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ABSTRACT

This study was performed to investigate the cost-effectiveness of a program in which low-achieving fourth-grade students are tutored by a professional mathematics educator. It was hypothesized that a highly trained educator could apply effective diagnostic, prescriptive, and remediation strategies. By avoiding use of published materials and other aids, tutoring could be provided at minimal cost. A total of 20 fourth-grade students was randomly selected from a pool of 41 scoring at least one year below grade level on a standardized mathematics achievement test. These students received two half-hour tutoring sessions each week. Students were tutored in pairs for a period of eight months. Findings indicated that the tutored students showed mean grade level gains of 0.994, while untutored students gained 0.625. This difference was significant (p less than .025). Attitude changes favored the tutored group. Costs of the tutoring and classroom experience together were judged to be $1.79 per student per day, while the cost of mathematics classroom instruction alone was $0.29 per student per day. (SD)

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An Experiment Investigating the Effect Upon Mathematics Achievement and Attitude Using a 'Professional' Mathematics Educator as a Tutor

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An Experiment Investigating the Effect Upon Mathematics Achievement and Attitude Using a 'Professional' Mathematics Educator as a Tutor

Introduction

The extreme diversity of student interests, abilities, and backgrounds that has resulted, in part, from integration is one of the most pressing problems faced by mathematics educators today. Among the many methods in mathematics of dealing with widely divergent student bodies are the grouping of students according to ability and the use of individualized programs of instruction.

Unfortunately, these methods of dealing with diverse student bodies have serious shortcomings relative to students at lower achievement levels (Findley, 1973; McPortland, 1969; Bloom, 1973). The author is not asserting that these methods are completely ineffective and should be abandoned; rather, he is simply asserting that something remains lacking for attending to the needs of students performing at lower than average achievement levels.

One possible approach in attending to the needs of underachievers in mathematics is that of tutoring. The method of individual tutoring has, in the past, been employed only by concerned (and financially able) parents and sacrificial teachers. Due to the cost of such instruction, schools have seldom provided formally for one-to-one tutoring.

The author had been an active private tutor for two years prior to the beginning of this study. The frequency with which children tutored by the investigator were able to attain the achievement levels of their peers led to the belief that significant gains in mathematics achievement for diverse student bodies could be made by developing a financially feasible, in-school tutorial program.

Problem

Most mathematics tutorial projects in the past have utilized either student tutors or paraprofessional tutors. The present study was based upon the premise that much more could be accomplished by the use of a "professional" tutor, i.e., a highly trained mathematics educator.

The purpose of this study was, then, to demonstrate the feasibility of an in-school tutorial program as a means of helping underachievers in mathematics. The mathematics tutorial program had an emphasis on diagnosis, prescription, and remediation, and was designed pursuant to the belief that a professional tutor could determine not only the level at which an underachiever should be placed, but also why the underachiever was not performing at an average level, and what could be done to relieve the deficiencies.

The specific objectives of this study were:

1. To demonstrate that a "professional" mathematics educator could significantly improve student achievement in mathematics working as a tutor on an individual basis with children.

2. To "narrow the gap", i.e., to show that underachievers need not fall further and further behind academically each year.

3. To demonstrate that a "professional" mathematics educator, working in an individualized setting, could significantly influence more desirable student attitudes toward mathematics, and this in turn might contribute toward increased achievement.

4. To demonstrate, through a cost effective analysis, that an economical, in-school, tutorial program is realistic and feasible.

Procedure

The tutorial study was conducted with fifth grade students from an elementary school in Columbia, South Carolina. The school was located in a predominantly Negro neighborhood and had a predominantly Negro student population. Most of the students came from lower to lower-middle socioeconomic backgrounds. Many came from broken homes, and several of the students had no parents and were living in a childrens home.

All fourth graders in the chosen school were pretested in mathematics achievement in May, 1973. Of the 56 students tested, 41 scored a complete grade level or more below their grade placement. A random sample of 20 of these students was selected as the experimental group, and the remaining students served as a control group.

The author worked for three hours daily as a tutor for eight months. In an effort to make the tutorial program as economical as possible, no commercial materials or instructional aids were used. Diagnosis, prescription, and remediation activities were based primarily upon the author's judgement and training.

Each student was tutored twice weekly for one-half hour. Schedules were alternated each week, and students were usually brought to tutorial sessions in pairs. This aspect was introduced in a further effort to make the program as economical as possible. Concentration in the tutorial sessions was on improvement of attitude and self-concept, and also improvement in mathematics achievement. Anecdotal records were kept on each student for each session. These records, along with a first hand knowledge of each individual's personal strengths and weaknesses, provided the author with excellent insights for prescription and remediation.

Findings

Pre and posttesting in achievement were accomplished with alternate forms of the Comprehensive Test of Basic Skills, and a modified version of Dutton's Arithmetic Attitude scale was used to obtain attitude data (Dutton, 1956). The gain in mathematics achievement for the experimental group was significantly higher ($p < .025$) than that for the control group. The average grade level gains for the experimental and control groups during the eight months were 0.994 and 0.625 respectively. Analysis of covariance, with pretest achievement scores as a control variable, revealed that posttest achievement scores for the experimental group were significantly higher ($p < .022$) than those for the control group. Of course, the important assumption of homogeniety of regression was established prior to the use of ANCOVA.

Posttest attitude scores for the experimental group were higher than those for the control group, however the significance level was only .10. A teacher questionnaire revealed that the classroom teachers perceived students in the experimental group as having more positive attitudes than students in the control group.

A cost index for the classroom teachers and also for the teacher-tutor team was computed. This index was simply teacher salary per day per unit of time spent on mathematics instruction per pupil.

It was found that the classroom teachers alone could effect an average eight month grade equivalent gain of about 0.625 in mathematics grade level achievement at a cost of $0.29 per day per student. On the other hand, the teacher-tutor team effected an average eight month grade equivalent gain of about 0.994 in mathematics achievement at a cost of $1.79 per day per student. Thus, student achievement was increased by 63% for an additional $1.50 per day per student.

Discussion

There are two rather obvious conclusions to be drawn from the findings:

1. Individualized instruction in the form of professional remedial tutoring is effective in helping underachievers in mathematics in a cognitive sense, i.e., in 'narrowing the gap' academically, and

2. Individualized instruction in the form of professional tutoring is effective in helping underachievers in mathematics in an affective sense, i.e., in fostering more positive attitudes toward mathematics.

Although the financial feasibility of a tutorial program is still questionable, it seems reasonable to assume that certain modifications in the design may overcome objections to this issue. Among these are the following:

1. Inclusion of the degree of affective growth as a factor in the analysis.

2. Lowering (slightly) the qualifications of the "professional" tutor; thus decreasing the salary required for the tutor.

3. As students demonstrate sufficient achievement growth (and affective growth), replace them with other children needing individualized assistance. This could result in a much larger number of students being helped by the tutor each year.

Future research will have the responsibility of developing more detailed procedures for a mathematics tutorial program. Financial feasibility should be given every consideration. It seems reasonable that a program should contain, to the extent possible, well defined diagnosis procedures, a catagorization of learning difficulties and reasons for below-average achievement, and prescription guidelines matched to this catagorization.

The indisputable fact that so-called underachievers in mathematics need special help and assistance in itself justifies the appropriateness of this study. The appropriateness is further supported in the sense that this study has given much support to the claim that the ever-expanding "gap" for underachievers is, indeed, unnecessary.

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