The Impact of Mathematics Education Research and Brain-Learning Research on Student Performance in Algebra I

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Abstract

A large gap exists between mathematics education research and brain-learning research and classroom instructional practice. The researchers conducted an ex post facto study on the implementation of a research-based Algebra I curriculum built around high-cognitive demand tasks and student performance in Algebra I. Two groups of students were selected for the study. One group enrolled in Algebra I course that followed a typical textbook-driven curriculum and the second group enrolled in a course that followed a research-based curriculum with high-level tasks. The researcher used propensity score matching and multilevel modeling to compare the effects of the two curricula to determine whether student growth occurred. No significant difference existed in student performance between the traditional and research-based curricula. Additionally, African American and Hispanic student performance decreased and White student performance increased Grade 8 to Grade 9.

Keywords: Mathematics, Brain-Learning Research, Student Performance, Algebra I

1. Introduction

Educators and educational researchers, among others, commonly call high school algebra a gateway course for several reasons. The RAND Mathematics Study Panel reported that algebra proficiency primarily provides entrance into higher-level secondary mathematics coursework (Educational Testing Service [ETS], 2009; Matthews & Farmer, 2008; National Council of Teachers of Mathematics [NCTM], 1989). According to the University of Nebraska-Lincoln (n.d.), “Students who successfully complete Algebra I often continue to pursue the study of high school mathematics that prepares them for college, while students who are unsuccessful in Algebra I find their path to success blocked” (p. 1). Additionally, the Department Of Education [DOE] (1997) stated that students who take algebra and geometry in high school attend college at much higher rates than those who do not take these courses. Among low-income students, taking algebra and geometry makes college-going almost three times as likely (ETS, 2009).Those who master algebra and attain higher levels of mathematics coursework also tend to have access to more and higher quality career opportunities (Stapel, 2009). According to RAND (2003), “Without proficiency in algebra, students cannot access a full range of educational and career options, and they have limited chances of success” (p. 47).

RAND also reported that algebra is a gatekeeper that provides or denies access to academic and career success for all ethnic groups and socioeconomic statuses (SES) of society, which affects national culture as a whole. Lubienski (2007) stated, "Mathematics achievement is particularly important to our efforts to promote equity because it serves as a gatekeeper to high-status occupations and can provide a powerful ladder of mobility for low-SES students" (p.55). Regarding African American students, Moses and Cobb (2001) stated, "In similar fashion we believe that organizing around math literacy opens another path on which people can begin to transform their lives" (p. 5). They advocated for algebra as "the new civil right" (p. 5) that should be accessible to everyone.

2. Student Performance in Algebra

Because of its importance as a gatekeeper course, algebra is a requirement for many high schools in the United States, and in most, students must demonstrate proficiency in algebra to graduate (RAND, 2003). Unfortunately, poor student performance in algebra and secondary mathematics in the United States is a significant national concern (Schoenfeld, 1992) expressed among teachers, parents, educational administrators, and national commentators that has persisted for several decades (RAND, 2003). Specifically, national and international assessments have indicated consistent poor math performance in upper grade levels (Haycock, 2002). In 1989, the National Research Council (NRC) reported that mathematics achievement of U.S. students was well below what was necessary to "sustain our nation's leadership in a global technological society" (p. 1). In 1990, state governors nationwide joined then President Bush in establishing national educational goals. The group's collective announcement echoed across the nation: "By the year 2000, United States students will be first in the world in mathematics and science achievement" (Haycock, 2002, p. 3). During the 1970s and 1980s, the United States made considerable progress in raising mathematics achievement of minority and low-SES students. Between 1973 and 1986, the gap between White and African American students in eighth grade narrowed by half, from 48 to 25 points. Additionally, the gap between White and Latino students narrowed from 35 to 20 points (Haycock, 2002). However, gaps increased in the 1990s, and at the turn of the century, African American and Latino students in 12th grade had math skills equivalent to White students in eighth grade (Haycock, 2002). Based on the ACT (2005) national readiness standards, only 40% of high school graduates in the U.S. are ready for college algebra.

2.1 Mathematics Education Instructional Research: The Importance of Tasks

Cognitive scientists and educational researchers have published significant findings related to teaching and learning mathematics in the classroom, and many findings and recommendations focus on teaching strategies that call for student engagement in cognitively demanding mathematical tasks. Stein, Grover, and Henningsen (1996) stated that students must engage in mathematical thinking by doing mathematics through problem-solving tasks. The NCTM (1991) recommended that to develop high-level thinking in math classrooms, students must be provided opportunities to engage in dynamic, rich, and worthwhile mathematical tasks.

2.2 Brain-Learning Research

Lakomski (2000) described the 21st century as "the century of the brain," particularly because learning and brain research has characterized both educational and medical study landscapes. Brain-learning research since the late 1980s has grown exponentially (Caine & Caine, 2001). The study of how people learn as an outgrowth of neuroscience has significant instructional implications for the classroom (Bransford, Brown, & Cocking, 1999; Jensen, 2000; Willis, 2006). Many prominent brain-learning researchers have suggested specific pedagogy to ensure that content enters students' long-term memories; however, such pedagogy is virtually unknown and untried in most educational settings (Caine & Caine, 2001). According to Jensen (2008), "Brain-based education is the engagement of strategies based on principles derived from an understanding of the brain [and] this singular realization alone has fueled a massive and urgent movement worldwide to redesign learning" (p. 4).

Caine and Caine (2001) synthesized the results of current brain-learning research by introducing learning principles. These principles included (a) the brain naturally searches for meaning that is best met by engagement in and making sense of mathematical tasks;(b) the brain responds to classroom activities that satisfy curiosity and hunger for novelty, discovery, and challenge;(c) the brain uses patterning as a way to search for meaning; and (d) the brain learns best through interactive experiences. Caine and Caine (1994) advocated for incorporating brain-learning principles into the curriculum. They stated, "All education can be enhanced when this type of embedding is adopted"(p. 94).

2.3 Research-Based Algebra Curriculum

In mathematics, particularly in Algebra I, a generalized description of curriculum and instruction that includes findings from cognitive science, mathematics education, and brain-learning research is best met by a curriculum and by teaching strategies that embody experiential learning. Caine and Caine (1994) stated, “One of the most important lessons to derive from brain research is that in a very important sense, all learning is experiential” (p. 113). Experiential learning is defined as that which occurs when the learner is actively engaged; therefore, curriculum based on mathematics and brain-learning research would include challenging, high-thinking demand tasks experienced by students who practiced habits of mathematical thinking in group settings in the classroom (Caine & Caine, 2001). However, school districts have persisted in using rule memorization and skills practice, which are traditional teaching methods of past decades (Clements, 2003).

3. Statement of the Problem

Mathematics education and brain-learning studies are at the forefront of educational research; however, literature on secondary mathematics education lacks information on the implementation of an algebra curriculum embedded with research-based strategies. Limited research has been published on targeted brain-learning teaching strategies in mathematics that addresses specific content objectives. Additionally, Stein, Smith, Henningsen, and Silver (2009) published an in-depth treatise of case studies using mathematical tasks in middle school. However, to this researcher’s knowledge, no study has explored the relationship between the implementation of mathematics education using a brain-learning research algebra curriculum and student performance on state accountability measures.

4. Purpose of the Study

Secondary school administrators and mathematics teachers recognize the importance of first-year algebra as a gateway mathematics course; however, low secondary mathematics achievement is problematic in all sectors (RAND, 2003). Further, educators are hostages to an accountability system that undermines the use of research-based algebra curriculum and instruction in favor of test-preparation practices (Popham, 2007). The purpose of this study was to examine a meaningful, research-based Algebra I curriculum and its implementation using cognitively demanding tasks to identify possible relationships to student performance as measured by state accountability assessments.

5. Research Questions

The following research questions guided this study:

1. Does a statistically significant difference exist in the mathematical growth of students using a mathematics education and brain-learning research-based Algebra I curriculum that includes implementation of high-cognitive demand tasks compared to students using a traditional textbook-driven curriculum?
2. Does a statistically significant difference exist in the mathematical growth of students by ethnicity using a mathematics education and brain-learning research-based Algebra I curriculum that includes implementation of high-cognitive demand tasks compared to students using a traditional textbook-driven curriculum?

5.1 Null Hypotheses

The researcher tested the following null hypotheses at the $p < .05$ level of significance.

1. No significant difference exists in the mathematical growth of students using a mathematics education and brain-learning research-based Algebra I curriculum that includes implementation of high-cognitive demand tasks compared to students using a traditional textbook-driven curriculum.
2. No significant difference exists in the mathematical growth of students by ethnicity using a mathematics education and brain-learning research-based Algebra I curriculum that includes implementation of high-cognitive demand tasks compared to students using a traditional textbook-driven curriculum.

6. Significance of the Study

Mastery of high school algebra is critical for students to pursue advanced mathematics coursework, to gain access to more and higher quality college and career opportunities, and to facilitate equity among all students in society (RAND, 2003). While teaching methodology in algebra has changed little, achievement rates of U.S. students in algebra have been disappointingly poor for decades (Schoenfeld, 1992).

Almost from the inception of mathematics education in the United States, two distinct camps of teaching methodologies for secondary mathematics have existed (Fey& Graber, 2003). As early as 1850, proponents in one camp have advocated direct instruction, also called synthetic or rote learning. This type of learning most often using a textbook and is accompanied by memorization, drill, and practice (Cohen, 2003). The second camp has advocated inductive reasoning through discovery or experiential learning, with or without a textbook, characterized by student behaviors applied to solving special problems designed to facilitate student conceptual discovery and learning (Cohen, 2003).

The two camps continued stringent debate into and throughout the 20th century. Influences, such as national socioeconomic conditions and World War II, precluded calls for more student-centered instruction in favor of vocationally oriented courses in which students memorized and practiced basic skills (Angus & Mirel, 2003). Although research increased and expanded during the last few decades of the century, which contributed significantly to the mathematics education literature, the debate culminated in the Math Wars toward the end of the century (Angus & Mirel, 2003).

More recently, educational literature has explored new factors that may influence teaching practice. Mathematics education researchers have begun examining how the brain learns and have added new insight into the centuries-old debate over issues of mathematics teaching methodologies (Hiebert et al., 1997). Cognitive psychology has also contributed research into constructivism as the means for learning. In the late 20th and early 21st centuries, mathematics educators turned their attention toward the importance of cognitively demanding mathematics tasks to construct knowledge (Doyle, 1988).

Recently, the role of educational administrator has undergone profound change. The expectations placed on superintendents are both more challenging and more complex. In addition to community and school board responsibilities, superintendents have the added role of personal involvement to improve district student performance (Lambert et al., 2002). In fact, research indicates that reforms at the school district level can occur only when senior leadership takes the initiative to understand and support the instructional design of the district (Resnick & Glennan, 2002). For example, members of the Connecticut Superintendents' Network recognized that teaching and learning is "job number one" (City, Elmore, Fiarman, & Teitel, 2009, p. x). In fact, the first objective of these superintendents was to develop the knowledge and skills necessary to lead a district-wide instructional improvement effort (City et al., 2009).

Curriculum has been narrowed to focus on the primary goal of raising test averages, and classroom instruction is often given as decontextualized practice for assessments (Nichols &Berliner, 2008). Administrators need data on student achievement outcomes as a result of research-based teaching versus teaching for test preparation; however, there is currently a gap in the literature in this regard.

This study aimed to fill the gap in mathematics education literature by exploring the implementation of Algebra I curriculum, developed and built around current mathematics education and brain-learning research. The results of this study contribute to the literature by providing educators with student achievement data related to the implementation of a research-based algebra program.

7. Method of Procedure

It is not feasible to explore differences in student performance by randomly selecting some students to receive instruction based on one type of Algebra I curriculum and others to serve as a control group with another type of curriculum. In fact, experimental studies on the effects of student achievement using particular curricular programs are problematic because of the necessity and ethical considerations of providing one student group with a curriculum that is purported to be better for conceptual learning and withholding it from another group. However, the district-wide implementation of a textbook-driven curriculum in one school year and the district-wide implementation of a research-based curriculum the following year provided a unique and excellent opportunity to explore outcomes. Gall, Gall, and Borg (2003) described non-experimental research as that in which researchers study phenomena as they already exist without intervention.

7.1 Selection of Sample

The researcher selected two groups of students from the same school district as samples for the study. One group included Grade 9 students who studied Algebra I using the textbook-driven course and who took the Grade 9 mathematics TAKS assessment in 2008.

The second group included Grade 9 students who studied Algebra I using the mathematics education and brain-learning research-based curriculum (which included high-level tasks) and who took the Grade 9 mathematics TAKS assessment in 2009.

Class rosters of students, identified by masked student identification numbers, who were enrolled in Algebra I were matched with their teachers whose identities were also masked. Only teachers who taught Grade 9 Algebra I in both 2007–2008 and 2008–2009 were included in the study. Additionally, only students who were in Grade 9 for the first time, who had both Grade 8 and Grade 9 TAKS assessment scores, and who had a first semester grade for Grade 9 Algebra I, were included. Students identified as having limited English proficiency (LEP) or special education students who received instruction separately from the regular student population were not included in the study. Finally, students whose teachers were not included in the study; that is, teachers who had not taught Algebra I during both the 2007–2008 and 2008–2009 school years were excluded.

7.2 Collection of Data

Data were obtained from the school district evaluation and accountability department and included ethnicity, gender, home language, SES (based on free- and reduced lunch status), and Grade 8 and Grade 9 mathematics TAKS scale scores for the samples of Grade 9 students enrolled in Algebra I. For those students who took Algebra I in 2008, TAKS math scale scores were obtained for 2007 and 2008. For students who took Algebra I in 2009, TAKS math scale scores were obtained for 2008 and 2009.

7.3 Treatment of Data

The researcher built a dataset that included students who were in Grade 9 in 2007–2008 and 2008–2009 who met the qualifications for participation. The dataset included student demographic and academic variables. A Statistical Package for the Social Sciences (SPSS) propensity score matching (PSM) procedure (Thoemmes, 2009) was used to calculate a propensity score for each student, which indicated the probability of receiving the treatment (research-based curriculum). Propensity scores were then matched using a 1:1 nearest neighbor matching logistic regression algorithm with a .25 caliper on the pretest covariates of gender, ethnicity, SES (based on free- and reduced lunch status), home language, and the pretest Grade 8 mathematics TAKS scale score to create a comparable sample and force exact matching on the masked teacher identification number to eliminate teacher and school effects. After matching, 767 students in each group were identified. The researcher checked data for differences no larger than .25 standard deviations. Statistical analyses were then computed on the outcomes of the treatment (research-based curriculum) and control (traditional curriculum) groups.

Research questions were answered using multi-level modeling (MLM) to examine data that were hierarchically structured as students nested within teachers, using both between- and within-students analyses to assess students in the same classrooms with the same teachers. The null model was assessed to ensure sufficient variation to warrant an MLM analysis (Heck, Thomas, & Tabata, 2014). The researcher added growth rate to the model. To answer Research Question 1, time-varying treatment effects were included in the model and analyzed to evaluate differences in outcomes between the two groups. To answer Research Question 2, the researcher computed dummy variables for the ethnicities of African American, Hispanic, and White. The researcher assessed the influence of ethnicity, gender, and SES.

7.4 Research Summary

The researcher used archival student demographic and assessment data to analyze the effect of implementing a traditional, textbook-driven curriculum versus implementing a mathematics and brain learning research-based curriculum in a first-year algebra course in a public school district. It would have been unfeasible, and perhaps unethical, to randomly assign some students to a research-based course and others to a typical, textbook-driven course. Because the school district used a curriculum that followed a textbook in 2007–2008 and then instituted a research-based curriculum with embedded instructional tasks in 2008–2009, observational studies were required.

Propensity score matching created a well-matched sample of students by teacher for analysis. The researcher estimated the treatment effects using MLM to compare a particular outcome—Grade 9 mathematics TAKS scale score—between those who experienced Algebra I instruction with a typical textbook curriculum versus those who experienced Algebra I with a research-based curriculum for students nested within teachers. Differences by gender were also assessed.

8. Presentation of Findings

The researcher specified exact matching for teacher to reduce teacher effects, which eliminated many students from the matching procedure because only 26 teachers taught both years. The researcher then matched students using a 1:1 nearest neighbor matching logistic regression algorithm with a .25 caliper on the pretest covariates of gender, ethnicity, economic status determined by free- or reduced-priced lunch eligibility, home language, and pretest mathematics TAKS scale score.

In the matched sample, the same number of students for each group in the years 2007–2008 and 2008–2009 were identified as traditional and research-based, respectively. Before the researcher conducted the PSM procedure, the control group had 3,684 students and the treatment group had 3,792 students. The mean scale score for the Grade 8 TAKS for the control group was 2119.15 (*SD* = 141.26) and that of the treatment group was 2185.0 (*SD* = 132.85; see Table 1). After PSM, each group had 767 students. The mean scale score for the Grade 8 math TAKS for the control group was 2141.49 (*SD* = 141.63) and 2156.86 (*SD* = 133.21) for the treatment group. The propensity score for the matched control group was 0.526 and 0.543 for the treatment group.

The sample size after propensity score matching was much smaller less than in the original sample; however, the dataset was more conducive for study because of the importance of the teacher on student performance. Additionally, the difference in pretest scores in thematched sample and difference in propensity scores were much smaller in the final sample. Across most demographic characteristics, differences were smaller in the matched sample.

8.1 Research Question 1

The TAKS mathematics scale scores for all students decreased from Grade 8 to Grade 9, perhaps attributable to the change from eighth-grade general mathematics to ninth-grade Algebra I. The findings from all MLMsindicated no significant difference in the growth of student performance from Grade 8 to Grade 9based on the curriculum used. That is, no significant difference existed in the performance of students learning Algebra I with a traditional curriculum and those learning Algebra I with a research-based curriculum. Therefore, the researcher failed to reject the null hypothesis.

8.2 Research Question 2

Findings from the MLM indicated that African American students had the greatest loss in TAKS performance from Grade 8 to Grade 9 (-53.31). The loss among African American students was nearly nine times that of Hispanic students (-6.44). White students were the only ethnic group that recorded a gain (25.6). No significant difference existed in the mathematical growth of students by ethnicity using a research-based Algebra I curriculum compared to students using a traditional curriculum. Therefore, the researcher failed to reject the null hypothesis.

9. Summary of the Study and Conclusions

This retrospective study examined state assessment performance of two groups of students in a large metropolitan school district after completing Grade 9 Algebra I. One group was enrolled in Algebra I using a traditional curriculum driven by a textbook and delivered with direct instruction in 2007–2008. The following year, 2008–2009, the school district changed Algebra I to a research-based curriculum with teaching strategies driven by high-cognitive demand instructional tasks.

Propensity score matching (PSM) was used to equalize, as much as possible, the two groups of students for analyses. The researcher matched students on gender, ethnicity, home language, economic status, and the Grade 8 state mathematics Texas Assessment of Knowledge and Skills (TAKS) scale scores. Only students of teachers who taught Algebra I both school years were included in the study and were matched by teacher to minimize teacher effects. The importance of the classroom teacher is universally accepted, and in fact, researchers consider the teacher to be the single most influential factor of student performance (Darling-Hammond, Berry, & Thorenson, 2001).

Before matching, the original student groups included 3,684 students from 68 teachers and 3,792 students from 65 teachers for the 2007–2008 and 2008–2009 school years, respectively. After PSM, the number of students was reduced by over three-fourths and the number of teachers was reduced by more than half. The matched sample included 26 teachers and 767 students.

Multilevel modeling (MLM) was used to assess differences between groups in growth on TAKS mathematics scale scores from Grade 8 to Grade 9. Changes in TAKS scores from Grade 8 to Grade 9 were nested within teacher. Level 1 analysis focused on differences in scores within students, that is, students with the same teacher. Level 2 focused on differences between teachers at Grade 9, regardless of the curriculum they taught. The MLM procedure provided data regarding the percent of variance that occurred between-teachers, between-students, and within-students who had the same teacher.

Analysis of the descriptive statistics in the study noted a decrease in TAKS math scale scores of 39.32 points from Grade 8 to Grade 9 when no covariates were included, regardless of whether the traditional or research-based curriculum was taught. This decrease was not unexpected because of difference in content taught in the two grades. Grade 8 mathematics is a general mathematics course that includes basic operations, fractions, decimals, and percentages. Algebra I is the typical Grade 9 math course during which students are introduced for the first time to functions, equations, the Cartesian coordinate system, graphing, modeling, and factoring.

The transition from general mathematics in Grade 8 arithmetic to Grade 9 Algebra I is challenging for students as they often have difficulty with algebra content (Herscovics, 1992).Kieran and Wagner (1989) stated, "Much of school arithmetic is oriented toward 'finding the answer' and students can proceed with informal intuitive processes. However, students in algebra are "required to recognize and use the structures they could avoid in arithmetic" (p. 33). Algebra is abstract, thus, it deals with more abstract thinking and deductive and proportional reasoning, and with generalizations rather than specifics as in arithmetic (Kieran & Wagner, 1989). After 8 years of general mathematics, the new content introduced in algebra could account for the decrease in TAKS scores.

One benefit of using MLM is the decomposition of variance components, although explaining variance is more complex than in other models, such as single-level regression models (Hox, 2010). Because the researcher used two-level models, variances in scores were partitioned in three ways, between-teachers, between-students, and within-students of the same teacher. At Level 1, the repeated covariance matrix was a diagonal covariance matrix and Level 2 random effects for the intercept and intercept + time models were computed using the scaled identity covariance matrix (Heck et al., 2014). This combination of covariance matrices also allowed for partitioning of variance to occur at both Grade 8 and Grade 9. The null or no predictors model is used as a baseline to examine change in residual variance when additional variables are added to the model. The researcher examined these variances for patterns that would provide an explanation for the non-significant difference in math TAKS scale scores between the traditional and research-based Algebra I curricula.

For Grade 8, variances were essentially the same between-teachers, between-students, and within-students of the same teacher, regardless of which variables were in the model. All students in Grade 8 mathematics studied the same curriculum that followed the textbook, and students were taught the same way with direct instruction. Adding other predictor variables, such as student ethnicity, gender, and economic status did little to change the decomposition of variance found in the no predictor's model, with the majority of variance explained by differences between students.

However, variances shifted in Grade 9 when half of the students learned Algebra I in a different way. In particular, variances shifted within students of the same teacher for every model in the study. Half of the Grade 9 students learned Algebra I following a textbook-driven curriculum delivered by direct instruction methodology for explaining examples, working practice problems, and assigning homework. The other half of the students experienced research-based Algebra I curriculum. That curriculum introduced concepts through instructional tasks as Stein et al. (2009) recommended, rather than by direct instruction. Perhaps for the first time in their schooling experience, students worked individually and collaboratively to solve challenging mathematical tasks designed to facilitate their understanding of mathematical concepts.

Heck et al. (2014) stressed that variables added at Level 1 (i.e., student demographics) could explain variance at Level 1 and Level 2. However, variables added at Level 2 (i.e., curriculum) do not always affect the variance at Level 1. Adding all variables, including the Level 1 student variables and the Level 2 treatment variable, to the no predictors model for Grade 9 caused a shift in variance within students of the same teacher from 56.7% to 18.1%. Much more variance was found between-students than within-students of the same teacher. Between student variance increased from 37.1% to 71.2%. The Level 2 between teacher variance also increased from 6.2% to 10.7%.

These shifts in variance point to two possible conclusions. At the initial null model for Grade 9, variance for within students of the same teacher was high because two different forms of instruction occurred. For students who received the research-based curriculum, instruction was delivered much differently and it made students think and learn differently. Through instructional tasks, not only were students asked to think mathematically, but the instruction also called for students to conjecture, explore solution paths, and explain their reasoning, thereby learning what it means to be a mathematician (Stein et al., 2009). However, when the student level variables traditionally known to effect achievement (i.e., ethnicity, gender and economic status), were included in the model, those differences accounted for more variance than the differences in curriculum. This finding was shown in Research Question 2, where differences existed in growth from Grade 8 to Grade 9, although these differences were not statistically significant.

9.1. Implications

The lack of significant difference in growth found in this study should be a catalyst for additional study of research-based mathematics curricula rather than an assumption of ineffectual pedagogy. Variances in Grade 8 were very similar for all models, which is indicative of students who had been taught with the same mathematics curriculum, using the same textbook, and through direct instruction. The implementation of the research-based curriculum with instructional tasks contributed to the variances in Grade 9. The large shift in variance in Grade 9 from within-students of the same teacher in the no predictors model to between-students in the all predictors model implies that a deeper exploration of the effect of research-based curriculum and instruction strategies on different ethnic groups would be profitable. If reform strategies facilitate learning of one group more than another, the reasons why must be explored. The African American decrease in TAKS performance is evidence of the significant negative effect on future opportunities of students and consequences for society (Moses& Cobb, 2001; RAND).

Additional factors added to the model included gender, home language, and economic status. The large shift in variance to between-students implies an influence of these factors. The importance of Algebra I supports research into the other factors that affect performance.

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