THE IMPACT OF MATH SUPPORT ON ACHIEVEMENT IN GEORGIA PERFORMANCE STANDARDS MATH COURSES

by

DYLAN SINN CLARK

(Under the Direction of David F. Jackson)

ABSTRACT

This study evaluates the impact of enrollment in Math I or II Support class on students' achievement in Math I or II courses. The Georgia Department of Education recently introduced new math courses as part of its implementation of the Georgia Performance Standards. Math Support classes were introduced as an academic intervention strategy in which students take the course in addition to and in tandem with their regular math course. The possibility of offering Support-style courses for high school science courses is also explored. The results of this study indicate that Support enrollment does not have a positive effect on achievement. Among Math I students, Support enrollment showed a negative impact on math achievement, and among Math II students, Support enrollment showed no impact on achievement.

INDEX WORDS: math achievement, Math I, Math II, Support, intervention, Georgia Performance Standards

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INTRODUCTION

Underachievement among American students in math and science is a persistent concern for the educational community. The 2007 Trends in International Mathematics and Science Study (TIMSS) shows that students in the U.S. are weaker in math and science compared to students in several Asian and European nations. Only 10% of 4^{th} graders and 6% of 8^{th} graders scored at or above the advanced benchmark in math, and 15% of 4^{th} graders and 10% of 8^{th} graders scored at or above the advanced benchmark in science (NCES, 2009). While the 2007 TIMSS indicates an overall improvement in math and science scores among U.S. students since the 1995 TIMSS, students in the U.S. are still trailing students from parts of Europe and particularly Asia.

Educational reform efforts to address this concern can be found at the national level in legislation (i.e. No Child Left Behind) and reflected in state and local decisions about curriculum. The Department of Education of Georgia implemented a reformation of curriculum by introducing a new set of content standards in 2004 called the Georgia Performance Standards (GPS) for English language arts, social studies, math, and science. The GPS for math sought to create a curriculum with increased rigor and focus that prioritizes student-centered pedagogy, specifically inspired by Japanese math instruction (GADOE, 2005). While high school science content changed slightly, math courses under GPS were restructured from the traditionally separate Algebra, Geometry, and Trigonometry courses, combining the concepts into an integrated curriculum that spans the four years of high school. The new courses are titled Math I, Math II, Math III, and Math IV, each containing components from traditional secondary math subjects. The intended course sequence is that one course is completed for each year of high school, with 9th graders taking Math I, continuing until 12th graders complete Math IV.

Additional new math courses were created to complement Math I-III known as Math I Support, Math II Support, and Math III Support. The following is Georgia Department of Education's stated purpose of math Support courses:

> To provide additional support to students in their effort to meet the standards of more rigorous and relevant mathematics courses. This course should be taught concurrently with a student's regular math class, giving extra time and utilizing a variety of strategies to help students build a stronger foundation for success in their current and future mathematics courses. (GADOE, 2007)

The criteria for enrolling students in Support courses is determined by local school districts, which can include teacher recommendation, parental request, and a student's previously demonstrated math achievement. Math Support courses are designed to be an intervention strategy to help students succeed in their GPS math coursework.

Intuitively, the most notable advantage for students enrolled in math Support would be receiving double the amount of math instruction each day. A report published by the U.S. Department of Education in 1994 expressed concern that American students received far fewer hours of instruction per year than students in France, Germany, and Japan, and recommended drastically changing school schedules to include more time for schooling (U.S. Department of Education, 1994). There is considerable evidence in research literature that shows a positive correlation between time spent learning and academic achievement (Coleman, 2003; Harris, 2009; Walberg, 1997). However, there have been conflicting results regarding the effect of time on learning when educational research studies explored the same questions (Karweit, 1976). One theme that has emerged is that the strength of the positive correlation between time and learning largely depends on the quality of learning time rather than only the quantity of time. For example, simply allocating more time for instruction does not elicit nearly the same positive achievement outcomes as when additional time is structured to ensure students are productively and successfully completing learning activities (Ellis, 1984). This makes generalizing the relationship between time and learning difficult; but with regard to GPS math courses, one would expect to find enrollment in math Support to show increased achievement.

Math Support classes can also be viewed as a type of group tutoring within the school day, since the content matches what the students are learning in their GPS math courses. Research on the efficacy of tutoring when it is paired with classroom instruction shows that tutoring is substantially more effective when it occurs in combination with classroom learning in the same subject (Fuchs, 2008). Additionally, it has been shown that increasing the amount of tutoring has a positive effect on academic achievement, even when tutoring is administered by minimally trained volunteers (Allen, 2004). Given that math Support classes are taught by certified math teachers, achievement results similar to these could be expected.

Offering a high school course like math Support which has the sole purpose of helping students succeed in a course that covers the same material is a new intervention strategy. It seems logical to offer such a course given that mastery of the secondary math requires having a set of computational and analytic skills that enable understanding the larger, overarching concepts. It is the failure to obtain these specific skills that frequently impedes students' ability to take higher level math courses in high school. Arguably, higher level science courses such as chemistry and physics also require a similar set of mathematic and analytic skills. Perhaps the model of offering a Support class could be successful in increasing student access and achievement in challenging science courses. Research shows that the effects of high school course-taking in math and science are more important to attaining science, technology, engineering, and mathematics (STEM) degrees in college than factors such as parental education and income (Schneider, 1998). Increasing the number of students pursuing STEM careers is a stated goal of federal education policy makers (STEM Education Coalition, 2005). If the Support model is effective in math, it may also be effective in science, offering an intervention that increases success in STEM pathways. As Tyson and colleagues point out,

> …it is critically important that schools find ways to offer opportunities for all students to enroll in the highest level courses in mathematics and science, for if they do, students taking these courses are more likely to persist in the STEM pathway… (Tyson, 2007)

This paper presents findings from a study investigating a Georgia high school's implementation of GPS math courses designed to improve student achievement in mathematics. The purpose of this study was to investigate the impact of math Support enrollment on students' achievement in GPS math courses.

METHODS

The study was conducted in a metropolitan high school in Georgia with a student population of about 1500. Within the student population, 68% are economically disadvantaged, 14% are diagnosed with disabilities, and 6% are English Language Learners. The school has a racial composition of 58% African American, 21% Caucasian, 17% Hispanic, and 2% Asian, and 2% Multiracial students (GADOE, 2009). Data were gathered for students who had previously taken either Math I or Math II. At the time of the study, Math I and Math II were the only GPS math courses offered. The following demographic and academic information was collected for each student: gender, race, and free/reduced lunch status, special education status, average middle school math CRCT score, Math I/II transcript grade, and Math I/II Support enrollment. Students for which any of this information was unknown were not included in the study.

While the focus of the study was to investigate the impact of Support enrollment on a student's math achievement, demographic and previous achievement variables were included in the analysis. Race and free/reduced lunch variables were included because discrepancies in academic achievement are well documented along racial and socioeconomic lines (Braun, Wang, Jenkins, & Weinbaum, 2006; Jencks & Phillips, 1998). Gender as a variable was included because of the discrepancy in the prevalence of men versus women in STEM career fields (Tyson, 2007). To statistically control for the potential discrepancy in Math I/II achievement between Support versus non-Support students, previous math achievement data was also collected. Average middle school math Criterion-Referenced Competency Tests (CRCT) scores were used as an indicator of previous math achievement for Math I students, and Math I transcript grades were used as a previous achievement measure for Math II students. Inclusion of all of these variables in the analysis helps to indentify the true impact of Support enrollment and avoid confounding variables.

Multiple regression analysis was used to measure the impact of demographic and achievement variables on Math I/II transcript grades. To identify which variables to include in the regression, correlation analysis was conducted for Math I and Math II separately. For each course, the correlation matrix included Math I/II transcript grades, Support enrollment status, all of the demographic variables, and all of the previous achievement variables. Any variable that was significantly correlated with both Math I/II transcript grade and Support enrollment was included in the multiple regression analysis.

RESULTS

The correlation analysis for Math I students showed that free/reduced lunch status and average math CRCT score were significantly correlated ($p<0.05$) with both Math I transcript grade and Support enrollment (Table 1). Accordingly, these variables were included with Support enrollment as independent variables in the multiple regression and Math I transcript grade as the dependent variable. Regression analysis showed that average math CRCT score did not have a significant ($p<0.05$) impact on Math I transcript grade, while both free/reduced lunch status and Support enrollment did have significant impacts (Fig.1). The coefficient for free/reduced lunch in the regression indicate that being eligible for free/reduced lunch predicts a decrease of 4% in the Math I grade. The Support enrollment coefficient shows that being enrolled in Math I Support predicts a decrease of about 4% as well. Therefore, the Math I transcript grade of a student that is both eligible for free/reduced lunch and enrolled in Math I Support is predicted to be 8% lower than students who do not fall into those categories.

Within the Math II data, the correlation analysis indicated that only the Math II students' Math I grades were significantly correlated with both Math II transcript grades and Math II Support enrollment (Table 2). Thus, the multiple regression with Math II grade as the dependent variable included Math I grade and Support enrollment as the independent variables (Fig.2). Math I grade was a significant predictor for Math II grade, while Math II Support enrollment was not a significant predictor. The coefficient for Math I grade was 0.75, indicating an almost one-to-one linear relationship between Math I grades and Math II grades for students.

DISCUSSION

The results of this study were unexpected. It is counterintuitive that for Math I students, being enrolled in Support had as much of a negative impact as being economically disadvantaged (receiving free/reduced lunch). Low socioeconomic status is a well documented predictor for reduced academic achievement, and the fact that Math I Support class enrollment predicted an equally negative influence on achievement is somewhat startling. Among Math II students, Support enrollment did not have any significant impact on achievement (although Support was negatively correlated with Math II grades), which is also troubling. How did students receiving literally double the amount of instructional time demonstrate either no increase in achievement or a decrease in achievement?

One of the instructional strategies utilized in the Math I/II Support classes in this study was regular use of computers. Students were given time on a weekly basis to work with educational mathematics software that is designed to be a self-paced, investigative tutoring program. Research has shown computer assisted instruction to have a positive effect on math achievement for a variety of students (Tienken, 2007; Waxman, Connell, & Gary, 2002). However, a synthesis of studies conducted by Baker, Gersten, and Lee (2002) found that computer assisted instruction did not significantly improve math achievement among low-achieving students. It appears that the results of this Math I/II Support study fall into the latter of these groups of findings.

Perhaps enrolling in Math I/II Support was ineffective in increasing math achievement because of how the learning time was arranged. While the students received twice the amount of instruction, it may be the case that the distribution of the time was ineffective. Following the Georgia Department of Education's recommendations, students enrolled in Support took the course at the same time as Math I/II. Because the school in this study was on block scheduling (four, 90-minute classes per day), students enrolled in Support spent half of their school day in math classes. This arrangement does nothing to address the pacing of the math content. Students still have one academic semester to learn the material, with classes covering approximately one new topic each day. Additionally, for students who struggle with and do not enjoy math, it is easy to imagine their attitudes toward spending half of each school day in math class. This scheduling arrangement may be encouraging students to "burnout" on math rather than gaining appreciation and confidence in the subject. These findings suggest the need for research regarding student attitudes and perceptions toward math Support classes.

Teachers are another factor that may help explain the surprising effect of Support enrollment. The students from which this data was gathered were some of the first classes to take Math I/II and Support as part of the rolling out of Georgia Performance Standards math courses. Accordingly, the teachers of these classes had little to no experience teaching Math I/II or Support. It is arguable that for any subject, the more experience a teacher has teaching a course, the more confident and focused they are in their instruction. It is possible that over time the effect of Support enrollment may improve as teachers become more experienced with implementing GPS math courses.

The implications of this study's results are clear. As an educational intervention in math, Support class enrollment was ineffective and a change in strategies should be implemented. Therefore using a Support-style model for science instruction is not advisable as a means to improve enrollment and success in high school science courses. Further research is needed to determine if other schools in Georgia are experiencing a similar lack of success with Math I/II Support courses. There are some Georgia high schools incorporating Math I/II and Support classes into a year-long schedule rather than one semester. More research is needed to investigate whether spreading out the increased learning time that Support offers over the academic school year, thereby slowing the pacing of the Math I/II course, increases the effectiveness of the intervention. This study indicates that strategies other than the Math I/II Support model are needed to increase learning time and academic achievement among secondary math and science students.

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APPENDIX: TABLES AND FIGURES

Table 1 **Correlations for Math 1 Students (n=483)**

	Math 1 Grade	Support Enrollment (1=yes)	Free/Reduced Lunch Status (1=yes)	Ave. Math CRCT Score	Black (1=yes)	White (1=yes)	Hispanic (1=yes)	Gender (1=female)
Support Enrollment (1=yes)	-0.207 0.000							
Free/Reduced Lunch Status (1=yes)	-0.138 0.000	0.098 0.032						
Ave. Math CRCT Score	0.123 0.007	-0.206 0.000	-0.050 0.274					
Black (1=yes)	-0.146 0.001	0.066 0.150	0.196 0.000	-0.130 0.004				
White (1=yes)	0.017 0.117	-0.111 0.015	-0.405 0.000	0.108 0.018	-0.446 0.000			
Hispanic (1=yes)	0.048 0.291	0.004 0.935	0.126 0.006	0.036 0.429	-0.720 0.000	-0.158 0.001		
Gender (1=female)	0.179 0.000	0.002 0.968	0.174 0.000	-0.084 0.066	-0.009 0.840	-0.152 0.001	0.112 0.014	
Special Education Status (1=yes)	0.015 0.735	0.135 0.003	-0.036 0.431	-0.121 0.008	0.012 0.793	0.058 0.201	-0.084 0.065	-0.092 0.043

Cell contents: Pearson correlation
P-Value

Math 1 Grade = 66.3 - 4.24 Support Enrollment* - 4.02 Free/Red Lunch Status* + 0.0107 Ave. Math CRCT Score

Fig. 1 - Regression Analysis for Math 1 Students (n=483, *$p<0.05$)

Table 2 Correlations for Math 2 Students (n=170)

	Math 2 Grade	Support Enrollment (1=yes)	Free/Reduced Lunch Status (1=yes)	Math 1 Grade	Ave. Math CRCT Score	Black (1=yes)	White (1=yes)	Hispanic (1=yes)	Gender (1=female)
Support Enrollment (1=yes)	-0.184 0.016								
Free/Reduced Lunch Status (1=yes)	-0.035 0.649	0.003 0.970							
Math 1 Grade	0.597 0.000	-0.308 0.000	-0.112 0.146						
Ave. Math CRCT Score	0.222 0.004	-0.098 0.205	-0.063 0.418	0.131 0.089					
Black (1=yes)	-0.238 0.002	0.081 0.294	0.155 0.044	-0.207 0.007	-0.112 0.145				
White (1=yes)	0.059 0.445	-0.183 0.017	-0.319 0.000	0.119 0.121	0.120 0.120	-0.395 0.000			
Hispanic (1=yes)	0.153 0.047	0.042 0.586	0.100 0.196	0.073 0.346	0.011 0.885	-0.728 0.000	-0.178 0.020		
Gender (1=female)	0.102 0.187	-0.038 0.620	0.248 0.000	0.122 0.113	-0.021 0.791	-0.163 0.034	-0.153 0.047	0.259 0.001	
Special Education Status (1=yes)	0.063 0.411	-0.100 0.194	-0.119 0.121	0.156 0.042	-0.250 0.001	-0.022 0.772	0.092 0.234	-0.062 0.419	-0.123 0.110

Cell contents: Pearson correlation
P-value

Math 2 Grade = 16.9 - 0.00 Support Enrollment + 0.757 Math 1 Grade*

Fig. 2 - Regression Analysis for Math 2 Students (n=170, *p<0.05)