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RECENT TRENDS AND PRACTICES IN INDIVIDUALIZED
ARITHMETIC INSTRUCTION

by 6791

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INTRODUCTION

For many years teachers have talked about the individual differences of their students. Various methods have been tried to provide for these differences; some have produced a degree of success. The problem is one that should be high on the priority list of every educator, for until it is solved quality education for all students can be only a dream of the future.

Historically, the method of instruction used in American schools before 1850 was one of individual progress. At that time few people could go to school, and those who could were not always able to attend regularly. Each student progressed page by page through his text in each subject and at the end of the term the teacher recorded his progress. The next term he started at the terminal point of the previous term.¹

Since the mid-1800's American school procedures have followed two general theories: (1) the Grade-Standard Theory, and (2) the Continuous Pupil Progress Theory. In the former, schools are organized by grade levels and students are placed in certain grades according to age and academic achievement. As it became feasible for more people to attend school, the organization of students into "grades" provided a way to accommodate the ever increasing numbers. This system led to such practices as graded texts, whole-class methods of instruction, common achievement standards, competitive evaluation, and non-promotion. The second theory, that of Continuous Pupil Progress, has influenced

¹Henry J. Otto and Dwaine M. Estes, "Accelerated and Retarded Progress," Encyclopedia of Educational Research, ed. Chester W. Harris (3rd ed.; Macmillan Co., 1960), pp. 4-11.

many of our recent practices in education. This theory has been the basis for the development of such practices as the non-graded school, individualization of instruction, varied media to meet the requirements of individual differences and independent study, non-graded curricula, and changes in marking and reporting practices which show concern for the individual.²

Edwin A. Read, Assistant Dean of the Graduate School of Education at the University of Utah, has stated that:

"The theory of continuous pupil progress is evolving, shaped and strengthened by research findings, experimental projects, and the changing educational philosophy of our times.

The fundamental assumption of this theory is that the function of the school is to promote and facilitate the optimum growth and development of each child in relation to his own potential and growth timetable and in relation to the goals of American education.

This assumption is in harmony with the dominant philosophy of American education, with our determination to provide equal educational opportunity for all, and with research findings about individual variability. It is, however, in sharp contrast to the Grade-Standard Theory of pupil progress which perceives the function of the school as that of teaching a body of essential knowledge which can be parceled out according to some kind of sequence and dispensed in accordance with a predetermined timetable to all children. One finds it difficult to believe that this century-old assumption still reigns supreme in many graded schools operating for children in this space-age generation."³

A nationwide study, conducted through the U. S. Office of Education and still in progress, is surveying the ways in which educators are attempting to meet the needs of students through individualized instruction. Although there are many variations in procedure,

²E. A. Read, "Educational Practice and the Theory of Continuous Pupil Progress," Audiovisual Instruction, February 1970, pp. 38-40.

³Ibid.

they have one thing in common: the traditional method of having all students taught the same skill or concept in the same way is being changed to a method where pupils are working at a self-determined pace toward self-determined goals, and sometimes on self-determined subjects. Following is a list and short description of a few of many individualized instructional programs.

The Continuous Progress Plan (CPP)--provides for the uninterrupted development of each child without restrictions as to materials or methods of instruction.

Contracts, UNIPAC's, Learning Activity Packages (LAP's), Performance Criteria Units, Teaching-Learning Units (TLU's) and various other names--usually consist of packages of materials that meet one or more specific objectives, including sample test items or equivalents that suggest the way the student is to be measured, and a list of materials that will aid the student in reaching the objective.

Project PLAN (Program for Learning in Accordance with Needs)--the American Institute for Research in Palo Alto, California through this project is developing and testing TLU's for many subject areas.

Individually Prescribed Instruction (IPI)--a program of the Learning Research and Development Center at the University of Pittsburgh and the Regional Educational Laboratory in Philadelphia, called Research for Better Schools, Inc.--have developed materials for elementary mathematics and language arts. IPI contains carefully sequenced objectives, materials which permit pupils to plan and proceed independently, provisions for diagnosing and monitoring progress, written prescriptions for each learner, continuing teacher diagnosis, and frequent regular feedback to learners.

Duluth (Minnesota) Public Schools--employ student contracts but emphasis is on the learner's planning his own program of studies and evaluating his own achievement.⁴

Edling, in referring to individualized plans such as those mentioned previously and others, stated:

"The effects of these efforts are impressive, not necessarily in terms of performance on standardized tests (although gains here are sometimes rather startling) but rather in terms of change in the behavior of learners and teachers. There is an almost unanimous report of renewed interest in school and educational activities. Traditional disciplinary problems have virtually disappeared. There is a major reduction in truancy and drop-out, and attendance is improved, i.e., less 'illness,' 'travel,' and other reasons for absenteeism. An increasing number of high scores are appearing on specific achievement measures. Teachers report working harder than before, but they are more satisfied because they feel they are doing more for their students."⁵

Although at present only the early adopters have accepted the method of individualized instruction, and although we may see changes in current practices as other techniques are developed and tested, the trend is apparently toward individualized instruction.

STATEMENT OF THE PROBLEM

The purposes of the study were: (1) to review the trends and practices of individualization in arithmetic, especially in the intermediate grades through (a) the literature describing individualized programs and (b) literature describing the research being done in this area; and (2) to evaluate a self-paced program set up in three

⁴Jack V. Edling, "Individualized Instruction: The Way It Is--1970," Audiovisual Instruction, February 1970, pp. 13-16.

⁵Ibid.

fifth grade rooms as a first step toward individualization of instruction.

LIMITATIONS OF THE STUDY

This study was limited to a review of various methods being used to individualize arithmetic at the intermediate grade level. The information in this report was based on library research and the experience of developing a self-paced program in arithmetic at fifth grade level.

DEFINITION OF TERMS

Individualized Instruction. An instructional method in which the student is given learning tasks geared to his interests and level of achievement. He may or may not proceed at his own pace.

Self-paced. The student sets his own rate of progression through the material to be learned, proceeding only after he has mastered the previous task.

REVIEW OF THE LITERATURE

DESCRIPTION OF INDIVIDUALIZED PROGRAMS

In looking at individualized instruction in the specific field of arithmetic, let's consider the opinions of some who have described their experience in this field. Why is it important to individualize instruction? What are some of the programs teachers have tried in the classroom? What do they consider to be the strengths and weaknesses of individualized arithmetic?

Gibb, in an article written for the Golden Jubilee Anniversary of the National Council of Teachers of Mathematics, stated:

"Let us assume that individualized instruction provides ways to teach a group of students so that each pupil can take what is for him the "next step" in his development of mathematical understandings and competencies at the time when he is ready to move ahead. Individualizing instruction requires developing ways to motivate him to think creatively in formulating his mathematical concepts and knowledge of mathematics."⁶

This is an awesome challenge for teachers. The importance of accepting the challenge is pointed out by Gagné in discussing modern concepts of learning. When asked, "if repetition or practice is not the major factor in learning, what is?" his reply was:

"The answer I am inclined to give is that the most dependable condition for the insurance of learning is the prior learning of prerequisite capabilities. Some people would call these 'specific readinesses' for learning; others would call them 'enabling conditions.' If one wants to insure that a student can learn some specific new activity, the very best guarantee is to be sure he has previously learned the prerequisite capabilities. When this in fact has been accomplished, it seems to me quite likely that he will learn the new skill without repetition."⁷

Experienced teachers are aware of the wide range of ability found in any classroom. In an upper grade classroom, a 3 to 6 year range in arithmetic ability and achievement is not uncommon. The average student in such a room will probably move through the course mastering the material step by step and will learn the rules and skills with varying degrees of success. The below average student will find it difficult to keep up and unless his more capable classmates are

⁶E. Glenadine Gibb, "Through the Years: Individualizing Instruction in Mathematics," The Arithmetic Teacher, May 1970, pp. 396-402.

⁷Robert M. Gagné, "Some New Views of Learning and Instruction," Phi Delta Kappan, May 1970, pp. 468-472.

"held back" until he understands the concepts, the achievement gap will grow wider each year. As this kind of child faces the continual frustration he must face in a situation where he does not have the background and skills necessary for success, he may quit trying. The above average child, who learns the basic skills and uses them accurately in much less time than his average or slow classmates, may become bored because the pace is too slow. A situation in which a child receives no challenge can be as frustrating to him as is the situation of the child who cannot understand the work being done. Those students at both ends of the scale who have totally different learning rates suffer the most when they are kept in a single-ability grouping system. This type system pushes (or pulls) all children toward the average ability level. As a result, many of our children are receiving a mediocre arithmetic education in elementary school.⁸

Teachers have tried many ways of individualizing instruction in an attempt to alleviate the problems created by individual differences. True individualization of instruction requires that much of the instruction provided for the learner be on an individual basis. This must take place within a given group of children and cannot be accomplished by restructuring the groups. Basically, individualization is not a problem that can be solved by an administrative rearrangement.⁹

An article written by Caroline C. Potamkin describes an individualized program tried by the author in her classroom. The program

⁸Walter L. Whitaker, "Why Not Individualize Arithmetic," The Arithmetic Teacher, Vol. 7 (December, 1960), pp. 400-403.

⁹Gerald C. Ubben, "A Look at Nongradedness and Self-Paced Learning," Audiovisual Instruction, February 1970, pp. 31-33.

was set up so that each child could go on to the next assignment as soon as he had correctly completed the previous one. Lists of assignments were dittoed and one provided to each student. Answer sheets were made so the students could check their own papers. No answer sheets were prepared for tests; the teacher checked these. Tests were graded and returned quickly. Students were then either permitted to go on to the next step or were given instructions for review. A student who was ready for a new concept was taught individually or, if several were ready at the same time, in a small group.

The author, in replying to questions about cheating, indicated that it was not a problem. She felt that the atmosphere was not conducive to cheating because there was no stigma attached to asking for help or for working more slowly than someone else. Another deterrent was the test that was always coming along and in which basic failures in comprehension were inevitably discovered.

The positive reactions of the class indicated the success of the program. They showed increased interest in arithmetic and began using spare time to work on it. They acquired independent work habits and a sense of responsibility that carried over to other subjects.¹⁰

Whitaker described a program he used with a sixth-grade class in Washington School, Culver City, California. Each child was taught at his level of achievement regardless of ability. He was placed at a point where he could experience success and make progress. The student met with the teacher to determine assignments. After he had completed

¹⁰Caroline C. Potamkin, "An Experiment in Individualized Arithmetic," Elementary School Journal, Vol. 64 (December, 1963), pp. 155-162.

and checked the work, he wrote a description of any error he had made. Next he conferred with the teacher for an explanation of any part of the assignment he did not understand. If at any time during the work he needed help, he could ask for it. A check list of skills was maintained for each student to avoid overlooking a skill. This program was based on having a wide range of textbooks and materials in the classroom. The assignments were moved from text to text in order to use the best ideas from each book.

The author felt the results in terms of the children's attitude and class control were gratifying. The slow learner was relaxed and learned more easily because he was not compelled to meet the standards of the group. The average student could learn as much above the basic skills as he was capable of learning. The above average child had the opportunity to extend his knowledge in any area of interest and was not held to the pace of the others in the class.¹¹

The individualized arithmetic program carried out by fifth and sixth grade teachers in Kilby School, the campus laboratory school at Florence State College, Florence, Alabama was described by William Graham, director of the school. To start the fifth grade program, the teachers determined (by testing) what skills each student had mastered. If several needed the same help, they were taught in a small group. When they had mastered these skills and were ready to go on they were given assignment sheets. If, after completing the work and checking it, the pupil showed evidence that he understood the work, he was given a new lesson. The sequence was planned carefully. Work material was

¹¹Whitaker, loc. cit.

kept where each student could get the specific items he needed. If several students were working on the same thing, they were encouraged to work together. The completed units were checked, corrected, and filed in individual files. Tests were given and these were corrected by the teacher.

The sixth grade program was much the same, except students who had mastered the fundamental processes used them to solve problems in area, volume, made charts and graphs, planned trips, and solved a variety of written problems. Tests given every two weeks reviewed the fundamental processes and determined the needs and future assignments of each individual.

The teachers felt the most evident outcome was increased interest in mathematics, greater independence, and a wider range of growth. The classes were more heterogeneous at the end of the year. Dependent children were watched carefully to see that they did not become confused. They tended to group themselves together and the teacher worked with them in small group sessions. These teachers also reported that children elected to do arithmetic during free-time periods.¹²

The IPI (Individually Prescribed Instruction) program administered by Research for Better Schools, Inc., a regional research laboratory funded under Title IV of the Elementary and Secondary Education Act of 1965, was used in 97 schools during 1968-1969. RBS planned to add 86 more schools for 1969-1970. Richland Elementary School, a demonstration

¹²William A. Graham, "Individualized Teaching of Fifth- and Sixth-Grade Arithmetic," The Arithmetic Teacher, Vol. 9 (April, 1964), pp. 233-234.

school, in Quakertown, Pennsylvania illustrates how an IPI program operates.

IPI classes at Richland are ungraded. Placement tests help to determine pupil groupings. Although the child is a part of a group, emphasis is on the pupil working on his own. At times when it seems advisable some group instruction is given. This occurs more frequently at the primary grade level when children are at about the same level of development. As individual differences become greater, work and assignments are prescribed for each student. After studying and completing the assignments for a particular step, each student is tested. If he fails to score 85% or better, equivalent assignments are given or tutoring is done in the deficient area until he is able to raise his score to the required level. It is necessary to have ample and diverse resources available to the teacher for use in prescribing suitable work for the pupil.

School board, principal, staff, and pupils at Richland agree that the system has improved instruction and made it more interesting. Fourth grade pupils, when asked to indicate which they preferred (the traditional method or IPI) unanimously voted in favor of IPI. No thorough test results are yet available for the RBS-directed program; however, lab officials feel confident that the program will be proved successful.¹³

Proponents of the system of individualizing instruction point out many advantages. A quite complete list of these is found in an article by Noddings. She includes the following: (1) students and

¹³K. G. Gehret, "Richland's Teachers Prescribe Instruction the Way Doctors Prescribe Pills; Individually Prescribed Instruction," The American School Board Journal, August, 1969, pp. 24-25+.

teachers work together in a common goal—the individual student's growth; (2) fear of tests is largely eliminated; (3) the brightest, most ambitious students complete more work than they might in a conventional classroom; (4) the slowest students learn something and achieve a sense of satisfaction; (5) we no longer have the effect of cumulative ignorance because a student does not undertake work for which he is not prepared; (6) failures have almost disappeared; (7) students learn how to study, how to pace themselves, and how to evaluate their own strengths and weaknesses."¹⁴

Gurau indicated absences had ceased to be a problem since it was possible for the student to continue his work at home and he never missed a vital lecture. Short teacher absences were less of a problem since each student could continue with his work. Another advantage listed was improved class discipline.¹⁵

Zeitz included the advantage of increasing student self-confidence. A situation in which the learner experiences success gives him more confidence in attacking the next level.¹⁶

While most of the teachers and administrators found many advantages, some criticisms of the system were also listed.

Ubben felt an extremely heavy requirement was placed on the quality of materials used. He also pointed out the lack of materials

¹⁴Nellie L. Noddings, "Providing for Individual Rates of Learning in Mathematics," Mathematics Teacher, November, 1969, pp. 543-545.

¹⁵Peter K. Gurau, "Individualizing Mathematics Instruction," School, Science, and Mathematics, Vol. 67 (January, 1967), pp. 11-26.

¹⁶F. Zeitz, "Individualized Curriculum," School and Community, November, 1969, p. 46+.

available, and thus the requirement for schools to develop their own materials.¹⁷

The criticisms of the IPI program listed by Gehret were: (1) Prescription writing requires too much time during the teacher's work-day. (2) Individual attention in an average size IPI class (25 pupils) takes too much teacher time. (3) Costs put IPI out of reach for the typical elementary school district.¹⁸

A limitation suggested by Flournoy and Otto was that research evidence is too meager to tell us how much and in what direction individualized instruction affects motivation and ultimate achievement.¹⁹

Those who listed criticisms seemed to feel that the program was worthwhile, but that there are flaws to be corrected—certain aspects that make the program impractical at this time, and evaluations that we simply must wait for research to verify or determine.

The programs described seem typical of most individualized programs. They may differ in the procedure used to progress from one step to the next. They may use varied materials and techniques such as programmed texts, learning packages, contracts, phases of instruction, teaching machines, team teaching, media center, and many more. However, all have one thing in common: they are striving to provide equal educational opportunity for all children regardless of individual differences.

¹⁷Ubben, loc. cit.

¹⁸Gehret, loc. cit.

¹⁹Frances Flournoy and Henry J. Otto, "Types of Class Organization for Meeting Individual Needs," Improving Mathematics Programs: Trends and Issues in the Elementary School. M. Vere DeVault (ed.) Columbus, Ohio: Charles E. Merrill Books, 1961.

They attempt to do this by placing the child at his level of achievement and allowing him to progress to the more complex at his own pace, thus building a solid foundation and, at the same time, providing a sense of accomplishment.

SUMMARY OF THE RESEARCH

A series of five studies concerned with the use of programmed instruction in the classroom was conducted by Robert Glaser and others at the University of Pittsburgh Learning and Research Development Center, Pittsburgh, Pennsylvania. The studies, carried out in third, fourth, and fifth grades, evaluated individualized procedures in the teaching of spelling and various arithmetic topics. A sixth study was made at fifth-grade level in which programmed materials were used to individualize the review of fourth-grade material before beginning fifth-grade work.

More than fifty teachers and 2,000 pupils participated in these studies, not all of which are reported here. However, all of the studies were similar in design and procedure. Groups of students received individualized programmed instruction as part of their work. They were matched with control groups on such variables as IQ and academic achievement. A battery of tests was selected for each grade level and administered as pre- and post-tests in order to compare control and experimental achievement.

These studies indicate that programmed materials appear to be an effective means of providing individualized instruction. In all of the studies the experimental groups were able to cover considerably more material than the control groups who received conventional instruction. The achievement level of the experimental groups was in most cases equal to or above the achievement level of the control groups. The various levels of achievement and the different rates of progress through the

materials seem to indicate the need for development of instructional practices which provide for these differences and for adapting the instructional program to the needs of the student.²⁰

A study of an IPI program in mathematics and reading achievement was made in Urbana, Illinois. One group of 200 pupils was given IPI math and reading programs. The experimental group was paired with a control group consisting of 200 children enrolled in Urbana's regular ungraded primary program. At the end of the test period (which lasted one school year, 1966-1967) the pupils were given the California Achievement Test.

IPI students at almost all IQ levels scored better on the test than non-IPI students. In a few instances IPI students scored lower.

Although IPI officials at Urbana are personally convinced that use of IPI programs will result in greater student achievement, they are reluctant to make definite statements until they have more evidence. In fact they warn that IPI pupils may not compare favorably on standardized tests with students who have been exposed to more skills. IPI students do not proceed to new skills until they have mastered (85% achieved on tests) the previous skill.

Other outcomes which IPI officials feel may be more significant than improved skills are improved attitude, self-motivation, and independence.²¹

²⁰ Robert Glaser, and others, Studies of the Use of Programmed Instruction in the Classroom (University of Pittsburgh, Learning Research and Development Center, Pennsylvania, ERIC—ED 010 208, May, 1966), 194 pp.

²¹ George W. Neill, and others, Individually Prescribed Instruction (Education U.S.A. Special Report #8, National School Public Relations Association, Washington, D.C., ERIC—ED 031 815, 1968), 68 pp.

The purpose of a study designed by Lewy was to measure the effect of individually prescribed instruction on the cognitive achievement of fourth and fifth graders. The sample was composed of fourth and fifth grade students from four schools. Two schools served as a control group and two others as an experimental group. All students in fourth and fifth grades in the control schools were included in the control groups. The experimental group included only those students in fourth and fifth grades who had completed two years of IPI instruction. The control group had 198 students, the experimental group 141. The schools were matched on geographic and socioeconomic factors.

Several tests were administered to each participant. Data analyses divided students into grades, sex, schools and IQ levels. No significant differences between groups was established. This indicated that IPI and non-IPI students achieve equally well in the areas tested.²²

A study of self-initiation was conducted by Scanlon at Oakleaf Elementary School, Baldwin-Whitehall School District in Pennsylvania. The district as a whole tends to be upper middle class. Oakleaf Elementary School is in a somewhat lower socioeconomic area than the district as a whole and could be considered lower middle class.

The study included 28 fifth graders and 22 sixth graders. Student behavior was observed during math, science, and social studies. The experimenter categorized the source of initiated behavior: from the teacher, from another pupil, or from the student himself. Only math classes received treatments during the study. The purpose of the treatments was to increase self-initiation. Treatment one consisted of having

²²Rafael A. Lewy, Individually Prescribed Instruction and Academic Achievement: A Report on an Experimental Project. (Illinois Department of Program Development for Gifted Children, ERIC—ED 033 082, March, 1969), 157 pp.

student volunteers help organize a math materials center. Treatment two permitted students to explore areas of math that interested them and treatment three provided special reinforcement or rewards.

Three measuring instruments were developed and used for this study: (1) an instrument to categorize the source of initiation; (2) an instrument to measure student interest in the three subjects; (3) an instrument to measure peer ratings of the extra work each student contributed to his class. Student interviews were also used to collect data.

The following conclusions were drawn: (1) individualized instruction seems to be more self-initiated than non-individualized; (2) the amount of self-initiation can be increased by the use of specific techniques; (3) self-initiation has little relationship to intelligence, achievement, or sex of students; (4) expressed interest in math did not change during the four months of the study; (5) the treatments had no measurable effect on expressed interest; (6) the procedures used to encourage self-initiation in math had little carry-over to science and social studies; (7) pupils expressed a desire to continue some of the treatments.²³

Bartel conducted a study to determine the feasibility of building a mathematics program including both new math and individualized instruction. A review of the literature established the need for incorporating a multiple text library and enrichment materials with the individualized program.

²³Robert G. Scanlon, Factors Associated with a Program for Encouraging Self-initiated Activities by Fifth and Sixth Grade Students in a Selected Elementary School Emphasizing Individualized Instruction. (University of Pittsburgh, School of Education, Pittsburgh, Pennsylvania, ERIC—ED 015 785, 1966), 99 pp.

Both a standard arithmetic achievement test and a Concept Test designed to be more sensitive to detecting achievement gains in new math concepts were used. The study took place in two fourth-grade classrooms at Brodhead, Wisconsin in 1964-1965. Another fourth-grade class in the same school served as control. Pre- and post-tests were administered and test score data used to determine whether or not the progress of the experimental group was adequate.

No difference in achievement was noted between the groups when the standardized arithmetic achievement test was used as the dependent variable. However, when the Concept Test was used, students in the individualized program scored significantly higher than those in the control group. It was concluded that, on the basis of this study, a program in individualized instruction in elementary school mathematics was feasible.²⁴

A pilot study by Moench was concerned with studying the effect of permitting a student to practice math topics at his own level and rate. The subjects were fourth grade students in a heterogeneously grouped class. The class was divided into low, average, and superior performers and the control group containing all three levels. In long term findings the groups of high and low performers who practiced at their own level showed greater achievement than the group who practiced at the level set for the grade. The middle performers achieved at about the same level. Since the sample was so small this pilot study can serve

²⁴Elaine Vetter Bartel, "A Study of the Feasibility of an Individualized Instructional Program in Elementary School Mathematics," Dissertation Abstracts, 26:5284, March, 1965.

only to suggest there is a trend in this group which should be studied with more and larger groups.²⁵

Greathouse investigated three arithmetic teaching methods with pupils at fifth and sixth grade levels. The comparison of the effectiveness of the methods was based on standardized tests. Several conclusions were drawn: (1) pupils taught by individual-oriented meaningful method achieved greater gain than pupils taught by other methods; (2) the meaningful method achieved equal or better computational skills than the drill-computation method; (3) IQ appeared to be the best single criterion for grouping pupils; (4) there was no significant correlation between pupil variables influencing computational ability and reasoning ability; (5) teachers using the individual-oriented meaningful method became more perceptive of pupil needs than those using other methods.²⁶

An experiment was conducted by Meadowcraft in Wilkinsburg Junior High School, Wilkinsburg, Pennsylvania in 1963-1964. The study was a comparison of two methods of programmed learning. The seventh grade class was randomly divided into two comparable groups. Each was divided into five class sections: the accelerated, the above average, two average sections, and the slow. The total sample included 303 pupils. Two methods of instruction were used. The individual method was employed with the average and the low sections of the experimental group. They used programmed materials 70% of the time and were taught by the teacher 30% of the time. These three groups were tested individually, and

²⁵Laurel Moench, "Individualized Practice in Arithmetic—A Pilot Study," The Arithmetic Teacher, Vol. 9 (October 1962), pp. 321-329.

²⁶Jimmie Joe Greathouse, "An Experimental Investigation of Relative Effectiveness Among Three Different Arithmetic Teaching Methods," Dissertation Abstracts, 26:5913, April, 1966.

progressed at their own pace. The accelerated and above average sections of this group were taught by conventional method with very little programmed learning used since it had been previously determined that they learned less and had poorer attitudes when using programmed materials. The restrictive method called for the use of programmed materials, but only for homework and practice purposes. The teacher introduced the unit and provided additional instruction. All students began at the same place, were tested at one time, and progressed as a group.

Attitude scales and achievement tests were used to gather data. The author concluded that there is still much to be learned about the use of programmed material, but the results suggested that the restrictive method was inferior to the teacher textbook method used with the top groups and also inferior to the individual approach with the other groups.²⁷

²⁷Bruce A. Meadowcraft, "Comparison of Two Methods of Using Programmed Learning," The Arithmetic Teacher, Vol. 12 (October, 1965), pp. 422-425.

A SELF-PACED MATH PROGRAM SET UP AS A FIRST STEP TOWARD INDIVIDUALIZING INSTRUCTION

INTRODUCTION

This self-paced math program was set up by three fifth grade teachers in an effort to better meet the individual needs of their students. The teachers involved had had several years of teaching experience and were well aware of the wide range of abilities usually found in any one classroom. The teachers realized the self-pacing program they set up was not true individualization because each student worked through all of the lessons. This program was set up as a first step toward individualization and as a program that could be managed with the limited amount of planning time available to the instructors.

OBJECTIVE

The objective of the program was to permit the students to progress individually at their own most efficient speed. It was hoped that those who were more capable would be able to progress farther than they had been able to in the past and that those who had difficulty understanding a concept would not be pushed on before they had a reasonable mastery of a given concept.

ORGANIZATION OF THE PROGRAM

The first step in setting up the self-paced program was planning and reproducing the lessons. By design, groups of ten lessons were presented on each duplicated sheet. These lessons each contained two parts, a study section and an assignment section. The study section included page numbers from the text and other sources where the student could find an explanation of the process being studied. This section

also contained practice work on that process. Some of the other sources used were supplementary books, work sheets, film strips, tapes, and booklets. The assignment section of the lesson consisted of a self-test or a test to be handed in for the purpose of teacher evaluation to determine student mastery of the particular lessons covered.

Each assignment to be handed in had an asterisk placed before it; these soon became known as starred assignments. The students were encouraged to discuss work together and to get individual help from the teacher if they were having difficulty understanding a lesson. The starred assignments were treated as tests for which pupils were not permitted to receive help, nor could they take them home. Not all of the starred assignments were used as test grades; some were simply to help the teacher know whether the student understood the lesson under study.

The assignments handed to the teacher for evaluation were checked each day. As time permitted the teacher checked assignments just after submission so that results were promptly known by the pupil.

Study pages and assignments not to be handed in had keys available, the student checking his own work. Cheating was not a serious problem since the student discovered this to be a learning situation in which he would not be penalized for errors; rather, errors found would help him to know when he needed to seek help. He also sensed that he must develop the ability to do the given type of problem in a test situation.

Teacher help was provided in the following circumstances: (1) When the student felt he needed help and asked for it, or (2) When the teacher, after checking a starred assignment, felt that the student needed help. This help was provided in one or more of several ways. (1) The teacher might help the student individually. This method was the most

frequently used. (2) The teacher might ask another student to work with the student needing help. (3) The student might be directed to some drill work such as flash cards or tapes. (4) If several students were having difficulty in a particular area, a small group was formed and the teacher worked with the group.

CLASSROOM ORGANIZATION

Several math stations were set up in the room. Each station was in a different area to avoid congestion.

One area consisted of a box in which both the lesson sheets and the keys to student-checked work were kept. These were stored in manila folders, each labeled. The student removed the key, checked his paper, and returned the key to the folder. The folder was not removed from the box. Remarkably few filing errors were made.

A second area had a box containing a folder for each child. In this folder he kept all of the work he had done for each week. These were checked once a week to determine how much progress the student was making.

A box in the third area contained worksheets and materials such as graph paper, cross-number puzzles, manila paper, etc. which the student needed to complete various assignments. These were kept in folders labeled with a lesson number.

The fourth area was located at the teacher's desk where she kept the starred assignments and a folder in which the student placed the starred assignment when he had finished.

STUDENT ATTITUDES

At the end of the year the students were asked to write a short evaluation of the math program. They were not required to sign their

paper; however, most did sign their names. In asking for their opinions it was stressed that the purpose was to help the teachers in making a decision regarding the math program for the following year. Should we keep this program, or return to a one-group class? Should we keep this program but make some changes? What changes would they suggest?

Ninety-three pupils wrote evaluations of the program. Seventy-one preferred the self-paced program, twelve expressed a preference for a different type of program, and ten said they had no preference. The most frequently mentioned reason for preferring the self-pacing method was not having to wait for those who didn't understand. The second in frequency was checking your own work. Another reason mentioned quite often was they liked the teacher helping them individually when they needed help and not having to listen to an explanation about something they already understood. A few mentioned not having to hurry through something they didn't understand. Others listed several times were "it keeps you busy" or "there is always something to do." This was also mentioned as a reason for disliking the program. One boy wrote, "I hate it--there's always something to do. But I think it's doing the job pretty well."

A few students expressed a fear that some who were not working very fast were not being penalized enough for their rate while several others expressed concern that some wouldn't cover all the material they should.

A suggestion listed seven times was that there should be ability grouping and only the high group be self-paced. An interesting aspect of this comment was that all seven suggesting it would have been in the self-paced group.

Other suggestions mentioned once or twice were: more games and fun pages; a longer period for working on math; and fewer starred assignments.

STUDENT PROGRESS

In looking at students' Stanford Achievement Scores, ranked according to stanine, there seemed to be some improvement in computation skills but little change in either applications or concepts. This would seem to be in agreement with studies that found change in achievement was not great.

The teachers observed some apparent changes in many student attitudes toward math.

1. Pupils seemed to have greater confidence in their ability to do the work.

2. More students voiced a like for math and used some of their free time to work further.

3. Students seemed to feel freer to ask for help when they needed it.

4. Fewer discipline problems developed when pupils could continue working and see that their work was resulting in progress.

5. Students became more self-reliant.

Several areas were found that caused some problems and will require some changes.

1. A few students seemed to need a more structured program, at least in terms of a definite time when an assignment was due.

2. Several took advantage of the freedom to loaf or disturb others. Frequently this was handled by the students—they didn't want to be disturbed.

3. At times students had to wait for help from the teacher.

In general, students and teachers were enthusiastic about the program and felt it should be continued. Some changes will need to be made in an effort to alleviate the problems mentioned previously.

SUMMARY AND CONCLUSIONS

The concept of teaching a group or class is changing. There is an apparent trend toward a kind of instruction that will provide for the wide differences found in students. "In sociologists' terms, only the 'early adopters' have made the transition, but what is emerging is a significant departure from traditional instruction, and variation of the new form, unquestionably, will be adopted widely in the future."²⁸

The literature reviewed seems to reinforce the likely realization of this prediction. Most of the research looked at indicates advantages in individualized programs. Even some of the studies that showed no significant difference in achievement of pupils in an individualized program found other aspects such as attitude, self-reliance, and self-initiation, quite improved.

The writer's experience with a self-paced program proved very rewarding. The close work with each individual, although time-consuming, was worth the effort. Greater understanding of the pupils' needs and apprehensions, not only in math, but in general resulted and students responded with greater effort on their part when the teacher took time for their individual problems.

Although the use of individualized instruction is increasing,

²⁸Edling, loc. cit.

much research needs to be done in order to verify results already obtained and in order to explore areas that have not been explored. Frequently it has been suggested that present standardized tests are not appropriate for measuring achievement in an individualized program. There has also been great demand for instruments to measure such traits as responsibility, self-concept, independence, and other characteristics which have not been the objectives of traditional instruction. Trait and character measurement is an area in which much research needs to be done.

Certainly more knowledge is needed regarding the way children learn—especially as to individual learning patterns. Other aspects of this that would provide interesting topics for study are teacher characteristics, attitudes, and practices as they affect individualized instruction.

Inquiry into the effectiveness of special techniques of individualizing would be of great assistance to those embarking upon such a program.

Many projects have been initiated but are not yet complete or reported. A publication of the U. S. Department of Health, Education, and Welfare called Pacesetters in Innovation lists and abstracts projects being done in Education. ES accession numbers are listed for use with Educational Resources Information Center (ERIC) materials.

These programs, along with numerous others mentioned in articles as being in progress, should produce much more conclusive evidence as to the value of individualized instruction.

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RECENT TRENDS AND PRACTICES IN INDIVIDUALIZED
ARITHMETIC INSTRUCTION

by

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AN ABSTRACT OF A MASTER'S REPORT

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The purposes of the study were: (1) to review the trends and practices of individualization in arithmetic in the intermediate grades and (2) to evaluate a self-paced arithmetic program.

Library research was used to obtain information concerning the trends and practices of individualization. Participation in setting up and using a self-paced program was the basis for evaluation of the program.

Through study about various individualized programs it became apparent that although they might differ in procedure, materials or techniques all had the same basic purpose. All were striving to provide equal educational opportunity for all children by placing the child at his level of achievement and allowing him to progress to the more complex, thereby permitting him to feel a sense of accomplishment.

There was general agreement regarding outcomes of the programs. Most showed little change in achievement of the students, but certain traits were modified. Student attitudes toward arithmetic improved. There seemed to be greater self-reliance and self-confidence among pupils. They exhibited less fear of tests and of arithmetic in general. The study habits of many improved. Discipline was less of a problem.

Some criticisms of individualization were found. These included: (1) the great requirement placed on materials used as well as the lack of these materials, (2) there is not enough research evidence to indicate how individualized instruction affects motivation and ultimate achievement, (3) some programs required too much teacher time, and (4) some programs would be too expensive for general use.

The self-paced program developed by the writer and two colleagues

was set up to better meet the individual needs of students. This program was not purely individualistic because there was no differentiation in assignments, only in the rate at which each student progressed. A change in many of the attitudes mentioned previously was also observed in the students participating in this program. In general, students and teachers were enthusiastic about the self-paced program and felt it definitely should be continued in some form.

The conclusion reached after studying the literature is that there is an apparent trend toward individualization of instruction in order to meet the wide differences found in students. Most of the research looked at indicates advantages in individualized programs. Although the use of individualized instruction is increasing, much research needs to be done in order to verify results already obtained and in order to explore new approaches.