

## The Predictive Power of Homework Assignments on Student Achievement in Mathematics

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**Abstract:** This study examined the relationship between homework performance (percent of homework completed and percent of homework correct), student characteristics (Stanford Achievement Test score, gender, ethnicity, and socio-economic status), perceptions, and challenges and academic achievement determined by the students' average score on weekly tests and their score on the Florida Comprehensive Assessment Test (FCAT) Norm Reference Test (NRT) mathematics assessment.

Homework has been a subject of controversy to education researchers for the past 75 years (Cooper & Valentine, 2001). The literature demonstrates that homework practices have been popularized notions tied to changing educational philosophies and theories. Early in the 20<sup>th</sup> century, homework was seen as exercise for the mind, and memorization was the key to acquiring new knowledge. Since memorization could be easily accomplished at home, homework was the answer. The 1940s brought a shift in attitude towards homework. Increasing and improving student initiative along with interest in learning was the focus. Homework was viewed as an intrusion on student's extracurricular activities (Cooper, 2001). However, the launch of Sputnik by the Russians in 1957 sparked the movement for increased academic rigor and encouraged homework as a means to accelerate learning. However, by the mid 1960s the movement once again reversed, and homework was seen as too much pressure for students (Cooper, Lindsay, Nye, & Greathouse, 1998). Another reversal was brought on in the mid 1980s by the publication of *A Nation at Risk* (National Commission on Excellence in Education, 1983) that cited homework as a means to end the mediocrity of U.S. education. However, in recent years homework has been once again viewed by many as an inconvenience and intrusion into family life and as an impediment to a full and active social life for children (Cooper, 2001).

The purpose of this study was to examine variables related to homework that appear to make the most difference in results of academic achievement among grade levels: (a) difficulty, (b) length, (c) objectives, (d) feedback, (e) support, and (f) scheduling time. This study also investigated the differences in the academic success of students in grade three and the relationship of those differences to: (a) the student's homework performance (i.e., the percentage of completed mathematics assignments turned in and the percentage of mathematics problems completed correctly), (b) student characteristics (Stanford Achievement Test 9<sup>th</sup> ed. mathematics application score [SAT-9], gender, ethnicity, and socio-economic status), (c) perceptions (i.e., difficulty of assignment, amount of homework, and objectives of homework), and (d) challenges (i.e., homework feedback, support for doing homework, and scheduling time).

### Review of Literature

Due to the increase in local, state, and national accountability models requirements, such as those in the No Child Left Behind Act of 2002, school administrators and teachers must develop homework policies that are successful, interact with other goals, and lead to enhanced achievement in academic areas. Although homework has taken on new significance in light of various comparisons between or among schools, the importance of this study also takes on added

significance as it evaluates the extent to which, and how homework is useful in aiding elementary students' success in mathematics

Understanding the nature of homework and its influences on school achievement can be attributed to isolating the effects of numerous and complex variables affecting homework assignments and their completion (Cooper & Valentine, 2001). These influences include: (a) the ways teachers structure and monitor assignments, (b) students' discretion about whether, when, and how to complete the assignments, (c) conducive home environments for completing homework, and (d) competition with community leisure activities competing for the students' attention.

Homework works because it increases time-on-task. Effective time-on-task is most important and often depends upon what is done by the student in processing the homework. Homework should have an effect on memory because of practice requirements. It should have an effect on transfer to the extent that properly devised application problems are included. The effectiveness of assignments depends on the difficulty of the assignment, the facilities for doing the assignment, and interferences. What is learned (i.e., effectiveness) may be dependent upon standards (i.e., objectives or goals) represented in the content of the assignment and the nature of the processing required. The extent to what is learned depends on whether the assignment is completed and on the amount of accuracy and constructive feedback provided to the student.

The amount of homework completed has been linked to achievement (Cooper, 1994; Cooper et al., 1998) with increasing benefits over grades. The benefits of homework are differentially related to school achievement according to grade level (Muhlenbruck, Cooper, Nye, & Lindsey, 2000). Such benefits are necessary under conditions of good monitoring, parental involvement, ease in doing assignments, and completion of assignments (Callahan, Rademacher, & Hildreth, 1998). The developmental trend is attributed to such explanations that young children: (a) take longer to finish assignments, (b) have limited ability to keep their attention focused, and (c) lack good study skills (Cooper, Jackson, & Nye, 2001).

The relationship between homework completion and test scores is indicated in a positive relation between the frequency of completed homework assignments and mathematics achievement gains; lengthy homework assignments, on the other hand, tend to be negatively related to achievement gains (Trautwein, Koller, & Schmitz, 2002). Yet, another study by Swank and Greenwood (1999) showed no relationship between academic performance and homework completion. A review of 100 homework studies (Black, 1997) showed less than expected improvement on standardized test scores, especially at the lower grades.

These varying results suggest the need to include individual differences in student attitudes toward homework (i.e., motivation and study habits), the relation of homework and classroom work, the contributions of home environment, and the kind of feedback given on assignments (Muhlenbruck et al., 2000).

### **Methodology**

The main analysis was based on a multiple regression of average test scores and FCAT NRT scores on the predictor variables: (a) homework performance, (b) student characteristics, (c) perceptions and, (d) challenges. Archived data were obtained from a district maintained database, including gender, ethnicity, SAT-9 score, socio economic status, parent, student, and teacher questionnaires; classroom test/quiz scores; and standardized test results based on the statewide test (FCAT). The sample was taken from an elementary school with 928 students representing a diversity of ethnic backgrounds and socioeconomic levels. One hundred forty-three third grade students in five different homerooms taught by seven different mathematics

teachers were studied. The data for this study were collected using non-experimental methods. The subjects were measured on a variety of variables. Therefore, the variables were called predictors and criterion rather than independent variables and dependent variables, respectively. This study involved unordered sets of predictors which were divided into five different sets: (a) student characteristics, (b) homework accuracy, (c) homework completion, (d) perceptions, and (e) challenges. The multiple regression analysis provides a tool to determine the predictive power of some variables over a criterion variable. Hierarchical regression analysis, on the other hand, provides a mechanism of capturing the combined relationship between a set of variables and the criterion variable in incremental steps with a series of more inclusive sets of variables at each step. The order in which the predictor variables were entered in the hierarchical regression was determined by the researcher based on logical considerations and the purpose of this study.

Descriptive statistics including means, standard deviations, frequencies, and percentages were used to summarize data of all subjects for student characteristics, homework performance, perceptions, challenges, average test scores, and FCAT NRT scores. Two theoretical constructs were proposed in this study: perceptions and challenges of homework. Pearson's correlations examined the relationship among the survey items in each construct. The associations for the perception items categorized as difficulty, objective, and amount were all significant. Likewise, the associations for the challenge items categorized as support, feedback, and scheduling were also significant. Pearson's correlations were used to examine associations of the predictor variables (student characteristics, homework performance, perceptions, and challenges) with the average test scores and the FCAT NRT scores. Additional Pearson's correlations were computed to examine the relationships between the different predictor variables.

Regression analyses were carried out to examine the influence of all of the predictor variables (student characteristics, perceptions, challenges, and homework performance) on each of the criterion variables (FCAT NRT score and average test score). Hierarchical multiple regression analyses were performed on the FCAT NRT score and average test score from the predictor variables. Sets of ordered predictors were entered in three steps. At step one, the student characteristics were entered and tested for significance. At step two, perceptions and challenges were entered, and at step three, homework performance was added. Correlational and regression analyses results were considered statistically significant at  $p < .05$ . Data analysis was carried out using SPSS Version 13.0.

### **Findings**

The study explored the effects of the percent of homework completed as opposed to the amount of time spent on homework as suggested by Cooper et al. (1998). It also looked at the effects of the students' attitudes about homework based on their responses to the survey administered which was also suggested by Cooper et al. (1998). This study additionally addressed the need for further studies using elementary students as the present number of these studies is limited.

In contrast to Muhlenbuck et al. (2000), this study indicates significant correlations between homework completion and students' academic success in Grade 3. In addition, controlling for student characteristics, perceptions and challenges, the percent of homework completed was a strong predictor of students' average test score.

The review of the literature, specifically Muhlenbruck et al. (2000), indicated that the correlation between homework and academic achievement is weak in the lower grades and grows stronger as children age. Cooper's (1989) meta-analysis of research on the effects of homework found that the correlation between homework and academic success of students in

Grades 3-5 was nearly zero. Yet, it was .07 for students in Grades 5-9 and .25 for high school students. In contrast, this study of students in Grade 3 found that the correlations between percent of homework completed with average test score ( $r = .61, p < .01$ ) and with the students' score on the FCAT NRT ( $r = .41, p < .01$ ) were significant. Similarly, average homework correct was significantly correlated to average test score ( $r = .64, p < .01$ ) and to FCAT NRT ( $r = .46, p < .01$ ). The higher correlations with average test score could be attributed to fact that the two sets of scores were assigned by the same source, the teacher.

This study suggests a positive relation between the portion of homework completed and student achievement and supports the research by Cooper et al. (1998), which focused on five sets of questions regarding homework and student achievement. Cooper et al. made a differentiation between the amount of assigned homework and the amount that was actually completed. In contrast to previous studies that did not make this differentiation, the amount of homework completed was related to student achievement.

Analysis of the regression results indicated that for Grade 3 students the percent of homework completed was a statistically significant predictor of how the students scored on the weekly tests and the second most important predictor of how the students would perform on the FCAT NRT. The hierarchical regression analysis demonstrated that homework performance was significantly related to the students' average test score and their score on the FCAT NRT after controlling for the other variables. These findings support those by Cooper et al. (1998), which suggested a positive relationship between the portion of homework completed by students and their achievement. As in Cooper's study this relationship was stronger for teacher-made tests than standardized test scores. This study, however, differed from Swank and Greenwood (1999) who concluded that homework was not, in general, a significant factor in academic achievement as demonstrated by teacher-made test scores in math at the fourth grade level.

Cooper et al. (1998) suggested that the causal link between the attitudes of the role players and student achievement should be examined by research. This study found that student perceptions and student challenges explained 2.7% of the variance in average test scores when student characteristics were controlled, indicating that student attitudes play a limited role in their academic achievement. When student characteristics were controlled for, student perceptions and student challenges explained only 1% of the variance of FCAT score, indicating it had less importance in predicting students' FCAT score than average test score.

#### **Educational Importance: Conclusions and Implications**

This study provided evidence that students' homework performance is a strong predictor of students' academic success in mathematics, most notably in the performance in classroom evaluations developed by the teacher. In addition to homework performance, the students' scores on the SAT-9 were also a significant predictor of their academic success. Specifically, controlling for student characteristics, including the level of the students' academic aptitude from their score on the SAT-9, students' perceptions, and students' challenges, the percent of homework completed was still a strong predictor of the students' average test score. The literature supports the view that homework completion has a positive effect on student academic achievement (Cooper et al., 1998 Muhlenbuck et al., 2000). This study was based on the assumption that a combination of homework performance, student demographics, perceptions, and challenges would be strong predictor of academic success.

Several ideas related to homework can be learned from this study. First, homework performance is a significant predictor of students' performance on teacher-made tests but not for standardized tests, such as the FCAT. Although there are much more stringent accountability

standards imposed on schools today by all levels of government, more homework is not the answer to higher standardized test scores. This study suggests that two hypotheses are plausible for why the correlation between homework performance and average test score is stronger than the relationship between homework performance and FCAT. First, the teacher designs, creates, and scores both the classroom evaluations and the homework. Thus, it is likely that both are very similar and that the teacher emphasizes those objectives which will be tested. In contrast, the FCAT and any other standardized test is developed by a publisher and the teacher is never exactly certain what topics will be covered and how the questions will be phrased.

Second, the scores for students on classroom tests may be artificially inflated. Specifically, the students may be permitted to retake tests, may receive assistance from peers or the teacher, may be permitted to use notes or the text, or may be scored on a curve. However, standardized tests are only administered once and scored objectively by computers or persons who are not familiar with the students.

Future research should utilize a larger set of criteria to determine the effectiveness of homework on achievement. Researchers should not only look at performance on evaluations, whether teacher developed or standardized, but also at other outcomes that can be viewed as successes. Some of these other outcomes are improved motivation, better study habits, and improved critical thinking skills. Homework is a universal practice in many areas of education. It is a variable of manipulability. Teachers and administrators control whether to assign homework, what homework to assign, and how much to assign. Its design and purpose should be clearly understood. The research on homework has been limited, specifically at the elementary level, thus future studies should examine a larger population across different grade levels to assist in the determination of amount, design, and purpose of homework assignments.

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