimulated. Methods of instruction and educational purposes must be reconsidered and revised to meet the nature of modern living.