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ABSTRACT

This study investigated differences between the mathematics achievement of students receiving homework assignments and those not receiving homework. Thirty college students were divided into two equal groups. One group was given homework by the instructor, and the other group was not given any homework during the course. As predicted, the mathematics achievement of students receiving homework assignments was significantly greater at the .10 level than the mathematics achievement of students not receiving homework. (MP)

THE EFFECT OF HOMEWORK ASSIGNMENTS ON THE MATHEMATICS ACHIEVEMENT OF COLLEGE STUDENTS IN FRESHMAN ALGEBRA

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The effectiveness of homework assignments in facilitating student learning in mathematics has been under examination for several decades. Research has included the general effects of homework on achievement, the effectiveness of graded compared to nongraded homework, and the impact of homework on student attitudes.

The instructor who wishes to base his procedure on the best available evidence finds the research on the relationship between homework and student achievement contradictory and fragmentary. Many of the available studies are out of date, and the best contemporary studies frequently reach mutually contradictory conclusions. There is also a dearth of studies dealing with homework and mathematics mastery in the last two grades of high school and in college.

In a technological society where mathematics ability is important to the individual and to society, one can expect the concern that has been voiced in recent years over declining student achievement in mathematics. In addition to the well-advertised decline in SAT and ACT mathematics scores, a cross-cultural survey using a large population found that United States students ranked eleventh out of the twelve participating nations (Husen, 1967); thus, it is important for teachers, students, parents, and guidance counselors to consider the effects of homework assignments on the mathematics achievement of students.

The literature includes a number of prescriptions not necessarily based on empirical evidence. Shortly after the turn of the century, homework was regarded as detrimental to student interests, perhaps because of poor lighting and other environmental factors. In 1913, The Ladies' Home Journal inveighed against the "useless and really dangerous practice of carrying books home and asking pupils to do evening studies" (cited in Austin, 1979, p. 115). A period of general homework assignments followed which was succeeded by a decade of opposition to homework between 1930 and 1940 (Austin, 1979). The Sputnik shock in 1957 contributed to the development of the "New Math" and to the reimposition of homework. Pressure on teachers to assign homework resulted from the general feeling that American students had to catch up with their Soviet counterparts and that homework would surely help them to do so. In recent years, the pressures to assign homework appear to have eased (Austin, 1979). It may well be that those school districts now participating in the "Back to Basics" movement are giving more homework than are those applying less traditional modes of education, but the literature is silent on this point. Indications are that "external pressures and not new research findings were the major catalysts for change" (Austin, 1979, p. 115).

Goldstein (1960) reviewed 17 experimental studies which were conducted between 1900 and 1959 concerning the effectiveness of homework. Twelve of these studies dealt with mathematics. The results were mixed. Di Napoli's 1937 study, for example, showed no difference for seventh-grade students but significant differences favoring the compulsory-homework group for fifth-grade students (cited

in Goldstein, 1960). Goldstein (1960) concluded that the results of most homework research were inconclusive and statistically insignificant, but he indicated that the most solid research appeared to favor homework as a factor in student outcomes.

Foran and Weber (1939) compared the effects of homework on problem-solving and computational skills among seventh-graders. Although the homework assigned consisted chiefly of problem-solving exercises, the test gains for the homework group occurred in the area of computation, not in that of problem solving. The researchers concluded that "this somewhat anomalous result suggests that whatever other differences exist must be attributed to conditions of learning other than those evaluated in this experiment" (Foran and Weber, 1939, p. 214).

Anderson (1946, p. 43) came to more positive conclusions about the value of homework in student outcomes. Two sections of an eighth-grade class, each with 29 pupils, were used as the experimental and control groups respectively. Those pupils on the home-study program scored significantly higher on tests in a number of subjects, including mathematics. The researcher concluded the following:

1. Home study, properly assigned and evaluated so far as it related to the pupils in this experiment, is an aid to improving scholarship.
2. Home study is equally valuable to pupils of average intelligence in English, social studies, and mathematics.
3. On the basis of this study, nonhome-study pupils are sporadic in their achievements.

4. The brightest pupils in the nonhome-study group did not on the whole gain as much proportionately as did those in the home study group.

Gray and Allison (1971) collected data from 64 pupils with mean IQ's of 114 in two sixth grades in a middle-class suburban school to determine the effect of homework on mathematics skills. All children received both treatments (homework versus no homework) in order to control for the differential effects of teaching styles on various pupils and to eliminate a possible Hawthorne effect. No statistically significant differences attributable to treatment effects, teacher effects, or sex differences were observed. Gray and Allison (1971, p. 345) concluded that consideration should be given to the possibility that "drill type homework is in fact unrelated to pupil growth in computational skills."

Maertens and Johnston (1972) undertook a more elaborate experiment designed to measure attitude as well as achievement. Four hundred fourth-, fifth-, and sixth-graders were divided into three treatment groups. One group received homework with delayed feedback from parents, and one received no homework at all. Tests prepared by the researchers were administered after six weeks to assess computational and problem-solving skills. The two homework groups did significantly better on the tests than did the no-homework group, except in the case of problem solving in the fifth grade. No differences in attitude among the groups were noted. The results may well have been influenced by the fact that the two homework groups had the benefit of parental involvement, while the no-homework group did not. Parental involvement and interest rather than homework may, therefore, have

been responsible for the different results.

Two 1966 surveys are of interest, although they are not correlated with student achievement. Check (1966) surveyed students in the lower and upper elementary grades, junior high school and senior high school students, the parents of the students, teachers on the same four levels, professors from the University of Michigan, and education students majoring in educational psychology or educational sociology. The consensus seemed to favor homework, if only because class periods were too short to permit studying a subject in suitable depth. However, homework should be related to materials being studied, and the operations involved should be explained clearly. No homework should be assigned over weekends (Check, 1966).

Kerzig (1966) surveyed sixth, seventh-, and eighth-graders in a small southern California intermediate school. A majority of the students expressed the opinion that homework helped them achieve better grades. A large majority of the students reported that they sometimes needed parental help. Homework was most resented when there were interruptions at home, when it was perceived as uninteresting, and when it conflicted with watching television. In order to complete homework assignments, students needed a clear understanding of the assignments, a quiet place to work, and all relevant materials (Kerzig, 1966).

The dubious merit of homework is a topic that has been debated for years, and this continuing debate reflects the differences in underlying attitudes. The traditional opinion considers homework a valuable and important supplement to classroom instruction; however,

others view homework quite differently and believe its worth has been exaggerated. Hence, the purpose of this study was to determine whether significant differences exist between the mathematics achievement of students receiving homework assignments and that of students not receiving homework assignments.

Method

Subjects. Ss consisted of 30 volunteer students, six females and twenty-four males at Ft. Benning, Georgia in a college algebra class. The students were primarily active duty and retired enlisted military Caucasians with an average age of 32 years (range = 18-67). They had completed an average of one year in college (range = 0-3) with a mean grade point average of 2.65 (range = 2.0-4.0).

Independent Variable. The independent variable of this study was homework versus no homework. The only difference between the instruction administered to the two groups was the weekly assignment of homework to the experimental group. These homework assignments were selected exercises from the students' textbook, College Algebra, by Munem, Tschirhart, and Yizze. Each assignment provided drill upon materials previously covered in class and provided the students with the opportunity of applying the mathematics principles explained in the lecture. The homework assignments were given to the experimental group just prior to their leaving class on Mondays, and the students were instructed to turn in the completed assignment before class began on the following Monday. The homework assignments were corrected by the instructor, and a percentage grade was recorded.

Dependent Variable. The dependent variable of this study was the mathematics achievement of students receiving homework during the course compared to the mathematics achievement of students not receiving homework during the course.

Mathematics achievement in the context of this study was defined as mastery of the basic concepts of algebra: equations and inequalities; functions and their graphs; non-linear functions and relations; and exponential and logarithmic functions, as contained in chapters one through five of the class textbook and explained in the lectures. The extent which the students mastered the fore-stated material was determined on the basis of student performance on a test prepared by the instructor.

The posttest instrument used in this study was the same instrument used for the pretest and was administered by the classroom instructor. Prior to the beginning of the experiment, during the first class session, each student was given the test. The test instrument was developed by the researcher specifically for this experiment and is included in the appendix. The test consists of nine computation problems and one story problem including the same content as described above. The test was designed for power rather than speed.

Procedures. After securing the written consent of all subjects involved, the researcher obtained the permission of the Academic Affairs Director, Troy State University, Ft. Benning, Georgia, to conduct the study in a section of Mathematics 111 (College Algebra) at Troy State University, Ft. Benning, Georgia. The 30 students in his class were divided into two groups on a random basis with a pretest used to establish that the two groups were approximately equal. Group I consisted of 15 students given homework by the instructor once each week, and Group II consisted

of 15 students not given any homework during the course. The course began April 8, 1981, and continued until June 15, 1981.

Both groups met during the same period under the same mathematics instructor. The method of instruction was lectures with opportunity for the students to ask questions at any time.

Students received a syllabus indicating which chapters of the textbook would be studied during each class session. They were, additionally, informed which chapters would be covered by the mid-term test and which chapters would be covered by the final examination. Students were informed that all other tests would be announced a week ahead of time.

The only difference between the instruction administered to the two groups was homework or lack of homework. The instructor of both groups prepared all tests and grades for both groups and prepared and graded the homework assignments.

Results

A pretest-posttest control group design was used in this study. The t-test was used for statistical analysis of the results of the study.

The findings from the pre- and posttest are summarized in Table I below as follows. The results of the t- test show no statistically significant differences in the pretest scores ($t = 0$). The findings of the t-test for the posttest results were significant only at the .10 level ($t = 1.744$, $df = 28$, $p < .10$) indicating that students receiving homework assignments are likely to learn more than those not receiving homework assignments.

Table I

Method	N	Mean	Variance	S.D.
Homework				
Pretest	15	0.40	0.257	0.507
Posttest	15	6.33	7.382	2.717
No Homework				
Pretest	15	0.40	0.257	0.507
Posttest	15	4.87	3.127	1.768

The research design of this study should have overcome some of the methodological problems noted in the literature stemming from the possible effects of different teaching styles on similar groups of students.

The results are in harmony with Mulry's (1969) review of a number of previous studies, including that of Hines (1957), indicating that the results of experimental studies were inconclusive. She stated that there was "little conclusive evidence available concerning either negative or positive effects of homework" and called for additional, carefully-designed research into the problem (Mulry, 1969, p. 49).

Hines (1957) compared two classes in plane geometry. One class received homework, while the other did not. The two classes were similar in IQ test scores. The researcher's conclusions were that out-of-class study, usually written work, improved test scores in plane geometry, and this improvement was cumulative. Hines expressed the belief that homework could increase a student's grade by one letter, as from B to A. Hine's belief is not supported by the results of this research study. Subjects

in both groups received almost identical grades in the course. However, a factor that Hines had not taken into account in arriving at his conclusions was that each group was taught by a different teacher, and in this research study, both groups were taught by the same teacher.

The results of this study are also consistent with Friesen's (1979) analysis of 24 research studies dealing with the value of homework. The studies had been conducted between 1923 and 1976. Friesen's general conclusion was the following:

> The results of the studies reported do not provide a clear-cut endorsement for either the homework or the no-homework groups. This may be explained by the results of Mason's (1969) study. He reported a significant teacher by homework method (required homework and no-homework groups) interaction and concluded that each teacher should determine which of the two methods to use in order to maximize student achievement (1979, p. 15).

Summary and Conclusions

Summary. This research study and the literature reviewed suggests that there is a slight preponderance of evidence indicating that students who receive homework assignments achieve somewhat better academic results than do those who receive no homework assignments. In addition, past and recent surveys indicate that teachers, parents, college professors, and even students believe that homework in some way contributes to academic growth. On the other hand, there is very little evidence that the assignment of homework has any negative effect on achievement.

Conclusions. The results of this research study and the literature reviewed do not provide a clear-cut endorsement for either the homework or the no-homework groups. There is a tendency, however, for homework, properly assigned and evaluated, to improve achievement. Each teacher should determine which of the two methods to use in order to maximize student achievement.

The theoretical advantages of homework assignments seem difficult to realize in practice. Until more efficient methods of controlling the total environment (teachers, curriculum, and the student's own inherited and acquired characteristics) are developed, it would seem that further research in this area is unlikely to have much payoff.

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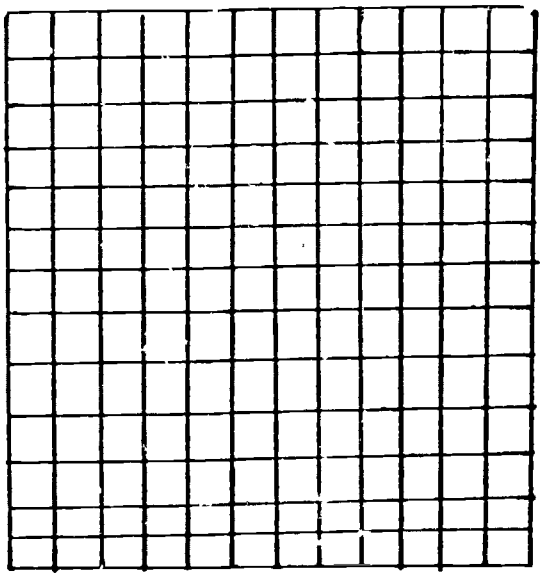
Pretest - Posttest

1. Use the properties of radicals to simplify each expression. Assume that all variables represent positive real numbers:

$$\sqrt[100]{x^{98}} \cdot \sqrt[100]{x^{2}}$$

2. Plot the following point and indicate the quadrant, if any, that contains the point.

(-4, 5/2)



3. Use the distance formula to find the distance between each given pair of points:

(-3,2) and (6, -1)

4. Find the domain and range of each relation:

$R = \{(-2,1), (-5,5), (3,-1)\}$

5. Let $f(x) = 3x^2 + 2$, $g(x) = x^3$, and $h(x) = 7x - 1$. Find the value of the following:

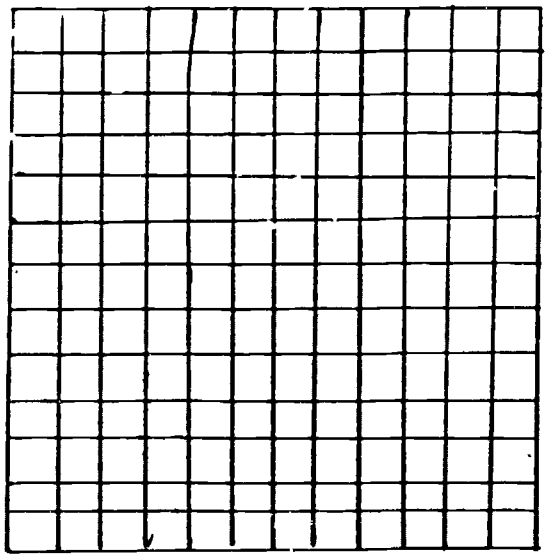
f(3), g(3), and h(3)

6. Find the equation of the line:

   Slope m = 3 which contains the point (4,5)

7. Graph the quadratic function by locating the x and y intercepts and the extreme point. Then use the graph to determine the range of f and the solution set of the given associated inequality:

   $f(x) = x^2 + 2x - 3$; $x^2 = 2x - 3 < 0$



8. A gardener wishes to enclose a rectangular garden with 100 feet of fencing, using a wall for one side of the garden. What is the largest area she can enclose?

9. Find the value of the following logarithm without using a table or calculator:

   $\log_{17} 17$

10. Assume that log 2 = 0.69, log 3 = 1.10, log 5 = 1.62 and log 7 = 1.94. Find the following value:

    $\log_a (3^5 \cdot 3^7)$