

PREDICTING 9th GRADE ALGEBRA
SUCCESS

By

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Master of Science in Educational Psychology

OKLAHOMA STATE UNIVERSITY

TULSA, OKLAHOMA

2009

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE
May, 2009

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SUCCESS

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ACKNOWLEDGMENTS

To my committee chair and advisor, Dr. Laura Barnes, thank you for the time and energy you have spent with me over the course of this study. And to my committee members, Dr. Katye Perry and Dr. Janice Miller thank you for giving your time and guidance to this study.

To Todd Nelson and Dr. Shannan Bittle, thank you for your time as this study was being formulated. The access to district data and practices was beneficial. I especially thank you both for our many conversations, both formal and informal, that helped me see the importance of my work.

To all my friends and colleagues, thank you for your words of encouragement and understanding. You kept me in the loop even when I was out of it.

To my church family, thank you for your inquiries, your kind words, and mostly for your love and prayers as you nurtured me through this sometimes difficult process.

To my family, thank you for sparing me during the times when I had to lock myself away. You never gave me anything except support and never ever suggested this couldn't be done.

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CHAPTER I

INTRODUCTION

Background

Algebra is an important component of the United States' educational curriculum system. Much has been written about its benefits and why the taking and the mastering of this one course is so necessary. It has been referred to as “a keystone subject” (Usiskin, 1987), a “gatekeeper course”, (Atanda, 1992; Wu, 2001) and the “cornerstone of the student’s program of study in mathematics during the high school years” (Bloland & Michael, 1984). Algebra determines a pathway to college (Silva & Moses, 1990), career and financial enrichment (Ma, 1999), and “preparation for the world of work” (Choike, 2000). “Algebra means access” (Steen, 1999).

No one seems to doubt the importance of mathematics. It is both a serious education issue (McCoy, 2005) and an object of much attention in the testing arena (Pajares & Graham, 1999). But students don’t always score well on these assessments. In the report from the Third International Mathematics and Science Study (TIMSS, 1995) United States’ 8th graders scores below average in mathematics when compared to students in 41 other countries (Fischer & Warshauer, 2003). There have been challenges to the validity of these international comparisons, specifically in the areas of sampling

and test bias (Stedman, 1994). In the subsequent TIMSS (1999) study, with 39 participating countries, 26 of whom were included in both studies, the United States' 8th graders did only slightly better. Nonetheless, it is likely that this showing may be one of the factors that eventually led to the development of such improvement initiatives as the No Child Left Behind Act of 2001. As a result of that initiative, the success of a school is measured by their Adequate Yearly Progress/Academic Performance Index (AYP/API) scores. The testing performances of students, as well as their yearly improvement, affect this score. Our national education system's success seems to be riding on how well our students perform in many subject areas, but particularly Mathematics (Lee, Grigg, & Dion, 2007).

The Education Commission website indicates that most school districts in the United States require Algebra I for High School graduation (<http://mb2.ecs.org/reports/Report.aspx?id=900>). For many students, there is the extra requirement of a passing or satisfactory test score on an End-of-Course/End-of-Instruction exam. So often the measure of success in an endeavor is determined by passing the final test (Roy, 2007). Algebra teachers are experiencing new levels of pressure as the responsibility for success falls partly on them (Choike, 2000). Consequently, our federal government, policy makers, local school districts and school boards, Algebra teachers, as well as parents and the students themselves, not only want to see passing scores in the course, but also want to see satisfactory scores on the Algebra EOI (End of Instruction) exam. In 2006, President George W. Bush created the National Mathematics Advisory Panel to study the teaching and learning of mathematics. The responses of 743 Algebra teachers across the country were included in this report. The

teachers generally rated their student's preparedness as less than satisfactory. Overall students were considered "weak" with specific concerns regarding rational numbers (fractions), word problems, and study habits (NMAP, 2008, Chap. 9). Success in Algebra has become critical. With all this pressure on so many, being able to more closely predict a student's success in Algebra would be very useful.

Statement of the Problem

Algebra I is a crucial education stepping stone. Not only does it provide the opportunity to improve problem solving skills and critical thinking, but it is the gateway to higher level mathematics, college, and possible future success. Regardless of when this course is taken (7th, 8th, or 9th grade) passing it is a requirement for high school graduation. And in most states, proof of proficiency in the form of a test is an additional requirement. Finally, as a result of *No Child Left Behind*, these test scores contribute to a school district's Adequate Yearly Progress (AYP) and Academic Performance Index (API) ratings which demonstrate compliance with the directives of NCLB.

As important as this course may be to the individual student as well as the district that educates them, not all students who take Algebra I are successful. A school district may provide students with the chance to take Algebra I early (an advanced track) and it may even provide remediation opportunities. But when the End of Instruction/End of Course (EOI/EOC) exit test is taken, not all students attain "satisfactory" or passing status. A visit to the school districts' and States' Department of Education websites shows that not all students are successful. The goal of NCLB is that all students *WILL* be proficient by 2014.

This brings us to the questions of this proposal. If students are required to take and pass Algebra, and to score satisfactorily on an End of Instruction exam, we need to know what it will take to achieve that desired outcome. We already know that not all students perform appropriately. Why not? Are there certain test scores, grades, or other measures that might indicate Algebra success? Are there specific objectives (standards) on the test whose mastery is shown to be an indicator of success? What are these factors and which ones will be the strongest predictors of success in Algebra I?

Purpose of the Study

The purpose of this study is to determine what to look for when trying to predict which students will be successful on the Algebra I EOI test. This researcher is interested in students who take Algebra in the 9th grade, the traditional, on-level path. When delving into the vast amount of work written about this subject (Barnes & Asher, 1962; Bloland & Michael, 1984; Cooke & Fields, 1932; Dickter, 1933; Elder, 1926; Hanna, Bligh, Lenke & Orleans, 1969; Kovaly, 1979; Pinkham & Ansley, 1996; Roy, 2007; Tate, 1928; Wu, 2001;), speculation continues in regards to which variables best predict success. This study will look at some of the same variables addressed in previous studies and some that have not, at least not in this particular combination. It does seem worthwhile to investigate some specific math concepts for their predictive ability. The usual academic predictors will be investigated again (i.e. course grades, CRT test scores) as well as performance on specific standards (i.e. fractions, linear equations). The data for each of these variables are easily obtained from the school district.

Definition of Terms

Academic Performance Index (API) – The API is a numeric score that measures school site and district performance based on a variety of educational indicators. The API score range is 0 to 1500.

Adequate Yearly Progress (AYP) - Adequate Yearly Progress is the minimum level of improvement that states, school districts and school sites must achieve each year. The performance indicators used to determine AYP include: state mathematics test results, state reading/language arts test results, student participation in state testing program, student attendance (elementary and middle/junior high schools), and graduation rate (high schools and K-12 districts).

Assessment – Another word for “test”. Under No Child Left Behind, tests are aligned with academic standards. Beginning in the 2002-03 school year, schools must administer test in each of three grade spans: Grades 3-5, Grades 6-9, and Grades 10-12 in all schools. Beginning in the 2005-06 school year, tests must be administered every year in Grades 3 through 8 in mathematics and reading. Beginning in the 2007-08 school year, science achievement must also be tested.

Criterion Referenced Test (CRT)- A test designed to measure performance against a defined set of learning requirements or expectations.

End of Instruction/End of Course Exam (EOI/EOC) – An exam given by the state that measures the proficiency in the designated subject. It is traditionally given toward the end of the school year (May).

National Mathematics Advisory Panel (NMAP) - A panel of experts created by President George W. Bush in 2006 who reviewed more than 16,000 research studies as well as input from individuals and organizations in an effort to advance the teaching and learning of mathematics. The report of their findings was released on March 13, 2008.

No Child Left Behind (NCLB) – The educational reform initiative designed to reactivate the Elementary and Secondary Education Act (ESEA) of 1965. Passed as federal law in 2001 and signed into law in 2002, it focuses on accountability and standards based education. Through regular yearly assessment, proficiency, as well as a need for remediation and improvement, is determined.

Norm-Referenced Test – A test designed to compare student performance to that of other students, a general population of students (the norm group).

Performance Level - The Oklahoma School Testing Program (OSTP) reports student achievement on the state assessments in four performance levels: advanced, satisfactory, limited knowledge and unsatisfactory.

Priority Academic Student Skills (PASS) – The state academic content standards identified at each grade level and for each content area.

Proficiency – Proficiency is the ability to perform at grade level. Students who have scores at the advanced or satisfactory level on the Oklahoma Core Curriculum Tests (OCCT) have attained proficiency.

Prognostic test – A readiness test designed to predict aptitude.

Reliability – the degree to which a test (or qualitative research data) consistently measures whatever it measures.

Third International Mathematics and Science Study (TIMSS) – An international study done to compare the math and science proficiency of students in all major countries. Originally done in 1995, it included 41 countries. It was repeated in 1999 and included 39 countries, 26 of whom participated in both studies.

Validity - the degree to which a test measures what it is intended to measure; a test is valid for a particular purpose for a particular group.

Significance

This study is important because success in Mathematics is seen as an indicator of the success of the educational system of this country. Education, in general, has been in a state of transformation as philosophies and practices are analyzed and changed. Overall, the effectiveness of America's educational system is in question. When comparisons are continually made between our students and those in other countries, it is hoped that our students would make a better showing, especially in Mathematics. When our educational performance is viewed by some as mediocre, even second-rate, change becomes necessary. Algebra success, both in the course itself, as well as the exit test, is at the heart of the educational testing maelstrom. As NCLB demands accountability and proficiency, the student needs to successfully test in Algebra. It is important to have a clear indicator(s) of what will determine that success. In the past this information was important primarily as a tool of proper placement. Now, with high school graduation on

the line, and compliance with NCLB, it becomes much more significant. If successful Algebra students do well on certain tests, or if they exhibit mastery of particular content standards, it would be the hope that those predictors could be identified and those results replicated. Therefore, allowing more and more students to be successful in their Algebra undertaking.

Limitations

There are some limitations to this study. As mentioned above, the work will focus on the data routinely collected from one school district. Although this district grows more ethnically diverse every year, it still reports that 52% of the students are white. Perhaps a more diverse population would yield more generalizable results. This study uses 8th and 9th grade data for one class of students: the graduating class of 2010. Another limitation comes from the natural attrition found in most school districts. So the focus of this study will be only the students that remain in the district for that entire span.

Since course grades are to be used as a predictor, then a case could be made regarding the subjectivity that invades all grading (Helwig, Heath, & Tindal, 2000), as being a limitation. Another issue is the Algebra EOI test itself. Due to poor past performances, changes have been made to the test by the state's Department of Education. Recently, the calculator usage policy, what concepts actually appear on the test, and the cut off scores have been adjusted. Although the passing scores change with each taking of the test, the percentage of correct answers needed to be deemed "satisfactory" on the Spring 2008 Algebra EOI exam was only 42% (T. Nelson, personal

communication, September 3, 2008). Future changes in the test and/or how it is scored could impact findings from this study or similar future studies.

Another limitation could be this state's decision to use only Criterion Referenced tests as the assessment instruments. The argument could be made that Norm Referenced tests have a much higher internal consistency and may be perceived by some as a much stronger test (Sax, 1996). However, since internal consistency reliability relies heavily on variability and the variability with criterion referenced tests is somewhat irrelevant, or at least not measurable using standard indices, this may not be a limitation (Popham & Husek, 1969). But the selection of a CRT versus a NRT is not in the control of this researcher.

Organization of the Study

This study will be arranged into five sections including an introduction, a review of the literature, the methods used, an analysis of the findings, and indications of further research. The introduction states what is being studied and why there is a need. The review of the literature section gives examples of the work that has already been done in regards to this topic. The methods used and the participants will be discussed in the Methodology section. The statistical procedures used and their findings will be discussed in the Analysis section. And finally there will be a discussion of how these findings may point towards further research in this area.

CHAPTER II

REVIEW OF LITERATURE

Much of what has been researched and published concerning Algebra success is predictive and quantitative. It also becomes necessary to make a distinct choice between what is written about 8th grade Algebra (usually an advanced option) and what is written about 9th grade Algebra. Interestingly, if you exclude what is written extolling the necessity and availability of Algebra for all and what is written debating the best time to take Algebra, the literature concerning 8th grade Algebra predictive variables tends to mirror what is written about 9th grade predictors. In studies that targeted 8th grade Algebra performance, predictors chosen were previous course grades, prognostic test scores, and basic skills tests (Flexer, 1984; Helwig, et al., 2000).

Within each category, when appropriate, the literature is presented in chronological order. That order seems to best demonstrate the metamorphosis that is occurring in the work of mathematics and public education. It also seems to indicate that with the availability of bigger and faster computers, as well as the development of statistical analysis software, more researchers are able to analyze more variables easily. Academic measures are readily available through the school district making their selection one of ease. Academic measures play a predominant role in many studies

which makes them a strong, historical choice. So the first area for inspection will be the literature that focused on traditional academic measures. Within that grouping, a specific look will be taken at what was written about the 8th grade math course grade as a predictor and what was written in regards to a test of some kind given to determine IQ, aptitude, or achievement. Also, the recent work that targets student performance on End of Instruction tests, as well as what some researchers and authors are saying about specific content standards and concepts will be investigated.

Traditional Academic Predictors

For more than 80 years, there have been studies attempting to predict Algebra success. This indicates that this issue is certainly not a new concern. When searching for studies that target predictors of Algebra success, many commonalities are observed. A score on some kind of achievement test, intelligence, and/or the grade made in the previous year's math class are seen as familiar choices. Specific mathematical concepts were suggested by some researchers to possess predictive abilities. Some early researchers chose to only look at one variable, and others concentrated on multiple variables.

8th Grade Math Course Grade

The grade earned in the 8th grade math course stands out as a typical Algebra success predictor. In early studies the 8th grade math grade was used as a variable. When looking at the relationship between the Freshman Algebra grade and an average of the grades made in 8th grade, a correlation coefficient of .74 was found (Tate, 1928). When predicting the achievement at the end of the last term of elementary Algebra, a composite

of the grades made in 8th, a prognostic test, and IQ resulted in another correlation coefficient of .74 (Dickter, 1933). Later, two studies used multiple variables (mostly achievement test scores and sub scores) along with the 8th grade math grade and again it was revealed as a strong predictor of success when the criterion variable was the grade made in the Algebra course (Barnes & Asher, 1962; Shadeed, 1969). Although additional variables continued to be considered, the 8th grade math grade maintained its presence. In some studies it was found to be statistically significant on its own (Callicut, 1961; Siglin & Edeburn, 1978) and in others it was significant when considered in combination with other variables such as achievement test scores (Johnson, 1972) and prognostic test scores and teacher predictions (Kovaly, 1979). More recently, the 8th grade math course grade was featured strongly in two studies done in 1996 and 2007, showing the resiliency of this predictor. In the 1996 study the 8th grade math course grade was highly correlated (.82) with the final Algebra grade (Pinkham & Ansley, 1996). In the more recent study, the highest correlation involving the 8th grade math course grade was found between it and the score on the first Semester Algebra test at .67 (Roy, 2007).

Tests as Predictors

The grade made in the previous year's math class (8th) was still reported as a valuable variable of prediction. But more researchers began to use various tests or components of a test as possible predictors. In an early study IQ was considered as a predictor (Elder, 1926). In the previously mentioned work done by Dickter (see 8th Grade Course Grades), IQ was part of a composite that accounted for a high correlation coefficient. He does add, however, that because of the subjectivity that comes with

teacher grades, an IQ test brings the needed reliability factor (Dickter, 1933). Aptitude tests were popular choices as more researchers tried to find what predicted Algebra success (Cooke & Fields, 1932; Lee & Hughes, 1934). Prognostic tests became more widely used. Gerald Hanna and his colleague, Joseph Orleans are the authors of the now widely used *Orleans Hanna Algebra Prognosis Test*. Not surprisingly, in their study, their Algebra prognosis test was used, and shown to be a strong predictive variable (Hanna, et al., 1969). Marlene Kovaly, unsatisfied with the published prognostic tests available, created her own prognosis test to be included as a predictive variable. Her first question was to consider if three variables in combination (the prognostic test, the Math 8 grade, teacher predictions) could discriminate between those students who succeeded in Algebra I. After affirming that they did, she then explored which of these contributed to the discrimination. The results showed that all three predictors contributed significantly (Kovaly, 1979). Two additional studies chose to use a test score as a predictor. The Iowa Test of Educational Development was used and found to be a significant predictor when the criterion variable was the Algebra I mid Year Exam (Beers, 1968). And the MEAP (Michigan Educational Assessment Program) Test was used and correlated significantly with the Algebra Final Exam score (.59) and the final Algebra mark (.61)(Elgammal,1987). In addition to chronological age, numerous tests were used by Ruth Bloland and William Michael in their study. They chose to use the Orleans Hanna Prognosis test, the Arlin Test of Formal Reasoning, and components of the Iowa Basic Skills Test. Chronological age and the score on the prognosis test were the most promising predictors (Bloland & Michael, 1984). Another study among 977 students in grades 6 through 9 from seven Iowa schools looked at the predictive power of the Iowa

Algebra Aptitude Test and again, the Iowa Test of Basic Skills (Mathematics) and found the former to be an important measure when attempting to predict mathematics grades. When combined with the previous year's math grade, they resulted in "the most accurate and efficient classification possible" (Pinkham & Ansley, 1996). And Lori Roy created her own readiness test to predict Algebra success. She looked at which of the four criterion variables (Final course grade and Final exam score – 1st and 2nd semesters) could best be predicted by her test. Her independent variables were the performance on her test, a self-concept questionnaire, 8th grade math grades, 9th grade reading scores, and gender. When the Algebra I final exam was the desired variable of success, her test proved to be the number one predictor. But when the final course grade was the desired variable (which included the final exam) the grade made in the 8th grade math course was the best predictor. In her own literature review, she notes that when researchers have used standardized tests as predictors, they get better results when the previous year's math grades are also used (Roy, 2007). The widespread use of a prognostic or readiness test may earn it a prominent position when considering tests as predictors. In addition to the studies previously mentioned two more researchers interested in predicting Algebra success for student taking Algebra in the 8th grade also used a prognostic test, specifically the Orleans Hanna Prognostic Test. In her study, Flexer found that the Orleans Hanna prognostic test was the "best overall predictor" of 8th grade Algebra achievement (Flexer, 1984). More recently, another study also significantly predicted Algebra success when the performance on the prognostic test correlated with the 1st quarter Algebra grade at .56 (Kimball, 2005).

Non-Traditional Predictors

Predicting Success on an EOI

Since this researcher is using the state's Algebra I EOI exam as the criterion variable, there was interest in what was written about predicting success on those types of tests. The following studies specifically address that assessment. Although previous mathematics achievement was still noted as a strong predictor, William Crawford speculated about the relationship between teacher performance ratings and the achievement on the North Carolina End of Course test scores. That proved to be a significant relationship (Crawford, 1991). Additionally there is the work of Wiersma and McNamara. Both are specifically targeting student performance on state End of Instruction exams (Virginia and Tennessee, respectively). In a mixed methods study exploring what factors led to success on the Virginia Algebra I EOI exam, the grade earned in the 8th grade math class, when examined in combination with the Algebra I final course grade, a Stanford 9 Total Math score, and race, proved statistically significant as a predictor (Wiersma, 2002). McNamara sought to create a prediction equation using the school system (city/county) along with 8th grade achievement tests and subtests scores, the first semester numeric course grade in Algebra, and gender. The regression equation she developed accounted for 70% of the variance in the EOI test scores (McNamara, 2004). The inclusion and the significant contribution of such demographic variables as race, gender, and school district may indicate the need for future exploration into how much of a role these types of variable may play in the Algebra success enterprise.

Specific Mathematical Concepts as Predictors

In the most recent research (the last 18 years or so), some of the same variables arise. However, student proficiency with certain math concepts is also being introduced as a factor deserving consideration. Hung-Hsi Wu of the University of California at Berkeley hypothesizes that until we drastically change the way we teach fractions and decimals, students will continue to do poorly in Algebra. This is the subject of his paper that examines the preparation necessary to do well in Algebra. “In other words, is it reasonable to expect a person to run well if his walk is wobbly?” (Wu, 2001, p. 6).

George Brown and Robert Quinn of Reno, Nevada echo this belief when they state that math teachers all over the world know that students struggle with fractions and this leads to difficulties in Algebra. Their analysis did show that there was a significant relationship between a student’s success manipulating fractions and their final semester test scores. They did choose a southwestern high school with strong parental involvement. That choice suggests they may also consider parental involvement to be a factor of success (Brown & Quinn, 2007).

The Math standards put forth by each state were “graded” in a report by David Klein. He compared and contrasted the standards of 49 states plus the District of Columbia. In his discussion on overemphasized and underemphasized topics, he addresses the fraction issue. He found that not enough attention was given to the “coherent” development of fractions in the late elementary/early middle school grades. He also found that not enough time was spent in pencil and paper calculations. Following that trend, he also reports a weakness in the standards targeting the high school level when he observes that arithmetic of fractions is a frequently missing topic (Klein,

2005). In March of 2008 the National Mathematics Advisory Panel released its results and “fluency with fractions” was listed as a key concern. “The difficulty with fractions (including decimals and percents) is pervasive and is a major obstacle to further progress in mathematics, including Algebra” (p xix). When Algebra I teachers were surveyed for this report regarding student preparation, fifteen different topics were rated. The topic dealing with Rational Numbers and operations involving fractions and decimals was 14th on the list indicating very poor preparation. Only “solving word problems” was listed as poorer (NMAP, 2008, Chap. 9, p. 7).

In the 8th grade Math CRT test being used by this researcher, it is Standard 2 that addresses what should be taught in regards to fractions: Standard 2.1a - Compare and order rational numbers (positive and negative integers, fractions, decimals) in real life situations; Standard 2.1b - Use basic operations on rational numbers to solve problems in real life situations (<http://www.sde.state.ok.us>). If fraction proficiency is necessary to advancement in mathematics, and Algebra is the next step after 8th grade math, then it would seem appropriate to include this standard as a predictor.

If specific mathematical concepts are to be considered as possible areas of prediction, then the teaching strategies outlined by James Choike become even more interesting. One of his major strategies is the emphasis on multiple representations. For example, he states,

Students should be taught the value of representing mathematics in words, numerically in tables, visually in graphs, and algebraically in symbols, and how these various representational forms of mathematics are connected (Choike, 2000, p. 4).

This idea of multiple ways for students to problem solve is being echoed by many states. In this state, the 8th Grade Math Standard 1 is the standard that deals with Algebraic Reasoning. It has two components: Equations and Inequalities. The objective that deal with equations is further divided into 3 parts: 1.1a – Model, write, and solve two step linear equations using a variety of methods; 1.1b – Graph and interpret the solution to linear equations on a number line with one variable on a coordinate plane with two variables; 1.1c – Predict the effect on a graph of a linear equation when the slope changes (<http://www.sde.state.ok.us>). The National Council for Teachers of Mathematics, NCTM, lists the following as Algebra Standards: “Understand patterns, relations, and functions, represent and analyze mathematical situations and structures using algebraic symbols, use mathematical models to represent and understand quantitative relationships, and analyze change in various contexts” (<http://www.nctm.org>).

In their study about innovative teaching strategies, Ogbuehi and Fraser cite the *Mathematics Framework for California Public Schools Algebra I Standards* as saying,

The first basic skills that must be learned in Algebra I are those that relate to understanding linear equations. In Algebra I the students are expected to solve only two linear equations in two unknowns, but this is a basic skill. Students solve a system of two equations in two variables algebraically and are able to interpret the answer graphically (Ogbuehi & Fraser, 2007, p. 102).

These echo an idea put to this researcher by a Math Curriculum Specialist that linear equations is a concept that could strongly suggest Algebra EOI success. She felt

that there was strong evidence that if a student mastered the 8th grade objective for Linear Equations (Standard 1.1) they would score “satisfactory” on the state Algebra EOI exam (S. Bittle, personal communication, February 14, 2008). And in the recently released report from the NMAP, Linear Equations was listed as a “major topic of school Algebra” (NMAP, 2008, Chap. 4, p. 16).

When gathering topics to be included in their Algebra Readiness/prognosis tests, both Roy and Kovaly included fractions and their operations as well as Linear Equations (Kovaly, 1979; Roy, 2007). Interestingly, the NMAP results did report that teachers found their incoming Algebra I students to be better prepared in the area of Linear Equations than that of Fractions (NMAP, 2008, Chap. 9, p. 7).

Summary

Prediction of success in Algebra is the area of interest to this researcher. The body of literature dealing with the quantitative predictors spans a long period (1926 – 2008). The earlier studies focused mostly on grades and test scores as predictors. In the late 70s and into the 80s other types of standardized tests and aptitude tests began to make appearances. The later studies still seem to cling to some grades and some tests, but also include suggestions and trials incorporating non-academic measures when looking for possible predictors. Two researchers clearly state that multiple predictors are more likely to predict Algebra success (Kovaly, 1979; Pinkham & Ansley, 1996).

Academic data is usually readily available from a school district and that, combined with the literature findings seem to strongly advocate the continued use of such data as predictive tools. But these may not tell the whole tale. Specific mathematical

topics are also suggested as necessary for Algebra readiness and therefore also worthy of inclusion. Not only is this researcher interested in using the 8th grade math course grade and 8th grade CRT performance to predict an outcome on the Algebra I EOI exam, but the proficiency level in fractions and linear equations (Standards 2.1 & 1.1) are also variables of interest. The findings from the National Mathematics Advisory Panel support this choice. So, from the literature, the case is made that grades, tests, and proficiency all may predict readiness for Algebra and therefore success.

Hypothesis/Research Questions

There is no doubt that many people have written about the study of Algebra. Whether it is right or wrong to expect all students to take Algebra, whether it should be taken in 8th grade or 9th grade, whether or not we are even teaching it correctly, are not the subjects of this study. Students must be successful in Algebra. Many researchers have hypothesized about which predictors are best. Previous school year grades and performance on certain standardized achievement tests have been tried in various combinations with various results. So, what is the best predictor?

The previous year's class grade in mathematics (8th grade) and any kind of achievement or standardized test have both been used in multiple prior studies. Those variables will be included in this study, as well. They have been strong predictors in the past, which is why they will be used again. However, the research indicates there are still some areas of interest that have not previously been used. Little from the literature review suggested linear equations as an area of attention. But when the very same thing was mentioned to this researcher as part of an interview about Algebra and testing

success, it became a variable of interest. Fraction mastery was also raised as a predictor, as well. When this was reported in the NMAP report as an area of weakness, it became variable of interest.

Looking at one class of students over two years, the following data will be collected on each of the students: 8th grade math course (Pre-Algebra) grade, performance on the state's 8th grade Math CRT, the CRT performance on the linear equations standard (1.1), and the CRT performance on the fractions standard (2.1). These are the predictive variables. The criterion variable will be the performance on the Algebra I EOI exam. This variable was chosen because it has become a determining factor of high school graduation. The primary research questions are: (1) Can 9th grade Algebra EOI performance be significantly predicted from some combination of 8th grade Pre-Algebra course grades, 8th grade CRT math scores, proficiency level score on linear equations, and the proficiency level score on fractions? (2) Will the standard specific scores (linear equations and fractions) emerge as significant predictors of Algebra EOI success? Since Pre-Algebra is the on-level math course option for 8th graders and Algebra I is the on-level math course option for 9th graders, all students in this study who were enrolled in 8th grade Pre-Algebra, regardless of their earned grade, were allowed to take Algebra I as 9th graders.

CHAPTER III

METHODOLOGY

Participants and Data Sources

According to the district's website accessed in June, 2008, it is a suburban district that serves approximately 14,000 students (www.unionps.org). As of October, 2007, this was the demographic breakdown: Asian – 6.6%, Hispanic – 16.9%, Black – 13.8%, Indian (Native American) – 10.6%, White – 52.2%. Compared to the state's demographics (633,006 students as of SY 06-07), the breakdown is as follows: 8%, 9.5%, 10.8%, 19.3%, and 58.6%, respectively. So this district appears to be somewhat representative of that population (www.sde.state.ok.us). The targets of this study are the students of the graduating class of 2010. Since the interest lies only in on-level students with all data available, only 589 students were included in this study. These participants were selected partly out of convenience, but also because they come from a sizable district with a relatively diverse population that closely mirrors the state.

Instruments

The state's 8th grade math standards-based, criterion-referenced assessment (CRT) is given to all 8th graders in April of each year. The Educational Testing Services (ETS), Data Recognition Corporation (DRC), and the State Department of Education worked

together to construct the test forms aligned to the PASS (Priority Academic Student Skills) objectives. It is an un-timed multiple choice test with 55 questions that students should be able to complete in 60 minutes. Ten of those are built in Field Test questions. Eight different forms were used and 20% of the test questions are devoted to Standard 1 which deals with Algebraic reasoning (including linear equations) and 18% of the test questions are devoted to Standard 2 which deals with rational numbers (fractions). For this study the interest is only in Standard 1.1 and Standard 2.1. There are five questions devoted to Standard 1.1 and four questions devoted to Standard 2.1. These nine questions (out of the scored 45) make up 20% of the test. The statistical test data can be located on the Oklahoma State Department of Education website. The 2007 Technical Report provides extensive information on test item analysis, standard error of measurement, and reliability. In the report, there was no validity score given but explanations of test item selection were provided. Review and approval by Oklahoma content, bias, and sensitivity committees deemed the items to be of “good quality” (p 13, Technical Report). Internal consistency, measured as Cronbach’s alpha coefficient, was reported as .89 with a Standard Error of Measurement of 2.84. It was also reported that 90% or more of the students who met or exceeded the satisfactory score would obtain the same results if their true scores were known. And 87% of the students receiving satisfactory scores would do so again with another administration of the test (www.sde.state.ok.us , 2008).

The End of Instruction (EOI) exam is a state-mandated, secondary level, criterion-referenced test. It is used to assess proficiency as it relates to the PASS objectives. The PASS objectives are skills that students are expected to know at the end of instruction in

the content area. This assessment was developed by CTB McGraw-Hill in connection with the State Department of Education, but Pearson Educational Measurement actually administers and scores the test. During the Spring 2007 administration, there were 5 forms of the test. The 75 question multiple choice test included 20 field test items. Again, the statistical data can be found on the state Department of Education website's Technical Report. Item analysis, test item bias, and standard error of measurement were discussed thoroughly. There was a subheading for content validity, but no specific value was provided. The report did state that the Oklahoma Priority Academic Student Skills (PASS) were studied by CTB's content experts, as well as content area specialists, teachers, and assessment experts to assure adequate content validity. Once again it was Cronbach's alpha coefficient that determined reliability. That value was given as .93 which should indicate strong internal consistency (www.sde.state.ok.us, 2008).

Research Design and Procedure

The design for this study was primarily correlational. This study used one criterion (dependent) variable. That measure of success was the raw score performance on the Algebra I EOI exam (EOI) taken during the Spring of the 9th grade year. Because this researcher was interested in more than one predictive (independent) variable, none of which was manipulated, Multiple Regression Analysis was chosen as the statistical analysis method. The predictive variables are the grade made in the 8th grade math class (MTHGRD8), the performance on the Oklahoma 8th grade Math CRT (MTHCRT8), and the performances on Standard 1.1 (STDL) and Standard 2.1 (STDF). The multiple correlation coefficient that was obtained during the analysis will estimate the magnitude

of the relationship between the Algebra EOI and the best linear combination of the grade, the CRT score , and each of the standard performances (STDL and STDF)

(Shavelson,1996, pp. 525-533). All scores collected for this study were raw scores.

The data for this study comes from the district's Director of Student Assessment. Using a Microsoft Excel spreadsheet, the measures of interest were retrieved from the district's collection of data bases. After the data was gathered all students' names were removed to assure anonymity. Descriptive statistics were generated and are included in table form as part of the results. These coupled with correlational data were the first areas of interest. Relationships were noted and analyzed. Because the standards are a part of the CRT test, it was anticipated that more than one regression might be run in order to ascertain the strongest predictor.

CHAPTER IV

FINDINGS

Correlation and regression analyses were conducted to address the research questions posited in this study. In addition to the more traditional predictive variables (i.e. grades, test scores), interest was raised in the predictive power of fractions and linear equations performance. These are both individual standards measured as part of the state CRT. It was the original goal of this researcher to develop a prediction equation that might best predict success on the Algebra I End of Instruction Exam. Upon examination of the correlations it became apparent that more could be learned from running more than one regression with the variables in different combinations. The standards (1.1 and 2.1) were also a consideration. These standards are part of the whole CRT test, so care was used in choosing which variables were to be a part of which regressions. So three separate simultaneous Multiple Regressions were run and are analyzed here. For all the regressions, the criterion (or dependent) variable was the score received on the Algebra I EOI exam. In the first regression the predictor (or independent) variables were the grade obtained in the 8th Grade Math course and the score received on the state's 8th Grade Math CRT. In the second regression the predictor variables were the 8th Grade Math course grade and the performances on the individual standards: fractions (STDF) and

linear equations (STDL). In the third regression the predictor variables were only the performances on each of the standards.

The means, standard deviations, and correlations of all variables are presented in Table 1. The means for MTHGRD8 come from percentage grades. The means for the MTHCRT8 and EOIALG9 are raw scores indicating correct answers out of 45 and 55, respectively. The standard addressing linear equations is a raw score out of 5 and the fractions standard is a raw score out of 4. Because the standard scores are part of the whole CRT score, the correlations between each standard and the CRT are part/whole correlations. All of the Pearson bivariate correlation coefficients (see Table 1) reached statistical significance.

TABLE 1
Means, Standard Deviations, and Correlations of All Variables (N = 589)

Variable	MTHGRD8	MTHCRT8	STDL	STDF	EOIALG9	Mean	SD
MTHGRD8		0.64*	0.46*	0.47*	0.66*	80.49	12.55
MTHCRT8			0.67*†	0.68*†	0.70*	29.20	7.22
STDL				0.43*	0.48*	2.95	1.16
STDF					0.49*	2.83	1.00
EOIALG9						37.26	10.98

* $p < 0.001$

† Part to whole correlation

First Regression

The first regression was run using the 8th Grade math course grade and the performance on the 8th Grade Math CRT as predictors. The objective was to see which of these predictors accounted for the most variance in the Algebra I EOI scores. The highest correlation was observed between the 8th grade Math CRT and the Algebra I EOI ($r =$

.70). So 49% (r^2) of the variance in the Algebra EOI scores is explained by the performance on the 8th Grade CRT. The correlation between the 8th Grade course grade and the EOI was .66, so 44% of the variance is attributable to that predictor. The correlation between the two predictor variables was the lowest ($r = .64$) with 41% of the variance in the dependent variable explained.

The multiple regression analysis determined that taken together, 56% ($R = .75$) of the variance in the Algebra I EOI scores is accounted for by this model. The goal of this study was to generate a regression equation that would allow for prediction of the score that might be earned by future students. In future applications the sample correlations would almost always be smaller than the R calculated here for this sample – a phenomenon called “shrinkage” (Pedhazur, 1997). The R^2 and the R^2 adjusted were very close in all regressions so the adjusted R^2 is what is reported ($R_{adj}^2 = .56$). The overall relationship was significant ($F_{2,589} = 377.82, p < 0.001$). When each predictor was assessed individually, both tests of the regression coefficients reached statistical significance (MTHGRD8, $t = 10.27, p < 0.001$; MTHCRT8, $t = 13.11, p < 0.001$). The score achieved on the 8th Grade CRT was a stronger predictor ($\beta = .46$) than the grade earned in the 8th Grade Math course ($\beta = .36$) but not by much. In this sample of students, 76% scored “satisfactory” on both the CRT and the EOI (see Table 6). In conclusion, the significant prediction equation generated during this analysis ($EOIALG9 = -8.97 + .32 \text{ MTHGRD8} + .71 \text{ MTHCRT8}$) could be used by anyone wishing to estimate the score to be earned on the Algebra I EOI exam.

TABLE 2
First Regression Results

Predictor	Unstandardized Coefficient	Standard Error	Standardized Beta	t
MTHGRD8	0.32	0.03	0.36	10.27
MTHCRT8	0.71	0.05	0.46	13.11

F (2,586) = 377.82; p < 0.001
R² = .563; Adjusted R² = .562

Second Regression

The second regression used the same criterion variable (EOIALG9) as the first regression. The chosen predictors were MTHGRD8 and the performance on the two individual standards: linear equations (STDL) and fractions (STDF). Because these standards are included in the MTHCRT8, it was excluded as a predictor variable. The objective was to see which of these predictors would be the strongest in predicting the outcome variable. Amongst these three, the strongest was the correlation obtained between the 8th Grade math course grade and the EOI ($r = .66$). About 44% of the variability in the EOI scores was accounted for by the grade earned in the 8th Grade Math course. The correlations between each of the standards, STDL ($r = .48$) and STDF ($r = .49$), and the EOI accounted for 23% and 24% of the variance in scores, respectively. The correlations between each of the standards and the MTHGRD8 were similar to those found when compared to the EOI (STDL $r = .46$; STDF $r = .47$) accounting for 21% and 22% of the variance. Finally, the correlation between the two standards ($r = .43$) produced an r^2 value of .19 (19% shared variability). As mentioned above, all of the Pearson bivariate correlations achieved statistical significance at the 0.001 level.

The multiple regression analysis determined that taken together, 50% ($R = .71$) of the variance in the Algebra I EOI scores is accounted for by this model ($R_{adj}^2 = .50$). The overall relationship was significant ($F_{3,585} = 195.98, p < 0.001$). When each predictor was assessed individually, all three tests of the regression coefficients reached statistical significance (MTHGRD8, $t = 14.04, p < 0.001$; STDL, $t = 5.04, p < 0.001$; STDF, $t = 5.57, p < 0.001$). The score achieved in the 8th Grade Math course was a stronger predictor ($\beta = .49$) than either of the standards, STDL or STDF ($\beta = .17, \beta = .19$). The significant prediction equation generated during this analysis ($EOIALG9 = -8.01 + .43$ MTHGRD8 + 1.64 STDL + 2.09 STDF) could be used by anyone wishing to estimate the score to be earned on the Algebra I EOI exam (see Table 3).

TABLE 3
Second Regression Results

Predictor	Unstandardized Coefficient	Standard Error	Standardized Beta	t
MTHGRD8	0.43	0.03	0.49	14.04
STDL	1.64	0.33	0.17	5.04
STDF	2.09	0.38	0.19	5.57

$F(3,585) = 195.98; p < 0.001$
 $R^2 = .501; \text{Adjusted } R^2 = .499$

Third Regression

The third regression used the same criterion variable (EOIALG9) as the previous regressions. This regression was run because of interest on the part of the researcher. The only chosen predictors were the performances on the two individual standards: linear equations (STDL) and fractions (STDF). Because these standards are included in the

MTHCRT8, it was excluded as a predictor variable. The objective was to see if the standards strongly predicted the outcome variable. Amongst these two predictors, the strongest was the correlation obtained between the fractions standard (STDF) and the EOI ($r = .49$). About 24% of the variability in the EOI scores was accounted for by the performance on the fractions standard. The correlation between the linear equations standard (STDL) and the EOI generated an r value of .48 indicating that about 23% of the variance in the EOI scores were accounted for by the performance on this standard.

The multiple regression analysis determined that taken together, 33% ($R = .58$) of the variance in the Algebra I EOI scores is accounted for by this model ($R_{adj}^2 = .33$). The overall relationship was significant ($F_{2,586} = 146.36, p < 0.001$). When each predictor was assessed individually, both tests of the regression coefficients reached statistical significance (STDL, $t = 8.84, p < 0.001$; STDF, $t = 9.43, p < 0.001$). When examining the beta weights the fractions standard yielded a slightly higher value ($\beta = .35$) than the linear equations standard ($\beta = .33$). The significant prediction equation generated during this analysis ($EOIALG9 = 17.13 + 3.14STDL + 3.85STDF$) could be used by anyone wishing to estimate the score to be earned on the Algebra I EOI exam using only the performance on these two standards (see Table 4). However, these two standards together would only account for 9 of the 45 questions. Essentially, you would be shortening the test, therefore possible decreasing the reliability.

TABLE 4
Third Regression Results

Predictor	Unstandardized	Standard Error	Standardized	t
STDL	3.14	0.36	0.33	8.84
STDF	3.85	0.41	0.35	9.43

$F(2,586) = 146.36; p < 0.001$
 $R^2 = .333; \text{Adjusted } R^2 = .331$

CHAPTER V

CONCLUSION

The objective of these analyses, as well as the objective of this study, was to determine which of the chosen predictor variables would best estimate a score on the Algebra I EOI exam. In the first regression, it was no surprise that the relationship between the CRT and the EOI was the strongest. That finding is supported by previous research and it is reassuring to reach the same conclusion as other studies done for similar purposes. Most in education would have intuitively suggested this result, so it is good to have the scientific, statistical support.

In the second regression, the goal was to discover if either of the specific standards, Standard 1.1 (linear equations) or Standard 2.1 (fractions), in combination with the performance in the 8th grade Math class would stand out as strong predictors. The 8th grade Math class grade did turn out to be the strongest predictor. That, too, is a finding that is supported by previous research. A third regression was run to target the specific contribution made by the individual standards (1.1 and 2.1) only. There was research done and articles written to posit that students would not do well in Algebra if their skills in either linear equations and/or fractions were weak. So it had been the expectation of this researcher that there would be some noteworthy relationships. Neither of the

individual standards was as strong as the other predictors, but there was still something to be learned from their inclusion (see further discussion below). These are necessary components of any Algebra curriculum and educators must continue to encourage mastery of these concepts.

Although not part of the regressions, some explanation of the term “satisfactory” may be needed. In the cases of both of the state tests (CRT,EOI) performance is broken down into four categories: ADVANCED, SATISFACTORY, LIMITED KNOWLEDGE, and UNSATISFACTORY. The state deems “satisfactory” or above as indicating success. In this group of students 83% achieved “satisfactory” status on the 2007 EOI. It may be of further interest to note that in this state on these exams (CRT, EOI) there are number of correct answers required to achieve the sought after “satisfactory” status. For the CRT (taken in April, 2006), only 22 out of the 45 answers (49%) must be correct to be “satisfactory”. For the EOI (taken in May, 2007), only 25 out of the 55 answers (45%) must be correct for satisfactory status. When performance on a standard is mentioned, it is a raw score (see Table 5).

TABLE 5
Numbers/Percentages of Students in Each Performance Level

MTHCRT8				
<i>2006</i>	U	LK	S	A
Raw Score/45	0 – 15	16 – 21	22 – 35	36 - 45
Number in Category	20	74	377	118
Percentage	3%	13%	64%	20%
N = 589			84% successful	
EOIALG9				
<i>2007</i>	U	LK	S	A
Raw Score/55	0 – 17	18 – 24	25 – 38	39 - 55
Number in Category	34	68	157	330
Percentage	6%	12%	27%	56%
N = 589			83% successful	

According to the state's Test Blueprint, there were 5 test items for Standard 1.1 and 4 test items for Standard 2.1. Mastery is not clearly defined by the reports provided, but on the state's website there was discussion about a minimum of 4 questions per standard to obtain 3 out of 4 as a 75% mastery score. No information about how the passing or cut scores were determined could be found on the state's Department of Education website. When the number of correct answers needed to "pass" the Algebra I EOI went from 45% (2007) to 42% (2008), how does that reconcile with a 75% "mastery" score? And if a student had this kind of performance in most any classroom, most teachers would label that as failing. Perhaps this explains how 56% of these students were able to score at an "advanced" level on the EOI.

It was also interesting that 17% of the students in this study managed to achieve a satisfactory rating on the EOI *without* mastering either of these targeted standards (see Table 6). A closer look at the numbers of students who mastered these standards found almost a 2 to 1 ratio between the number of students who mastered the Fractions standard and the number of students who mastered the Linear Equations standard (66% to 35%). Again 76% of the students who scored "satisfactory" on the CRT did the same on the EOI, regardless of their performance on the standards. In order to achieve "satisfactory" status on the EOI only 25 correct answers out of 55 questions were necessary. The mean for this group of students was 37.26 (see Table 1). According to the 2007 Technical Report, that was a higher mean than the state mean of 32.7 (www.sde.state.ok.us).

TABLE 6
Numbers/Percentages of Student Performance

	Number	Percentage
Scored SAT on CRT	495	84%
Scored SAT on EOI	487	83%
Scored SAT on CRT & EOI	449	76%
Mastered St. 1.1 (Lin.Eq.)	207	35%
Mastered St. 2.1 (Fractions)	386	66%
SAT on Both Test, Mastered Both Standards	165	28%
Scored SAT on EOI, Mastered St. 1.1	196	33%
Scored SAT on EOI, Mastered St. 2.1	351	60%
Scored SAT on EOI, Mastered Neither	103	17%
Scored SAT on CRT, Mastered Neither	89	15%
No SAT on CRT, but SAT on EOI	39	7%

N = 589

SAT = Satisfactory or better

So what does this mean in terms of predicting the success of Algebra I students in the 9th grade? It was the goal of this researcher to answer these research questions: (1) Can 9th grade Algebra EOI performance be significantly predicted from some combination of 8th grade Pre-Algebra course grades, 8th grade CRT math scores, proficiency level score on linear equations, and the proficiency level score on fractions? (2) Will the standard specific scores (linear equations and fractions) emerge as significant predictors of Algebra EOI success?

Since all regressions were run including various combinations of these predictors and all reached statistical significance, one could answer these questions affirmatively. However, other aspects must be considered before blindly predicting Algebra success based solely on the “significance” determined here. The emergence of the 8th Grade Math CRT as a predictor is solid, both intuitively and statistically. The first regression

equation included both the CRT and the grade for the 8th Grade Math class and anyone wishing to predict a student's score on the EOI in the subsequent year could do so without much reservation; although using a teacher given grade may interject some subjectivity. The strongest bit of predictive evidence would be the performance on the 8th Grade Math CRT. Only 39 students (roughly 7% - See Table 6) who did not score SATISFACTORY on the CRT scored SATISFACTORY or better on the EOI. So performance on the CRT does seem to indicate success on the EOI. This would, and does, give the district in question an opportunity to focus on these unsuccessful students.

The second and third regressions included the two standards of interest, linear equations and fractions. Initially, it was a disappointment to this researcher that either/both of these did not appear to have stronger correlations to the EOI. Each of their correlations was just under .5. Again, statistical significance was achieved, but when examining their individual contribution the variance in the EOI scores that *is* explained by each of these two standards is 23% (linear equations) and 24% (fractions). So the performance on these two standards shouldn't be discounted. However, when the amount of variance in the EOI scores that is *unexplained* is in the neighborhood of 75% (when considered separately), that requires careful treading. This researcher cannot conclusively state that performance on either the linear equations standard or the fractions standard will lead to success on the Algebra EOI exam. But in the third regression model where *only* these two standards were included as predictors, 33% of the variance in the EOI scores is being explained by 9 questions! Even considering the lower reliability of using just these two standards, their importance is probably being underestimated. Looking at it another way – In the first regression, the amount of variance in the EOI that

is explained by the CRT (the strongest predictor) is 48%. That tells us that there is only 17% more of the variance being explained by the remainder of the CRT (36 questions).

Most math teachers would agree that these standards represent concepts that are important components in Algebra. It is likely that most math teachers, especially those teaching middle school math and Algebra, will conclude that the mastery of the fraction standard is necessary for future mathematical success and it is frequently a weakness for students. As a middle school math teacher, this researcher can echo this concern. Just this week, in an email from a 9th grade Algebra I teacher, the subject of fraction weakness was raised. She said if only her Algebra students came to her with mastery of fractions (their relationships and operations) her students would *begin* the class prepared (M. Gamble, personal communication, April 23, 2009). The use of either of the equations resulting from the second and third regressions would certainly provide some interesting input about student success, but should not be regarded as a standalone measure. For anyone in this state who chooses to use any of these equations as predictors of an Algebra EOI score, they would need to further consider the cutoff score that determines success (satisfactory status) as defined by the state and any future changes in that determination that may occur.

For various reasons some possible predictors were omitted from this study. There was no knowledge of the grades made in the Algebra I course. This data is available through the district, but it was not chosen as a predictor by this researcher because the interest was only the performance on the End of Instruction exam. This could provide some extra pieces to the puzzle. Also, the district administers its own CRT. The district's Director of Student Assessment feels this test is more difficult than the state's

CRT (T. Nelson, personal communication, September 3, 2008). It certainly requires a higher level of mastery to achieve satisfactory status. But because there was no reliability data available, this test was not used. It may provide more information in regards to the mastery (or not) of the fraction and linear equations standards. In this district test there are 4 questions for every objective (parts of the standard). This makes determining mastery of each standard very clear. And since the district now administers this CRT quarterly (not done at the time of the testing featured in this study), failure to achieve mastery could be determined earlier and remediation could begin sooner. If all agree that these standards are measuring a necessary objective and that mastery of these objectives can only improve the performance on the EOI, it would seem that getting as many students as possible to demonstrate mastery as soon as possible should be a goal. The state CRT results are often not available to the district until late July and the district results are often available within days. In the future, this district may want to invest in obtaining reliability data and then this test score could be entered into additional regressions to see what could be learned. And since this state does not require the taking of any Norm-referenced or standardized tests, there was none of that data available.

This study does not include any mention of non-academic variables. No demographic data were used although it is certain that some interesting relationships could be observed. Anyone involved in behavioral research knows that there are always extraneous factors that can affect any outcome. Most in education realize that a test score (or any assessment measure) may not fully describe the progress of a student. Many previous studies, papers, and articles (some highlighted in this study) have been written regarding the non-academic variables. In addition to demographic data, some studies

have included attitude, motivation, and parental involvement measures. These non-academic measures are harder to come by, harder to measure, harder to obtain, and harder to synthesize, but indicate an area of research that should continue.

Undoubtedly more could be learned if this study were repeated in other school districts. It would be interesting to see what differences might be observed when the objects of the study were from a larger, more diverse district or, perhaps, a smaller, more rural district. Are individual superintendents content with the EOI and how its success is determined? Information should also be gathered that targets the differences in cut scores in different states. Do all states approach this similarly or is this state unique? Would there be notable differences between large and small states, rural and heavily populated, homogenous populations and heterogeneous populations?

As researchers and policy makers continue to attempt to explain behaviors and outcomes and as government continues to place the determination of success upon test scores, and as schools and districts are measured predominantly by their students' successes, it becomes obligatory to search for answers and the magic combination of variables and conditions under which all students may become successful. Although most educators know that any one measure cannot truly sum up a student and their progress.

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VITA

Susan O. Hickey

Candidate for the Degree of

Master of Science

Thesis: PREDICTING 9TH GRADE ALGEBRA SUCCESS

Major Field: Educational Psychology

Biographical:

Personal Data: Born in Houston, Texas on September, 7, 1955. Married to Michael Shane Hickey. Children: Jeremy & Christine Hickey, Justin Hickey

Education: Graduated from Sam Rayburn High School, Pasadena, Texas in May, 1973; received Bachelor of Science degree in Elementary Education from Northeastern State University, Tahlequah, Oklahoma in May, 1992. Completed the requirements for the Master of Science in Educational Psychology at Oklahoma State University, Tulsa, Oklahoma in May, 2009.

Experience: Elementary teacher (grades 4-5); Secondary Math teacher (grades 6-8), Adjunct Instructor for Tulsa Community College, Southeast Campus (Basic Math, Beginning Algebra, Intermediate Algebra)

Professional Memberships: NCTM (National Council for Teachers of Mathematics); PTA, REMS (Research, Evaluation, Measurement, Statistics) Society

Name: Susan O. Hickey

Date of Degree: May, 2009

Institution: Oklahoma State University

Location: Tulsa, Oklahoma

Title of Study: PREDICTING 9TH GRADE ALGEBRA SUCCESS

Pages in Study: 43

Candidate for the Degree of Master of Science

Major Field: Educational Psychology

Scope and Method of Study: The purpose of this study was to examine the relationships between the grade made in the 8th grade Math course, the performance on the state's 8th Grade Math CRT, and the performances on the individual standards that are included in the CRT that deal with Linear Equations and Fractions. The criterion variable was the performance on the 9th Grade Algebra I End of Instruction Exam. The participants were 589 on-level students who attended 8th and 9th grade in a Northeast Oklahoma school district. The design for this study is primarily correlational. Multiple Regression analyses were run to investigate which of these variables predicted success on the Algebra EOI exam.

Findings and Conclusions: All of the Pearson r correlations were found to be significant at the $p < 0.001$ level. Three separate regressions were run. The performance on the 8th grade CRT was shown to be significantly associated with performance on the 9th grade Algebra I End of Instruction exam ($r = .70$). The grade made in the 8th grade Math course yielded a correlation coefficient of .66 when compared to the criterion variable (EOI). The performance on each of the individual standards, Linear Equations and Fractions, produced correlations coefficients of .48 and .49, respectively, when compared to the criterion variable. Performance on the Algebra I EOI exam could be strongly predicted by the performance on the 8th grade CRT. In the third regression only the individual standards were included as predictors. The performance on the two individual standards together accounted for 33% of the variance in the Algebra I EOI exam.

ADVISER'S APPROVAL: Dr. Laura L. Barnes

Oklahoma State University Institutional Review Board

Date: Tuesday, February 24, 2009
IRB Application No ED0923
Proposal Title: Predicting Algebra Success in 9th Grade

Reviewed and Processed as: Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 2/23/2010

Principal Investigator(s):

Susan Hickey 810 E. Seattle Place Broken Arrow, OK 74012	Laura Barnes 700 N. Greenwood Tulsa, OK 74106
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The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Beth McTernan in 219 Cordell North (phone: 405-744-5700, beth.mcternan@okstate.edu).

Sincerely,


Shelia Kennison, Chair
Institutional Review Board

ADVISER'S APPROVAL: Dr. Laura L. Barnes