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# The Impact of Selected Academic and Demographic Variables on Mathematics College Readiness Predicted by ACT

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The Impact of Selected Academic and Demographic Variables on  
Mathematics College Readiness Predicted by ACT

The Impact of Selected Academic and Demographic Variables on  
Mathematics College Readiness Predicted by ACT

A dissertation submitted in partial fulfillment  
of the requirements for the degree of  
Doctor of Philosophy in Curriculum and Instruction

by

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This dissertation is approved for recommendation to the Graduate Council.

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## **Abstract**

The purpose of the study was to determine the degree to which academic and demographic variables affected the ACT results used in determining college readiness. This quantitative research study followed a non-experimental correlational design. A multiple regression was used to analyze archival data to determine the impact the combined Arkansas Comprehensive Testing, Assessment and Accountability Program (ACTAAP) mathematics end-of-course (EOC) score, high school GPA, and highest mathematics class completed had on the ACT mathematics exam. In addition, a hierarchical multiple regression model was used to determine how English language learner (ELL) status and socio-economic status (SES) impacted students' ACT performance used in determining college readiness.

The students who graduated from one Northwest Arkansas high school over a three-year period established the population for this study. The sample included students who graduated in the years 2010, 2011, or 2012; who participated in the district's individualized graduation plan (IGP); and who took the Algebra 1 EOC test, the Geometry EOC test, and the ACT exam.

The results indicated that the study's academic variables significantly influenced the mathematics score on the ACT. The strongest predictor was the combined ACTAAP mathematics EOC scale score. In addition, the demographic results of how ELL status and SES modified the predictive nature of the ACTAAP mathematics EOC scale score supported that ELL status had a significant impact; however, when SES was added it appeared to offer little additional predictive power beyond that contributed by ELL status.

The current study added to the literature by using high school curriculum, college admission tests, state-mandated mathematics assessments, and selected demographic information

to help parents, students, and school personnel improve their understanding of how to prepare students for college.

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## **Dedication**

I dedicate this work to my close family and friends. To my husband Brenton, who encouraged me every day. Hour after countless hour he listened and provided me with positive feedback. He sacrificed so much so that I could complete my dream. He has been my foundation and support for which I am truly grateful. To my father Alfred, who called me weekly with great enthusiasm enquiring about my progress. To my sister Mari and her family, Jonathan, RyAnne, and Grace, who filled my short times away from research and writing with fun and special moments. To my grandmother Marie, who believed in the importance of an education. Because of her I never doubted my abilities. To my close family John, Leigh, and Jim, who hold a special place in my heart. And to my close and dear friend Marlys, who supported me more than any friend should. You are a sweet spirit and I thank the Lord that He brought you into my life.



## Table of Contents

CHAPTER I: Introduction .....	1
Rationale .....	1
Assumptions.....	2
Theoretical Perspective .....	2
Background .....	4
Statement of the Problem.....	6
Assessments .....	7
Demographics .....	8
Purpose of the Study .....	8
Research Questions .....	9
Significance of the Study.....	9
Method of Data Collection.....	10
Delimitations and Limitations.....	10
Delimitations.....	10
Limitations .....	11
Definition of Key Terms .....	11
Summary .....	13
CHAPTER II: Review of the Research Literature.....	15
Arkansas High School Mathematics Graduation Requirements.....	17
GPA and Grade Inflation .....	18
High School State Assessments .....	20
College Admission Tests .....	21

Studies on College Preparation and Support .....	24
Studies on ELLs and SES .....	30
Studies on College Readiness .....	36
Summary .....	40
CHAPTER III: Methodology.....	42
Research Design.....	42
Site Selection .....	43
Rationale .....	43
Demographics and Academics of the Study’s School .....	44
Variables .....	48
Population and Sample .....	50
Data Collection Procedures.....	50
Data Analysis Procedures .....	51
Limitations of the Methods.....	54
Risks and Benefits.....	54
Summary .....	54
CHAPTER IV: Results and Data Analysis.....	56
Data Analysis Results .....	57
Research Question 1 .....	57
Research Question 2 .....	60
Summary .....	64
CHAPTER V: Conclusions.....	66
Summary of the Study .....	67

Overview of the Results.....	67
Discussion and Conclusions of Findings .....	70
Research Question 1 .....	701
Research Question 2 .....	70
Limitations of the Study.....	75
Recommendations.....	76
Future Research .....	76
Practice.....	77
Policy .....	81
Summary .....	83
References.....	85
Appendix.....	92

# **CHAPTER I**

## **Introduction**

Preparing students in high school for university life can be a daunting task. The knowledge and depth of understanding needed for university level classes coupled with non-academic factors can be overwhelming for students. Adelman (1999) asserted that high school achievement lays the foundation for students after graduation. With this understanding it is never too early for students to start planning and preparing for these post-secondary experiences as they transition through high school. Since a high school's function is to prepare students for life after high school, students planning on attending college deserve a quality college preparation program that aligns all post-secondary information (Conley, 2005). When looking at students entering and completing college, the findings support that more than any high school curriculum, the strongest influence on college completion is the highest level of mathematics a student takes (ACT 2005; Adelman, 1999). Therefore, this study investigated the effects of selected academic and demographic factors on college readiness in mathematics to add to the information of college preparation. The goal of the study was to connect current information in the areas of college readiness so parents, students, and school personnel could improve their understanding of how to prepare students for college.

## **Rationale**

Many students who plan to attend college after high school believe that once they meet the graduation requirements for high school, college can ensue. Unfortunately, this can be an unrealistic expectation. Requirements for high school graduation are different than those for unconditional college admittance (Arkansas Department of Education, 2009; University of Arkansas, 2012). Furthermore, there is a strong relationship between the rigor of high school

coursework and student readiness for college (ACT, 2005). Many high school students would benefit from information pertaining to college admissions requirements. Additionally, this study focuses on mathematics for its predictive power and fluidity of course sequencing that extends to college. According to Lucas (1999) there is a strong connection between where a student starts the mathematics sequence in high school and where they end. This study focused on mathematics with the intention that by identifying early connections to college readiness in mathematics students could begin preparing for college at a younger age (SREB, 2011).

### **Assumptions**

The assumption of this study was that by properly assessing students and placing them in rigorous and challenging courses early, higher mathematical achievement levels could be reached. For this to occur school personnel need to understand how academic and demographic factors impact college readiness so they can gauge students' college preparedness and assist students and parents with academic decisions.

### **Theoretical Perspective**

Researchers believed that learning is impacted by an individual's resources. Wang, Haertel, and Walberg (1997) explained that students frequently achieve proportionally to their learning opportunities. Additionally, Perna and Titus (2005) believed that college opportunities varied due to limited parental involvement, family income, access to educational resources, and school network. To provide an understanding of the impact of resources and information on student learning and college readiness, Bourdieu and Passeron's (1977) cultural capital theory and Bourdieu's (1986) social capital theory served as the theoretical framework for this study.

According to Bourdieu and Passeron (1977) the concept of cultural capital originates from one's *habitus*, or perceptions formed from a mutual social group's surroundings and

actions. As individuals go through their daily activities and life experiences, their *habitus* is formed by the values, ideas, and views of their social groups. Bourdieu and Passeron added that an individual's cultural capital is the accumulation of cultural signals, formal knowledge, behaviors, attitudes, and abilities that are influenced or acquired by groups in society. In education, an individual's social group influences their *habitus*, which impacts their educational experiences and aspirations (Bourdieu & Passeron, 1977).

Social capital was defined by Bourdieu (1986) as the benefits that are accumulated through relationships and social networks. These relationships are well-established within similar social groups and contribute to an individual's financial and academic accomplishments. Bourdieu added that an individual's social class is based on socio-economic status (SES), work position, schooling, and family name. Social capital in education occurs as individuals in the middle and upper classes make academic choices influenced by the resources and educational levels of their parents.

Cultural capital theory and social capital theory have impacted researchers studying the effects of minority and low SES on college-readiness. Cabrera et al., (2006) stated that:

Students of lower socioeconomic status are disadvantaged in the competition for academic rewards because their *habitus*, or sociocultural environment, may not provide the types of cultural capital required for success in school, such as academic attention, certain linguistic patterns, behavioral traits, orientation toward schooling, high expectations, or encouragement of college aspirations. (p. 83)

According to Cabrera et al., at-risk students such as those classified as English language learners (ELLs) or with low SES did not receive the benefits of the relationships and social networks that are necessary to be college-ready, nor did they have an understanding of the cultural capital needed to succeed. Since college goals are shaped by the direction and information individuals in a student's social setting provide, these individuals help establish the

social and financial behaviors that lead to college decisions. According to Cabrera et al., some ELLs and students who are low SES do not acquire the necessary information to be college-ready due to their surroundings and social groups, making it necessary for schools to play a larger role in informing students about college expectations.

The theoretical lens for this study rested on Bourdieu and Passeron's (1977) and Bourdieu's (1986) theories of cultural and social capital in which an individual's college readiness was influenced by resources and social groups. Understanding the impact of cultural and social capital resources on student learning lays the foundation for developing and linking mathematical academic and demographic factors to college mathematical readiness.

### **Background**

College readiness for Arkansas high school students includes taking challenging classes, receiving credits needed for graduation, and having a requisite high school grade point average (GPA) and college admittance test score (University of Arkansas, 2012). Students who were college-ready reached a level that allowed them to enroll and succeed without remediation in entry-level, credit-bearing, college-level classes (ACT, 2011). This research study investigated a number of facets of college readiness in mathematics, emphasizing the importance of the American College Testing (ACT). By understanding the impact of cultural and social capital resources on student learning, academic and demographic factors could be linked to college mathematical readiness.

The Scholastic Aptitude Test (SAT) and the ACT exam are national tests used to assess students on their college readiness in areas such as mathematics and English. Post-secondary admission criteria determine which test students take; however, the SAT is more commonly administered on the east and west coast, whereas the ACT is administered more in the mid-

western and southern states. Syverson (2007) contended that most colleges in the United States will accept either an ACT or SAT score for admissions. Emphasis was placed on the ACT since it is more frequently administered in Arkansas.

The ACT exam is considered one of the most important tests a student takes in college preparation because it is a common measure that can be used to compare all applicants on college readiness. Furthermore, ACT scores serve as a tool in determining scholarship selection. As Arkansas students were assessed on their academic readiness for college, surprising results were revealed. The Arkansas Public School Resource Center (2010) reported that 24% of national ACT test-completers met the college-readiness benchmark in all four subject areas. Arkansas was below the national average with only 18% of ACT tester-completers scoring as college-ready. Furthermore, the Arkansas average combined ACT score of 20.3 was below the national average combined ACT score of 21 (Arkansas Public School Resource Center, 2010). In 2011, the ACT high school profile of average ACT mathematics scores reported that Arkansas ranked 44<sup>th</sup> in the nation. Although 45% of national students were ready for college-level mathematics, only 33% of Arkansas students were ready (ACT, 2011). This information illustrated the importance of the ACT exam in determining college readiness and revealed the poor mathematical performance level of Arkansas students.

Demographic information specific to the study's site was discussed to gain greater understanding of mathematical college readiness. Data provided by the U.S. Census Bureau about Northwest Arkansas and the state indicated that Washington county had 15.5% Hispanic ethnicity, which was more than double the state rate of 6.4%. Additionally, 17.9% of Washington County residents were below the poverty level, similar to 18% for the state. More specifically, the data for a Northwest Arkansas city with a population of 69,792 revealed a 35.4%



Hispanic population and a 19.5% poverty level (U.S. Census Bureau, 2010). When compared to the region and state, this Northwest Arkansas city in which the study was conducted had a larger percent of Hispanic residents and individuals at the poverty level. The percentage of individuals classified in these demographics illustrates the reason ELL status and low SES were emphasized in this study.

The literature supported the idea that the ACT was an important tool in determining college readiness and that there was sufficient evidence that Arkansas students performed below the national average (ACT, 2011; Arkansas Public School Resource Center, 2010). What was not determined was how college readiness could be assessed prior to students completing the ACT, taking into consideration specific academic and demographic data. More information specific to Arkansas is necessary to tie students' mathematical preparation, such as state assessments, high school GPA, and mathematics classes, to college readiness. Additionally, the impact of ELL status and low SES on college readiness may assist school personnel in implementing practices that better prepare students to succeed. By providing this information to students prior to and during high school, students and parents can better prepare for college. The earlier students recognize their level of preparation, the earlier schools can offer additional support.

### **Statement of the Problem**

High school transcripts provide critical information to post-secondary schools assessing students for college admittance. Students benefit from suggestions about grades and course difficulty and understanding how state test scores align with college mathematical readiness expectations. Students need a foundation of knowledge that will prepare them to be college-ready in mathematics. No information could be found that determined the extent the Arkansas

Comprehensive Testing, Assessment and Accountability Program (ACTAAP) mathematics end-of-course (EOC) test scores, high school GPA, and highest mathematics class completed predicted student performance on the ACT used for determining college admittance.

Additionally, how students' ELL status and SES impacted students' mathematics performance on the ACT used for college readiness was necessary.

Students take state-mandated exams prior to and during high school; however, the results of these exams are used only for determining students' understanding of course content rather than as a means of determining college readiness. In addition, there was a lack of literature showing the impact of selected academics and demographic factors specific to mathematical college readiness. While previous studies addressed the impact of high school mathematical level and GPA on college readiness (Engberg & Wolniak, 2010; Sciarra, 2010), the current study added the variables of state testing and selected demographics.

### **Assessments**

Most Arkansas high school students take ACTAAP assessments and the ACT exam prior to and during high school in preparation for college. Both the ACT and ACTAAP tests have been useful evaluation tools when assessing students' academic abilities.

The ACTAAP exam is a criterion-referenced EOC assessment which includes items specifically aligned to the Arkansas state standards (Ark. Code Ann. §6-15-2009). Because it aligns with the Arkansas frameworks, the ACTAAP exams have only been used to assess and compare students, schools, and districts in Arkansas. The ACTAAP high school mathematics EOC exam includes only Algebra I and Geometry; therefore, comparisons have only been made at these mathematical content levels.

The ACT is a national standardized test that measures a student's high school general education development in the areas of English, mathematics, reading, and science. Concurrently, it compares students nationally on their ability to complete college level work (ACT, 2008). The ACTAAP and ACT are valuable assessments; however, aligning the ACTAAP mathematics EOC tests and mathematics portion of the ACT exam would allow students to have an earlier understanding of their mathematical college readiness.

### **Demographics**

The demographic factors that influenced college preparedness specific to this study included ELL status and SES. Garcia, Jensen, and Scribner (2009) found ELLs traditionally fell behind their English peers. Their findings revealed performance gaps that could be explained by low family income, lack of parent education, and limited English language proficiency. When investigating SES, Kazis (2006) asserted that college readiness was not distributed equitably. Individuals with a lower family income were more likely to have a multitude of factors leaving them unprepared for college success, such as family background, social influences, and quality of education. These studies indicated that demographic factors such as ELL status and low SES negatively influenced students' college readiness. The extent to which these demographics impacted college readiness needs further investigation.

### **Purpose of the Study**

The purpose of the study was to determine the degree to which the ACTAAP mathematics EOC test scores, high school GPA, and highest mathematics class completed predicted student performance on the ACT used for college admittance. Additionally, this study attempted to establish how ELL status and SES impacted students' mathematics performance on the ACT used for college readiness. The results of the study can be used to better understand the

mathematical needs of students planning to attend post-secondary learning institutions. The study also provides a framework for preparing students as they transition through high school.

### **Research Questions**

The study used data regarding students' high school mathematical performance to predict the college readiness of high school students preparing to enter a four-year college. The following questions guided the study:

1. To what degree do ACTAAP mathematics EOC test scores, high school GPA, and highest mathematics class completed predict a college admittance ACT mathematics score?
2. How do ELL status and SES impact the predictive nature of ACTAAP mathematics EOC scale scores, high school GPA, and highest mathematics class completed on ACT mathematics performance (i.e., college readiness)?

### **Significance of the Study**

Arkansas public schools are seeking to improve their understanding of how high school mathematics preparation informs individuals about college readiness. The significance of the study was to provide counselors, school personnel, parents, and students with information related to high school mathematics and college readiness. These individuals make the decisions about transitioning students through high school and into college and have a direct impact at home and school. This study provided information for these stakeholders regarding high school mathematical performance and academic support by determining what degree the combined ACTAAP mathematics EOC test score, high school GPA, and highest mathematics class completed predicted student performance on the ACT used for college admittance. Additional

information included how students' ELL status and SES impacted students' mathematics performance on the ACT.

### **Method of Data Collection**

A quantitative research method was used in this study. Quantitative research is a study that focuses on the research questions so that numerical data can be collected, analyzed, and reported in an objective and unbiased approach (Creswell, 2005). This study involved collecting specific academic and demographic information about graduates of one Northwest Arkansas high school, generating numerical data from the information, and statistically analyzing the data.

The study included data from fall 2009 through spring 2012. This information was collected using Arkansas Public School Computer Network (APSCN) and Triand (a web-based data service that provides student information for Arkansas students). Graduates of the study's high school were not identified; only numerical representations were used.

The data set was organized in Microsoft Excel and analyzed using the IBM SPSS Statistics (SPSS) software package. Graduate academic information included state and national mathematical assessments scores, high school GPA, and highest mathematics class completed. Demographic data included ELL status and SES based on meal status. A multiple regression and hierarchical multiple regression were conducted to predict ACT performance levels and determine variable relationships.

### **Delimitations and Limitations**

#### **Delimitations**

Data for the study included students' grades, state and national assessment scores, and background information from one Northwest Arkansas high school. Only students who graduated from the high school and participated in the ACTAAP state mathematics EOC exams,

the ACT test, and an individualized graduation plan (IGP) were eligible for this study. In December 2006 the Arkansas Department of Education (ADE) announced that “the U.S. Department of Education approved the Arkansas assessment system under Title I of the Elementary and Secondary Education Act of 1965 (ESEA), as amended by the No Child Left Behind Act of 2001 (NCLB)” (Arkansas Department of Education, 2010a, p.1). Additionally, the ADE established Smart Core as a college-ready curriculum, effective with the graduating class of 2010. While it was not necessary for students to have completed a Smart Core curriculum to be included in the study, the IGP process informing students about the importance of the Smart Core curriculum may have impacted their high school decisions. Thus, the numbers of participants were limited, as only a few years had passed since the establishment of the college-ready curriculum and approval of the Arkansas assessment system.

### **Limitations**

This study focused on one high school with a small sample of students who met the criteria for inclusion in the study and was limited due to the difficulty of the researcher obtaining data. Because the high percentage of ELLs and high percentage of low SES students were dissimilar to other Arkansas high schools’ demographic information, there were limits to the generalizability to other Arkansas schools.

### **Definition of Key Terms**

#### **American College Testing (ACT)**

The ACT is a national standardized exam containing multiple-choice questions in the areas of English, mathematics, reading, and science. An optional writing test is also included. The ACT exam assesses the achievement level of high school students and their ability to complete college-level work (ACT, 2011).

## **Arkansas Comprehensive Testing, Assessment and Accountability Program (ACTAAP)**

### **End-of-Course (EOC) Exam**

The Arkansas Comprehensive Testing, Assessment and Accountability Program (ACTAAP) exam is a criterion-referenced end-of-course (EOC) assessment that includes items specifically aligned to the Arkansas curriculum frameworks. Arkansas mathematics EOC exams are given in Algebra 1 and Geometry. These criterion-referenced exams are taken at the end of Algebra 1 and Geometry to determine if a student demonstrates mastery of the subject (Ark. Code Ann. §6-15-2009).

### **Arkansas High Stakes Exam**

A high stakes exam denotes that a student must receive a passing scale score of 159 or higher to earn course credit required for high school graduation. Algebra 1 as a high states EOC exam went into effect for ninth grade students in 2010 and is currently the only Arkansas high stakes exam (Ark. Code Ann. §6-15-2009).

### **College Readiness**

College readiness is a level students reach in college preparation that allows them to enroll and succeed without remediation in an entry-level, credit bearing college-level course at a two-year or four-year institution (ACT, 2011).

### **English Language Learner (ELL)**

An English Language Learner is also known as a **Limited English Proficient (LEP)** student. An ELL is between the ages of 3 and 21, is enrolled or about to enroll in a United States school, and was not born in the United States or speaks a native language other than English (NCLB, 2001).

### **Individualized Graduation Plan (IGP)**

An Individualized Graduation Plan is an outline of a student's post-secondary plans and the courses the student will take each year in high school to be prepared for their academic goals. These plans are revisited and revised yearly with students, parents, and counselors. The goal of the IGP is to increase parent support, address possible misconceptions or concerns, and prepare students for post-high school life (SREB, 2011).

### **Socio-Economic Status (SES)**

An individual's socio-economic status is determined by a number of variables, including family income, level of parental education, and parental occupation. For the purpose of this study, low SES is defined by students' eligibility for programs providing free or reduced meals (Bakle, 2010).

### **Summary**

Many high school students may not be aware of college expectations (Conley, 2005). In addition, they may not understand how high school mathematics impacts their college options. Some students believe that graduating from high school means they are prepared for college. Based on the findings of the ACT (2011) high school profile mentioned previously, only 33% of Arkansas students were ready for college-level mathematics. This fell significantly below the nation's 45% average and illustrated the need for additional mathematical understanding and preparedness in Arkansas.

The site for the study, a school in Northwest Arkansas, has a high ELL population and a large percentage of students who are classified as low SES based on their free- and reduced-meal status (APSCN, 2013). Many of the school's students and parents have little exposure to post-



secondary education and do not understand the high school graduation requirements that prepare students to be college ready (Kazis, 2006).

The findings of this study are important because there is a substantiated need for developing a greater understanding of mathematical college readiness and for creating a stronger foundation on which high school students and parents could base their mathematical decisions (SREB, 2011). The following literature examines high school mathematical graduation requirements, college admittance requirements, college preparation and support, selected demographics, and college readiness.

## CHAPTER II

### Review of the Research Literature

High school graduation marks a critical transition, with college-bound students often lacking the support and valuable information needed to be successful in the next stage of their academic careers. When defining college readiness, significant discrepancies existed specifically for low-income and minority students (Roderick, Nagaoka, & Coca, 2009). Gandara (2006) found that even though the United States educational system had initiated efforts to compensate for unequal educational opportunities, such groups as the underrepresented minority students still struggled as they transitioned to higher education.

Compensating for the educational inequalities found within schools and between states, accountability systems were put in place in the United States. In 2001 most states instituted accountability systems stemming from NCLB (2001). At the high school level, state assessments assumed an important role as these exams became a requirement for graduation in many states. In 2006 the Arkansas assessment system was approved by the U.S. Department of Education (ADE, 2010a), requiring high school testing services to increase the stakes and impact of state exams. The importance of mathematics became evident when Algebra 1 was designated as the only course for which students were required to pass an ACTAAP state EOC exam before required graduation credit could be earned.

Brown and Conley (2007) reported that many states were administering state exams to be used dually, first as a graduation requirement and second for post-secondary purposes. However, there was little documentation validating the content and standards relating to post-secondary endeavors. Although a passing score for the ACTAAP Algebra 1 EOC assessment in Arkansas

was established, information that connects this test or any other state high school mathematics exam with college readiness is lacking (Roderick, Nagaoka, and Coca, 2009).

Information connecting the concept of high school mathematical performance to the ACT is essential in improving options for college success. The Southern Regional Education Board (SREB) maintained that college success involves early discussions with parents about students' performance and readiness for high school and post-secondary studies (SREB, 2011). These discussions are extremely important as students spend four years creating high school transcripts that could expand their post-secondary opportunities. Without meaningful information guiding students and parents, it may be difficult for students to make educational decisions that can help them become college ready and lead them to acceptance in post-secondary institutions.

The purpose of the present study was to determine the degree to which the ACTAAP mathematics EOC test scores, high school GPA, and highest mathematics class completed predicted student performance on the ACT used for college admittance. Additionally, this study attempted to establish how ELL status and SES impacted students' mathematics performance on the ACT used to determine college readiness. This chapter explores the literature that is pertinent to understanding the following questions: To what degree do ACTAAP mathematics EOC test scores, high school GPA, and highest mathematics class completed predict a college admittance ACT mathematics score? How do ELL status and SES impact the predictive nature of ACTAAP mathematics EOC scale scores, high school GPA, and highest mathematics class completed on ACT mathematics performance (i.e., college readiness)? The review of the literature is divided into seven sections. The first section details the two high school courses of study offered to students to meet Arkansas high school mathematics graduation requirements. The second section explains the importance of a high school GPA in determining college

readiness, with special detail given to grade inflation and increasing GPAs. The third section discusses high school state assessments and the significance of the mathematics exams. The fourth section describes college admission requirements, with an emphasis placed on the ACT exam and student demographics. The last three sections explore studies involving college preparation and support, ELLs and SES, and college readiness.

### **Arkansas High School Mathematics Graduation Requirements**

The Arkansas Department of Education (2009) outlined two high school courses of study offered to students to meet graduation requirements: Smart Core curriculum and Core curriculum. Smart Core is designed as a college- and career-ready program in which where students completing the program are prepared to enter a two-year college, four-year college, or a technology institute of higher education. Mathematics requirements for Smart Core stipulate that four units must be taken, including a unit in Algebra 1, Geometry, Algebra 2, and a year beyond Algebra 2, with at least one unit taken in 11<sup>th</sup> or 12<sup>th</sup> grade (Arkansas Department of Education, 2010c).

The Core curriculum standards are not as rigorous as the Smart Core curriculum standards. The mathematics requirements are still comprised of at least four units of mathematics; however, Algebra 1 and Geometry can each count as a two-year course. Core curriculum can also include basic classes beyond Algebra 1 and Geometry which consist of algebra- and geometry-based skills (Arkansas Department of Education, 2009).

Even though students can successfully graduate from high school by meeting the requirements for Core standards, parents whose children are opting out of Smart Core are required to sign a waiver which states “failure to complete the Smart Core curriculum for graduation may result in negative consequences such as conditional admission to college and

ineligibility for scholarship programs” (Arkansas Department of Education, 2010b, p. 1).

Students who complete high school with the Smart Core requirements have met the Arkansas Department of Education’s college-bound expectations. While important, these requirements are not all-encompassing. The Smart Core graduation requirements do not take into account connections between state required assessments and national assessments.

### **GPA and Grade Inflation**

An acceptable high school GPA is extremely important for students who want to attend college. Generally, a student’s GPA is a picture of how well an individual does in high school and is a factor in college success. According to recent studies, the use of high school GPAs and class rank were leading factors in predicting college academic success (Hoffman & Lowitzki, 2005; McLaughlin, 2006). Since colleges look at high school GPAs for admittance, the higher the GPA, the more attractive an individual is to a university. The University of Arkansas (2012) requires a 3.0 GPA as one of the components for unconditional admittance.

High school GPAs are associated with grades and not with course rigor (Micceri, Bringman, & Spatig, 2009). Some students take easier classes, which can inflate a student’s GPA. However, Mathews (2007) reported this approach of taking non-college-bound courses could have a negative effect, causing students to be unprepared for college level work. The alternative to taking easy classes is the option of taking weighted Advanced Placement (AP) courses or honors classes to raise a GPA, in which a grade of A, B, or C is assigned one point higher than a regular class on a 4.0 scale. In addition, Mathews (2007) stated that AP classes could help prepare students academically for college.

Mathews (2007) referenced a large study on AP classes and college success in Texas in which researchers found strong evidence that students who took AP courses and their subsequent

exams received higher college GPAs and were more likely to graduate in four years. AP courses can benefit students in a multitude of ways and increase a student's college preparedness. It is evident that even though a high school GPA provides a general view; it is not holistic and does not take into account the numerous variables that affect its value.

Reys, Dingman, Nevels, and Teuscher (2007) prepared a report for the Center for the Study of Mathematics Curriculum (CSMC) and found that states varied greatly in their organization of high school mathematics curriculum standards, number of mathematics classes needed, and level of mathematics courses required for high school graduation. This variation from state to state limits the consistency in high school GPAs, requiring that additional information such as course level and grade inflation be considered.

Since discrepancies in high school grades exist and can vary between schools, districts, and states, the ADE attempted to regulate grades by assessing schools on grade inflation. According to the ADE (2009), grade inflation was determined by correlating a student's ACTAAP Algebra 1 EOC exam and ACTAAP Geometry EOC exam with the class grade. ADE determined grade inflation using Algebra 1 and Geometry courses only. An average class grade was calculated for students with multiple semester or quarter grades for the same course. Student course grades were converted to a four-point scale on which student grades of B (3.0) or higher were matched with their corresponding ACTAAP mathematics EOC scale score. If a student had a course grade of an A or B and scored basic or below basic on the mathematics EOC, grade inflation was deemed to have occurred. By dividing the number of basic or below basic students with an A or B by the number of students with an A or B and converting that to a percentage, school and district grade inflation was calculated. In the 2008-2009 school year, Arkansas schools with more than 20% grade inflation were identified and provided with

technical assistance to improve the consistency between course grades and state exams (Thompson, 2010).

Since grade inflation in Arkansas correlates to Algebra 1 and Geometry only, and not to other content areas such as English, a considerable emphasis is placed on the importance of mathematics. Also, for most students, Algebra 1 and Geometry are not taken until ninth and tenth grade, which means high schools and a few junior high schools are the only schools assessed on grade inflation. Grade inflation in Arkansas is important to understand because the ADE uses it to ensure that curriculum and grades correlate with what students are expected to know. ADE's monitoring of grade inflation helps detect grade discrepancy between schools, providing more consistency with state assessments, course grades, and student GPAs.

### **High School State Assessments**

High school state mathematical assessments are part of the Arkansas graduation requirements. Arkansas students must pass the Algebra 1 assessment to meet mathematics graduation requirements. The significance of the Algebra 1 assessment was revealed when Act 1307 was passed by the Arkansas legislature in 2009 (Ark. Code Ann. §6-15-2009). This act outlined the requirements for state testing by describing two types of EOC assessments: general stakes and high stakes. Currently at the secondary level the general stakes assessments are Grade 11 Literacy, Biology, and Geometry. The high stakes assessment is Algebra 1 and will include English II in 2013-2014. Effective as of the 2009-2010 school year, students must take and pass an Algebra 1 assessment through multiple opportunities and testing formats in order to be eligible to receive graduation credit for the course (Ark. Code Ann. §6-15-2009).

Since Algebra 1 is currently the only high stakes exam being administered, its impact is substantial. According to Arkansas Act 1307, high stakes EOC assessments have a requisite

scale score that demonstrates a minimum satisfactory passing level (Ark. Code Ann. §6-15-2009). The requisite scale score that demonstrates a minimum passing level is considerably lower than the proficient score; however, there is no available explanation of how this requisite scale score is determined. A minimum passing score of 159 on the Algebra 1 assessment is much lower than a minimum proficient score of 200. While passing the Algebra 1 state assessment means a student understands basic algebra concepts and is eligible to graduate from high school, it does not mean the student has met the Smart Core requirements and will be academically ready to succeed in college or a career, nor does it indicate a level of college readiness (Arkansas Department of Education, 2009).

Current measurements do not reveal an association between Algebra 1 and Geometry assessments and ACT mathematics performance (i.e., college readiness). Most high school exams that are used to measure competence are not aligned well with the knowledge and skills needed for college success. Conley (2005) explains that:

Because the tests are often given in the tenth grade, they are not likely to be very useful as admissions measures, but they can alert students to their readiness for college and to the knowledge and skills they should be working to develop during their remaining time in high school. (p.161)

A greater understanding of the relationships between state exams and post-secondary admission exams would provide meaningful information in determining college readiness.

### **College Admission Tests**

When determining admissions post-secondary schools customarily rely on tests such as the SAT and ACT. Arkansas four-year institutions primarily use the ACT exam as the college admittance assessment. The ACT is a national test used to compare students on their ability to complete college level work. The unconditional admission criteria for the University of Arkansas (2012) require a 3.0 or higher high school GPA and a score of at least 20 on the ACT.



If students are admitted conditionally and have an ACT score below 19 on the mathematics section of the exam, they are not considered college ready and are required to enroll in developmental courses. While the University of Arkansas establishes minimal guidelines for admittance, data revealed that on average students who met the minimal GPA requirement had more than minimal ACT scores. For instance, in the University of Arkansas (2011) Retention and Graduation Report, a GPA in 2000 ranging from 3.0 to 3.24 indicated an average ACT score of 22.4. In 2010 the same GPA range revealed an average ACT score of 23.4. While this information did not indicate mathematics specifically, it did suggest that for this specific GPA range that ACT scores were increasing.

High school ACT scores are used to determine college admittance and decide scholarship amounts awarded to high school students during their senior year. According to Adelman (1999) students' academic achievement in high school has clear consequences for their lives after graduation. College decisions are made based on student achievement levels and success on numerous assessments. For many individuals, preparing for these tests can mean the difference in where or if they attend college and what financial support, if any, they will receive.

A report by Gewertz (2009) discussed the nature of the results of the national 2009 ACT assessment which revealed that the ACT is infused in every part of college admittance. The ACT surveyed thousands of high school teachers and college instructors to determine college readiness. This study was conducted to better understand the knowledge and skills needed by students to pass first-year, credit-generating college courses. The study's findings revealed the average ACT composition score for both 2008 and 2009 was 21.1. From a college readiness perspective, less than one-quarter of the graduating high school seniors who took the ACT were college-ready in all four subject areas (Gewertz, 2009). The study suggested there were reasons

students fell short of being college ready. High schools were not focusing on the requisite skills for college, and high school students were not taking the correct courses. In some situations the courses did not have the rigor that is essential to prepare students at the college level.

Although ACT mathematics scores have remained fairly constant, the number of individuals participating in the ACT assessment has been growing, becoming more reflective of Northwest Arkansas high school student populations. Nationally “the number of test-takers has grown 25 percent since 2005. Since then, participation by black students has risen 41 percent, by Hispanics 61 percent, and by Asians 51 percent, compared with a 20 percent rise among white students” (Gewertz , 2009, p. 10). Some of the increase might be attributed to additional states requiring 11<sup>th</sup> grade students to participate in the ACT exam; however, the evidence is clear that the number of ACT test-takers has grown and become more diverse.

While the number of students taking the ACT has increased, troubling information still remains. Less than one-fourth of students taking the exam were college ready, and there was still an ethnic gap, with minority students performing lower than their Caucasian peers. Gewertz (2009) stated that “the ACT scores show only 4 percent of black students and 10 percent of Hispanic students meeting college-readiness benchmarks in all four subject areas in 2009, compared with 28 percent of white students and 36 percent of Asian students” (p. 11). Further analysis of the data revealed that ACT mathematics performance scores were lower than English performance scores, keeping many individuals from obtaining an acceptable college-readiness score. With such importance placed on the ACT exam, students must know the performance expectations that are required of them early in their high school careers.

With attention on ACT support, VanScoy (1997) investigated how students could improve their ACT mathematics score to help with college preparation and college admittance.

This study defined additional ACT support as review sessions, practice problems, and additional mathematics courses. While small in size with only 53 high school participants, the study established a connection between ACT review sessions and ACT mathematics performance. The study suggested that the strongest impact on ACT mathematical success was taking a fourth college preparation mathematics class during a student's junior year.

### **Studies on College Preparation and Support**

Most high schools equipped with basic information about four-year colleges have difficulty providing extensive admissions counseling for students. Since high schools have general knowledge about colleges, the amount of information provided to students is limited (Conley, 2005).

Student support plays a critical role in bridging the transition from high school to college. College-bound students have higher prerequisites and are required to take more rigorous classes (Arkansas Department of Education, 2010b). Creating credit check sheets may help students assess their current academic status and determine what mathematical path is necessary to meet the rigor of college. It is important for schools to prepare parents and students for the demands of college, beginning as early as the seventh and eighth grades. In many places, students, along with their parents, are developing Individualized Graduation Plans (IGP) in eighth grade. These IGPs outline a student's post-secondary plans and the courses the students will take each year in high school to be prepared for their established goals. These plans are reviewed and revised yearly with students, parents, and counselors. According the Southern Regional Education Board (SREB), the goal of the IGP is to increase parent support, address possible misconceptions or concerns, and prepare students for post high school life (2011).

The SREB identified ten best practices that improved student achievement. One of the best practices was to provide each student with proper guidance and advisement, to ensure that each student was connected to an adult, and to expand students' understanding of future careers and educational opportunities (SREB, 2011). The practice stated the following:

At the most-improved middle grades schools, parents are involved in discussions about students' performance and readiness for high school; students understand what will be expected in high school; students are exposed to a range of careers and educational opportunities; and students receive assistance in developing a six-year plan for high school and postsecondary studies. (p. 6)

While important, the IGP outlines course history and graduation requisites but does not include state and national assessments. The IGP is only a portion of the information parents and students need when preparing for college. An IGP can help students and parents with a general idea of college expectations; however, understanding college readiness is much more involved.

A study conducted by Deil-Amen and Tevis (2010) examined the relationship between college expectations and college readiness. The study's sample involved 110 high poverty students. Two types of assessments, high school and college interviews and high school essays, were used. Three rounds of interviews took place, including 110 student participants in the first interview, 102 in the second interview, and 84 in the third interview. The study took place over three years as students transitioned from high school to college. The decline in participants occurred because students either did not start college or stopped attending college. The students were interviewed about the ways counselors and teachers provided information and support about the ACT and the influence of the ACT on their college plans. Seniors wrote essays, and an extensive analysis was done to decipher themes in the essays. Deil-Amen and Tevis (2010) found that:

Rarely did students in the study say that a low ACT score justified not enrolling in college, but their interpretations of their scores and the relevance or irrelevance they

assigned to those scores were either drastically overestimated or drastically underestimated. (p. 152)

High school students did not have realistic expectations about ACT scores and did not understand how the ACT affected college admittance or how ACT results related to college performance.

Deil-Amen and Tevis (2010) also examined an individual's understanding of college preparedness. While ACT scores were important, the study revealed that college decisions were made by students using their own understanding of self-constructed multi-faceted ideas, both real and perceived. These ideas involved many components such as test scores, social influences, and self-confidence brought on by an individual's subjective understanding. These factors impacted how students perceived their ability to succeed in college.

The findings from Deil-Amen and Tevis (2010) also suggested a lack of individualized counseling limited students' ability to understand college decisions and make educated college plans. Additionally, the transition process was the responsibility of the whole school. It was imperative that college opportunities, information, and a post-secondary school culture saturate the entire high school environment. It was also important that information for teachers and counselors be available so high school students could receive guidance in college admittance, interpreting assessment results, and preparing for college (Deil-Amen & Tevis, 2010).

A prior study conducted by Perna et al. (2008) yielded similar results. This descriptive case study looked at 15 high schools from five states. This study focused on counseling, higher education, and the importance of using counselors as a source of information about college and financial aid, especially for underrepresented college groups. High school counselors have limitations including financial constraints, time restrictions, and other responsibilities. From this a number of misconceptions occur as students are making decisions about college. Teachers,

counselors, and parents all perceive four year institutes differently, and the information they provide may be overwhelming for students. Many post-secondary institutions vary in their requirement levels, sending conflicting messages about college readiness. The multitude of information from different providers and varying opinions about college expectations may distort the foundation upon which high school students build their college understanding. As a result, students are unaware of how to prepare for college, and they frequently develop misconceptions about post-secondary education. Thayer (2000) emphasized that first-generation, ethnic minority, or low-income students find adjusting to college more difficult than their middle-income peers. These individuals also relied heavily on high school counselors for guidance when they did not have the support of college-bound individuals or college social experiences (Venezia, Kirst, & Antonia, 2003).

The intent of the Deil-Amen and Tevis (2010) and Perna et al. (2008) studies was to capture students' understanding of their experiences in high school and college. Though the qualitative approaches to the studies involved subjective interpretations, they identified critical components of college preparedness.

The ACT (2005) study *Crisis at the Core: Preparing All Students for College and Work* used ACT data to provide additional information regarding student academic preparedness for college. The findings revealed the following weakness: the title of the course may not reveal its rigor and more students should be taking challenging classes. The summary of the study stated that:

Students who take a minimum core curriculum are more likely to be ready for college-level work than are students who do not take the core. But students who take rigorous courses beyond the recommended minimum number of core courses are even more likely to be ready for college. . . . And this is true of students at all levels of achievement, not just the high achievers. (p. 21)

The focus of the previous study highlighted the need for better understanding of student academic performance. Students who took a mathematics course beyond Algebra 2 as well as upper level science courses were the individuals who were most likely to be college ready (ACT, 2004).

Adelman (1999) conducted a 13-year longitudinal study to examine high school factors that impacted college success. A national cohort of students was followed to determine degree completion. The students were followed from 10<sup>th</sup> grade through high school and beyond. The data that was used included transcripts from high school and college, test scores, and surveys. Linear regressions were used to identify variances in degree completion. Adelman (1999) concluded that colleges relying predominantly on test scores and high school GPA rather than curriculum intensity for college admittance were more likely to have lower college completers. He believed that high school curriculum was consistently a better predictor of bachelor's degree attainment than test scores, GPA, or class ranking.

Similarly to the ACT (2004) findings, Adelman (1999) supported the idea that individuals entering a post-secondary education program having successfully passed a mathematics course beyond Algebra 2 more than doubled their chance of completing a bachelor's degree. Furthermore, they performed better on the mathematics portion of the ACT. Additionally, both studies determined the ACT is a challenging exam for many students, and that it is important for students to take more challenging classes to raise ACT scores. However, while rigor is important, it cannot be determined by the title of the class.

Additional research on mathematical preparedness was presented in a 2006 study conducted by the ADE. This study revealed how university professors believed public schools were performing. Over 315 college professors from 33 post-secondary institutes were surveyed,

and the results indicated that the way high schools prepared students needed to change. Professors participating in the survey graded the “overall academic quality of the public high schools in preparing students for college with mostly D’s (50.2%) and C’s (38.6%). One in ten college professors ‘graded’ the public high schools F (9.6%) in overall academic quality” (Arkansas State Department of Education, 2006, p. 7). The results indicated that professors from both two- and four-year colleges believed remedial courses were needed by over half of the freshmen level students. The study suggested that the following high school areas be strengthened: fostering good study habits, increasing independent thinking skills, and enhancing understanding in mathematics and literacy (2006).

Further research was revealed in an ACT National Curriculum Survey where there was a disconnection in understanding of college readiness between educators at the high school and college levels. While high schools are required to follow state ACTAAP testing requirements and universities adhere to minimum ACT admission requirements, discrepancies exist between the individuals preparing students for college and the individuals who teach students at the college level. The results of the survey indicated radically different perspectives of what constituted college-prepared students. The survey revealed that “71% of high school teachers reported that their state standards defined well or very well what students need to know to be college ready. Comparatively, only 28% of postsecondary instructors responded in that way” (ACT, 2009, p. 5). These findings illustrated the lack of a clear understanding of what college readiness encompasses and send mixed messages to students and parents about what constitutes high school preparation for college success.

Though the perspectives on college preparedness vary, Kazis (2006) believed “that to succeed in college, you need to be academically ready to do college-level work. Just showing up



isn't enough. College completion correlates highly with academic preparedness for college-level work" (p. 13). This means preparation starts prior to and continues through high school. Too many high school graduates enter college unprepared for college-level work and jeopardize their chance to succeed because college-ready standards are not clearly defined and effectively communicated.

College preparation and support as discussed in this section revealed poor student performance on the ACT and a lack of proper counseling support. Additionally, it is imperative that students take more challenging courses if they are to be successful in college. With the dismal results on students' ACT performance and the large number of college professors giving public schools low ratings, schools must determine ways to gauge students' college readiness in high school so individuals planning to attend college can prepare.

### **Studies on ELLs and SES**

Discrepancies in student performance exist between ELLs and low SES students and their peers (Nation's Report Card, 2009; Sciarra, 2010; Sedlacek, 2004). According to the National Assessment of Educational Progress (NAEP), districts and schools across America are chosen to represent the nation's population. Tests are administered in these schools to selected students to provide NAEP with an accurate and representative picture of how students are performing nationally. The results of NAEP were released in the Nation's Report Card which informed the public about how different states were performing. According to the Nation's Report Card (2009) 11 states, including Arkansas, participated in NAEP. While the nation as a whole showed improvement, Arkansas was one of three states that scored below the national mathematics average. The percentage of students in Arkansas in 2009 who performed at or above the NAEP basic level was 59%. This percentage was less than the national average of 63%. When

comparing ethnicity, 21% of Caucasian students in Arkansas were proficient or advanced, whereas 7% of Hispanic students were proficient or advanced. According to the results from NAEP, discrepancies in student performance are evident.

The data from NAEP raised demographic concerns about student performance, especially with the changing dynamics of some Northwest Arkansas school districts. One school district in Northwest Arkansas has seen a dramatic growth in both the Hispanic and low SES student population. According to the district's profile for 2010-2011, the Hispanic student population increased from 5.35% in 1995 to 42.56% in 2010. Equally as astounding is the growth in the low SES student population. In 1995, the district's low SES student population was 36.44%, and in 2010 the percent grew to 64%. This change in demographics occurred as the district's student population doubled in size from 9,342 to 18,810 (District Profile, 2011).

Sedlacek (2004) revealed the SAT and other standardized tests are not an accurate assessment of all students' abilities and that every student should not be assessed the same way. In his book *Beyond The Big Test: Noncognitive Assessment In Higher Education*, Sedlacek challenged the use of standardized tests as the only tool used for college admittance, stating that standardized measures of cognitive assessment continued to reflect extensive discrepancies across racial and ethnic groups. Sedlacek believed it is essential to use standardized tests in conjunction with non-cognitive assessments. He contended that a combination of factors yields a more complete picture of a student's potential. These assessments must measure what students know by determining what they can do and how they deal with an array of different contextual problems. Additionally, it is important to assess minority students with varied backgrounds and experiences in such a way to allow for these differences. While college admission requirements include exams such as the SAT and ACT, these exams should not be the single factor. Other

background measures should be used as these assessments are not as consistent in predicting college performance or achievement for minority students.

A study by Sciarra (2010) discussed the impact of background and ethnicity on college admittance exams. The study was undertaken to provide counselors with information they could share with students and parents to encourage participation in a mathematics class beyond Algebra 2. Sciarra (2010) conducted a longitudinal study from 2002 to 2004. The study's sample included 11,909 high school seniors where logistic regressions were used to analyze the data. The study examined high school mathematical factors that led to college success. Background variables included, but were not limited to gender, SES, race, parent schooling, and record of enrollment in an English as a Second Language (ESL) class. The study's independent academic variables were 10<sup>th</sup> grade GPA and standardized mathematics achievement scores. The dependent variable was the completion of a high school mathematics course of Algebra 2 or below, or a mathematics class higher than Algebra 2.

The three factors of interest from the Sciarra (2010) study related to the present study were race, ESL class participation, and SES. The results indicated that when the background factor of race was addressed, Latinos were more than twice as likely as Caucasians to not complete a course beyond Algebra 2. When looking at participation in an ESL class, these individuals were almost twice as likely to complete a course in Algebra 2 or less than a course higher than Algebra 2. When examining SES the results revealed that individuals in the top quarter percentile of SES were more likely than individual students in the lower quarter percentile to complete a mathematics course higher than Algebra 2. The study also investigated the addition of mathematical achievement and GPA as factors. These academic additions reduced the significance of the background variables of students taking a class beyond

Algebra 2. This is useful information because early interventions might reduce the academic racial gap so when students transition to high school, courses similar in format and rigor can be created (Sciarra, 2010).

As suggested in the study by Sciarra (2010), one way to improve ACT scores is to increase the number and/or level of mathematics classes taken by students. Based on the 2004 high school transcript data file, 21.7% Indian, 69% Asian, 41.7% African American, 34.3% Latino, and 54.3% Caucasian students took a course beyond Algebra 2 (U.S. Department of Education, 2006). With particular focus on Latino and Caucasian students, there was a significant difference in the percent of Latino students and the percent of Caucasian students who took a class beyond Algebra 2, with 20% fewer Latino students reaching this level. Sciarra (2010) added that increasing the number of students taking a mathematics class beyond Algebra 2 might decrease the academic racial gap. Ideally these courses would offer a more challenging curriculum, allow for quality classroom interaction, and provide requisite mathematical content needed for college.

Riegle-Crumb (2006) conducted a study using two national data bases to examine race and gender patterns in high school mathematics. Caucasians were compared to African Americans and Latinos. Students who enrolled in similar courses were compared on the final mathematical sequence. The performance variables were GPA and failed courses. This study examined how mathematics grades shaped students' mathematical courses taken from the beginning of high school to the end of high school. It was conducted to understand racial and gender inequality in high school achievement.

Relative to Caucasian males, African-American and Latino males did not achieve as well while transitioning through their sequence of mathematics courses beginning with an Algebra 1

class their freshman year. Additionally, Riegle-Crumb's (2006) study revealed that "approximately 20 percent of all male African American and Latino students failed their freshman year math course, with slightly fewer of their female peers exhibiting a similar disadvantage" (p. 112). Additionally, while starting at the same level of mathematics, Caucasian students reached higher levels of mathematics course sequencing than their African-American and Latino peers. The impact on minority female students was not significant. The study suggested that more attention, especially with males, be given to mathematics racial inequality (Riegle-Crumb, 2006). Moreover, this study clarified that the differences were not explained by academic performance, implying demographic factors may be the reason. Knowing this information early may encourage students to seek additional assistance before negative consequences occur.

When making connections between the two previous studies, Sciarra (2010) recommended that a main factor of high school achievement was taking a mathematics class beyond Algebra 2. Riegle-Crumb (2006) suggested that less demographic discrepancies occur in high school when students' academic performances are closely related at the onset of high school. It could be argued that if the academic gaps prior to high school are addressed then demographic discrepancies could be reduced in high school, increasing the number of students taking a mathematics class beyond Algebra 2.

To provide an illustration of mathematics grade level performance, House (2005) reported that the U.S. Department of Education showed a gap in the mathematics level of 12<sup>th</sup> grade students. Looking specifically at the information pertinent to the study, Hispanic students were reading and participating in mathematics around the level of the average 8th grade Caucasian student, revealing a four-year discrepancy in mathematics and English. Additionally,

Hispanic students were obtaining diplomas at about half the rate of Caucasian students (House, 2005).

According to generated district summary reports from the 2010 National Office for Research on Measurement and Evaluation Systems (NORMES) for Algebra 1, the overall results for one Northwest Arkansas school district showed 81% of students scored proficient or advanced compared to the state average of 76%. While this information was noteworthy for a district with a Hispanic population with almost 43%, it is more remarkable that 429 of the 1,595 limited English proficient Algebra 1 testers in Arkansas were from this district. This was approximately 27% of the state's Algebra 1 Hispanic population. In addition, NORMES (2010) reported that this district's low SES results were similar to the state's results. The district had 73% of its low SES students scoring proficient or advanced, which was better than the state's average of 68%. Additionally, 91% of the district's non-economically disadvantaged students scored proficient or advanced compared to the state average of 86%. Both state and district results differed by 5%, with the district scoring better than the state. However, when comparing low SES to non-low SES, there was a large discrepancy between them, with low SES scoring 18% lower at both the district and state level (NORMES, 2010).

The previous studies on the performance of ELLs and low SES students show that minority students such as Hispanic and low SES students underperform relative to their counterparts in mathematics proficiency. Taking a mathematics class past Algebra 2 is a critical component in college readiness. Also, the smaller the difference is in student performance prior to starting high school, the smaller the academic gap will be at graduation (Riegle-Crumb, 2006). With this understanding, students can be evaluated on critical factors prior to high school and monitored as they continue through graduation. By determining students' mathematical

proficiency levels early, it can be determined what level of support, if any, is needed to be successful in college.

### **Studies on College Readiness**

There is national concern that students leaving high school are not college and career ready (ACT, 2005). Recent studies using multiple variable approaches have been conducted on college readiness and college access (Engberg & Wolniak, 2010; Roderick, Nagaoka, & Coca, 2009). Engberg and Wolniak (2010) examined the effects of high school contexts on post-secondary admissions where the study's variables were categorized into two levels: student-level and school-level. The contexts in the study referred to race, SES, highest level of mathematics taken, grades, social influences, and college connections. The data was retrieved from a national longitudinal survey where a stratified sample of 11,940 high school seniors from 740 high schools comprised a national representative sample. The intent of the study was to build understanding of how students' human, social, and cultural capital affected college attendance.

The pertinent information revealed in this study provided insight into college readiness. First, race did not influence college enrollment. However, the study suggested that some racial groups differed in some areas, but the variations might be explained by other variables in the study. Second, college enrollment was influenced by SES and impacted an individual's chances of attending college. Third, the most significant overall impact of college readiness was academic achievement, particularly grades, highest high school mathematics class, and social networking aspiration. This study also indicated that the context of peer networks and college connections assisted with college enrollment. This study was distinct in that it included counselors, teachers, peers, and college personnel. Early information about college and social networking was critical for college enrollment (Engberg & Wolniak, 2010).

Additionally, Engberg and Wolniak (2010) implied that preparing students for college requires both high schools and colleges to work collaboratively. Developing an understanding of the effects of the study's variables will allow high schools to produce college ready students. Post-secondary schools must provide additional information to help students make the connection to college. High schools and colleges working together enable more students to have post-secondary opportunities.

Roderick, Nagaoka, and Coca (2009) concentrated on the importance of improving college access in urban high schools for low income and minority students. Their research integrated numerous studies along with data from the Department of Education to build its foundation. The study focused on researchers and policy-makers defining the exact skills and knowledge required for college performance.

The background findings of Roderick, Nagaoka, and Coca (2009) claimed no states were using their high school exit exams as a standard for determining college readiness. In addition, only a few states have made connections between specific performance indicators and college achievement. One of the reasons mentioned was that students' high school and college data were just becoming available to districts so most studies relied on information from the Department of Education. The lack of available data made rigorous evaluations in college readiness difficult; therefore, current studies were at best descriptive in nature.

While it is challenging determining students' college readiness, it is also difficult assisting high schools preparing students for college. Roderick, Nagaoka, and Coca (2009) suggested there are a variety of approaches high schools could use to align their program with college readiness requirements, including high school curriculum, graduation requirements, more participation in rigorous courses, and rigor of state exit exams. This study compared these



indicators and high school data to students' performance in post-secondary institutions. It evaluated college readiness when predicting enrollment in a four-year college in various ways, noting that coursework, high school GPA, and achievement test scores were better indicators than ACT scores. Additionally, the results indicated that ethnicity and low SES showed significant differences in all of the indicators (Roderick, Nagaoka, & Coca, 2009).

The level of high school students' college aspirations in the United States has increased in all areas of SES, ethnicity, and race. However, substantial differences still exist in college enrollment and college readiness (ACT, 2005). The identifying factors that high schools must emphasize to increase college access and performance are content knowledge, core academic and behavior skills, and the ability to access college information. Roderick, Nagaoka, and Coca (2009) determined that schools need to provide opportunities for students to be college ready. To do this school personnel must understand what it takes to be prepared for college by having precise indicators and a clear understanding of performance standards. In addition, these standards for high school students must be established at a level where admittance to a four-year college is high. Specific guidelines are needed using ongoing student assessment results to identify areas of student improvement. The study concluded that existing data and current testing systems could be used to develop the indicators of college readiness; however, additional college information is required for school systems to expand their data. It is essential that evidence about student performance in college be connected to high school performance so that more detailed college readiness information could be assembled (Roderick, Nagaoka, & Coca, 2009).

In 2008 a report discussed the recommendations for successful transitions from high school to post-secondary education (Lewis, 2008). Fifteen states conducted forums which

involved collaborations for these two academic levels. The reports were combined so that recommendations on transitioning students could be seen more broadly.

First, the report indicated that a vision for the future was critical for students who are transitioning. For this to occur, schools must have opportunities starting as early as middle school. Similar to an SREB (2011) practice, this report emphasized the importance of developing six-year career plans. However, Lewis (2008) added that while creating the plans was important, inconsistent actions were taken across the states. Not surprisingly, school counselors focused the majority of their time on the students enrolling in four-year colleges (Lewis, 2008). This study emphasized the importance of students participating in a six-year career plan starting in 9<sup>th</sup> grade and the establishment of a teacher advisor system.

Second, college readiness and workplace readiness must be addressed at the high school and community college level. Specifically, the report suggested that mathematics must be rigorous and that AP classes be made available to students earlier. Implementing college readiness programs included requiring students to complete a demanding academic program and providing rigorous real-world assignments in career and technical classes (Lewis, 2008). For educators, it is essential to bring students to grade-level and to understand how to align curriculum, college, and careers so that real-life activities can be created.

Moreover, the report made additional suggestions. First, states must provide experiences that are work specific where students feel encouraged to graduate from high school. Among the recommendations were rigorous curricula, building students' awareness in highly sought-after careers, and providing students secondary experiences that connected local jobs to post-secondary educational opportunities (Lewis, 2008). Second, ninth grade is a critical year for students to plan and prepare for a career. To reduce the dropout rate, it is important that all

stakeholders are involved in creating an environment where students, especially those at-risk, are provided with career exploration opportunities. Third, concurrent classes are not as rigorous as AP classes which have common curriculum and assessment components; therefore, students should not enroll in these classes. For dual enrollment classes to be successful, standards need to be created. Fourth, readiness standards must be developed for all secondary and post-secondary institutions so that expectations are established and unnecessary resources are not spent at the community college level remediating students (Lewis, 2008).

The studies on college readiness and college access included numerous variables and various approaches to data gathering. Although demographic variables may impact students' college readiness, it is important that all students have a vision about where they are going, an understanding of how to get there, and the means to accomplish it. The studies supported developing six-year career plans and evaluating the impact of grades, highest mathematics class taken, and social networking aspiration. In addition, there is evidence supporting the alignment of high school curriculum with graduation requirements, college expectations, career readiness, and state exams.

### **Summary**

Preparing students for college and career is a focus of the United States educational system, and mathematics has an important role (Alberti, 2012). For educators this means understanding the needs of the students and educating them to their fullest potential. While this is an expectation of the educational system, many young individuals face challenges that make attending college difficult. ELLs and students of low SES must overcome additional obstacles that make college requirements and acceptance a formidable task (Kazis, 2006; Sciarra, 2010).

The literature revealed that the Arkansas Algebra 1 ACTAAP mathematics EOC exam is the only state exam tied directly to high school graduation (Ark. Code Ann. §6-15-2009), and that the ACT exam is used for determine a student's college readiness (ACT, 2005). Additionally, ELLs and students of low SES lacked family support, the knowledge of how college works, and academic college preparation (Mathews, 2007). The literature showed that ACT exam results revealed low SES students and Hispanic students struggled when compared to their Caucasian counterparts in mathematics and that a mathematics class beyond Algebra 2 was a good predictor of college readiness (ACT, 2004; Adelman, 1999). While research about state assessments, academics, and specific demographic factors exists, there is a lack of integrated information where connections are made between these factors and ACT mathematical performance used for determining student college readiness.

## **CHAPTER III**

### **Methodology**

The literature review indicated a substantial academic gap between non-economically disadvantaged Caucasian students and Hispanic students of low SES. In addition, there was a lack of information that collectively connected ACTAAP mathematics EOC exams, high school GPA, and highest mathematics class completed to ACT mathematical performance. The purpose of the study was to determine the degree to which the ACTAAP mathematics EOC test scores, high school GPA, and highest mathematics class completed predicted student performance on the ACT used for college admittance. Additionally, this study attempted to establish how ELL status and SES impacted students' mathematics performance on the ACT used for college readiness. This chapter discusses the study's research design, which includes the site selection, rationale, demographics and academics of the study's school, variables, population and sample, data collection procedures, data analysis procedure, limitations of the methods, and risks and benefits.

### **Research Design**

This quantitative research study followed a non-experimental, correlational design where archival data was used to examine correlations between the combined ACTAPP Algebra 1 and Geometry EOC scale score, high school GPA, highest mathematics class completed, ELL status, SES, and ACT mathematics score. Fraenkle and Wallen (2000) maintained that by using a non-experimental design, relationships among two or more variables could be studied without any attempt to influence them. In addition to being non-experimental, this study was correlational in nature, meaning the collection of information from existing data was used to determine relationships without concluding causality (Christensen & Johnson, 2012; Swanson & Holton,

2005). A non-experimental correlational design was chosen with the purpose of predicting relationships between the study's variables.

### **Site Selection**

The study's site is a high school located in Northwest Arkansas. In 2010, with a population of 69,797, the city where the high school is located had 69.9% high school graduates, 19.5% persons below the poverty level, 64.7% Caucasians, and 35.4% persons of Hispanic or Latino descent (U.S. Census Bureau, 2010). The city is known for its trucking companies and its poultry industry with more than 75 poultry plants in operation. Between 1990 and 1995 the increase in job opportunities in the poultry industry more than tripled the city's Hispanic population. In addition to the Hispanic population, the city has a large Marshallese population of over 4,000, which is second only to the Marshallese Islands (Brotherton, 2011).

The city where the study's site was located has one private and three public high schools. Established in 1901, the study's high school is the largest of three high schools in the district (Brotherton, 2011), with an enrollment of approximately 2,100 students in grades 10 through 12. In the school 67.9% of students received free and reduced meals, 35.0% were Caucasian, 51.4% Hispanic, and 9% Marshallese (APSCN, 2012).

### **Rationale**

Because the researcher held a district mathematics leadership position and desired to understand more about the mathematical readiness of high school students, certain variables, specifically ELL status and SES, were explored to understand how these variables related to college readiness. A sample of students who met the study's parameters was chosen so the researcher could study individuals relevant to the study.

The purpose of this study was to determine the degree to which selected academic and demographic variables affected the ACT results used in determining college readiness. The University of Arkansas in Fayetteville was chosen because of its proximity to the study's site and because it is the flagship campus of the University of Arkansas system. Founded in 1871, it is a land grant, four-year public research university that Carnegie Foundation classified as the only research institution in Arkansas (University of Arkansas, 2013).

Understanding how the combined ACTAAP Algebra 1 and Geometry EOC scale score, high school GPA, and highest mathematics class completed predicted ACT mathematics scores is important in gauging student preparedness for college. Given the demographics of the city and the location of the study's high school, it is critical that educators gain a better understanding of the impact of ELL status and SES on specific mathematics variables. Moreover, this knowledge could help educators inform parents and students about college readiness expectations to determine if additional support is needed to meet the unconditional mathematics admittance requirements at the University of Arkansas.

### **Demographics and Academics of the Study's School**

The study's high school, located in Northwest Arkansas, showed an enrollment of 2,088 students on March 20, 2013. This public school includes grades 10 through 12 and is the largest of three high schools in the district. Demographic information for the 2012-2013 school year was accessed using Cognos and collectedly reported in Table 1 (APSCN, 2013).

Table 1

*Demographic Information*

Categories	<i>n</i>	%
Gender		
Female	1,030	49.00
Male	1,058	51.00
Ethnicity		
African American	50	2.39
Asian	40	1.92
American Indian/Alaska Native	6	0.29
Caucasian	720	34.48
Hawaiian/Pacific Islander	191	9.15
Hispanic	1,081	51.77
ELL Status		
ELLs	805	38.55
Non-ELLs	1,283	61.45
SES- Based on Meal Status		
Free/Reduced	1,487	71.22
Paid	601	28.78

*Note.* The data were collected on March 20, 2013.

The APSCN data in Table 1 reflects that the school had 65.52% non-Caucasian students. What the data did not reveal was that 58.77% of these students were classified as ELLs. In addition, the percent of students classified as free/reduced meal status was more than double the



percent of students classified as paid meal status, with almost four times the number of students receiving free meals as reduced meals. Furthermore, 51% of the students classified as ELLs also received free or reduced meals.

Additional information about the study’s site revealed that in 2011 the school had a grade inflation rate of 3.7%, which was below the state rate of 4.7% (NORMES, 2011). This low rate of grade inflation indicated that Algebra 1 and Geometry course grades aligned with the scores earned on corresponding ACTAAP mathematics EOC tests. This state indicator for grade inflation provides support for the accuracy of high school students’ GPAs at the study’s site. High school GPA information broken down by grade level is shown in Table 2. This information generated from Cognos contains a complete view of the school’s average cumulative GPA for 2011- 2012 (APSCN, 2013).

Table 2

*Average Cumulative GPA Data for the 2011-2012 School Year*

Class	<i>n</i>	Avg. Score
Sophomores	755	2.52
Juniors	596	2.68
Seniors	534	2.79
Total	1,885	2.65

*Note.* The cumulative GPA data were collected after completion of second semester.

The information in Table 2 indicated that the average high school cumulative GPA for 2012 seniors was 2.79. While this information is important, what is not revealed is that 192 of these 534 seniors (35.96%) had a 3.0 cumulative GPA or higher, meeting the GPA requirement for University of Arkansas unconditional admissions (APSCN, 2012).

Further information about the academics of the study's site involved examining senior year mathematics classes. The distribution of seniors in their spring 2013 mathematics class is provided in Table 3.

Table 3

*Seniors Mathematics Class in Spring 2013*

Senior Mathematics Class	<i>n</i>	%
<b>Core Curriculum</b>		
Self-contained Mathematics	21	3.6
Resource Mathematics	7	1.2
Algebraic Connections	11	1.9
Geometry	1	0.2
Algebra 2	134	22.7
<b>Smart Core Curriculum</b>		
Algebra 3	102	17.3
International Baccalaureate Mathematics	13	2.2
Pre-Calculus/Trigonometry	24	4.1
Transition to College Mathematics	177	29.9
College Algebra/College Finite	23	3.9
AP Statistics	43	7.3
AP Calculus AB/AP Calculus BC	35	5.9

*Note.* N = 591. Total of percentages is not 100 because of rounding.

This information revealed that in spring 2013, 29.6% of the seniors did not meet the Smart Core requirement of a mathematics class higher than Algebra 2 (Arkansas Department of

Education, 2010c). Additionally, the data in Table 3 indicated that 13.2% of the seniors were enrolled in an AP mathematics class. These descriptive statistics provided a view of the academic and demographic factors of the study's site.

## **Variables**

The independent variables in the study included a combined ACTAAP Algebra 1 and Geometry EOC scale score, high school GPA, highest mathematics class completed, senior year ELL status, and SES based on meal status. A single combined scale score for the ACTAAP Algebra 1 and Geometry EOC exams was a discrete variable ranging from 0 to 908 (Arkansas Department of Education, 2010e), high school GPA was a continuous variable ranging from 0 to 5.0, where a score higher than 4.0 depended on the number of As received in AP classes. Theoretically a 5.0 could only be achieved if a student took non-credit-bearing or AP classes receiving As in all the AP classes. The highest mathematics class completed was a discrete variable and included nine options. Each course was assigned a value 1 – 9 according to the level of course content difficulty. The lowest mathematics class was Algebra 2 and was assigned a value of 1. AP Calculus was the highest class, and it was assigned a value of 9. ELL status and SES were dichotomous variables where graduates' senior year data were used. A value of -1 indicated the graduate was an ELL their senior year, whereas a value of 1 represented a graduate who was not an ELL or was no longer classified as an ELL. SES was based on an individual's senior year meal status, where receiving free/reduced meals or paid meals corresponded to the numerical values of -1 and 1 respectively. A description of the study's independent variables is provided in Table 4.

Table 4

*Description of Variables Included in the Research Questions*

	Variable	Definition
Question 1	Combined EOC mathematics scale score	Algebra 1 Scale Score + Geometry Scale Score
	High school GPA	9 <sup>th</sup> – 12 <sup>th</sup> Grade Combined Average GPA
	Highest mathematics class completed	1 = Algebra 2
		2 = Algebra 3
		3 = Transition to College Mathematics
		4 = IB Mathematics Studies
		5 = College Finite
		6 = Pre-Calculus with Trigonometry
		7 = AP Statistics
		8 = IB Mathematics Standard Level
9 = AP Calculus		
Question 2	ELL Status	-1 = ELL  1 = Non ELL
	SES	-1 = Free/Reduced Meal Status  1 = Paid Meal Status

The discrete dependent variable in this study was the ACT mathematics score. If an individual took the ACT multiple times, the mathematics score corresponding to the highest composite score was used. If two or more composite scores were equal, the highest mathematics score from these was used.

## **Population and Sample**

The students who graduated from the study's high school in Northwest Arkansas over a three-year period established the population for this study. The sample included students who graduated in the years 2010, 2011, or 2012, participated in the district's IGP program, took the Algebra 1 EOC test, Geometry EOC test, and ACT exam. Individuals were excluded from the study if one or more of these components were missing or not available.

First, high school graduates were eliminated from the study if they did not participate fully in the district's IGP program. Those individuals identified as out-of-district highly mobile were identified as not fully participating. Second, individuals were excluded if they did not meet graduation requirements by second semester of their senior year. Lastly, graduates were eliminated if they were missing an Algebra 1 EOC exam score or a Geometry EOC exam score followed by the removal of individuals without an ACT score. The remaining participants met the criteria for inclusion in the study.

## **Data Collection Procedures**

A request was submitted to the University of Arkansas Institutional Review Board (IRB) to conduct this study. Once approved, permission was requested from the school district where the study was conducted. After authorization was given from the district, information was collected using APSCN and Triand. The data collection procedure involved a two-step process. The first step was to determine which students graduated from the study's school in 2010, 2011, or 2012. The second step was to collect a variety of archival documents using APSCN and Triand.

The process for collecting data in APSCN incorporated Cognos, a report generator in which public folders allow tables of data to be accessed or created. Three years of student

demographic data including out-of-district mobility for IGP participation, ELL status, and SES was created and saved in a Microsoft Excel spreadsheet. An additional Excel spreadsheet with GPAs was collected using APSCN. Both of these spreadsheets were merged in Microsoft Access to create the initial columns of information that were used for the data analysis. Next, Triand was used to find additional and missing information such as ACTAAP Algebra 1 and Geometry EOC scale scores, highest mathematics class completed, and GPAs that could not be found in APSCN. This information was added to the initial Excel spreadsheet.

The final data set for the study was organized in an Excel spreadsheet. The column headings included IGP participation, highest mathematics class completed, high school GPA, ACTAAP Algebra 1 EOC scale score, ACTAAP Geometry EOC scale score, combined ACTAAP Algebra 1 and Geometry EOC scale score, high school senior year ELL status, SES based on meal status, and ACT mathematics score. Data not represented numerically were converted to values established in the *Variables* section of this chapter.

Individual graduates were not identified; only numerical representations were used where each participant was randomly assigned a unique number, and all other identifying information was eliminated from the Excel file. Once the information was collected and organized, all graduates' missing data were removed from the data set, and the findings were reported collectively.

### **Data Analysis Procedures**

The design of the study used archival data to investigate and report the findings. A quantitative approach was used in which the type of variable relationship involved a correlational study with more than two variables from the same group of subjects. This method measured the mathematical performance level students reached in high school to be considered college ready.

Research Question 1 involved a multiple regression. This statistical procedure used the data in the study's Excel spreadsheet to analyze and report the results used to predict performance levels and determine variable relationships. The combined ACTAAP mathematics EOC test score, high school GPA, and highest mathematics class completed were used to predict the college readiness performance level using the ACT mathematics score.

Research Question 2 involved a three-step hierarchical multiple regression to analyze the data. Model 1 was defined using the variables established in Question 1. Next, ELL status was added to the independent variables to establish Model 2. Finally, Model 3 was generated after adding SES to the four independent variables found in Model 2. Models 1, 2, and 3 in the hierarchical multiple regression were used to determine the additional impact, if any, that ELL status (Model 2) and SES (Model 3) had on the ACT used in determining college readiness.

Both questions used the IBM SPSS Statistics (SPSS) Version 20 software package for the statistical analysis, and results were reported in an unbiased manner. Figure 1 contains the process, design, questions, and procedures for analysis.

Requested permission from University of Arkansas Institutional Review Board (IRB) to conduct the study.

Requested permission from the Northwest Arkansas school district where the study was conducted.

Gathered student background information and created an Excel spreadsheet with columns of data that included IGP participation, combined Algebra 1 and Geometry EOC scale score, high school GPA, highest mathematics class completed, senior year ELL status, and SES.

Converted student data to numerical values for analysis. Used SPSS to run data to answer the research questions.

### Analyses of the study

#### Research Question 1 Multiple Regression

##### Model 1

Dependent Variable:  
ACT Mathematics Score

Independent Variables:  
Combined Algebra I and  
Geometry scale score  
High school GPA  
Highest mathematics  
class completed

#### Research Question 2 Hierarchical Multiple Regression

##### Model 1

Dependent Variable:  
ACT Mathematics Score

Independent Variables:  
Combined Algebra I and Geometry scale score  
High school GPA  
Highest mathematics class completed

##### Model 2

ELL added to the independent variables in Model 1

##### Model 3

SES added to the independent variables in Model 2

Reported the results of the study.

*Figure 1.* The sequential progression of the study's design with specific emphasis placed on the research questions' variables.



## **Limitations of the Methods**

Since the information was collected using APSCN and Triand, the study's method of data collection was limited to the accuracy of the data in these programs. The precision of data in these tools was critical to the study's findings; however, the information was entered into the state systems by registrars and other school officials and could contain human errors. The errors could not be detected by the researcher; therefore, the data was deemed correct to the best of the researcher's knowledge.

## **Risks and Benefits**

No expected risks were associated with this study. All participant information was kept confidential, and the study's results were presented collectively. However, the benefits of the study are potentially extensive. IGPs can be modified to include ACTAAP mathematics EOC scale scores, GPAs, and ELL status. Potential initiatives at the junior high level can include parent information about the importance of mathematical EOC scores, high school GPA, and highest mathematics class completed. At the high school level school personnel can use the information in the IGPs to gauge the mathematical status of students and prepare them for college success.

## **Summary**

The current study was prompted by the lack of research exploring the practices in high school mathematics leading to college readiness in Northwest Arkansas schools. In this study the connection between combined selected academic and demographic variables and mathematics college readiness was investigated.

The study used a non-experimental, correlational design where archival data were used to examine correlations between the combined ACTAPP Algebra 1 and Geometry EOC scale score,

high school GPA, and highest mathematics class completed and the ACT mathematics score. The impact of ELL status and SES on students' mathematical college readiness predicted by ACT mathematics performance was also examined. The data acquired for the study was collected using APSCN and Triand. The study's sample included students who graduated in the years 2010, 2011, and 2012 from the study's high school; participated in the district's IGP program; graduated by the second semester of their senior year; and took the Algebra 1 EOC test, Geometry EOC test, and ACT exam. The research questions involved a multiple regression and hierarchical multiple regression where the statistical procedure used archival data to predict performance levels and determine variable relationships. Results are reported in Chapter IV.

## CHAPTER IV

### Results and Data Analysis

The purpose of the study was to determine the degree to which the ACTAAP mathematics EOC test scores, high school GPA, and highest mathematics class completed predicted student performance on the ACT used for college admittance. Additionally, this study attempted to establish how ELL status and SES impacted students' mathematics performance on the ACT used for college readiness. The following questions guided the study:

1. To what degree did ACTAAP mathematics EOC test scores, high school GPA, and highest mathematics class completed predict a college admittance ACT mathematics score?
2. How did ELL status and SES impact the predictive nature of ACTAAP mathematics EOC scale scores, high school GPA, and highest mathematics class completed on ACT mathematics performance (i.e., college readiness)?

To answer the above questions, archival data relating to the study's site were obtained from APSCN and Triand. The initial data of all 2010, 2011, and 2012 high school graduates included 1,481 individuals. From the original data, 73 were excluded for not participating in the district's IGP program and 31 were excluded because they did not meet graduation requirements by second semester of their senior year. Furthermore, 163 were eliminated because they were missing an ACTAAP Algebra 1 EOC score or ACTAAP Geometry EOC score and an additional 557 were excluded because they did not have an ACT score. The remaining 657 graduates met the criteria for inclusion in the study. Of these individuals, 51 took Algebra 2 as their highest mathematics class, 606 met the Smart Core requirements of a mathematics class higher than Algebra 2, 103 were classified as ELLs, and 124 were classified as low SES based on their meal

status. The following data analysis section examines the impact of selected academic and demographic factors on college readiness.

### **Data Analysis Results**

This study was guided by two research questions that were used in determining the impact the combined ACTAAP Algebra 1 and Geometry EOC test score, high school GPA, and highest mathematics class completed had on the ACT mathematics score used for college admittance. Additionally, the impact of ELL status and SES on students’ mathematical college readiness predicted by ACT mathematics performance was determined. The data analysis for each question is contained in this section.

#### **Research Question 1**

Research Question 1: *To what degree did ACTAAP mathematics EOC test scores, high school GPA, and highest mathematics class completed predict a college admittance ACT mathematics score?*

The data set for this research question contained a large sample; therefore, descriptive statistics helped manage the data (see Table 5).

Table 5

#### *Descriptive Statistics*

Variables	Min.	Max.	<i>M</i>	<i>SD</i>	Skewness		Kurtosis	
						<i>SE</i>		<i>SE</i>
Combined EOC Math Scores	218	642	470.53	56.78	-.09	.095	.42	.19
High School GPA	1.14	4.83	3.17	.60	-.19	.095	-.08	.19
Highest Math Class Completed	1	9	4.53	2.67	.43	.095	-1.28	.19

*Note.* N = 657.

Five different types of correlations were computed to determine the degree of association between two variables. A bivariate correlation approach was used where a  $p$  value of less than .05 was required for significance. First, a Pearson's correlation was computed between the interval variables, and a Point-Biserial correlation was calculated between the interval and dichotomous variables. Second, a Spearman's rank correlation was computed between the interval and ordinal variables. Next, a bivariate correlation was calculated between the dichotomous and ordinal variables using a Rank-Biserial correlation. Last, a Phi correlation coefficient was calculated between the dichotomous variables. The results of the analysis in Table 6 indicated all of the correlations were statistically significant and were greater than or equal to .077.

Table 6

*Bivariate Correlation for the ACT Mathematics Score and the College Readiness Independent Variables*

Variable	ACT Math Score	1	2	3	4	5
ACT Math Score	-					
Independent variables						
1. Combined EOC Math Score	<sup>a</sup> .777**	-				
2. High School GPA	<sup>a</sup> .554**	<sup>a</sup> .511**	-			
3. Highest Math Class Completed	<sup>b</sup> .511**	<sup>b</sup> .495**	<sup>b</sup> .508**	-		
4. ELL Status	<sup>c</sup> .316**	<sup>c</sup> .288**	<sup>c</sup> .279**	<sup>d</sup> .297**	-	
5. SES	<sup>c</sup> .134**	<sup>c</sup> .077*	<sup>c</sup> .159**	<sup>d</sup> .171**	<sup>e</sup> .359**	-

*Note.* \*  $p < .05$ , \*\*  $p < .01$ . <sup>a</sup> Pearson correlation coefficient; <sup>b</sup> Spearman correlation coefficient; <sup>c</sup> Point Biserial correlation coefficient; <sup>d</sup> Rank Biserial correlation coefficient; <sup>e</sup> Phi correlation coefficient.

The results suggest that if students achieved a high score in one academic area they tended to have high scores in the other academic areas. In addition, a correlation between the demographic variables suggested ELL status and SES were significantly related. All the bivariate correlations between the college ready-measures and the ACT mathematics score were positive, as was expected.

Next, a multiple regression analysis was conducted to evaluate how well the selected academic variables measured the predicted ACT mathematics score. An effect size was calculated using the coefficient of determination ( $R^2$ ) as revealed in Model 1 (see Table 8). According to Vacha-Haase, Nilsson, Reetz, Lance, and Thompson (2000), an effect size is a “statistic that quantifies the degree to which sample results diverge from the expectations” (p. 473). For the current study the effect size was a descriptive statistic that showed how big a difference the independent variables (combined ACTAAP Algebra 1 EOC scale score and Geometry EOC scale score, high school GPA, and highest mathematics class completed) made on the dependent variable (ACT mathematics score) regardless of the sample size. The linear combination of the independent variables was significantly related to the ACT mathematics score,  $F(3, 653) = 404.695$ ,  $p < .01$ . Approximately 65% of the variance of the ACT mathematics score could be accounted for by the set of variables of combined ACTAAP Algebra 1 and Geometry EOC scale score, high school GPA, and highest mathematics class completed (see Table 8).

Model 1 in Table 9 contains the output of Bs, which are the values of the unstandardized coefficients. To standardize the dependent and independent variables, a mean of 0 and a standard deviation of 1 (z score) were used. These standardized variables are labeled  $\beta$  (see Table 9). The results indicated that all the selected independent variables were significantly

related to the ACT mathematics score; however, the combined ACTAAP Algebra 1 and Geometry EOC score was most strongly related (.623).

**Research Question 2**

Research Question 2: *How did ELL status and SES impact the predictive nature of ACTAAP mathematics EOC scale scores, high school GPA, and highest mathematics class completed on ACT mathematics performance (i.e., college readiness)?*

A hierarchical multiple regression was conducted to determine how ELL status and SES impacted the predictive nature of the combined ACTAAP Algebra 1 and Geometry EOC scale score, high school GPA, and highest mathematics class completed on the ACT mathematics performance used for college readiness. According to Howitt and Cramer (2011) in a hierarchical multiple regression analysis, the researcher determines the order that independent variables are entered into the regression equation. ELL status was entered first, followed by the inclusion of SES, because the impact of ELL was considered by the researcher as a more temporary situation that could be improved with school support. The sample’s numbers, means, and standard deviations for ELL status and SES are presented in Table 7 below.

Table 7

*Descriptive Statistics for ELL Status and SES*

Variable	n	Combined EOC Score		High School GPA		Highest Mathematics Class Completed	
		M	SD	M	SD	M	SD
ELL Status							
No	554	478	55.33	3.24	.58	4.75	2.70
Yes	103	433	49.15	2.78	.54	3.37	2.22

Table 7 (continued)

Variable	<i>n</i>	Combined EOC Score		High School GPA		Highest Mathematics Class Completed	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Free/Reduced Lunch							
No	533	473	57.22	3.21	.60	4.68	2.68
Yes	124	462	54.17	2.97	.56	3.91	2.54

Next, to examine the unique contribution of ELL status in the explanation of college readiness, a hierarchical multiple regression analysis was performed. The academic variables that explain college readiness were entered in Model 1 in which the ACT mathematics score was the dependent variable, and the independent variables were: (a) combined ACTAAP Algebra 1 and Geometry EOC scale score, (b) high school GPA, and (c) highest mathematics class. In Model 2, the dependent variable remained the same; however, ELL status was added as an independent demographic variable. This allowed the researcher to examine the contribution above and beyond the first group of independent variables. In Model 3, SES was added to the previous independent variable, and the contribution above and beyond the second group of independent variables was examined. The hierarchical multiple regression analysis is presented in Table 8 and Table 9.



Table 8

*Hierarchical Regression Analysis Predicting ACT Mathematics Score with College Readiness Variables*

Model and Independent Variables	<i>R</i>	<i>R</i> <sup>2</sup>
Model 1	.806	.650
Combined ACTAAP mathematics EOC scale score		
High school GPA		
Highest mathematics class completed		
Model 2	.809	.655
Combined ACTAAP mathematics EOC scale score		
High school GPA		
Highest mathematics class completed		
ELL status		
Model 3	.810	.653
Combined ACTAAP mathematics EOC scale score		
High school GPA		
Highest mathematics class completed		
ELL status		
SES		

Table 9

*Hierarchical Multiple Regression Analysis Summary for College Readiness Variables Predicting ACT Mathematics Score (N = 657)*

Model	<i>B</i>	95% CI	$\beta$	<i>t</i>	<i>p</i>
1 (Constant)	-4.525	[-6.202, -2.847]		-5.297	< .001
Combined EOC Score	.044	[0.040, 0.048]	.623	21.791	< .001
High School GPA	1.116	[0.738, 1.495]	.166	5.795	< .001
Highest Math Class	.207	[0.123, 0.292]	.138	4.811	< .001
2 (Constant)	-4.046	[-5.744, -2.349]		-4.681	< .001
Combined EOC Score	.043	[0.039, 0.047]	.608	21.113	< .001
High School GPA	1.029	[0.648, 1.409]	.153	5.308	< .001
Highest Math Class	.208	[0.124, 0.292]	.138	4.854	< .001
ELL Status	.399	[0.134, 0.664]	.072	2.959	.003
3 (Constant)	-4.119	[-5.823, -2.416]		-4.749	< .001
Combined EOC Score	.043	[0.039, 0.047]	.611	21.129	< .001
High School GPA	1.015	[0.633, 1.396]	.151	5.225	< .001
Highest Math Class	.206	[0.122, 0.290]	.137	4.804	< .001
ELL Status	.349	[0.068, 0.631]	.063	2.437	.015
SES	.131	[-0.120, 0.381]	.025	1.025	.306

*Note.* N = 657. CI = confidence interval for *B*.

The hierarchical multiple regression analysis was conducted to predict the overall college readiness index. Model 2 analysis included combined ACTAAP Algebra 1 and Geometry EOC scale score, high school GPA, highest mathematics class completed, and ELL status where the dependent variable was the ACT mathematics score. The results of the

regression equation with ELL status was significant,  $R^2 = .650$ , adjusted  $R^2 = .653$ ,  $F(4, 652) = 309.289$ ,  $p < .01$ . Next, a multiple regression analysis was conducted that included the previous independent variables and SES. The linear combination of the SES college readiness measures was not significantly related to the ACT mathematics score,  $R^2 = .655$ , adjusted  $R^2 = .653$ ,  $F(5, 651) = 247.665$ ,  $p = .306$ . Based on these results, SES was not statistically significant.

Of the four college readiness indicators (combined EOC mathematics score, high school GPA, highest mathematics class completed, and ELL status), combined EOC mathematics score was most strongly related to the ACT mathematics score. Supporting this conclusion was the strength of the bivariate correlation between combined EOC mathematics score and the ACT mathematics score, which was  $.78$ ,  $p < .01$  (see Table 6), as well as the comparable correlation controlling for the effects of the other three measures, which was  $.637$ ,  $p < .01$ .

### Summary

This chapter addressed the study's two research questions and provided supporting results for each. Using descriptive statistics, bivariate correlations, a multiple regression, and a hierarchical multiple regression, archival data were used to calculate the impact the combined ACTAAP Algebra 1 and Geometry EOC scale score, high school GPA, and highest mathematics class completed, had on the ACT used for college admittance. In addition, the impact of ELL status and SES was examined.

The descriptive statistics summarized the academic and demographics information of the sample, bivariate correlations were computed to determine the degree of association between each of the study's variables, and a multiple regression and hierarchical multiple regression were calculated to determine the impact of the academic and demographic variables respectively on ACT mathematics performance. The results of the multiple regression indicated that the

combined EOC Algebra 1 and Geometry EOC scale scores had a larger impact on college readiness than high school GPA, or highest mathematics class completed. Furthermore, the results of the hierarchical regression revealed that ELL status had an impact on college readiness when included as an independent variable with the combined ACTAAP Algebra 1 and Geometry EOC scale score, high school GPA, and highest mathematics class completed. However, when SES was added to the model, no significant impact occurred on the ACT mathematics score used for predicting college readiness.

The results of this study offered a preview of the impact of academic and demographic variables on ACT mathematics performance, with specific attention given to ELL status and SES. The following chapter provides conclusions and recommendations that will provide a foundation of knowledge to prepare students for college mathematics.

## CHAPTER V

### Conclusions

The National Council of Teachers of Mathematics affirmed that “in this changing world, those who understand and can do mathematics will have significantly enhanced opportunities and options for shaping their futures” (2000, p. 1). In 2012, the National Center for Education Statistics (NCES) reported that approximately 15 million students were predicted to enroll in grades 9 through 12 in the 2015-2016 school year. As these individuals transition through high school, mathematics will become a critical component in college readiness. According to NCES (2004), 41% of students take at least one remedial course when entering college, with mathematics requiring more remedial assistance than any other subject (Adelman, 2004; Parsad, Lewis, & Greene, 2003). While the findings of the current research may impact the remediation issues found at the college and university level, the main goal of this study was to preemptively address the mathematical issues related to college readiness.

While previous college readiness research focused on relationships between performance measures such as high school GPA, class rank, course difficulty, and the ACT (ACT, 2005; Adelman 1999; Mathews, 2007), there are multiple factors that impact college readiness in mathematics. The current study used a multi-level research approach to determine the impact of selected academic and demographic factors. Conley (2007) explained that it is important for students to assess their level of college readiness before developing strategies that will guide them to college admission and success. For this to occur it is necessary for students to have a foundation of knowledge linking high school academics to college preparation.

## **Summary of the Study**

The purpose of this study was to determine the degree to which the ACTAAP mathematics EOC test scores, high school GPA, and highest mathematics class completed predicted student performance on the ACT score used for college admittance. Additionally, this study attempted to establish how ELL status and SES impacted students' mathematics performance on the ACT score used for determining college readiness. Participants considered for the study were graduates from one Northwest Arkansas high school. Individuals were included in the sample if they graduated from the school in the years 2010, 2011, or 2012, participated in the district's IGP program, took the ACTAAP Algebra 1 EOC test, ACTAAP Geometry EOC test, and the ACT exam. Individuals were excluded from the study if one or more of these items were missing or unavailable.

## **Overview of the Results**

Archival research data were collected using APSCN and Triand. Graduates were not identified; only numerical representations were used. The data set was organized in Microsoft Excel and analyzed using SPSS. Student academic information included the combined ACTAAP mathematics EOC scale score, high school GPA, highest mathematics class completed, and the ACT mathematics score. Additionally, the student demographic data included ELL status and SES. A multiple regression and hierarchical multiple regression were conducted to determine the impact of selected academic and demographic variables respectively on college readiness. A summary of each question's results is presented below.

Research Question 1: To what degree did ACTAAP mathematics EOC test scores, high school GPA, and highest mathematics class completed predict a college admittance ACT mathematics score?

In Question 1, a multiple regression was used to analyze the data, where the results helped explain the relationship between the independent variables (combined ACTAAP Algebra 1 and Geometry EOC scale score, high school GPA, and highest mathematics class completed) and the independent college readiness variable (ACT mathematics score). The multiple correlation coefficient (.806) for Question 1 indicated that approximately 65% of the variance of the ACT mathematics score in the sample could be accounted for by the linear combination of combined independent variables.

As expected, high school GPA and highest mathematics class completed had a considerable impact on students' ACT mathematics performance. When looking at each independent variable, the results of this study revealed that high school GPA was related ( $\beta = .166$ ) to the ACT mathematics score used to predict college readiness. These findings were supported by previous research that showed high school GPA had a significant impact on college readiness (Engberg & Wolniak, 2010; Hoffman & Lowitzki, 2005; Sciarra, 2010). Additionally, the study's findings indicated that the highest mathematics class completed was strongly related ( $\beta = .138$ ) to the ACT mathematics score. These findings confirmed other studies that suggested high school curriculum significantly impacted a student's college readiness (Adelman, 1999; Engberg & Wolniak, 2010; Sciarra, 2010).

The results of Question 1 revealed that the combined ACTAAP mathematics EOC scale score was most strongly related ( $\beta = .623$ ) to the ACT mathematics score. While the impact of the combined ACTAAP mathematics EOC exam on the ACT mathematics score was expected, the strength of the relationship was surprising. According to Green and Salkind (2011), the multiple regression analysis "examines the validity of each set of predictors, the incremental validity of each set of predictors over other sets of predictors, and the validity of all sets in

combination” (p. 286). In the present study, the value of the ACT mathematics score changed most when the combined ACTAAP mathematics EOC test score varied.

This study included multiple academic factors, each of which had a substantial impact in predicting college admittance ACT scores. Moreover, the findings of Question 1 suggested that the combined Arkansas EOC mathematics exam had the strongest correlation to the ACT and should be considered valuable information when determining college readiness. While no previous studies could be found linking ACTAAP mathematics scale scores with the mathematics portion of the ACT, Conley (2005) supported the idea that a greater understanding of the relationships between state exams and post-secondary admission exams would provide meaningful information in determining college readiness. The central findings of Question 1 fill the gap between state mathematics exams and the ACT mathematics exam used in determining college readiness.

Research Question 2: How did ELL status and SES impact the predictive nature of ACTAAP mathematics EOC scale scores, high school GPA, and highest mathematics class completed on ACT mathematics performance (i.e., college readiness)?

A hierarchical multiple regression was conducted to determine how ELL status and SES impacted the predictive nature of the combined ACTAAP Algebra 1 and Geometry EOC scale score, high school GPA, and highest mathematics class completed. First, the impact of ELL status was analyzed, followed by the impact of SES. When adding ELL status to the independent variables in Question 1, the multiple correlation coefficient increased slightly, indicating that approximately 66% of the variance of the ACT mathematics score in the sample could be accounted for by the linear combination of the independent variables where  $p < .01$ . Other research involving ELL status supported these findings with the idea that nationally ELLs



underperformed relative to their English-language counterparts an average of 20% to 50% in all content areas (Menken, 2010). Furthermore, Slavin, Madden, and Claderon (2010) stated that the gap between ELLs and non-ELLs widened from fourth grade to eighth grade. According to their findings, compared to the 35% of non-ELLs who were proficient or advanced on the 2009 NAEP assessment, only 5% of ELLs were proficient.

The most unexpected results of the study were revealed when SES was investigated. The findings indicated that when adding SES to the previous variables, the variance was 65% with no significant impact ( $p = .306$ ). Based on these results, SES offered no additional predictive power beyond that contributed by ELL status. This differed from the findings of other SES research in which students in poverty were more likely to have low academic achievement (Hodgkinson, 1995; Moore and Redd, 2002), and where their cognitive ability was affected by numerous factors, not least of which was SES (Jensen, 2009).

The combined ACTAAP mathematics EOC scale score, high school GPA, and highest mathematics class completed all had a significant impact in predicting ACT mathematic scores for college admittance, with the ACTAAP mathematics exams having the greatest impact. Furthermore, when ELL was added it was significant; however, the addition of SES provided no additional impact on the ACT used for determining college readiness.

### **Discussion and Conclusions of Findings**

The results of this study revealed the importance of taking into account a multitude of academic and demographic variables when assessing students for college readiness. Conley (2007) stated that “college readiness is a multifaceted concept comprising numerous variables that include factors both internal and external to the school environment” (p. 8). This section discusses the selected academic and demographic findings and conclusions of the research

questions that guided this study.

### **Research Question 1**

The first research question focused on selected academic characteristics of college readiness. All three academic variables had a significant impact on predicting a college admittance ACT mathematics score. Based on the results of the current study, it was evident that high school GPA and highest mathematics class completed impacted the ACT score used for determining college readiness. Moreover, this study suggested that the combined ACTAAP mathematics EOC test score showed a more significant impact on the ACT performance than the study's other academic variables. As a result, increasing performance on ACTAAP mathematics EOC exams, raising high school GPAs, and taking higher mathematics classes suggest an improvement will occur in students' ACT mathematics scores used for determining college admissions.

Some studies went beyond college readiness and explored college completion. In 2006, Adelman analyzed transcripts and determined that the best indicator of completing a bachelor's degree was a challenging high school curriculum, which supported this study's college readiness results. In addition, the impact was even greater for Hispanic and African-American students than their Caucasian counterparts. When addressing mathematics curriculum, the students who took Algebra 2 or higher in high school were consistent in obtaining a bachelor degree, and every level at or below Algebra 2 had a declining rate. Additionally, when assessing bachelor's degree completion, the correlation of class rank and GPA were second, followed by test scores (Adelman, 2006). The results of the current study provide additional evidence that supports students taking more rigorous mathematics courses and increasing their GPA in preparation for college.

While numerous college readiness studies have focused on high school GPA (Hoffman & Lowitzki, 2005; Sciarra, 2010) and course difficulty (Adelman, 1999; Sciarra, 2010), little effort has been given to study the predictive value of state exams because they are relatively new in education. In 2006, Arkansas revised the Elementary and Secondary Education Act, which pertained to Arkansas' assessment system (Arkansas Department of Education, 2010a). Because the implementation of the new assessment system is relatively new, supporting data is limited. The present study addressed the gap in the literature between state exams and the ACT used to determine college admittance. Most importantly, this study identified that state exams had a stronger impact than high school GPA and the highest mathematics class completed when determining ACT mathematical performance. Knowing this information, schools could use the ACTAAP mathematics EOC exams as tools in determining college readiness.

The federal No Child Left Behind Act (NCLB, 2002) requires states to administer high school exams. However, the limited information beyond course content creates a challenge in using the results of these exams. States developed end-of-course exams; however, most of the tests are taken prior to or during 10<sup>th</sup> grade. While the results of these exams allow students to start early when planning and preparing for college, a set of standards or exams for high school seniors have not been developed.

The findings of the present study challenge Conley's (2003) research, which states that expectations for post-secondary learning are not aligned. While his findings supported the idea that state exams are a good measure of basic skill, they do not provide information on the skills and knowledge needed to be successful in college. Conley (2007) stated in some cases students may incorrectly believe that the scores they received on the state exams are a good indicator of college success. The results of the current research study indicated that the ACTAAP is an

important tool that can be used as a means of informing students of their college readiness early; therefore, students in 11<sup>th</sup> and 12<sup>th</sup> grade can increase their college preparedness.

This study showed that the variables of curriculum, high school GPA, and the state mathematics exams have a significant impact on the ACT mathematics score. While the findings of this study add to the literature and inform individuals planning to attend college, the implementation of the new Common Core State Standards (CCSS) national curriculum will not only affect the curriculum but also the assessment component involved. It will take years before there is enough data from the new standards to determine their impact on ACT scores and college readiness.

### **Research Question 2**

The second research question focused on adding selected demographic characteristics to the academic characteristics of college readiness used in Question 1. The findings of this study indicated that ELL status, but not SES, had a significant impact on students' academic performance.

A number of studies supported the idea that ELLs underperform relative to their English-language peers (Menken, 2010; Slavin, Madden, & Claderon, 2010). Additionally, when looking at the growing number of ELLs in the United States there is cause for concern. In the 1997-1998 school year, the number of ELLs enrolled in public schools was approximately 3.5 million. This number grew to 5.3 million in the 2008-2009 school year, which was an increase of 51%. During this same time period the total enrollment in public schools grew only 7% (National Clearinghouse for English Language Acquisition, 2011). With this dramatic growth and the low academic performance of ELLs, further exploration pertaining to ELL status was needed.

Furthermore, unexpected results of this study revealed that SES did not have a significant impact on students' ACT mathematics performance and challenged the findings of other studies (Adelman, 2006; Sciarra, 2010). Sciarra (2010) indicated that among other variables, SES and ESL were strong predictors in taking a mathematics class beyond Algebra 2; however, SES was stronger. For example, students in the highest SES quartile were more likely to complete a higher mathematics class than Algebra 2 when compared to students in the lower SES quartile.

Regarding college completion, Adelman (2006) stated that "SES plays a significant role in bachelor's degree completion: each step in the "SES ladder" increases the probability of degree completion for this population by around 6%" (p. 3). The higher an individual's SES, the more likely they were to attain a bachelor's degree.

Sciarra added that when high school GPA and achievement scores were added, the effects of SES were reduced. For example, students in the low SES range increased their chances by approximately 50% that they would complete a class beyond Algebra 2, but were still less likely to do so when compared to those in the highest SES range. However, according to Garcia, Jensen, and Scribner (2009), while ELLs traditionally fell behind their English-language peers, much of the performance gaps could be explained by low family income, lack of parent education, and limited English language proficiency.

In the current study, part of the impact of ELL status may have been contributed to low SES, suggesting these variables may be linked. Therefore, SES may already be considered a contributing factor, revealing no additional effect beyond that of ELL status. The data was examined further to explore the possibility of conflated statistics. In the sample 103 graduates were ELLs, 124 were low SES, and 53 were both. Therefore, 51% of the graduates in the ELL sample were identified as low SES. Since a substantial number of the individuals were classified

as ELLs and low SES, a portion of the SES variance could be included in the ELL status previously determined; therefore, the differences between the variables may have become lost and no additional impact was contributed by SES.

The findings of the SES demographics in this study resulted in two additional thoughts. First, the impact of the SES background factor was reduced when academic variables were added because students with similar academic expectations had already established goals and were seeking to achieve them. Second, some families are prideful of not reporting their low income. This study defined SES using meal status only. For some students, free or reduced school meals could be seen as stigma, and many students entitled to receive these meals may not have applied (Mirtcheva & Powell, 2009). Therefore, if a student did not want to receive free or reduced meals, his or her parent did not have to fill out a meal status form.

The selected demographic factors revealed that while ELL had a significant impact, SES did not. However, if the hierarchical multiple regression in this research study added variables in a different sequence, where SES was added before ELL status, the results may have differed.

### **Limitations of the Study**

A limitation of this study was the inability to generalize the results to other high schools or other student populations. Since the study used archival data from one high school, the results may not be representative of other Arkansas high schools. Furthermore, there was a limitation of size. Only students who graduated from the study's high school and participated in the district's IGP program, the ACTAAP mathematics EOC exams, and the ACT test, were eligible for this study. The number of participants was limited as only a few years had passed since the establishment of the college-ready curriculum and approval of the Arkansas assessment system. Of the original 1,481 graduates over the three-year period, only 657 met the criteria to be

included in the study. This comparatively small number of participants may affect the ability to generalize the results to other schools or districts.

A further limitation of this study pertained to the generalizability of state graduation requirements. Passing the ACTAAP Algebra 1 EOC was an Arkansas graduation requirement, and both the ACTAAP Algebra 1 and Geometry EOC exams were specific to Arkansas; therefore, it may be difficult to generalize these results to other high schools that have different graduation requirements and mathematical assessments.

## **Recommendations**

### **Future Research**

The results of this study provided only partial insight into Arkansas state testing, national testing, current Arkansas curriculum, and college readiness. Therefore, additional research is needed to add to this body of research. This section offers three recommendations for future exploration: (1) evaluate the new Common Core State Standards (CCSS) curriculum and assessments, (2) longitudinally investigate college completion, and (3) examine the sample's high number of non-ACT testers.

First, curriculum changes in Arkansas occurring in the 2013-2014 school year with the implementation of the CCSS will require the new curriculum to be evaluated. The secondary mathematics curriculum changes will begin in fall 2013, followed by new CCSS assessments in the spring of 2015 (Arkansas Department of Education, 2013). Since the curriculum changes have not yet been implemented, research has not been conducted to investigate the relationships of the new CCSS assessments, specific demographic variables, and the ACT. Once the new CCSS secondary mathematics curriculum is in place, and the new CCSS assessments have been thoroughly piloted and deemed reliable, it will be necessary to conduct further research that

follows the design of this study. The results of the two studies could be compared to determine the success and impact of the CCSS mathematics curriculum and the new accountability system.

Next, a longitudinal study that examines the impact of academic and demographic factors beyond college acceptance and into college completion is recommended. When defining college readiness, this study looked at the level students reached in college preparation that allowed them to enroll without remediation and succeed in entry-level, credit-bearing college-level courses at a two-year or four-year institution (ACT, 2011). A longitudinal study linking college preparation to college completion would allow comparisons to be made between high school college readiness variables and college completion. According to Astin and Oseguera (2005), only 58% of college freshmen graduated within six years from the same college. In addition, most of the college attrition occurred during the freshman year. A deeper understanding of how high school variables impact college admission and college retention could pave the way for how post-secondary institutions help students in college to reduce the attrition rate.

The last research recommendation would involve exploring the high number of graduates considered for this study who were not included. There were 557 out of 1,481 (31.2%) graduates excluded from the study because they did not take the ACT exam. Additionally, 87 out of 557 (16%) met the GPA and mathematics Smart Core requirements for unconditional admittance to the University of Arkansas but did not take the ACT. Further research may reveal why these students did not participate in the ACT exam and might uncover areas that are important for schools to know to help students prepare for college.

## **Practice**

According to Conley (2007), a definition of college readiness must “address the issue of how students combine and integrate various dimensions of college readiness. For students, the



process is complex because it includes the elements that are under the school's control as well as elements that are not" (pp. 23-24). There are three college-readiness practices that could help students bridge the gap from high school to college by increasing their ACT mathematics score: (1) implementing programs that increase students' understanding of the ACT and ACTAAP mathematics EOC exams and ways to improve test scores, (2) providing assistance in helping students increase their GPA, and (3) creating academic support systems.

First, implementing programs that increase students' understanding of the ACT and ACTAAP mathematics EOC exams requires a foundation of knowledge based on sound practices. Students would benefit from schools offering preparation sessions to help them attain higher test scores. According to VanScoy (1997) coaching students improves ACT scores. Since both the ACTAAP and the ACT are curriculum-based assessments and many ACTAAP skills can be tied to the ACT content, coaching might have the same impact on improving ACTAAP scores. School programs can be designed that follow current state-approved programs.

Since an ACT mathematical score of 19 or higher is required for college admission at some state universities (University of Arkansas, 2012), students could gain insight into the ACT exam by participating in an ACT preparation program offered by their high school. One example is the College Preparatory Enrichment Program (CPEP), a 75 hour comprehensive program of ACT preparation for 11<sup>th</sup> and 12<sup>th</sup> grade students scoring below 19 on the ACT test. The goal of the CPEP program is to help high school students improve their ACT college entrance exam scores by reviewing subject areas covered on the ACT and by giving students extensive test-taking practice.

The CPEP program in Arkansas has a set of standards that outlines the funding process for each school. One of the CPEP eligibility requirements for funding is based on the percentage of students who receive free or reduced lunches (Arkansas Department of Education Rules, 2010). Childers (2008) conducted a study on CPEP where the results indicated CPEP participants made gains on the ACT, with higher gains for students who only needed support in one subject.

Another way to help students increase their ACT and ACTAAP mathematics scores is for teachers to provide time during class or outside of class to review testing strategies (VanScoy, 1997). The more students are exposed to the test and understand what is expected of them, the more prepared and comfortable they will be when taking the exam. This means teachers must expose students to the exam, the types of exam problems, and the pacing process on the test.

Second, this study supports the idea that increasing a student's high school GPA may increase the likelihood of post-secondary access and readiness. Mathews (2007) reported strong evidence that students who took AP courses and their subsequent exams, received higher college GPAs and were more likely to graduate from college in four years. Encouraging students to take AP courses can benefit students academically and increase a student's college preparedness. Moreover, before a low grade is earned and placed on a transcript, students can access additional support in a tutor or study group to help them grasp the course content, increase their understanding, and earn a higher grade in the class. Robinson, Schofield, and Steers-Wentzell (2005) claimed that student academic achievement increases when they are tutoring and receiving tutoring.

Third, bridge the gap from high school to college by creating district support systems. It is important that students participate in the right college-bound courses. College-bound students

have higher requirements and more rigorous classes; therefore, students in seventh and eighth grade would benefit from taking more rigorous courses. A list of high school graduation requirements, college admittance requirements, college expectations, and high school level course offerings, provided by Arkansas junior high schools, would allow parents and students to make informed academic decisions. According to Dounay (2004), family involvement leads to more rigorous academic decisions.

Once families know what courses colleges expect students to have completed in high school, the next step is making sure that parents are in the loop when their kids choose their courses—seeing to it that students pick algebra II after geometry instead of that easier math course with the “nice” teacher, for example. (p. 5)

In many situations parents are more involved with students in younger grades; therefore, it is critical to increase family involvement by encouraging parents to attend meetings about college preparation long before graduation. Schools could offer seminars that provide information to parents “about how to be involved in the decisions affecting course selection, career planning, and preparation for postsecondary opportunities” (Dounay, 2004, p. 5).

Together the stakeholders can determine what is required of students to attain four mathematics classes where at least one class is beyond Algebra 2. Creating credit check sheets can help students observe their current academic status and determine what mathematical path is required in high school to be successful in college.

The results of the current study contained information that could be used when conducting IGP meetings. The results of the hierarchical multiple regression analysis in Table 9 included the three academic independent variables (combined ACTAAP Algebra 1 and Geometry EOC scale score, high school GPA, and highest mathematics class completed) and the demographic independent variable (ELL status). Using the unstandardized coefficient independent variables ( $B$ ) in Model 2 the dependent variable was calculated from a linear

combination of the multiple independent variables to predict ACT mathematics scores (see Table 9). Random values of combined ACTAAP scores, GPAs, and highest mathematics classes completed, along with corresponding predicted ACT mathematics scores for all students and ELL students are provided in an organized table and could help guide the IGP conversation (see Appendix).

The SREB (2011) encourages schools to revisit and revise the IGPs yearly with students, parents, and counselors. The goal of the IGP meeting is to increase parent support, address possible misconceptions or concerns, and prepare students for post high school life.

### **Policy**

Ultimately a student planning on attending a four-year university has a set of admittance requirements that must be met. It is essential that high schools inform parents and students of these requirements and establish ways for students to meet and go beyond to achieve them. Four policy recommendations are suggested in this section: (1) expand the evaluation of grade inflation, (2) review policies about repeating classes, (3) examine current college admittance requirements, and (4) require state IGP programs.

The first recommendation is for state and district policymakers to assess the current Arkansas Department of Education (2009) grade inflation policy and incorporate procedures for calculating course standards and grade inflation rates in all subjects that have state and national exams. It is paramount that low grade inflation aligns with what the students know within the appropriate grade. Some districts and states have increased the courses students take to improve the curriculum rigor. These requirements may not add academic value if the school has low academics expectations and standards. According to the ACT (2005), what matters most is the quality of the courses students take. Therefore, students would benefit by taking difficult courses that include course-quality measurements. While students focus on their GPA and increasing

their cumulative GPA, it is the responsibility of the ADE to address discrepancies in high school grades by assessing grade inflation so that students' GPAs accurately reflect what they know.

The second policy recommendation includes reviewing local policies about retaking classes. Students with low grades may benefit from repeating classes by increasing their academic understanding of the subject as well as increasing their GPA. It is essential that educational leaders consider the impact of higher GPAs on students' college success (Hoffman & Lowitzki, 2005; Mathews, 2007; McLaughlin, 2006).

Third, a multitude of factors impact a student's college readiness (Conley, 2007). With the changing demographics of undergraduate college students comes the need for a more thorough examination of those student variables previously used in determining college readiness. It is important that colleges and universities look at their current admission policies and determine if the weight of test scores used for college admissions is appropriate or if a deeper look at college applicants is required (Conley, 2007; Reason, 2009).

Currently high schools do not use end-of-course exams for the purpose of college preparation. While AP exams and International Baccalaureate tests are given at the end of courses or content areas and are one component of college admissions, state exams are not necessarily used as a college-readiness measure. Conley (2007) stated that "a college readiness assessment system that consisted of a series of end-of-course exams would yield much more detailed, fine-grained information regarding student knowledge and skills relative to college readiness standards" (p. 17). Using current end-of-course tests or creating specific college-readiness exams, colleges can obtain a thorough look at each student's academic abilities before making decisions about college admittance. Consequently, students could have more than just one or two items determining their college admittance.

Finally, it is recommended that state educational leaders implement policies that require IGP programs in schools to help students transition between junior high, high school, and post-secondary institutions. By requiring these programs, the ADE can regulate standards so that schools have uniformed information that can be provided to students about college expectations and keys to success.

### **Summary**

Arkansas is ranked 44<sup>th</sup> in the nation in average ACT mathematics scores. In addition, only 33% of Arkansas students are ready for college-level mathematics (ACT, 2011). These statistics are alarming. The results of this study provide evidence that the ACT mathematics scores used in determining college readiness are impacted by multiple variables. If these variables are addressed in such a manner that they positively impact a student's mathematics performance, it is likely that a smooth transition can occur from high school to college.

Most information about college readiness is collected but not necessarily combined into a comprehensive summary for students. To gauge their college readiness, students need an integrated personal profile that contains all their useful information about what will help them assess, develop, and progress in their college preparation. The supporting literature asserts that multiple variables, both academic and demographic, affect a student's college readiness. This study provided additional information to the existing college-readiness research to fill the gap in the literature. This study determined that multiple factors, including ACTAAP mathematics EOC scale scores, high school GPA, and highest mathematics class completed, predicted a college admittance ACT mathematics score. The results of the multiple regression indicated that all selected academic variables significantly impacted the mathematics score on the ACT, where the strongest was the combined ACTAAP mathematics EOC scale score. In addition, the

demographic impact of how ELL status and SES modified the predictive nature of the ACTAAP mathematics EOC scale score was investigated, using a hierarchical multiple regression model. The results indicated that ELL status had a significant impact, but when SES was added, it appeared to offer little additional predictive power beyond that contributed by ELL status.

The current study integrated the literature and results of college readiness to substantiate necessary changes. For students to be successful in college, initiatives and adjustments in current programs and schools are recommended that will provide a foundation of knowledge to help prepare future students to be college-ready in mathematics.

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**Appendix: ACT Predicted Scores of Random Combined ACTAAP Mathematics Scores,  
GPAs, and Highest Mathematics Classes Completed**

The predicted ACT mathematics scores were calculated from the linear combination of the multiple independent variables. The chart is derived from the equations:

$$\hat{Y}_{\text{ACT score all}} = 0.044X_{\text{ACTAAP}} + 1.116X_{\text{GPA}} + 0.207X_{\text{Highest Math Class}} - 4.525 \text{ and}$$

$$\hat{Y}_{\text{ACT score ELLs}} = 0.043X_{\text{ACTAAP}} + 1.029X_{\text{GPA}} + 0.208X_{\text{Highest Math Class}} + 0.399X_{\text{ELL}} - 4.046$$

Combined ACTAAP mathematics EOC scale score	High school GPA	Highest mathematics class completed	Predicted ACT mathematics score for all	Predicted ACT mathematics score for ELLs
400	3.5	2	17.395	16.773
400	3.5	6	18.223	17.605
400	3.5	9	18.844	18.229
400	4	2	17.953	17.287
400	4	6	18.781	18.119
400	4	9	19.402	18.743
440	2.5	2	18.039	17.464
440	2.5	6	18.867	18.296
440	2.5	9	19.488	18.920
440	3	2	18.597	17.978
440	3	6	19.425	18.810
440	3	9	20.046	19.434
440	3.5	2	19.155	18.493
440	3.5	6	19.983	19.325
440	3.5	9	20.604	19.949
440	4	2	19.713	19.007

Appendix (continued)

Combined ACTAAP mathematics EOC scale score	High school GPA	Highest mathematics class completed	Predicted ACT mathematics score for all	Predicted ACT mathematics score for ELLs
440	4	6	20.541	19.839
440	4	9	21.162	20.463
460	2.5	2	18.919	18.324
460	2.5	6	19.747	19.156
460	2.5	9	20.368	19.780
460	3	2	19.477	18.838
460	3	6	20.305	19.670
460	3	9	20.926	20.294
460	3.5	2	20.035	19.353
460	3.5	6	20.863	20.185
460	3.5	9	21.484	20.809
460	4	2	20.593	19.867
460	4	6	21.421	20.699
460	4	9	22.042	21.323
480	2.5	2	19.799	19.184
480	2.5	6	20.627	20.016
480	2.5	9	21.248	20.640
480	3	2	20.357	19.698
480	3	6	21.185	20.530
480	3	9	21.806	21.154



Appendix (continued)

Combined ACTAAP mathematics EOC scale score	High school GPA	Highest mathematics class completed	Predicted ACT mathematics score for all	Predicted ACT mathematics score for ELLs
480	3.5	2	20.915	20.213
480	3.5	6	21.743	21.045
480	3.5	9	22.364	21.669
480	4	2	21.473	20.727
480	4	6	22.301	21.559
480	4	9	22.922	22.183
500	2.5	2	20.679	20.044
500	2.5	6	21.507	20.876
500	2.5	9	22.128	21.500
500	3	2	21.237	20.558
500	3	6	22.065	21.390
500	3	9	22.686	22.014
500	3.5	2	21.795	21.073
500	3.5	6	22.623	21.905
500	3.5	9	23.244	22.529
500	4	2	22.353	21.587
500	4	6	23.181	22.419
500	4	9	23.802	23.043

*Note.* A combined ACTAAP mathematics EOC scale score of 400 is the lowest average proficiency score and a score of 500 is the lowest average advanced score. Highest mathematics class completed 2, 6, and 9 correspond to Algebra 3, Trigonometry, and AP Calculus respectively.