Standardized Testing Placement And High School Gpa As Predictors Of Success In Remedial Math

Susan Carol Burrow
University of Mississippi

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STANDARDIZED TESTING PLACEMENT AND HIGH SCHOOL GPA AS PREDICTORS OF SUCCESS IN REMEDIAL MATH

A Dissertation presented for the Degree of Doctor of Philosophy in the Department of Leadership and Counselor Education The University of Mississippi

by

SUSAN C. BURROW

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ABSTRACT

The purpose of this quantitative study was to determine if a relationship existed between success in elementary algebra and a set of predictor variables including COMPASS score and high school GPA. Relationships for intermediate algebra and college credit accumulation over three semesters were also examined with COMPASS score and high school GPA as predictor variables. The study was conducted in a multi-campus regional rural community college in the southeast United States. The sample included 527 community college freshmen placing via COMPASS score into elementary algebra. Cases were sorted and 216 case level files were selected for study inclusion, 85% of which were traditional students and predominately female (69%). A series of multiple regressions yielded two significant models. A statistically significant relationship exists between elementary algebra score, COMPASS score and high school GPA. High school GPA was significant to the prediction model but COMPASS score was not. The same findings were true for college credit accumulation over three semesters. No significant relationship exists between intermediate algebra score, COMPASS score and high school GPA.

Findings from this study support the use and effectiveness of high school GPA as a predictor of short and long term success. Furthermore, study results support previous studies suggesting that standardized testing did not contribute to the strength of a prediction model. This study investigated two primary questions. First, who belongs in developmental mathematics and secondly, what is the nature of the relationship between current placement methodology and community college student success in developmental mathematics courses? In this study the researcher examined the relationship between single measure course placement methodology and
success in developmental mathematics. Findings support current research on an emerging avoidance model to reduce the number of students placed into developmental coursework. Results from this study do not clearly answer who belongs in developmental mathematics but findings do question the use of single measure standardized testing as a method to determine who does belong. Study results offer insight into the relationship of single measure placement methodology and student success.
DEDICATION

This work is dedicated to my loving and patient husband, my children, my sister and especially my parents. Their support, dedication, patience and unwavering faith in me throughout this journey have been crucial to my success.
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I would like to thank my family and friends for their support and encouragement. I would like to thank the many community college students who have inspired and will continue to inspire my life’s work. Without the support and effort of my stellar sounding boards and editorial team of Carla and Amanda this project would not have been possible. Finally, I must extend my deepest gratitude to K. B. Melear for inspiring me, believing in me, and serving as the chair of my dissertation committee. I am very thankful for the patience, support and professional guidance of Dr. Amy Wells-Dolan, Dr. Sparky Reardon, and Dr. Joel Amidon. All have been stellar committee members.
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CHAPTER I INTRODUCTION

Developmental education is not a new phenomenon and is commonly defined as a comprehensive program designed to promote student success through academic and social support (Gerlaugh, Thompson, Boylan & Davis, 2007). However, due to a steady decline in the United States’ world ranking as a highly educated nation, a significant national conversation is underway to address the college readiness issue (ACT, 2011; Gerlaugh et al., 2007; Safran & Visher, 2010). Key concepts driving this conversation are the significant economic, political, and social implications of a rapidly growing underprepared workforce and an uneducated populous. Increasingly, new high school graduates and adults returning to college must participate in developmental courses to address significant skills gaps in reading, writing, and mathematics. Confounding the problem is the lack of a uniform standard defining who needs developmental education, which content should be included, and the optimum instructional methods. Data analysis from ACT (2011) indicated that only 25% of high school graduates met the national college readiness benchmark in all academic areas. An area of great concern was mathematics, where only 45% of students met the readiness benchmark. Clearly, not all students perform academically at the same level. However, standards defining college readiness must be clearly defined and curriculum mapped to facilitate matriculation through the educational system.

In addition to the lack of clarity defining college readiness, there is a lack of empirical evidence (Collins, 2008; Edgecombe, 2011; Porchea et al., 2010; Scott-Clayton, 2012) to support
effective methods by which to improve developmental education. Researchers agree that a variety of models exist (Edgecombe, 2011; Rutschow & Schneider, 2011; Safran & Visher, 2010) and should be considered while addressing the issue. The lack of clarity leads many to question the purpose of developmental education given the limited success achieved by many students taking developmental courses.

During economically challenging times, many may question the value of developmental education. However, studies have shown that well-defined developmental programs address gaps and facilitate college completion. Phipps (1998) suggested that the failure of higher education to address students’ remedial needs would have tremendous negative financial and social impacts. Regardless of the documented need for developmental education, developmental programming faces many challenges. One of the greatest challenges facing successful remediation is how best to sort students and thereby, promote academic success. Historically, prior to engaging in coursework students have been sorted, by various means, into academic ability or academic skill categories. The sorting tools, most often standardized assessment tests, and how the results are utilized can become a barrier to progress and permanently deter individuals from pursuing education. Collins (2008) and Belfield and Crosta (2012) indicate that COMPASS and ACCUPLACER are the two most common standardized exams used for assessing and sorting community college students. COMPASS, produced by ACT, and ACCUPLACER, produced by the College Board, provide computerized adaptive testing and are promoted as a convenient and cost effective means by which to assess and place students into academic ability groups. Accurate sorting becomes vital given that Attewell, Lavin, Domina, and Levey (2006) found that only 30% of students taking developmental math courses passed
while counterparts taking developmental writing and reading passed at a rate of 68% and 71% respectively.

**Statement of the Problem**

The current state of college readiness is a problem of national significance. Spence (2009) estimates that 70% of all high school graduates lack the academic skills needed to enter credit bearing college courses. In a recent study, Boylan (2009) indicated that over 2,000,000 students tested into developmental courses and invested, on average, one full year to successfully complete developmental work. These numbers support the lack of college readiness. A complex multi-level set of educational practices and policies shape college readiness. An individual’s educational foundation is most likely formed in the K-12 system where educators are expected to prepare students to successfully enter the workforce, engage in career training, or enter higher education. Current curriculum, testing, and service alignment among educational systems have failed to adequately meet college readiness (ACT, 2011; “Closing the expectations gap,” 2011). In response to these failures, conversations have begun and the dialog calls for national reform in educational practice and interventions to remedy the lack of college readiness (ACT, 2011; Boylan, 2009; Safran & Visher, 2010).

While a national movement is underway to address the college readiness gap, an equally urgent search is underway (Attewell et al., 2006; Bailey, 2009; Belfield & Crosta, 2012; Edgecombe, 2011) to identify measures that best serve the learning needs of students currently enrolled in developmental education. Rutschow & Schneider (2011) identify four basic models or approaches to improving developmental education outcomes. The four models include student support, contextualized learning, acceleration, and avoidance models. This study will focus on the avoidance model by examining the relationship between a single measure placement
exam and additional contributing factors as they relate to community college student success in elementary algebra.

**Purpose of the Study**

This study seeks to investigate two primary questions. First, who belongs in developmental mathematics and secondly, what is the nature of the relationship between current placement methodology and community college student success in developmental mathematics courses? Therefore, the purpose of this quantitative study is to examine the relationship between single measure course placement methodology and success in developmental community college mathematics. Short term success will be investigated through examination of the relationship between course grade and COMPASS placement score. Longer term success will be investigated thorough successful completion of the subsequent mathematics course and ultimately college credit accumulation over a three-semester period. The statistical analysis will include the examination of COMPASS scores and high school GPA as predictors of success in developmental mathematics. The cluster sample will include students drawn from a population attending a multi-campus, mid-size, rural regional community college in the southeastern United States. The predictor variables will be defined as COMPASS test scores placing students into Elementary Algebra (MTH 098) and high school GPA as verified on the high school transcript. The criterion variables are MTH 098 course grade, College Algebra (MTH 100) course grade, and college credit accumulation over a three-semester period. In addition, descriptive statistics will provide meaningful insight into the interaction or relationship of other variables when considering placement score, high school GPA, and student success. Specifically, examination of each subjects’ high school transcript, college transcript, and COMPASS score report will allow the investigation of influence by age, gender, time since high school graduation, range of
COMPASS scores, breadth of remedial needs, matriculation patterns over three semesters, and characteristics of course repeaters.

**Hypotheses**

The main null hypotheses and supporting hypotheses are:

- \( \text{Ho}_1 \): There is no significant relationship between MTH 098 course grade and a group of predictor variables, including COMPASS score and high school GPA.
- \( \text{Ho}_2 \): There is no significant relationship between MTH 100 course grade and a group of predictor variables, including COMPASS score and high school GPA.
- \( \text{Ho}_3 \): There is no significant relationship between college credit accumulation over three semesters and a group of predictor variables, including COMPASS score and high school GPA.

**Significance of the Study**

The lack of college readiness impacts a significant portion of entering college freshmen. Many states have mandated policy to address the growing financial burden of meeting developmental education needs. For example, the Tennessee State Legislature mandated that community colleges, not universities, will provide developmental education to the masses (Collins, 2008). In addition, current research indicates that some states have established cut scores and a common placement method, using a specific assessment exam, yet other state practices vary widely (Bahr, 2007; Hughes & Scott-Clayton, 2010; Illich, Hagan & McCallister, 2004; Scott-Clayton, 2011). For example Bahr (2007) conducted a study to determine the efficacy of developmental mathematics. Bahr concluded that developmental mathematics works. However, the study revealed that within the California Community College System, the largest postsecondary system in the world, placement procedures and exit standards vary among institutions. Additionally, Hughes and Scott-Clayton (2010) found that developmental
assessment policy and practice varied among and within states. Variations included the use of mandatory versus voluntary assessment, selection of the assessment tool, predetermined versus autonomous cut-off scores, mandatory versus voluntary placement based on assessment, and limited policy dictating timing of remediation. Overall, most states have begun to propose state-wide developmental education reform.

Reform efforts are aimed at clearly defining and improving college readiness in K-12. Reform efforts include creating uniform assessment and placement procedures, and increasing the effectiveness of remediation through implementing a variety of curricular changes and through piloting new instructional pedagogies and delivery methods (Collins, 2008; Gordon, 1999; Hughes & Scott-Clayton, 2010). Driven by the urgency to meet these complex challenges, research into developmental education practice and policy has surged dramatically. The significance of the college readiness problem is well documented throughout the literature. Despite public concern, research regarding assessment, placement, and effective instructional approaches to address the issue remain limited.

The available literature addressing assessment, placement, and developmental education effectiveness yields conflicting results. Several studies found that students who successfully complete remediation are just as likely to graduate as their non-development mental counterparts (Illich et al., 2004; Sawyer & Schiel, 2000). Conversely, two significant studies (Gordon, 1999; Hughes & Scott-Clayton, 2010) report that remediation did not improve student outcomes and dropout rates were alarming among students placed into remediation. These contradictory findings indicate the need for further research to examine the wide variance in reported developmental outcomes. Developmental outcomes are dependent upon several factors. Accurate placement is a key factor to optimizing student success and avoiding the discouraging
effect of being placed into developmental studies (Bahr, 2007; Calcagno, Jenkins, Bailey, & Crosta, 2006).

A review of the literature reveals a significant amount of descriptive research addressing the economic and social impacts of remediation and how gaps in K-20 education are contributing to the national college readiness crisis. Testing and placement remains a vital component of the remediation process. Yet, little research documents the dynamic interaction of placement testing and course success. In fact, during the initial scan of the existing literature only three studies similar to this study were found. Later, during the extensive review of the literature, two additional and very important studies were published relating specifically to the use of single measure course placement methodology and a set of predictor variables of urban community college student success. Research specific to rural community colleges was not found.

Findings from recent studies (Bahr, 2007; Bailey, 2009; Calcagno et al., 2006) recommend future research should be institution based. Due to the variability among institutional practices and policies, institutional research would be an effective means to gather student success data and a means to begin building helpful models for addressing the effectiveness of developmental education. Creswell (2009) suggests that case study research involves an in-depth qualitative examination of a particular institution or event bound by time and that such studies yield a rich foundation for future research. While this study is not qualitative in nature, the results will yield a quantitative case study, similar to a Safran and Visher (2010) case study. Safran and Visher (2010) examined institutional policy and practice for assessing and placing developmental students at three community colleges in the northeast United States. Safran and Visher’s (2010) study provided a detailed statistical description of how local policy and practice varied among the institutions and also highlighted the significant
challenges community colleges face in developing effective measures to assess and place students.

In a recent study Horn, McCoy, Campbell, and Brock (2009) examined developmental testing and placement in community colleges. The study investigated how placement, via COMPASS test, into developmental reading courses affected successful completion of the degree required college level English course sequence. The study found that 44% of non-developmental students entering college level courses successfully completed the English sequence and that only 19% of students entering developmental coursework later successfully completed the college level course sequence. Similar completion rates were reported by Pike and Saupe (2002) who found that high school GPA, standardized test scores, and academic rigor explained more than one-third of the variance in first year grades. Furthermore, Porchea et al. (2010) found that the same three variables proportionately predicted degree attainment in community college students. Clearly, there is a need to examine methods of accurately placing students to maximize student success. One consideration is the use of multiple measures for more accurate placement of students.

Current research findings support the utilization of multiple measures to accurately assess and place students into coursework (Bailey, 2009; Boylan, 2009; Gordon, 1999; Hughes & Scott-Clayton, 2010; Pike & Saupe, 2002; Porchea, et al., 2010). The vendors of COMPASS and ACCUPLACER, the most widely used standardized placement exams, recommend the use of multiple measures for optimum placement results (ACCUPLACER, 2003; ACT, 2011). When variables such as high school GPA and high school course rigor are combined with standardized test scores, such as COMPASS or ACCUPLACER scores, the results significantly improve the effectiveness of assessment and placement (Pike & Saupe, 2002; Porchea et al., 2010). Despite
these findings, colleges commonly use a single test measure to place students into developmental courses as a matter of cost containment and convenience. Solutions for testing and placement issues are being investigated on a broad level. The lack of a consistent definition of college ready continues to cloud the issue and hinder the analysis of exiting data. Due to the wide variations in policy and practice, studies by Bahr (2007), Bailey (2009), and Calcagno et al. (2006) asserted that the proposed solutions must be examined and applied on the institutional level.

This institutional level study will contribute to the existing body of literature and provide valuable insight into the relationship between student course success and single versus multiple placement variables. As indicated throughout the literature, Bahr (2007), Bailey (2009), and Calcagno et al. (2006) asserted that institutional level data can provide a basis for data driven decisions impacting student placement and student success. The cluster sample population will be derived from a medium sized rural public community college in the southeastern United States. The multi-campus community college serves over one-quarter million people in a seven county area and is comprised of four main campuses and one educational center. The study site exists within a state community college system that mandates the use of COMPASS for testing and placement of all degree and certificate seeking students. The multi-campus structure of the college, large regional service area, and state wide COMPASS placement mandate are factors which allow for greater generalizability than one would typically see from a single institutional study. The information gathered from this study will contribute to formulating evidence based practice for testing and placement of community college students.
**Limitations**

Only students who successfully complete Elementary Algebra (MTH 098) at the selected multi-campus community college in the southeastern United States will be included in the second phase of the study. There is no means of controlling factors impacting grade attainment, such as variance of math skill gained in high school, personal, social, or financial situations. Maturation of students, particularly non-traditional, may play a factor as the students acclimate to performing in an academic setting. Students will be served by a variety of instructors depending upon campus and class section. Quality of instruction and pedagogical approach may vary between instructors. The study is limited to a single institution in one state; therefore the results cannot be generalized to populations beyond those regional community college populations who mirror this demographic.

**Delimitations**

The study will be delimited to MTH 098 students enrolled at a multi-campus community college located in the southeastern United States. The student population of the community college is predominantly Caucasian and rural. At the study site, MTH 098 has the largest enrollment population among the mathematics courses. In addition, MTH 098 is the prerequisite course leading to the gateway mathematics course, Intermediate College Algebra (MTH 100). MTH 098 also has the greatest DFW rate, with students earning failing grades of D or F or selecting to withdraw. Assessment for the purposes of placement will be delimited to use of COMPASS. Placement cut scores will be delimited to those in use during the fall 2011 term at the selected community college. The results of the study will be generalizable to community colleges in the Southeast with similar student population demographics and comparable assessment and placement procedures.
Terms and definitions

- Academic rigor: the highest level of mathematics courses successfully completed during high school; an indicator of intrinsic motivation (Adelman, 2006)

- Avoidance model: a process to maximize accuracy of community college admission testing and placement to promote student success and avoidance of unnecessary developmental education (Rutschow & Schneider, 2011)

- College readiness: the ability to place into and the ability to complete a college gateway course, the first college credit bearing course (Adelman, 2006)

- Cut score: a predetermined range within which students must score to be placed into certain classes; a sorting method typically used for incoming students to determine placement into math, English, and reading (Bahr, 2007)

- Developmental education: a comprehensive program that provides academic and social support to promote student success (Boylan, 2009)

- Elementary Algebra (MTH 098): the prerequisite math course leading to the gateway mathematics course Intermediate College Algebra; entrance is based upon pre-established institutional placement policy (See Appendix A)

- Gateway course: the entry point course for earning college credit (Adelman, 2006; Boylan, 2009)

- High school GPA: the overall grade point average earned by a student while accumulating credits during high school; an indicator of intrinsic motivation (Adelman, 2006)
• Nontraditional student: nontraditional students will be defined by their most prevalent characteristic as those students over age 24 enrolling in postsecondary education (Bean & Metzner, 1985)

• Open admissions: a policy which indicates that anyone can be admitted but all students are sorted via some form of placement assessment (Provasnik & Planty, 2008)

• Placement assessment: a test designed to help determine academic college readiness; in this study COMPASS will be used (ACCUPLACER, 2003; ACT, 2011)

• Remediation: a process commonly delivered via targeted instruction designed to bring a learner’s skills into compliance with preexisting standards (Phipps, 1998); non-credit bearing courses a student completes to meet the standards necessary to enter a gateway course

• Success: earning a course grade of C, with C equaling 70%, or higher for MTH 098 and MTH 100 courses (See Appendix A)

• Traditional instructional delivery: classroom instruction as opposed to online or hybrid delivery of instruction (See Appendix A)

• Traditional student: students age 24 years and under enrolling in postsecondary education (Bean & Metzner, 1985)

**Organization of the Study**

Chapter I supplies an introduction to the study, explains the problem, lists the hypotheses, argues the significance of the study, includes the limitations and delimitations, and defines relevant terms and concepts. Chapter II is a review of the literature, and Chapter III provides a detailed guide to study methodologies, design, procedures, and data collection. Finally, Chapter IV presents the study results and Chapter V presents conclusions and recommendations.
CHAPTER II LITERATURE REVIEW

Introduction

This chapter presents a review of the literature related to college readiness and explores educational practices to move community college students toward degree completion. Educational attainment and degree completion impacts the quality of life for citizens and the economy of our nation. The lack of college readiness is not a new concept but one that is viewed as a growing concern and a concept where if successfully addressed, gains in college completion could be achieved. In the past decade, the United States has experienced a significant decline in economic growth and a slip in ranking as a world power based on declining educational attainment. These factors have sparked a national conversation regarding quality educational outcomes and created an urgency to significantly increase college completion rates. The literature review will be presented in sections pertinent to the issue. First, terms and concepts significant to developmental programs and remedial education are discussed. This section is followed by an overview of the literature describing the current state of national college readiness and developmental education. The third section describes educational practices that can impact college readiness. The final section concludes with a discussion of findings to guide possible educational practices and interventions.

Terms and Concepts

Remediation is a process commonly delivered via targeted instruction designed to bring learners’ skills into compliance with preexisting standards (Phipps, 1998).
Developmental Education refers to a comprehensive program that provides academic and social support to promote student success (Phipps, 1998). The need for remediation and the need for comprehensive developmental education programs are well documented based on the existing skills gap. Rutschow and Schneider (2011) suggest that educational interventions designed to address remediation and developmental education fall into one of four basic models. The acceleration model allows students to progress through developmental coursework at their own pace and frequently involves modularized instruction delivered via software. Rutschow and Schneider (2011) consider technology-driven approaches, like other instructional approaches, untested instructional innovations. Through acceleration students may successfully work through multiple remedial courses in a shorter time frame.

Other forms of acceleration may be combined with the second intervention model, student support. For example, Bailey (2009) and Edgecombe (2011) suggest that combining acceleration and student support provides an effective model. This model allows students who score near but below the prescribed placement score to advance to the next higher course while mandating additional support measures. Students in this category are required to participate in tutoring or supplemental instruction sessions in addition to the normally required coursework. Edgecombe (2011) reported this acceleration technique as one of the few innovative practices supported by empirical evidence, albeit limited. The student support model rarely is seen as a stand-alone model. Student support is frequently paired with any or all of the remaining three models (Safran & Visher, 2010). Student support involves tutoring, supplemental instruction, early alert systems, advising, and various social support measures.

The third model, contextualized learning, integrates remediation into courses required for the student’s major. The developmental instructor may co-teach alongside the career course
instructor to help students make the connection between conceptual and practical applications of content. This approach is more common to career and occupational degrees and is also frequently paired with student support systems.

Finally, the avoidance model seeks to address the methods by which students are assessed and placed into developmental education. The avoidance model relies upon building effective methods of assessing and placing students into course work to maximize success. Safran and Visher (2010) examined how assessment and placement policy and practice varied among three community colleges striving to achieve the avoidance model. To maximize avoidance a comprehensive assessment and placement strategy must include strategic selection of assessment methods, carefully crafted placement guidelines, a pre and post assessment advising system, and targeted instruction to meet individualized learning needs. Safran and Visher (2010) found inconsistencies in all areas among the colleges. Common to all three of the colleges was the practice of an open admission process. The open admissions process, a bedrock principal for most public two-year colleges, adds to the balancing act between assessment and placement of students.

Nationally, 95.4% of public two-year colleges practice an open admissions process (Provasnik & Planty, 2008). An open admissions policy indicates that anyone can be admitted but all students are sorted via some form of placement assessment. National data (Provasnik & Planty, 2008) indicates that all two-year public open-enrollment institutions require some form of basic academic skill assessment upon admission. Placement assessment is designed to help determine academic college readiness (Spence, 2009). These assessments may be delivered in a broad array of methods and can vary by individual institutions or across systems.
Assessment methods include examination of high school grades, high school coursework, college prep exam scores, or other forms of national placement exam scores. The two most commonly used national exams are the COMPASS test produced by ACT and ACCUPLACER produced by the College Board. Course placement recommendations are based on one of these measures or a combination of these measures. Both vendors suggest that multiple measures be employed for making placement decisions, not simply based on test scores alone (ACT, 2011; ACCUPLACER, 2003). Some states have a set of consistent cut scores and implement mandatory remediation while others allow institutional discretion for cut scores and mandatory or voluntary remediation (Bahr, 2007; Illich et al., 2004; Scott-Clayton, 2011).

Placement testing sorts students into “gateway” college level credit courses or places them into remediation courses.

Gateway courses include courses that all students must successfully complete to earn a degree, regardless of individual college major. Many students are deemed not college ready and fall short of entering gateway courses. These students are advised and placed into corresponding developmental coursework. Remediation is directed at reading, writing, and mathematics based on the placement results administered upon admission. Adelman (2006) suggests that the number of students placing into and successfully completing gateway courses reflects the student population who are considered college ready and likewise, the number requiring remediation represents the remaining student population who are not college ready. Belfield and Crosta (2012) report that only a fraction of developmental students go on to achieve an award or even complete the required developmental course sequence.

For this population, it is especially critical to accurately place students and utilize effective predictors of college success. Sparks and Malkus’ (2013) data indicates that 24% of
first-year undergraduate students entering public two-year institutions reported taking one or more developmental courses. Of those taking one or more developmental courses, mathematics remediation represented the largest group or 22.3% of students requiring remediation. This lack of academic preparation demonstrates the skills gap or lack of college readiness indicated throughout the literature. The national skills gap and the decline of the United States standing in academic preparation are now driving the national education reform agenda improving college readiness.

**Current State of National College Readiness and Developmental Education**

Many researchers questioned the importance and effectiveness of developmental education. Phipps (1998) chronicled the success of developmental education and asserted that it is a core function of higher education and that failure to attend to students’ developmental needs resulted in negative social and economic impacts. Phipps (1998), Attewell et al. (2006), and Gallard, Albritton, and Morgan (2010) documented the success and positive return on investment of developmental education, yet cited little progress toward reducing the need for remediation.

The current college readiness skills gap was clearly illustrated by the fact that nationwide 66% of ACT tested high school students met the benchmark for English, 52% of students met the benchmark in reading, 45% met the benchmark in math, 30% met the benchmark in science and only 25% of students met the college readiness benchmark in all four areas (ACT, 2011). No literature was found to dispute the existence of a national skills gap in college readiness. A primary discussion found throughout the literature (ACT, 2011; Boylan, 2009; Phipps, 1998; Safran & Visher, 2010) is the need to clearly define college readiness and to establish common standards by which to measure college readiness.
To address the college readiness issue, the U.S. Department of Education as well as nonprofit foundations have developed and are supporting programs targeting college readiness. Programs such as the National Education Longitudinal Study (NELS:88/2000), Diploma Project, Achieve, and Achieving the Dream are focused on assessment of readiness and the discovery of effective instructional strategies to address skills gaps. The ultimate goals of such projects are to reform public policy and promote effectiveness and efficiency of U.S. K-20 education. The U.S. Department of Education commissioned longitudinal studies to examine and address the college readiness issue.

One such study, NELS: 88/2000, conducted by the National Center for Educational Statistics (NCES), collected data from a national sample of eighth graders in 1988 and tracked the participants through December 2000. Examination of the vast data set demonstrated the significance of the skills gap and identified statistically significant predictors of college degree completion. In a significant piece of literature, Adelman (2006) presented findings from NELS: 88/2000 which outlined students’ progress toward degree completion from high school through college. Of the 1992 NELS:88/2000 graduate cohort, who then attended community colleges, 64.5% took at least one developmental course and 43.7% took more than one developmental course. Similarly, Attewell et al. (2006) examined NELS: 88/2000 data and reported that approximately 40% of all undergraduates took at least one developmental course. Both Attewell et al. (2006) and Bahr (2007) found that the number of developmental courses taken did not demonstrate a statistically significant impact on the likelihood of degree completion or credential attainment. In addition, they found transfer rates for community college students who successfully completed developmental courses rivaled those of students not required to take developmental courses (Attewell et al., 2006; Bahr, 2007). Interestingly, Attewell et al. (2006)
found that most students successfully completed developmental courses with the exception of developmental mathematics. The authors reported that while 68% of students pass developmental writing and 71% of students pass reading, only 30% pass developmental math courses.

Bahr (2007) also found that fewer students successfully passed developmental math courses and further asserted that the depth and breadth of developmental needs impacted successful transition to college level courses. Breadth of remediation refers to the number of developmental subject areas and the depth of remediation refers to the degree of deficiency for a particular subject. Bahr (2007) illustrated the significance of developmental depth issues while studying the effectiveness of developmental math programs. Only one in 15 basic arithmetic students ever completed college level math compared to 50% of the algebra and geometry students successfully completing college level math (Bahr, 2007).

Further analysis from NELS: 88/2000 revealed that the impact of poor high school academic preparation can be differentiated from the impact of developmental education when measuring community college graduation rates. Both Attewell et al. (2006) and Adelman (2006) pointed out poor high school academic achievement as the primary contributor to lack of community college graduation. In more recent projects, the Lumina Foundation and Jobs for the Future (JFF) assessed state community college systems testing and placement practices (Collins, 2008). Similarly, Gerlaugh, Thompson, Boylan and Davis (2007) conducted a more general demographic survey of current developmental education practices among 29 community colleges throughout the U.S.

To examine system practices JFF conducted interviews, reviewed policy manuals, and conducted a nationwide survey of community colleges to determine current state practices. JFF
sought to determine if systems requiring the use of a common assessment tool, use standardized cut scores, define placement policies, and implement mandatory enrollment policies for developmental coursework to be completed and if so, was there a specified time frame for course completion. The Gerlaugh et al. (2007) study gathered a broader range of survey information regarding student success and practice in developmental education programs that also included assessment and placement practice data.

Collins (2008) reported that all fifteen Achieving the Dream states and 31 of the 35 remaining states provided policy and practice data. JFF compiled the responses to formulate a snapshot of national trends. Of the 46 states reporting, 27 required some developmental education assessment, 21 specified a particular placement tool, and 19 set standardized cut scores or provided a required range of scores (Collins, 2008). For the 15 Achieving the Dream states, Collins (2008) noted that only three of the 15 states required students to enroll in or complete developmental coursework within a specified time frame.

In a similar survey, Gerlaugh et al. (2007) examined the practice of mandatory assessment. Gerlaugh et al. (2007) found that 92.4% of respondents practiced mandatory assessment and 79% required course enrollment based on this assessment. The snapshot revealed that, although progress has been made, testing and placement practices were vastly different among and within community college systems. JFF asserted that, through the establishment of standardized testing and placement, a widely accepted definition of college readiness is possible (Collins, 2008). Common measures would allow educational systems to establish coherent curriculums and avoid gaps in K-20 education. Testing and placement are one of the many necessary steps toward improving college readiness and would provide a consistent foundation on which to build instructional strategies to produce quality student outcomes and
move students in developmental education into college credit coursework and credential attainment (Safran & Visher, 2010).

Additionally, with the national emphasis focusing on accountability measures for schools and colleges, the likelihood of linking school and college accountability measures to student college readiness and to effective remediation is growing rapidly. In his study of California State University’s Early Assessment Program (EAP), a college readiness initiative, a key finding for Spence (2009) discounted the overreliance on ACT, SAT, and national college admission testing. Furthermore, Spence (2009) asserted that system-wide and state-wide change will be possible with changes in accountability measures and funding tied to college readiness. To facilitate self-scrutiny for quality assurance in the EAP initiative, teachers were given access to professional development on the subject of preparing students for college and accountability was built into the system.

The literature consistently outlined the challenges community college educators face in achieving quality learning outcomes and in meeting the national completion agenda to double degree attainment by 2020, all while maintaining open access to students. As indicated throughout the literature, many of these are historical challenges and not easily overcome.

**Educational Practices That Impact College Readiness**

A common finding throughout the literature is the lack of a consistent definition for college readiness or even a clear description of how college readiness should be determined. State educational systems are struggling to define and achieve college readiness. In 1996, Achieve, an independent nonprofit organization, whose aim is to reform education, embarked on a movement to help states raise academic standards and improve learning outcomes. Achieve is
leading the movement to ensure that college and career readiness are recognized as a national priority. In 2005, the organization created the American Diploma Project (ADP).

The ADP is designed to align high school and postsecondary assessment and curriculum, to increase graduation rates, to develop K-20 data systems, and to ensure students are college and career ready. To accomplish this goal, Achieve partnered with the National Governors Association and the Council of Chief School Officers to develop the Common Core State Standards (CCSS). To date, the CCSS have been adopted by 45 states and the District of Columbia (“Closing the expectations gap,” 2011). By design, the work of this group should lead to a common definition of college readiness. Through the CCSS high school students will have been exposed to appropriate course work leading to college entrance. If the ADP is successful in implementing the common standards, the need for developmental education should be significantly reduced. This national project forms the foundation of education reform and holds promise in the race for college readiness.

California State University’s Early Assessment program (EAP), another example of college readiness reform, was designed to raise awareness of college readiness. The EAP project established reading, writing, and mathematics readiness standards for all California public high schools. Spence (2009) shared lessons learned from the EAP and how this partnership with California Public Schools synergistically produced common diagnostic test items, a revised curriculum, and devised appropriate professional development to support project implementation. Interestingly, the California Community Colleges (CCCs) were not early adopters of the project. Spence (2009) asserted that the project challenged CCCs fundamental mission of maintaining open enrollment. Project outcomes have increased awareness, altered high school college readiness testing, and initiated slow change. Through initiatives such as ADP
and EAP, education reformers have addressed what promises be a highly effective, albeit difficult to broker, cooperative partnership along the K-20 continuum. Alignment of curriculum between K-12 and postsecondary institutions would address skills gaps and create a more seamless transition for graduates making the transition to college.

Until avoidance of developmental education is possible, community colleges must focus their reform efforts on improving the admissions process, improving current testing, assessing advisement and placement practices, and strengthening academic and student support services for incoming freshman (Safran & Visher, 2010; Zachry & Schneider, 2010). Also impacting the college readiness issue is the lack of consistent testing and placement practices within and among community college systems and four-year institutions. Safran and Visher (2010) documented, through a quantitative case study of three community colleges, inconsistencies in the definition and the application of standards for college level work readiness.

The study demonstrated that three colleges had some minor similarities in practice but broad implementation varied greatly. The institutions utilized a variety of assessment tools and some used subjective measures for placement, advancement, and exit from developmental courses. Many researchers cited these inconsistencies (Safran & Visher, 2010; Zachry & Schneider, 2010) as a contributing factor to skepticism among four-year institutions as to the college readiness of community college transfer students. Several states have adopted common placement exams and defined cut scores; however, researchers struggle to find data that demonstrates consistent implementation practices which further confound analysis (Bailey, 2009; Safran & Visher, 2010).

While awaiting the positive changes resulting from the ADP and the CCSS, colleges must adjust institutional admissions and testing processes. Scott-Clayton (2011) cited the lack of
structure in many community colleges as a stumbling block for students making decisions about how to proceed and persist toward credential attainment. The very mission of community colleges can create navigational challenges for students. Students seeking admission to a community college may be confused by the many program options available and lack of available assistance to guide their decision making. Scott-Clayton (2011) suggested that colleges create student pathways to guide them from initial contact to credential attainment. Often students begin an educational pursuit without a highly defined plan. Advising for community college students is crucial and academic momentum and credential attainment are closely linked to earning meaningful credits not just accumulating courses (Bahr, 2009).

The advising process which guides course selection and credential attainment is a multifaceted and highly individualized process. Colleges should provide career guidance, a comprehensive plan of study leading to credential attainment, and offer intrusive academic and student support services (Center, 2012; Spence, 2009). According to Safran and Visher (2010), college advisors reported that many students take placement exams without preparing or without knowledge of the test purpose or high stakes nature of placement testing. Given the apparent lack of college readiness among a significant number of students seeking admission to community colleges, institutions should work to reduce the number of students placing into developmental education by implementing avoidance techniques. Such techniques include early testing opportunities for high school students, compressed review courses for nontraditional students, remediation programs while in high school, and summer skills building courses to help students prepare and understand the significance of admission testing and placement (Calcagno et al., 2006; Hughes & Scott-Clayton, 2010; Scott-Clayton, 2011).
Bahr (2009) and Calcagno, et al. (2006) noted significant differences between traditional and nontraditional student response to placement testing and subsequent success rates in mathematics courses in particular. Both studies examined, via discrete time history event analysis, how attainment of educational milestones affected the probably for graduation, the extent to which enrollment in a developmental course was a barrier to completion, and how timing of the first college level math or writing class affected the probability for graduation. Both researchers found that older and younger students were impacted in significantly different ways and suggested that developmental education strategies should be designed specifically to address the needs of each group. Similar to Bahr (2007), Calcagno et al. (2006) suggested that traditional students are impacted by the “discouraging effect” from testing into developmental education. Unlike their non-traditional counterparts, traditional students carried with them an expectation of success in college level work similar to the level of success experienced in high school.

Non-traditional students often attributed skill shortcomings, especially in mathematics, to being “rusty” or having been away from math concepts for extended periods of time and did not suffer the loss of self-esteem from testing into developmental education (Calcagno et al., 2006). Both Calcagno et al. (2006) and Bahr (2009) found that success in the first college level math course was a predictor of graduation. The predictor odds for older students was almost half that of traditional students, demonstrating the impact of success for traditional students versus non-traditional students. Bahr (2009) found that failing the first developmental math course decreased a student’s rate of progress and specifically reduced the likelihood of college graduation. Bahr (2009) further asserted that traditional students are disproportionally impacted by failure. In fact, traditional students earning a “C” had a negative effect equivalent to that of
earning an “F.” The same was not true for non-traditional students. These findings supported the importance of carefully and appropriately placing students into developmental education courses and aiming for avoidance if possible.

Avoidance of developmental education will not be possible for all students. Bailey (2009), Boylan (2009), and Hughes & Scott-Clayton (2010) suggested that community colleges should study institutional level data and develop consistent assessment and placement methods that most accurately sort students and increase the likelihood of success. Adelman’s (2006) analysis of NELS data indicated three major factors that predict, with 95% accuracy, the likelihood that a student will complete a bachelor’s degree within six years of high school graduation. The highly predictive factors are the score on a standardized exam, high school GPA, and high school course rigor. Adelman (2006) found no other statistically significant predictors of credential attainment. These findings played a significant role in shaping the new CCSS and current educational reform efforts. From these findings community colleges can begin to explore, through institutional data, the most effective method for sorting students and avoid unnecessary remediation. Perhaps the use of multiple measure assessments and reevaluation of standardized cut scores could decrease the number of students being misplaced. The concept of incorporating factors beyond standardized test scores alone is supported by both ACT and The College Board, the two major producers of placement exams.

In addition to more effective testing and placement procedures, colleges must chart student pathways based on the needs of learners. As previously noted, Bahr (2007) and Calcagno et al. (2006) documented the need to differentiate practices for traditional and nontraditional students. Institutions should explore alternative delivery methods, effective pedagogies, and determine local best practices on which to base developmental education
practices. It is at the institutional level where a foundation for best developmental education practices can be formed.

**Findings to Guide Educational Practices and Interventions**

Research into postsecondary developmental educational practices and interventions continues to be limited in scope and depth. Concerns about this issue can be summed up in a few simple questions. Who belongs in developmental education? What is the most effective means of identifying those students? Why does the skills gap exist? How do we effectively educate them? These four questions are central to the reformation of developmental interventions and practices. Although articles and papers are abundant, most are anecdotal or reviews of literature with very little quasi-experimental data. It seems that the past decade has been spent defining and understanding the issues, with efforts to enact real research only now beginning to take shape. Therefore, one must exercise caution when researching and formulating interventions based on such publications. However, the best of the current available research has begun to forge a path toward what appears to be significantly more effective interventions and practices in developmental education. While the focus of the research study associated with this literature review will be the effectiveness of the assessment process, it is important to consider all areas of developmental education to determine the most effective means of reforming assessment.

Of the four questions earlier posed, the first two questions are inherently linked. To determine the most effective means of identifying students who need developmental intervention, one must understand who those students are. Those questions are answered through the current direction of assessment and placement for traditional college freshmen. The most common method of assessing students in U.S. colleges and universities is through the use of a standardized test such as COMPASS or ACCUPLACER (Boylan, 2009 and Hughes &
Scott-Clayton, 2010). The Center for Community College Student Engagement (CCCSE) reported that 74% of students are required to take some type of placement test and 72% of those are prescribed at least one developmental course (Center, 2012). Of that group, 68% had to take the course during the first academic term, but only 83% of the 68% chose to do so (Center, 2012). Remarkably few students, only 9% to 28%, prepared in any way, prior to taking the placement assessment (Center, 2012). Research shows that students who successfully complete remediation are just as likely to graduate as their peers who were college ready (Illich, Hagan, & McAllister, 2004 and Sawyer & Schiel, 2000). These studies suggest that college success or failure extends beyond a student’s academic ability in a particular subject. This is demonstrated by the fact that students successfully completing remedial coursework, while concurrently enrolled in college level work, were equally successful in college level coursework as their peers who required no remediation. Students failing remedial course work, while concurrently enrolled in college level work, were not as successful as non-remedial peers. These findings suggest that factors other than subject knowledge or academic ability contribute to success or failure. Currently, placement methods rely heavily on a single measure of subject matter knowledge. These researchers suggest that placement factors should be examined in a more holistic fashion. Additional studies assert that remediation courses are often plagued with high drop rates and unimpressive pass rates (Gordon, 1999; Hughes & Scott-Clayton, 2010). Both attribute high drop rates and low pass rates to a lack of information about what students need to succeed in college and further suggest that current placement methodology provides a narrow snapshot of specific academic skills at a set point in time. These findings seem to say that if the right students are placed in remediation, they benefit from the process. Therefore, the issue of incorrect placement into remediation becomes a primary concern.
Current research indicates that the most effective means of improving the assessment and placement process is through the use of multiple measures (Bailey, 2009; Boylan, 2009; Gordon, 1999; Hughes & Scott-Clayton, 2010; Pike & Saupe, 2002; Porchea, Allen, Robbins, & Phelps, 2010). When variables such as high school GPA and high school course rigor are combined with standardized test scores, such as COMPASS or ACCUPLACER score, the results significantly improve the effectiveness of assessment and placement (Pike & Saupe, 2002 and Porchea et al., 2010). In fact, in a comparative analysis of three methods of predicting first year college grades, test scores, high school performance, and courses taken during high school explained more than one-third of the variance in first year grades among college freshmen (Pike & Saupe, 2002). Belfield and Crosta (2012) assert that, alone high school GPA is the single strongest predictor of college performance even when compared with all other measures combined. Furthermore, at the community college level, the probability of obtaining a degree and then transferring to a four-year institution improved with each standard deviation increase in high school GPA and standardized achievement test score (Porchea et al., 2010). The NELS: 88/2000 longitudinal study confirmed that academic intensity is the single most significant indicator in pre-collegiate history that propels a student towards successfully completing a bachelor’s degree (Adelman, 2006). Specifically, in the area of mathematics, a student’s highest level of mathematics achieved in high school is a key predictor of the momentum that student has towards completing a bachelor’s degree. At this time, the tipping point resides decidedly above Algebra II for momentum to a bachelor’s degree (Adelman, 2006). By the end of the sophomore year of college, 71% of students who will earn a bachelor’s degree report completing credits in college level mathematics compared to 38% who do not complete the degree (Adelman, 2006). A common limitation reported among studies is the inability to attribute variance among student
performance based on the quality of instruction students receive. Quantifying or attributing student success to instructional quality is difficult given the nature of social science.

The math gap may be the most important element of secondary and postsecondary degree completion momentum (Adelman, 2006). But, overall momentum should not be underestimated. Students who earn less than 20 credits by the end of freshman year in college may be unlikely to earn a degree (Adelman, 2006). To help students move past that 20 credit benchmark, it would be immensely beneficial to begin college credit accumulation in high school through dual enrollment (Adelman, 2006). Accumulating a minimum of six credits or an optimum of 12 would help ensure that students reach that vital 20 credit point in their march toward a degree (Adelman, 2006).

General momentum is also valuable, with timing of entry to college gaining importance over the decade from the 1982 high school cohort to their 1992 counterparts, a change that means entering college immediately after high school, and enrolling full-time, is directly related to degree completion (Adelman, 2006). However, even if enrollment is part-time, being continually enrolled is better than stopping and reenrolling (Adelman, 2006).

Other variables have been researched as potential indicators of success in college. For example, psychosocial factors such as motivation, academic self-confidence, family income, and parents’ educational level were found to have marginal to negligible influence on college success. However, even those that were found to play a role in college success were not as significant as high school GPA and standardized test scores (Porchea et al., 2010). The stereotypical idea of the developmental student is not necessarily supported by research (Adelman, 2006). When looking at student demographic characteristics, socioeconomic status did not have a significant association, but a modest association (Adelman, 2006). Furthermore,
gender, race, and ethnicity were not significantly associated, even when each race and ethnicity group was treated as an independent variable (Adelman, 2006).

With research strongly recommending multiple measures as the most effective means of assessment, the issue of placement becomes the next logical step in developmental reform. The placement issue revolves around factors such as the inconsistency of cut-off scores, subjective application of placement overrides, advisement, and mandatory versus voluntary placement. Setting cut scores too low means that underprepared students may be enrolled in classes in which they have little to no chance of succeeding and setting cut scores too high means that students waste time and money in classes they do not need (Collins, 2008). Across the nation, practices vary widely state to state and even within states (Hughes & Scott-Clayton, 2010). This lack of consistency means that a student’s placement can differ greatly depending on which institution he or she decides to attend. Inconsistency creates confusion for students who don’t understand why one institution deems their knowledge satisfactory while another says that developmental intervention is necessary. When transferring between institutions occurs, inconsistency creates additional confusion for students who may move from college ready to developmental or vice versa (Collins, 2008). Students are not the only ones who experience confusion. Community colleges who wish to compare data between institutions find it difficult to do so when differing standards apply (Collins, 2008). Inconsistency also directly impacts the skills gap issue. With postsecondary institutions demanding varying standards to be considered college ready, the K-12 reform movement has no definitive standard to which it must strive (Collins, 2008).

There is a movement to create some coherency and consistency for placement policies. However, certain issues must be addressed such as central cut-off scores which fail to appropriately place students in courses when some are institution specific and faculty developed
(Hughes & Scott Clayton, 2010). Research on behalf of Achieving the Dream, an initiative largely devoted to the academic success of developmental students, concluded that aligning placement expectations, standards, and assessments is an important factor for reducing the number of students who need developmental education (Collins, 2008). As policy teams in participating Achieving the Dream states have worked to address the issue, an interesting consensus has emerged. Teams have found that they may begin the process by setting a common cut score, but ultimately end up focusing on placement policy and issues such as how to pay faculty who teach developmental courses and the controversial use of calculators during placement assessment (Collins, 2008). For example, Virginia community colleges discovered that implementing a common cut score range worked well. But, questions arose about the wisdom of relying solely on COMPASS and the reliability of assessment scores when administration varied greatly between schools (Collins, 2008). Facing a similar challenge, by initially placing too much emphasis on setting common cut scores, the Connecticut Community College System determined that to be successful in improving student success they must first work to further refine testing and placement policies and practices.

With little success, Connecticut community colleges tried for several years to establish consistency in the assessment and placement process. In 2007, a state legislative mandate required them to accomplish the task within six months. The teams charged with creating the new policy quickly determined that cut scores were simply one part of a much broader issue. It was discovered that poor alignment existed between developmental and gatekeeper courses. Policies were also needed to deal with an array of problems such as readmitting students who were originally enrolled under different standards, the use of calculators, and testing protocols (Collins, 2008). Making changes could also prove to have disastrous funding implications. Some
colleges were projected to need up to ten additional sections of developmental education, a prospect that would require a significant increase in funding (Collins, 2008).

In a similar dilemma involving cut scores, the North Carolina committee discovered that they did not possess the necessary data to validate their initial cut score of the 50th percentile on ACCUPLACER. Intent upon completing a validation study to ensure the optimum cut score; it took three attempts before producing adequate grade data for the study. The North Carolina committee chose to set the cut scores based upon two important questions (Collins, 2008). Which point places the most college ready students in college level courses? Which point places underprepared students in developmental education? The committee was not comfortable making this decision solely on data they struggled to collect but chose to err on the side of inclusion. Ultimately, the committee selected cut scores similar to those they temporarily set when they began the process (Collins, 2008). The journey of Virginia, Connecticut, and North Carolina indicate that establishing a common cut score is simply a beginning to the process. The crucial goal is to rigorously examine the effect of placement policies and create a consistency among practices throughout the system (Collins, 2008).

Ideally, colleges and universities want students who are college ready at the time of enrollment. However, over 2,000,000 students enroll in developmental classes every year and average about one year to complete those courses (Boylan, 2009). Some estimates indicate that up to 70% of high school graduates are not prepared to enter college or career training programs (Spence, 2009). The skills gap between high school and college has been an issue plaguing education for many years. Recent developments have begun to address this problem.

In 2001, California State University’s Early Assessment Program (EAP) developed and published initiatives to address college readiness in that state (Spence, 2009). The initiative was
developed because California State University recognized a skills gap existed, wanted K-12 to comprehend the problem, and to help those schools work to address the issue. EAP urged all public schools and higher education institutions to adopt a single set of academic readiness standards for reading, writing, and mathematics that would prepare students for postsecondary education. Also, diagnostic assessment was advocated to make sure students got help in high school and that needed developmental courses and other supports were readily available. High schools were encouraged to provide senior students with activities intensively focused on college readiness. EAP was adopted by the K-12 system in California as a means of dealing with the college readiness skills gap in that state (Spence, 2009).

Achieving the Dream reiterates many of the EAP’s recommendations including establishing common core standards, vigorously communicating college entry standards, and providing early assessment options so that students have time to make up for deficits (Collins, 2008). The most comprehensive reform comes from the adoption of the CCSS fully by 45 states and the District of Columbia and partially by Minnesota, who adopted only the English language arts standards (ACT, 2011). In 2008, ACT advocated the adoption of education standards that would adequately prepare students for the rigors of college course work or career training programs. In 2011, ACT applauded the widespread adoption of the CCSS and challenged all states to align the standards to a rigorous core curriculum for all students, regardless of their choice to pursue college or a career track (ACT, 2011). The rigorous nature of courses is the key to success because research shows that the right type of courses is much more important than the number of courses a student takes (ACT, 2011). This is consistent with research which finds that the courses one takes in high school are a highly significant predictor of college GPA (Pike & Saupe, 2002 and Porchea et al., 2010). Furthermore, ACT asserted that performance standards
must be clear to all stakeholders, defining what performance is good enough for college and career readiness (ACT, 2011). Referring to a report by the American Diploma Project, Adelman (2006) asserted that communicating expectations is vital to improving outcomes because a clear display of expectations is the most effective means of helping students and parents understand what is expected of them and what they should expect from education. Finally, early monitoring and intervention were advocated as essential to catching and dealing with deficiencies early, in upper elementary and middle school (ACT, 2011).

Even with the strides being made toward closing the skills gap, there will always be students who enter college with academic deficiencies. Postsecondary education is addressing the issue of more effectively identifying and placing these students in the appropriate courses. For those placed in developmental education, one must also consider how to successfully educate those students. Research into the effectiveness of developmental education is promising, showing that the impact of remediation is positive.

An ACT research report series utilized post testing data to assess the effectiveness of developmental college instruction (Sawyer & Schiel, 2000). The results indicated that students who complete developmental courses demonstrate an increase in their academic skills, ranging from one to two COMPASS standard deviation units (Sawyer & Schiel, 2000). This jump in scores suggests a likelihood that those students could score above the posttest cut-offs and be eligible to enroll in college level courses. Another study found that students who fail to successfully complete their developmental courses tend to underperform in college level courses (Illich et al., 2004). Moreover, for those students who successfully complete their developmental courses, they performed as well as their peers who enrolled directly into college level courses.
(Illich et al., 2004). The bottom line is that students who need remediation and complete the prescribed coursework are as successful as their non-developmental peers.

The central goal of developmental education reform is to reduce the number of students who need remediation in college and to increase the efficiency of remediation interventions and practices. The two most direct and effective means of achieving these goals are to adequately educate students before high school graduation and to more accurately assess and place students into college courses. The adoption of the Common Core Standards is an important step toward ensuring that high school students exit secondary education with the skills necessary to enter college or a career training program. ACT’s current recommendation to align the standards to a rigorous core curriculum for all students is a move that can only serve to strengthen the effectiveness of K-12 education (ACT, 2011). Postsecondary institutions are responsible for the second half of the solution, more effectively placing students into the appropriate college courses. Researchers have made a strong case for changes needed to the assessment process, chiefly to utilize multiple measures of the core indicators to create a manageable and highly effective assessment. However, the issue of placement lags behind in comprehensive solutions due to institutional differences, variations in course sequences, faculty developed courses, and other factors that make adoption of state or national standards difficult.

Perhaps no one has articulated this better than Bailey (2009) in his summary of the few existing quasi-experimental studies on the effectiveness of developmental education for community college students. Bailey (2009) asserted that in the three major studies producing causal estimates, little or no data suggests that developmental education has a significant impact on college completion. In all three studies the greatest impact can be attributed to students whose placement scores were near the cut off scores. In these particular groups, student success
in subsequent college level math courses was analyzed for students scoring just above the cut score and for students scoring just below the cut score. Findings did not indicate a significant increase in student success rates (Bailey, 2009). These findings call to question, what is effective in developmental education? Scott-Clayton (2012) suggests creating different sections of college level courses and including supplementary instruction or tutoring for those in the lower band of cut off scores. As suggested by Scott-Clayton (2012) and Belfield and Crosta (2012) additional studies are needed to document the impact of a variety of placement methods. Bailey’s (2009) findings support the need for further research examining the impacts of single versus multiple placement methodology.

Bailey (2009) suggested that institutional level studies need to be conducted to determine the effectiveness of placement practices based on multiple measures and also to examine the impact of various developmental education pedagogies. The weak relationship between test scores and subsequent student success suggests that rethinking assessment is a beginning point for community colleges. Scott-Clayton (2012) found that using high school GPA alone did not change the percentage of students assigned to remediation, but did result in fewer severe placement errors. There is ample evidence to give serious consideration to Belfield and Crosta’s (2012) assertion that the relationship between high school GPA and college GPA is so powerful that colleges should revisit the use of placement tests. There will be no single solution. However, improvement actions must address assessment and should develop instructional strategies and support that help to ensure students’ success in college level work.

The consensus emerging from literature addressing college readiness and success in remediation calls to question the most prevalent current practices. The literature clearly indicates that effective tools for assessing student skills currently exist. Both the College Board and ACT
have documented the validity and effectiveness of COMPASS and ACCUPLACER. The area of concern is how institutions utilize these assessment tools. Strapped for funds and time, many institutions rely upon assessment as a singular source of information for making student placement decisions.

The focus of this study will address the growing concern about the use of single measure assessment and placement methodology as a means of placing students, specifically into community college mathematics. This will be achieved through examining the relationship between single measure placement exams, high school GPA, and community college success. Measuring success will involve examining MTH 098 course grades, the most common developmental course for incoming freshmen. In addition, the study will include the examination of MTH 100 course grades, the gateway mathematics course for degree completion in the state community college system. As a further measure of success, the study will examine the number of college credits accumulated by the cohort over a three semester period. The research methodology will be based upon the framework used by the two studies upon which this research is based, Belfield and Crosta (2012) and Scott-Clayton (2012).
CHAPTER III METHODOLOGY

Introduction

Developmental education continues to generate a great deal of interest in the academic arena, the political environment, and the corporate world. All issues surrounding the national skills gap crisis are considered significant. A foundational concern is the continued use of a single measure to assess and place students into developmental education (Belfield & Crosta, 2012; Scott-Clayton, 2012). Until the skills gap is addressed, Zachary and Schneider (2010) suggested that sound assessment, placement, and support practices are essential to avoid unnecessary remediation. Similarly, Safran and Visher (2010) asserted that efficient and effective placement methods would help students avoid developmental education. There are few studies providing data from which placement policy revision can emerge.

Through the Getting Past Go project, the Education Commission of the States (ECS) and other agencies are urging researchers, educators, and policy makers to address existing practice and to embrace data driven decision making (Parker, Bustillos, & Behringer, 2010). In a recent ECS publication, Fulton (2012) identified the need to ensure effective assessment and placement in developmental education as a top priority. The growing concern about the use of single measure assessment and placement methodology is confirmed in recent findings reported by Scott-Clayton (2012) and Belfield and Crosta (2012). These studies found that the use of single measure assessment, via placement exams, is an ineffective method by which to place community college students. The authors suggested the use of multiple measures for assessment
and placement and also suggested that further research is needed to examine the relationship of assessment and placement in community colleges. Both studies found that high school GPA is the best predictor of college GPA and that when combined, high school GPA and placement scores are predictive of a student’s ability to succeed in community college.

This study proposed to further examine the relationship between single measure placement exams, high school GPA, and community college success through a relational study. The following chapter outlines the study design and includes information about the population, sample, and the study subjects. A detailed description of the instruments and the statistical tests used to analyze the data are provided.

**Design**

The study proposed to examine the relationship between COMPASS scores, high school GPA, and community college success. In keeping with the Belfield and Crosta’s (2012) study, success in community college was measured by course grade in Elementary Algebra (MTH 098), course grade in Intermediate College Algebra (MTH 100), and through number of college credits accumulated over a three semester period.

**Population, Sample, and Participants**

The population from which a cluster sample was drawn represented typical community college students attending a medium sized rural public community college in the southeastern United States. A multi-campus community college located in the southeastern United States served as the study location. The selected community college serves over one-quarter million people in a seven county area. The regional institution is comprised of four main campuses and one educational center.
According to data provided by the Office of Grants Planning Research and Institutional Effectiveness (GPRIE), the average institutional enrollment was 4,206. Of these, 2,421 (58%) were enrolled full time and 1,842 (44%) were enrolled part time. The student population was heavily weighted by gender with 2,738 (64%) females and 1,525 (36%) males, and the student body was predominantly (3,402 or 81%) Caucasian. The gender distribution was common to community college enrollment throughout the Southeast region. Ethnic distribution varied by region of the state. However, this institution’s ethnic representation mirrored that of the region. African American students comprised the second largest ethnic group. There were 702 (17%) African American students enrolled. Hispanic, American Indian/Alaskan Native, and Asian/Pacific ethnicities represented less than 1% of the population each. Lastly, 100 individuals self-identified as “Other” and comprised 2% of the population. The population consisted of 2,637 (62%) students age 24 and under and 1,626 (38%) non-traditional students 25 years of age and older.

The sample was drawn from high school graduates who were admitted and placed into MTH 098, via COMPASS exam, during the fall 2011 term. Approximately 525 (N=525) students enrolled in the MTH 098 course each year. Using G*Power, an a priori power analysis was conducted. With an alpha level of .05, minimum power at .95 and a medium effect size of .15 (High, 2000), 74 subjects would be sufficient for the study.

**Instruments**

COMPASS exam results, high school GPA, and student college transcripts were utilized to conduct the study. The COMPASS exam, a computer-adaptive basic skills placement product of the ACT Corporation, was the primary method used to assess and place incoming freshman. Exception to this practice and alternatives to COMPASS testing were clearly outlined in College
policy (Appendix A). ACT reported content validity arguments for the two common uses of COMPASS scores. According to ACT, the COMPASS could be utilized to measure knowledge and skills and can also serve as a predictor of success in a given course matching that set of skills. ACT (COMPASS technical manual, 1997) reported a median accuracy rate of .67 for predicting the likelihood of a student to earn a “B” or better in MTH 098 and a median accuracy rate of .63 in predicting the ability of a student to earn a grade of “C” or better in MTH 098. The College adhered to ACT’s published course placement guidelines and to the Alabama Community College System’s published policy and implementation guidelines (Appendix B, Appendix C).

Procedure

Initially, the researcher obtained approval from the dissertation committee members and the University of Mississippi’s Institutional Review Board to proceed with the study. In addition, the researcher obtained approval for the study from the selected community college’s Institutional Review Board (Appendix D) to collect and use the data. The data was provided by the community college’s Office of Grants Planning Research and Institutional Effectiveness (GPRIE) and the researcher had no direct contact with the subjects. Therefore, participation consent forms were not required. The College GPRIE office provided student transcripts matched to COMPASS score reports containing basic student demographic data including: student age, gender, race, and high school GPA. No individually identifying information was made available to the researcher.

For the purpose of this study, course grades for MTH 098 and MTH 100 were recorded as their actual numeric value. Grades of W, WP, and WF were included as part of descriptive data only. Regional high schools report GPAs in a variety of formats. Some school systems use
numeric percentage representations of GPA and others report only numeric values on a 3.0 or 4.0 scale. The numeric value representing high school GPA was utilized for analysis. COMPASS scores were reported numerically. The cut score range for placement into MTH 098 was 39-100. All college level credit was reported on a semester basis.

Based on an a priori power analysis (High, 2000) a sample size of 74 was required. Anticipating data gaps, significant course attrition, and the need for a sufficient sample size to extend the analysis to the MTH 100 course, 350 case-level data files were requested. Each data file contained a high school transcript, a college transcript, and a COMPASS test result report. Individually identifying information was removed prior to the transfer of data files to the researcher.

The researcher examined all 402 data files for study inclusion. Files containing a college transcript denoting a MTH 098 course grade, a COMPASS pre-algebra score, and a high school GPA were included in the first analysis of the study. The second analysis included data files for students who completed the MTH 098 course with a C or better and earned a grade in MTH 100 within three semesters. Finally, all complete data files were examined for college credit accumulation over a three semester period. Only students who completed MTH 098 were included in the analysis.

**Hypotheses**

The null hypotheses were:

- **Ho₁**: There is no significant relationship between MTH 098 course grade and a group of predictor variables, including COMPASS score and high school GPA.
- **Ho₂**: There is no significant relationship between MTH 100 course grade and a group of predictor variables including, COMPASS score and high school GPA.
• Ho₃: There is no significant relationship between college credit accumulation over three semesters and a group of predictor variables including, COMPASS score and high school GPA.

Statistical Tests and Data Analysis

The purpose of this study was to examine predictors of success in developmental math. The criterion variables were MTH 098 course grade, MTH 100 course grade, and the amount of college credit accumulated within three semesters of admission, including fall 2011, spring 2012, and summer 2012 semesters. The predictor variables were COMPASS score and high school GPA for each of three criterion variables. A series of Linear Multiple regressions were deployed to analyze the data. Gall, Gall, and Borg (2007) asserted that Linear Multiple Regression is a common statistical tool used to examine strength of relationships or the form of a relationship between the criterion and predictor variables.

In this study, COMPASS scores and high school GPA both provided continuous data and served as the multiple predictor variables. In the first Linear Multiple Regression, MTH 098 course grade provided continuous data and served as the criterion or dependent variable. In the second Linear Multiple Regression, MTH 100 course grade produced continuous data and served as the criterion or dependent variable. Finally, in the third analysis, the amount of college credit accumulated over a three semester period yielded continuous data and served as the criterion variable. For the purpose of this study the forms of relationships between variables were examined. The use of multiple predictor variables producing continuous data and the use of a single criterion variable producing continuous data while examining the predictive nature of this relationship indicated the appropriate use of Multiple Linear Regression (Gall et al., 2007). SPSS software was utilized to analyze the data.
Gall et al. (2007) indicated that the first step in data analysis was to determine the order in which to enter the predictor variables. Furthermore, the authors suggested that SPSS would begin the Multiple Regression analysis with the most powerful predictor variable unless the researcher indicated otherwise. The literature suggested that high school GPA (Adelman, 2006; Belfield & Crosta, 2012; Scott-Clayton, 2012) is the strongest predictor of college success. However, examination of current practice indicated that community colleges most frequently (Adelman, 2006; Collins, 2008; Gerlaugh et al., 2007) utilize standardized testing to assess and place students and rarely consider a student’s high school GPA for determining college readiness. Collins (2008) and Belfield and Crosta (2012) documented that ACCUPLACER and COMPASS testing are the two most common tools for single measure assessment and placement for incoming freshmen. Based on the evidence found regarding strength of high school GPA as the stronger predictor, high school GPA was entered first into the computer followed by COMPASS score. The model was expected to yield the strength of high school GPA as a predictor for success and then to compute the additive strength of prediction, if any, yielded by adding COMPASS score. Manipulation of entry sequence for the predictor variables were expected to reveal important data regarding strength of single factors versus multiple factors for predicting success (Gall et al., 2007).

The Linear Multiple Regression SPSS outputs were examined to document basic descriptive statistics for the sample. The second step was to verify that the two predictor variables were indeed correlated to the criterion variable. This was expected to be evident by examination of the correlation matrix. Additionally, the Pearson’s r values, from the correlation matrix, were examined to determine that multicollinearity did not exist between the two predictor variables. Gall et al., (2007) indicated that strong correlation between each predictor variable
and the criterion variable is desirable. Conversely, strong correlation between each of the predictor variables is not desirable and can yield misleading results. Based on previous studies and foundational literature, multicollinearity was not likely to be a problem. However, if multicollinearity was encountered, the problem would have been addressed by increasing the sample size, removing the most intercorrelated variables from the analysis, or by combining variables to build indexes (Fattah, n.d.).

The third step in the analysis was to examine the model summary $R^2$ values to determine the proportion of variance each predictor variable explained. This analysis yielded the effect size of each predictor variable (Gall et al., 2007). Examining the ANOVA table to determine significance was intended to verify that indeed a relationship exists between the predictor and criterion variables. Finally, the coefficients table was examined to determine the predictive value of each single criterion value.

Additionally, a significant amount of descriptive data was analyzed for each complete case file. Following completion of the regression analysis the descriptive data was examined to explore trending or grouping of characteristics. For example, using Bean and Metzner’s (1985) guideline the data was sorted into traditional and non-traditional age groups and again analyzed. Other factors including, time since high school graduation, breadth of remediation, gender, COMPASS score range, matriculation pattern over a three semester time frame, and characteristics common to course repeaters were examined and reported.

**Conclusion**

Student academic success is impacted by many variables and is confounded by the well documented (Spence, 2009; Boylan, 2009) lack of college readiness that exists today. As a result, many high school graduates are placed into developmental coursework. Current research
(Scott-Clayton, 2012; Belfield & Crosta, 2012) questions the continued use of a standardized exam as the single measure for assessing and placing students into developmental education. As suggested by Scott-Clayton (2012) and Belfield and Crosta (2012), assessment and placement decisions should be based on multiple factors, not on a single assessment measure.

In this study, the researcher hoped to identify factors that will provide an effective means of placing students and predicting student success. Student success ultimately is measured by progressive course completion and the accumulation of college credit. Theoretically, accurate placement should increase student success and avoid diversion to unnecessary developmental coursework. Data presented by ACT suggested that COMPASS scores are an excellent method for predicting success in college level mathematics but recommended the use of multiple measures for accurately placing students. Upon predictive analysis, Scott-Clayton (2012) concluded that the validity of COMPASS use for placement in developmental mathematics is questionable at best.

There was little documented evidence of a single most effective method of predicting student academic success. Scott-Clayton (2012) and Belfield and Crosta (2012) clearly supported high school GPA as the best predictor of college GPA and as the best predictor of academic success in urban community college students. Additional examination of placement practices and student success data could contribute to the slow growing body of research exploring effective methods for assessing and placing students in a variety of populations. A logical conclusion is that if alternate accurate predictive assessment methods were identified and implemented, then more students would have an opportunity to be successful in community college.
CHAPTER IV RESULTS

Introduction

The purpose of this quantitative study was to examine the relationship between course placement methodology and success in developmental community college mathematics. Short term success was investigated by examining the relationship between Elementary Algebra (MTH 098) course grade and two predictor variables, COMPASS score and high school Grade Point Average (GPA). Long term success was investigated by examining the relationship between Intermediate Algebra (MTH 100) course grade and two predictor variables, COMPASS score and high school GPA. Finally, the relationship between college credit accumulation over a three semester time frame and two predictor variables, high school GPA and COMPASS score, was examined.

This chapter includes a description of the process utilized for identifying case file inclusion and a demographic description of the participants including age, gender, time since high school graduation, COMPASS score range, breadth of remedial needs, matriculation patterns over three semesters and characteristics of course repeaters. Next, a series of examinations were conducted to ensure that all assumptions were met for executing linear regressions on the three hypotheses. Finally, the researcher used linear regressions to examine the extent to which the predictor variables high school GPA and COMPASS score were predictors of MTH 098 course success, MTH 100 course success and college credit accumulation.
over three semesters. The data is presented and the results for three hypotheses are presented and summarized.

**Sampling and Procedures**

As addressed in Chapters I and III, while the study is quantitative in structure, descriptive statistics were examined in order to gain meaningful insight into the interaction or relationship of other variables when considering placement score, high school GPA, and student success. Specifically, each subject’s high school transcript, college transcript, and COMPASS score report allowed for the investigation of influence by age, gender, time since high school graduation, range of COMPASS scores, breadth of remedial needs, matriculation patterns over three semesters, and characteristics of course repeaters.

The sample was drawn from a pool of 527 students enrolled in MTH 098 during the fall 2011 term. The researcher targeted 350 complete case level files for students who were placed into MTH 098 via COMPASS test during the fall 2011 term, received a numeric score for the MTH 098 course, and who had a high school transcript on file. The secretary to the Dean of Academic Transfer Programs requested from the Information Technology department a data file for all 527 registrants. The files were sorted by section and all full time and adjunct faculty members who taught a section of MTH 098 during the fall 2011 were sent an email request to provide a numeric score for each of the students completing the course. From the file containing the course and demographic information for all 527 students the data was merged into an Excel spread sheet. A significant number of faculty members returned numeric scores from the fall 2011 term. Once numeric grades were received the grades were manually entered into the Excel data base. The spread sheet was sorted and this sort yielded 402 files for which random numbers were assigned. High school transcripts were requested from the admission data file. The files
were extracted from the File Bound System, identifiers redacted, assigned the matching random case file number, and then the files were forwarded to the researcher. The 402 case files were again sorted and cases with grades of W, WP, or WF were eliminated. The data base was examined for missing data and this final sort yielded 216 case files containing a fall 2011 term MTH 098 course placement COMPASS score, a numeric MTH 098 course grade, and a high school transcript documenting a final GPA and graduation confirmation.

**Demographic data**

The study contained 216 case level files. In addition to the stated study hypotheses, a significant amount of demographic data was examined to capture emerging patterns in student characteristics or behaviors common to student groups as they matriculated through the math courses over a three semester period. The following section contains a matriculation table that demonstrates patterns of credit accumulation, group characteristic by gender and age classification and age at enrollment, mean high school GPA, and mean COMPASS scores by course matriculation section for the 216 students. Following the matriculation table is a pie chart demonstrating the distribution of years since high school graduation for the sample. Finally, a series of graphs are presented for each matriculation group that demonstrates the relationship of the predictor variables, high school GPA and COMPASS score, to the criterion variables of math course grade, and college credit hour accumulation. The line graphs reveal interesting patterns that vary greatly among groups of students successfully completing the course, students failing the course, students who repeat and those electing to not repeat a course.

Interestingly, the sample of 216 students was dominated (85%) by traditional students, age 18-24. This percentage of traditional students far exceeded the traditional student population (62%) of the College. The sample (n=216) of MTH 098 students closely approximated the
gender makeup of the general College population. The sample was 69% female and 31% male whereas, the College population was 65% female and 34% male. The racial makeup of the sample was similar to that of the College population. From the sample, 85% of the students were white versus 81% white students for the College population. Similarity, the black student composition (10%) for the sample was lower than that of the College population (17%). The remaining minority populations or undisclosed ethnicity comprised 4% of the sample and 3% of the general College population. Based on these findings the sample closely approximated the demographic makeup of the general College population. The only exception was the significant number of traditional students represented in the study sample. To further investigate course success rates and college credit accumulation outcomes among demographic groups, frequencies and means were computed by group. Table 1 demonstrates the matriculation summary of students entering each section of MTH 098 and entering MTH 100, succeeding with a C or higher, and selected demographic profiles for each group.
Table 1 Matriculation pattern for students entering fall 2011.

<table>
<thead>
<tr>
<th>Matriculation pattern N = 216</th>
<th>Female</th>
<th>Male</th>
<th>Mean HS GPA</th>
<th>Mean COMPASS</th>
<th>Mean Age Enrollment</th>
<th>College Credit Accumulation Range</th>
<th>Traditional</th>
<th>Non-traditional</th>
</tr>
</thead>
<tbody>
<tr>
<td>216 enrolled FA 11 MTH098</td>
<td>150</td>
<td>66</td>
<td>85.56</td>
<td>51.85</td>
<td>20.92</td>
<td>0-44</td>
<td>184</td>
<td>32</td>
</tr>
<tr>
<td>122 C or higher FA 11 MTH 098</td>
<td>87</td>
<td>35</td>
<td>86.36</td>
<td>52.25</td>
<td>21.50</td>
<td>0-44</td>
<td>99</td>
<td>23</td>
</tr>
<tr>
<td>94 failed FA 11 MTH 098</td>
<td>63</td>
<td>31</td>
<td>84.53</td>
<td>51.33</td>
<td>20.16</td>
<td>0-35</td>
<td>85</td>
<td>9</td>
</tr>
<tr>
<td>50 repeated SP 12 MTH 098</td>
<td>35</td>
<td>15</td>
<td>84.66</td>
<td>50.14</td>
<td>19.46</td>
<td>1-35</td>
<td>47</td>
<td>3</td>
</tr>
<tr>
<td>10 repeat failures MTH 098</td>
<td>7</td>
<td>3</td>
<td>82.50</td>
<td>50.50</td>
<td>18.30</td>
<td>1-23</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>78 enrolled Sp12 MTH 100</td>
<td>60</td>
<td>18</td>
<td>86.72</td>
<td>51.28</td>
<td>20.56</td>
<td>8-44</td>
<td>66</td>
<td>12</td>
</tr>
<tr>
<td>53 C or higher Sp12 MTH 100</td>
<td>40</td>
<td>13</td>
<td>87.04</td>
<td>52.32</td>
<td>20.98</td>
<td>8-44</td>
<td>44</td>
<td>9</td>
</tr>
<tr>
<td>15 failed SP 12 MTH 100</td>
<td>10</td>
<td>5</td>
<td>85.20</td>
<td>48.33</td>
<td>20.40</td>
<td>8-35</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>5 repeated SU12 MTH 100</td>
<td>4</td>
<td>1</td>
<td>85.20</td>
<td>50.60</td>
<td>20</td>
<td>14-39</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>12 enrolled SU12 MTH 100</td>
<td>11</td>
<td>1</td>
<td>86.83</td>
<td>49.58</td>
<td>19.25</td>
<td>14-39</td>
<td>11</td>
<td>1</td>
</tr>
</tbody>
</table>

Time since high school graduation was examined as a potential influence on course performance. No significant difference was noted among students based on years since high
school graduation. As shown in Figure 1, the majority (64%) of the sample were freshmen, indicating that zero years have lapsed since high school graduation.

Figure 1. Years Since High School Graduation

![Pie chart showing years since high school graduation.](image)

**Fall 2011 MTH 098 success.**

Of the 216 students entering MTH 098 in the fall 2011 term, 122 (56%) completed the course with a 70 average or higher. Ninety nine members (86%) of the fall MTH 098 completer group were traditional (ages 18-24) students. The remaining 19% were non-traditional (ages 25 and higher) students. Fifty three percent of the group received a full ($5550) Pell award, 43% received no Pell award, and 26% received Pell award ranging from $600-5400.

COMPASS scores of 39-100 place a student into the MTH 098 course. The majority (44%) of the completer group scored in the 40-49. The second largest portion (33%) of the group scored in the 50-59 range. The remaining students’ COMPASS scores fell into the following ranges respectively, 60-69 = 14%, 70-79 = 5%, 80-87 = 1%. Three students from the completer group scored 39, the minimum score for placement in MTH 098. Course grade distribution for the group indicated that 52 students (43%) earned a C, 48 students (39%) earned a B, and 22
students (18%) earned an A. As shown in Figure 2, individual COMASS scores and MTH 098 course grade follow a similar pattern however, outliers are noted.

Figure 2. Comparison pattern of COMPASS scores and MTH 098 course grade by participant

High school GPAs for the group ranged from 71-98. The majority of the group (53%) earned a GPA in the 80-89 range, 42 students (35%) earned a GPA of 90-98, and 15 students (12%) earned a GPA of 70-79. As shown in Figure 3, the relationship pattern between high school GPA and performance in MTH 098 is most similar with students earning an A and less so for students earning B’s and C’s.
College credit accumulation for the completer group ranged from 0-44 credit hours. Four of the 122 completers took the MTH 098 course alone and although they successfully completed the course, they did not earn college credit since the course is classified as developmental, not college level work. For three of the four students this was the only course completed or attempted over the three semester study period. One of the four did register for MTH 100 during the spring term but did not successfully complete the course. College credit accumulation over three semesters for the remaining 118 group members are as follows: 6 students earned 1-3 credit hours, 20 students earned 4-12 credit hours, 44 students earned 13-19 credit hours, 29 students earned 20-27 credit hours, and 19 students earned 28-44 credit hours. As depicted in Figure 4, student’s COMPASS score, high school GPA, and college credit accumulation follow a similar pattern. The segmented by grade line, shows a consistency in pattern except for students who failed to earn college credit at a rate consistent with high school GPA and COMPASS score.
Spring 2012 MTH 098 repeaters

Of the 216 students entering MTH 098 in the fall 2011 term, 94 (44%) students failed the course. Of the 94 students failing, 50 (23%) chose to repeat the course during the spring 2012 term. Ages of students repeating MTH 098, ranged from age 18 to 39. Three of the 50 students were nontraditional (25 years or older) while the majority (94%) were traditional (18-24 years of age) students. Almost half (46%) of the students received a full ($5550) Pell award, while 14 (30%) received no Pell award. The remaining 12 students in the group received Pell awards ranging from $550 to $5300 per year.

COMPASS scores for the group ranged from 39-84. Overall, the majority (56%) of students in the repeater group scored 40-49 on the COMPASS placement exam. For this group, two students scored 39, the lowest point on the score placement for MTH 098. One student, age 19, scored 39 on the COMPASS, earned a high school GPA of 82, earned a 43 during the fall MTH 098 course and was awarded a withdraw passing (WP) grade for the spring 2012 MTH 098
course although, a numeric grade of 28 was provided for this study. A second student, scored 39 on the COMPASS, earned a high school GPA of 87, earned a 61 during the fall MTH 098 course, and earned an F for the spring 2012 MTH 098 course. No numeric grade was available for this student. One traditional student scored 84 on the COMPASS exam, earned an 81 high school GPA, scored a 67 in the MTH 098 course, and earned a 71 when repeating the MTH 098 course during the spring 2012 term. As shown in Figure 5, COMPASS score and grade earning rate patterns are more similar for students earning higher D grades. The two factors begin to diverge as course grades approach the 50 range and rapidly diverge for course grades below 50.

Figure 5. Relationship of MTH 098 course Repeaters COMPASS Score to Course Grade

High school GPAs among the group ranged from 74-95. Twenty percent of the students earned a high school GPA of 90-100, 62% earned 80-89, and 18% earned a 70-79. As shown in Figure 6, the relationship between high school GPA and MTH 098 course score indicates that the lowest performing MTH 098 students were not necessarily the lowest high school GPA achievers.
Finally, the researcher examined the grade distribution and college credit accumulation pattern for the group repeating the MTH 098 course in the spring 2012 term. Thirty two of the 50 students (64%) repeating the course passed with a course grade of 70 or higher. Of the failures, three earned a D, seven earned an F, and eight students earned a W or WP grade. College credit accumulation ranged from one credit hour to 35 credit hours over three semesters. The majority of students (54%) earned 13 to 35 credit hours, 34% earned four to 12 credit hours, and 12% earned one to three credit hours. As shown in Figure 7, the relationship of high school GPA, COMPASS score, and college credit accumulation indicates that high school GPA and COMPASS reflect college credit accumulation patterns, but outliers were noted.
Figure 7. Relationship of HS GPA, COMPASS, and College Credit Accumulation

Fall 2011 MTH 098 non-returning students.

Of the 216 students entering MTH 098 in the fall 2011 term, 94 students failed the course (44%). Of the 94 students failing, 44 (44%) did not return to take the MTH 098 course during the spring 2012 term. The demographics of the non-returners indicate that the group was predominately comprised of traditional age students. Traditional age (18-24) students were disproportionately represented in the group failing and in the group of non-returners. Over half (55%) of the students received a full Pell grant award and 14 (32%) received no Pell award. COMPASS scores for the group spanned from 39-82. A COMPASS score of 39-100 places a student into MTH 098. Of the two students with a COMPASS score of 39, one earned a 59 course grade, earned a high school GPA of 79, and earned 4 college credits over three semesters. The second student, earned a 30 course grade, a high school GPA of 84, and earned no college credits over three semesters. As Shown in Figure 8, the relationship of COMPASS score to MTH 098 course grade indicates that a more similar pattern is observed for students earning course
grades in the high 60 range. The pattern begins to diverge in the 50’s and significant divergence is noted in students earning a course score in the mid 40’s and below.

Figure 8. Relationship of COMPASS Score to MTH 098 Course Grade for Non-returners

For this group, high school GPAs ranged from 76 -95, with the majority (75%) earning in the mid to upper 80’s. As shown in Figure 9, the relationship of high school GPA to MTH 098 course grade demonstrates that course grades quickly diverge from high school GPAs.

Figure 9. Relationship of HS GPA to MTH 098 Course Score Non-returners
Examination of the college credit accumulation over three semesters among all other non-returning students indicated that six students did not earn any college credit while the remaining 38 earned from 1 to 25 college credit hours over three semesters. As shown in Figure 10, the relationship of high school GPA, COMPASS, and college credit accumulation demonstrates that patterns for high school GPA and COMPASS were similar, while college credit accumulated was less for the non-repeater group.

Figure 10. Relationship of HS GPA, COMPASS, and College Credit Accumulated Non-returners

**Spring/summer 2012 MTH 100.**

The Intermediate Algebra (MTH 100) course is classified as a college credit generating course and students may enter the course via placement exam scores or through successfully (C or better) completing the MTH 098 course. This study included the students matriculating to MTH 100 via successful completion (C or better) of MTH 098 during the fall 2011 term or successful (C or better) MTH 098 course repeaters during the spring 2012 term, all of whom placed into MTH 098 via COMPASS prior to beginning the fall 2011 term. Therefore, the MTH
100 group is comprised of students taking the course during the spring 2012 or summer 2012 term, who matriculated from MTH 098. The MTH 100 group includes 66 students from the spring 2012 course and 12 students from the summer 2012 course, including 5 students who were repeaters from the spring MTH 100 course.

Of the 122 students placing via COMPASS into MTH 098 and successfully completing the course during the fall or spring terms, 78 (64%) students matriculated to the MTH 100 course. Of the 78 MTH 100 students, 53 (70%) earned a grade of C or better therefore, successfully completing the course. Eight of the students earned a grade of D and six students earned a grade of F, for a composite failure rate of 30%. As shown in Figure 11, the matriculation pattern and grade comparison for students competing MTH 098 and progressing to MTH 100 during the spring or summer 2012 terms, indicates that overall students scoring in the mid-80s or above in MTH 100 performed better in MTH 100 than in the MTH 098 and the opposite was evident in students scoring below 85 in MTH 100.
The majority (85%) of class members were traditional (18-24 years) students. One third (33%) of the students received a full ($5550) Pell award, 40% received no Pell award, and 27% received a partial Pell award ranging from $555-5400. COMPASS scores for the group ranged from 39-81. The majority of the group (49%) scored between 40 and 49 on the COMPASS, 31% of students scored in the 50-59 range, 14% of students scored in the 60-69 range, 2% scored in the 70-79 range, 2 students scored a 39 and one student scored 81 on the COMPASS pre-algebra placement exam. As shown in Figure 12, the relationship of COMPASS score to MTH 100 course grade indicated no distinct pattern between course grade and COMPASS score except for the few students taking MTH 100 during the summer 2013 term where a similar earning pattern was evident.
High school GPAs for the group ranged from 73-98. The largest portion of students (49%) earned a GPA of 80-89, 38% of student earned a GPA of 90-98, and the smallest portion of students (13%) earned a GPA of 73-79. Figure 13 depicts the relationship of high school GPA to MTH 100 course grade. The segmented by MTH 100 course term lines, indicate that students scoring in the mid-80s for MTH 100, performed at a higher level than their high school GPA indicated. This trend flattened out to parallel at a score of 84 and then an inverse relationship was observed between high school GPA and MTH 100 course grade.
College credit accumulation over three semesters for the students matriculating to MTH 100 ranged from 8 credit hours to 44 credit hours. No students accumulated less than 8 college credit hours. The majority of the group (36%) accumulated 13-19 college credit hours, 31% accumulated 20-27 college credit hours, 23% accumulated 28-44 college credit hours, and 10% accumulated 8-12 college credit hours. As shown in Figure 14, the relationship of high school GPA, COMPASS score, and college credit accumulation indicates that overall patterns are similar, yet outliers do exist.
Finally, all of the five students who failed or withdrew from MTH 100 in the spring term successfully completed MTH 100 during the summer 2012. Among the group failing MTH 100, a slightly higher portion of the population was represented by non-traditional students (21%), as compared to the entire MTH 100 population (15%). COMPASS scores, high school GPAs, level of Pell award, and college credit accumulation over three semesters were comparable between student failing and the population of all MTH 100 students.

The preceding pages documented the demographic differences and similarities among the MTH 098 and MTH 100 groups in respect to course achievement, high school GPA, COMPASS scores and other demographics factors. The following sections describe the outcome for each of the three study hypotheses.

**Data Analysis and Results**

Hypothesis 1 stated that there is no significant relationship between MTH 098 course grade and a group of predictor variables, including COMPASS score and high school GPA. To
examine the relationship between Elementary Algebra (MTH 098) course grade and the two predictor variables, data were exported from the Excel data base to the Statistical Packages for Social Sciences (SPSS) version 20. The data was assessed for accuracy, outliers, and missing data prior to analysis. Analysis of hypothesis 1 was executed by entering high school GPA into the computer followed by COMPASS score. A linear multiple regression analysis was conducted to determine if the predictor variables, high school GPA and COMPASS score were significant in predicting MTH 098 course grades. A significant model emerged, F (2,213) = 5.67, p < .05. The model indicated that high school GPA and COMPASS scores are statistically significant predictors of MTH 098 score. High school GPA significantly predicted MTH098 course grades, B = .742, t (215) = 3.36, p < .05. Therefore, we reject Ho1: There is no significant relationship between MTH 098 course grade and a group of predictor variables, including COMPASS score and high school GPA.

Finally, high school GPA and COMPASS explained a portion of the variance in MTH 098 course grades, R² = .051, F (2, 213) = 5.67, p < .05. Although the model was significant, COMPASS scores were not statistically significant to the model, B = .036, t (215) = .314, p > .05. The statistics for high school GPA and COMPASS were R = .225, R² was .051, and adjusted R² was .042. The multiple regression formula for predicting MTH 098 course grade was Ŷ = .742 (high school GPA) + .036 (COMPASS) + 3.906. The 3D scatter plot in figure 15 demonstrates the relationship between MTH 098 course grade, high school GPA and COMPASS score.
Hypothesis 2 stated that there is no significant relationship between MTH 100 course grade and a group of predictor variables, including COMPASS score and high school GPA. To examine the relationship between Intermediate Algebra (MTH 100) course grade and the two predictor variables, data were exported from the Excel database to the Statistical Packages for Social Sciences (SPSS) version 20. The data for MTH 100, a subset of completers from MTH 098, was assessed for accuracy, outliers, and missing data prior to analysis. Analysis of hypothesis 2 was executed by entering high school GPA into the computer followed by COMPASS score. A linear multiple regression analysis was conducted to determine if the predictor variables, high school GPA and COMPASS score were significant in predicting MTH 100 course grades. A significant model did not emerge, $F(2, 75) = 3.05$, $p > .05$. Examination of the correlation matrix indicated that the predictor variables of high school GPA and COMPASS
were correlated to MTH 100 scores, but the relationship was not significant. The scatter plot in figure 16 demonstrates the relationship of MTH 100 scores to high school GPA and COMPASS.

Figure 16. Relationship of MTH 100 Grade to HS GPA and COMPASS Scores

While not indicated by a stated hypothesis, the researcher was interested in the nature of a relationship between student grade in MTH 098 and MTH 100, given that the courses are sequentially required for completion. To explore the relationship between MTH 098 scores and MTH 100 scores, course grades were entered into SPSS for linear regression analysis. Student grade in MTH 100 was entered as the criterion variable and grade in MTH 098 entered as the predictor variable. Using the enter method and significance level of .05, data were analyzed. Examination of the correlation matrix and the ANOVA table revealed that a relationship between
MTH 098 and MTH 100 exists. The regression produced a significant model, $F (1, 76) = 19.02$, $p < .05$. The model indicated that MTH 098 scores are statistically significant predictors of MTH 100 scores, $\beta = .447$, $t (77) = 4.361$, $p < .05$. Therefore, there is a significant relationship between MTH 100 course grade and MTH 098 as a predictor variable. Finally, MTH 098 explained a portion (20%) of the variance in MTH 100 course grades, $R^2 = .20$, $F (1, 77) = 19.02$, $p < .05$. The statistics for MTH 098 grade were $R = .447$, $R^2$ was .20, and adjusted $R^2$ was .19. The multiple regression formula for MTH 100 course grade was $\hat{Y} = .674 \text{(MTH098 score)} + 22.03$. The scatter plot in figure 17 demonstrates the linear relationship of MTH 100 grades to MTH 098 course grades.

Figure 17. Relationship of MTH 100 Scores to MTH 098 Scores

Hypothesis 3 states that there was no significant relationship between college credit accumulation over three semesters and a group of predictor variables, including COMPASS score and high school GPA. To examine the relationship between college credit accumulation
and the two predictor variables, data were exported from the Excel data base to the Statistical Packages for Social Sciences (SPSS) version 20. The data was assessed for accuracy, outliers, and missing data prior to analysis. Analysis of hypothesis 3 was executed by entering high school GPA into the computer followed by COMPASS score. A linear multiple regression analysis was conducted to determine if the predictor variables, high school GPA and COMPASS score were significant in predicting college credit accumulation. A significant model emerged, F (2,213) = 5.70, p < .05. The model indicated that high school GPA and COMPASS scores are statistically significant predictors of college credit accumulation over three semesters. High school GPA significantly predicted college credit accumulation, B = .402, t (215) = 3.273, p < .05. Therefore we reject hypothesis 3, there is no significant relationship between college credit accumulation over three semesters and a group of predictor variables including, COMPASS score and high school GPA. Finally, high school GPA and COMPASS explained a portion of the variance in college credit accumulation, R² = .051, F (2, 213) = 5.702, p < .05. However, COMPASS scores were not statistically significant to the model, B = -.046, t (215) = -.717, p > .05. The statistics for high school GPA and COMPASS were R = .225, R² was .051, and adjusted R² was .042. The multiple regression formula for predicting college credit accumulation was Ō = .402 (high school GPA) + -.046 (COMPASS) + -17.16. The 3D scatter plot in figure 18 demonstrates the relationship between college credit accumulation, high school GPA and COMPASS score.
Conclusion

Chapter IV included the results and data analysis as presented in chapter III. Results from execution of linear multiple regressions revealed that in two of the three hypotheses significant relationships did exist between the predictor and criterion variables. The following significant relationships were documented therefore, the corresponding hypotheses were rejected:

1. There is no significant relationship between MTH 098 course grade and a group of predictor variables, including COMPASS score and high school GPA. (Hypothesis 1)
2. There is no significant relationship between college credit accumulation over three semesters and a group of predictor variables including, COMPASS score and high school GPA. (Hypothesis 3)
One of the three relationships examined was not significant therefore, the researcher failed to reject the corresponding hypothesis:

1. There is no significant relationship between MTH 100 course grade and a group of predictor variables, including COMPASS score and high school GPA. (Hypothesis 2)

As a result of failure to reject Hypothesis 2, the researcher executed one additional linear regression to examine the relationship between MTH 098 course grade and MTH 100 grade. The model revealed that a significant relationship exists between performances in the two courses. While this was not stated previously as a study hypothesis the results were significant for this study sample.

Finally, extensive examination of performance by subgroups revealed that student performance patterns were more predictable among top performing students, stable among mid-level performers, and often inverse relationships were seen among lower performing students and the stated study predictor variables. Chapter V provides conclusions from this study as well as suggestions for future studies related to this topic.
CHAPTER V CONCLUSIONS, DISCUSSION, AND RECOMMENDATIONS FOR FUTURE RESEARCH

Introduction

This chapter presents a summary of the research study that includes theoretical foundation, description of participants, and methods of data collection. Study conclusions based on data analysis from Chapter IV are described, as well as how the conclusions relate to previous research. Finally, recommendations for future research on the focus of this study are discussed.

Summary of the Study

The purpose of this research was to investigate two primary questions. First, who belongs in developmental mathematics, and secondly, what is the nature of the relationship between placement methodology and community college student success in developmental mathematics courses? As addressed in the introduction, the available literature on assessment, placement, and developmental education effectiveness yields conflicting results, with several studies that support remediation and two significant studies that found remediation served to deter graduation. The consensus emerging from the literature highlighted a growing concern of the most prevalent current practices for determining college readiness and success in remediation. The literature clearly identifies both COMPASS and ACCUPLACER as effective tools for assessing student skills. However, there is concern for how institutions utilize assessment tools, especially the common practice of relying upon a single measure assessment as the sole basis upon which placement decisions are based. This research addressed concerns regarding assessment and placement through examination of the relationship between single
measure course placement methodology and success in developmental community college mathematics. The researcher sought to add to the body of research on this topic and assist colleges in improving student success.

**Theoretical Foundation**

Researchers are developing a growing body of research on identifying measures that most effectively address the education needs of students enrolled in developmental education (Attewell et al., 2006; Bailey, 2009; Belfield & Crosta, 2012; Edgecombe, 2011). Four models have been identified for improving student outcomes: student support, contextualized learning, acceleration, and avoidance models (Rutschow & Schneider, 2011). This study centered on the avoidance model through an examination of the relationship between a single measure placement exam and additional contributing factors that may relate to student success in elementary algebra.

The avoidance model seeks to address the methods by which students are assessed and placed into developmental education. Researchers examined assessment and placement policy and practice at three colleges working with the avoidance model and discovered significant variance (Safran & Visher 2010). The most effective avoidance model includes a comprehensive assessment and placement strategy, strategic selection of assessment methods, carefully crafted placement guidelines, a pre and post assessment advising system, and targeted instruction to meet individualized learning needs. Safran and Visher (2010) found inconsistencies in all areas among the colleges. Common to all three of the colleges was the practice of an open admission process, a practice common to most two-year public colleges. Open admission served as a complicating factor in the assessment and placement process. To add to the growing body of literature exploring the complex testing and placement piece of the avoidance model, this study examined the relationship between success in community college remedial mathematics and the
use of COMPASS scores and high school GPAs, as placement tools. The relationship between COMPASS and high school GPA to short term success was examined. In addition, to explore long term success the relationship of COMPASS and high school GPA to college credit accumulation over three semesters was also examined. A series of multiple linear regressions were executed to examine the relationships between course success, college credit accumulation and the predictor variables, COMPASS score and high school GPA. Student success was measured in MTH 098, MTH 100, and ultimately in the accumulation of college credit over three semesters.

**Participants**

The sample was drawn from a pool of 527 students enrolled in MTH 098 during the fall 2011 term. Complete case level files were requested for the study and included student files that contained evidence of placement into MTH 098 via COMPASS test during the fall 2011 term, a numeric score for the MTH 098 course, and files for which a high school transcript was available. To begin the case sorting process the Office of Grants Planning and Research (GPRIE) requested, from the Information Technology department, a data file for all 527 registrants. The files were then sorted to include only students who had a numeric score reported for MTH 098 during the fall 2011 term. This sort yielded 402 files for which high school transcripts were requested from the admission data file. The files were extracted from the File Bound System, identifiers redacted, assigned a random case file number, and then the files were forwarded to the researcher. From the 402 case files an expansive demographic data base was created on an Excel spread sheet. Files were sorted and cases with grades of W, WP, or WF were eliminated. Further sorting yielded 216 case files containing a fall 2011 term MTH 098 course.
placement COMPASS score, a numeric MTH 098 course grade, and a high school transcript documenting a final GPA and graduation confirmation.

**Data Collection**

The historical data was provided by the community college’s Office of GPRIE and the researcher had no direct contact with the subjects. The College GPRIE office provided student transcripts matched to COMPASS score reports containing basic student demographic data including: student age, gender, race, graduation date and high school GPA. No individually identifying information was available to the researcher. In addition to the high school transcript, COMPASS results and college transcripts were examined.

The COMPASS exam, a computer-adaptive basic skills placement product of the ACT Corporation, was the primary method used to assess and place incoming freshman. All data files used in the study included a COMPASS pre-algebra score. According to ACT, the COMPASS can be utilized to measure knowledge and skills and can also serve as a predictor of success in a given course matching that set of skills. ACT (COMPASS technical manual, 1997) reports a median accuracy rate of .67 for predicting the likelihood of a student to earn a “B” or better in MTH 098 and a median accuracy rate of .63 in predicting the ability of a student to earn a grade of “C” or better in MTH 098. Once gathered, data were analyzed using SPSS version 20 to execute the series of multiple linear regressions.

**Quantitative Conclusions**

The study contained 216 case level files. The sample closely approximated the demographic makeup of the general college population. The only exception was the number of traditional students represented in the study sample. The sample was dominated (85%) by traditional students, age 18-24. This percentage of traditional students far exceeded the
traditional student population (62%) of the College. Findings from the literature suggested that traditional students suffer greater negative impacts from placing into remedial coursework. Studies by Bahr (2007) and Calcagno et al. (2006) indicated that traditional students are impacted by the “discouraging effect” from testing into developmental education. Unlike their non-traditional counterparts, traditional students carried with them an expectation of success in college level work similar to the level of success experienced in high school. Non-traditional students often attributed skill shortcomings, especially in mathematics, to being “rusty” or having been away from math concepts for extended periods of time and did not suffer the loss of self-esteem from testing into developmental education (Calcagno et al., 2006).

Both Calcagno et al. (2006) and Bahr (2009) found that success in the first college level math course was a predictor of graduation. The predictor odds for older students was almost half that of traditional students, demonstrating the impact of success for traditional students versus non-traditional students. Bahr (2009) found that failing the first developmental math course decreased a student’s rate of progress and specifically reduced the likelihood of college graduation. Bahr (2009) further asserted that traditional students are disproportionally impacted by failure. In fact, traditional students earning a “C” had a negative effect equivalent to that of earning an “F.” The same was not true for non-traditional students.

These findings support the importance of carefully and appropriately placing students into developmental education courses and aiming for avoidance if possible. Examination of the demographic data and course success rates for this study, support findings reported by Calcagno et al. (2006) and Bahr (2009) which suggest that the discouraging effect may be a contributing factor to the lack of traditional student success.
Of the 122 students successfully completing the fall 2011 MTH 098 course, traditional students posted a 53.8% success rate, while non-traditional students posted a 71.8% success rate. Traditional students represented 85% of the fall MTH 098 course population and constituted 90% of the student population failing the course. During the spring 2012 term, 50 students repeated the MTH 098 course, 47 of which were traditional students and three were non-traditional. From this group, 37 traditional students posted a 78.7% success rate while, the three non-traditional students posted a 100% success rate in repeating the MTH 098 course. Forty four students did not repeat the course during the spring 2012 term. Of the 44 non-repeaters 38 (86%) were traditional students while only 6 non-traditional students chose to not repeat the course. This data further supports the notion of the “discouraging effect” among the traditional student population.

The success rates begin to level out for traditional and non-traditional students matriculating to and succeeding in the MTH 100 course. The traditional student population posted an overall success rate of 66.6% while the non-traditional student population posted a success rate of 75%. To further analyze the relationship of placement methodology to short and long term success, a series of linear regressions were executed.

In two of the three null hypotheses the relationship of predictor variables to the criterion variable were found to be significant and therefore, the null hypotheses were rejected. The significant relationships are listed below.

1. There is a significant relationship between MTH 098 course grade and a group of predictor variables including, COMPASS score and high school GPA.
2. There is a significant relationship between college credit accumulation over three semesters and a group of predictor variables including, COMPASS score and high school GPA.

For hypothesis one a linear regression was executed using the enter method to determine if a significant relationship existed between MTH 098 course grade (criterion variable), high school GPA and COMPASS scores (predictor variables). From this analysis a significant model was found, $F(2, 213) = 5.67, p < .05$. These findings indicated that a significant relationship exists between MTH 098 course grade, high school GPA and COMPASS score. Therefore, the null hypothesis was rejected.

Further examination of the results revealed that high school GPA alone was significant and explained a portion of the variance among MTH 098 course grades, the statistics were $\beta = .742, t(215) = 3.36, p < .05$. While the model explained variance in course grades, $R^2 + .051, F(2, 213) = 5.67, p < .05$, COMPASS scores did not significantly contribute to explaining course variance, $\beta = .036, t(215) = .314, p > .05$. Findings from this study are similar to the findings of Belfield and Crosta (2012) and Scott-Clayton (2012). Belfield and Crosta (2012) asserted that, alone, high school GPA is the single strongest predictor of college performance even when compared with all other measures combined. Scott-Clayton (2012) found that using high school GPA alone did not change the percentage of students assigned to remediation, but did result in fewer severe placement errors. As suggested by Scott-Clayton (2012) and Belfield and Crosta (2012) additional studies are needed to document the impact of a variety of placement methods. Bailey’s (2009) findings support the need for further research examining the impacts of single versus multiple placement measures. While COMPASS did not yield significant additive predictive ability to this study, prior studies found that combining prior high school performance,
standardized testing (COMPASS), and course rigor explained more than one third of first year college performance (Pike & Saupe, 2002 and Porchea et al., 2010).

For hypothesis 2 the relationship strength was not significant therefore, the null hypothesis was accepted. A significant model did not emerge, $F (2, 75) = 3.05, p > .05$. Examination of the correlation matrix indicated that the predictor variables of COMPASS and high school GPA were correlated to MTH 100 scores, but the relationship was not significant. This finding led to further exploration of relationships that could provide meaningful insight into student course success. Given that successful MTH 098 students, in this study, matriculated to the MTH 100 course, the relationship between MTH 098 and MTH 100 performance was examined.

A linear regression was executed using the enter method to examine the relationship between MTH 098 course grade and MTH 100 course grade. MTH 100 course grade was entered as the criterion variable and MTH 098 course grade was entered as the predictor variable. Examination of the correlation matrix and the ANOVA table revealed that a relationship between MTH 098 course grade and MTH 100 course grade exists. The regression produced a significant model, $F (1, 76) = 19.02, p < .05$. The model indicated that MTH 098 scores are statistically significant predictors of MTH 100 scores, $\beta = .674$, $t (76) = 4.361$, $p < .05$. Therefore, there is a significant relationship between MTH 100 course grade and MTH 098 course grade as a predictor variable. Finally, MTH 098 explained a portion (20%) of the variance in MTH 100 course grades, $R^2 = .20$, $F (1, 76) = 19.02, p < .05$. The statistics for MTH 098 grade were $R = .447$, $R^2$ was .20, and adjusted R2 was .19. The linear regression formula for MTH 100 course grade was $\hat{Y} = .674 \text{(MTH098 score)} + 22.03$. These findings suggest that successful completion of remedial coursework could lead to future success.
Several studies found that students who successfully complete remediation are just as likely to graduate as their non-developmental counterparts (Illich et al., 2004; Sawyer & Schiel, 2000). Conversely, two significant studies (Gordon, 1999; Hughes & Scott-Clayton, 2010) report that remediation did not improve student outcomes and dropout rates were alarming among students placed into remediation. These contradictory findings indicate the need for further research to examine the wide variance in reported developmental outcomes.

Developmental outcomes are dependent upon several factors. Accurate placement is a key factor to optimizing student success and avoiding the discouraging effect of being placed into developmental studies (Bahr, 2007; Calcagno, Crosta, Bailey, & Jenkins, 2006). Student success leads to college credit accumulation which is a significant predictor (Adelman, 2006) of graduation and completion.

For hypothesis 3 a linear regression was executed using the enter method to determine if a significant relationship exists between college credit accumulation over three semesters and a group of predictor variables including, COMPASS score and high school GPA. From this analysis a significant model emerged, $F(2, 213) = 5.70, p < .05$. The model indicated that COMPASS and high school GPA scores were statistically significant predictors of college credit accumulation over three semesters. High school GPA significantly predicted college credit accumulation, $\beta = .402, t(215) = 3.273, p < .05$. Therefore we reject hypothesis 3, there is no significant relationship between college credit accumulation over three semesters and a group of predictor variables including, COMPASS score and high school GPA. Finally, COMPASS and high school GPA explained a portion of the variance in college credit accumulation, $R^2 = .051, F(2, 213) = 5.702, p < .05$. However, COMPASS scores were not statistically significant to the
model, $\beta = -.046$, $t (215) = -.717$, $p > .05$. The statistics for COMPASS and high school GPA were $R = .225$, $R^2$ was .051, and adjusted $R^2$ was .042.

Identifying significant and predictive factors related to college success are important in that college credit accumulation leads to degree completion. In particular, Adelman (2006) demonstrates the power of credit accumulation by the end of the freshman year in college. The math gap may be the most important element of secondary and postsecondary degree completion momentum (Adelman, 2006). But, overall momentum should not be underestimated. Students who earn less than 20 credits by the end of freshman year in college may be unlikely to earn a degree (Adelman, 2006). To help students move past that 20 credit benchmark, it would be immensely beneficial to begin college credit accumulation in high school through dual enrollment (Adelman, 2006). Accumulating a minimum of six credits or an optimum of 12 would help ensure that students reach that vital 20 credit point in their march toward a degree (Adelman, 2006). Formulating accurate and effective placement methodology is a key first step toward achieving the avoidance model.

Although COMPASS did not show significant impact in this model, standardized tests such as COMPASS have been shown to be effective in predicting college success especially when used in combination with other measures. Adelman’s (2006) analysis of NELS data indicated three major factors that predict, with 95% accuracy, the likelihood that a student will complete a bachelor’s degree within six years of high school graduation. The highly predictive factors are the score on a standardized exam, high school GPA, and high school course rigor. Adelman (2006) examined a multitude of other demographic factors but found no other statistically significant predictors of credential attainment. Previous researchers (Adelman, 2006; Bahr, 2007; Bailey, 2009; Boylan, 2009; Calcagno et al., 2006) called for institutional
level studies to examine the relationship of placement methodology and student success. This
institutional level study produced specific findings about the relationship between single measure
placement methodology and student success. The results indicated a need for developing multi-
factor placement methodology. Recognizing the limitations of this study is important. The
strength of this study is that institutional level data and analysis were generated.

Recommendations for Future Research

The study was limited to a single institution in one state; therefore the results cannot be
generalized to populations beyond those regional community college populations who mirror this
demographic. Only students who successfully completed Elementary Algebra (MTH 098) at the
selected multi-campus community college in the southeastern United States were included in the
second phase of the study. There was no means of controlling factors impacting grade
attainment, such as variance of math skill gained in high school, personal, social, or financial
situations. Maturation of students, particularly non-traditional, may play a factor as students
acclimate to performing in an academic setting. Students were served by a variety of instructors
depending upon campus and class section. Quality of instruction and pedagogical approach may
have varied between instructors. Finally, the small sample size prevented the use of inferential
statistical methods to further investigate data within sample subgroups.

While recognizing the limitations of the study, the academic community must
acknowledge that institutional level research is needed to penetrate the complex issue of
placement methodology and student success. Therefore, the study produced significant results
contributing to the emerging body of avoidance model research and yields recommendations for
future research.
Given the climate of accountability and effectiveness in higher education today, institutions must develop more effective methods of placing students to increase completion rates. As indicated throughout the literature, sorting students for admission varies significantly across institution types and across systems. Additional institutional level and system level research is needed to determine which methods most accurately position students for success in college coursework. Based on the outcome from this study, researchers might consider the following list of questions and suggestions to guide future research:

1. Do institutions utilize course level assessments to verify correct student placement? If so, what is the relationship of this methodology to student success?

2. Given the widespread use of COMPASS and ACCUPLACER for placement, what additional factors should be used to establish multiple measure assessment and placement methodology?

3. Since high school GPA is well documented as the single most predictive factor for placement and student success, at what point does high school GPA lose effectiveness as a placement measure?

4. In an effort to identify and quantify characteristics of successful students, examine the relationship of high school GPA to short and long term success among sending high schools.

5. Examine the relationship of high school GPA, COMPASS score, and level of mathematics course rigor to short and long term success in college mathematics.

6. Should placement methodology be different for non-traditional versus traditional students?
7. Does college credit accumulation in high school impact student placement and student success, both short and long term?

Conclusion

Findings from this study confirmed that high school GPA remains a predictor of success in community college developmental mathematics. Adding COMPASS scores to the prediction model did not strengthen the ability to predict success but from a practical standpoint institutions must have sorting methods. Previous research (Scott-Clayton, 2012) indicated that standardized tests can serve as a predictor of success. Scott-Clayton (2012) and others found that standardized tests are more accurate in predicting success not failure and are more effective for use in mathematics placement. The weak relationship between standardized test scores and subsequent student success suggests that rethinking assessment is a beginning point for community colleges. Perhaps, the foundation for placement methodology should become high school GPA with additional measures as indicated by further research. Clearly, high school GPA is well documented as the best predictor of student success. Community colleges and high schools should partner to explore methods for integrating high school GPA into placement methodology. Community colleges should strive to develop multiple measure placement methodology and track outcomes to evaluate the effectiveness of new placement methodology.

Findings from this study support the use and effectiveness of high school GPA as a predictor of short and long term success. Furthermore, study results corroborate previous studies suggesting that standardized testing did not contribute to the strength of a prediction model. This study investigated two primary questions. First, who belongs in developmental mathematics and secondly, what is the nature of the relationship between current placement methodology and community college student success in developmental mathematics courses? In this study the
researcher examined the relationship between single measure course placement methodology and success in developmental mathematics. Findings indicated that the current use of COMPASS scores alone is not the most effective placement method. Additionally, COMPASS score alone did not exhibit a statistically significant relationship to short or long term success. Results from this study do not clearly answer who belongs in developmental mathematics but findings do question the use of single measure standardized testing as a method to determine who does belong. Study results do offer insight into the relationship of single measure placement methodology and student success. Results indicate that there is no significant relationship between COMPASS score and short or long term success in developmental mathematics. Finally, results from this study support the need for additional institutional level research investigating placement methodology and student success. The information gathered from this study contributes to the formulation of evidence based practice for testing and placement of community college students.
List of References
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LIST OF APPENDICES
Appendix A

XXX State Community College Placement Testing Policy

Placement Testing

All entering students who enroll in associate degree or certificate programs and who enroll for more than four credit hours or eight weekly contact hours per semester will be assessed using a placement assessment instrument and will be placed at the appropriate level as indicated by the assessment results:

Exceptions

- Any student scoring 470 or above on the SAT Writing or 20 or above on the ACT English within three years of enrollment is exempt from the English assessment requirement;
- Any student scoring 470 or above on the SAT Reading or 20 or above on the ACT Reading within three years of enrollment is exempt from the reading assessment requirement;
- Any student scoring 470 or above on the SAT Math or 20 or above on the ACT Math within three years of enrollment is exempt from the math assessment requirement;
- Students who have an associate degree or higher;
- Students who transfer degree-creditable college level English and/or mathematics courses;
- Non-award seeking majors who are taking classes for vocational reasons only;
- Students who have completed required developmental course work at another XXX Community College System institution within the last three years;
- Audit students;
- Students who can provide documentation of assessment (COMPASS) within the last three years; and
- Transient students.

NOTE: Certain programs at XXX State have specific testing requirements.

NOTE: XXX State accepts official COMPASS placement test scores from other postsecondary institutions.
NOTE: Each college is required to provide a written assessment, an individualized education plan, and appropriate guidance and counseling to any student who scores below the college’s minimum cut score. The requirements for the standard minimum cut scores for the System shall be set forth in guidelines established by the Chancellor.
APPENDIX B: ACT COMPASS GUIDE TO EFFECTIVE STUDENT PLACEMENT AND RETENTION IN MATHEMATICS
Appendix B

ACT COMPASS Guide to Effective Student Placement and Retention in Mathematics

Introduction
A recent survey* of educators at two-year public institutions nationwide identified the delivery of course placement services, academic advising, and learning support services as critical to helping students persist in their studies and to achieve academic success. Recognizing this need for strong course placement and advising support services, ACT developed the Computer-adaptive Placement Assessment and Support System (COMPASS) to assist with the delivery of these services. COMPASS is a comprehensive, computer-adaptive testing program that quickly and accurately assesses students’ skill levels in reading, writing skills, writing essay, mathematics, and ESL, provides the information you need to place them in appropriate courses, and connects them to the campus resources they need to achieve their academic goals.
For one low cost, the COMPASS mathematics test provides placement tests in up to five subject areas. In addition, the system includes fifteen (15) diagnostics tests covering key concepts in the areas of pre-algebra and algebra. Over 1,000 postsecondary institutions use COMPASS to help their students start their mathematics studies on a solid footing. This document provides an overview of the COMPASS mathematics tests, along with suggestions on how to align COMPASS mathematics test scores with the prerequisites you have established for your mathematics courses, with the goal of ensuring that students are placed appropriately, increasing the likelihood they will persist in their studies. Suggestions are also provided regarding placement messages and using COMPASS to connect students with appropriate courses and additional mathematics resources on campus.

* What Works In Student Retention? – Two-Year Public Colleges
http://www.act.org/path/postsec/droptables/pdf/TwoYearPublic.pdf

COMPASS Mathematics Test Overview
The COMPASS Mathematics Test consists of five (5) placement domains and fifteen (15) diagnostics tests. Each test item is presented in a multiple-choice format that evaluates students’ ability levels in terms of basic skills such as performing a sequence of basic operations, application skills such as applying sequences of basic operations to novel settings or in complex ways, and analysis skills such as demonstrating conceptual understanding of principles and relationships for mathematical operations.

Placement Tests - the COMPASS Mathematics Placement Test offers up to five subject areas:
- Pre-algebra
- Algebra
- College Algebra
- Geometry
- Trigonometry
**Diagnostics Tests** - the COMPASS Mathematics Diagnostics Test evaluates students'skill levels in up to 15 sub-areas in Pre-algebra and Algebra:

- Numerical Skills/Prealgebra Diagnostic Scores
  - Operations with Integers
  - Operations with Fractions
  - Operations with Decimals
  - Exponents, Square Roots, and Scientific Notation
  - Ratios and Proportions
  - Percentages
  - Averages (means, medians, and modes)

- Algebra Diagnostic Scores
  - Substituting Values
  - Setting Up Equations
  - Basic Operations with Polynomials
  - Factoring Polynomials
  - Linear Equations with One Variable
  - Exponents and Radicals
  - Rational Expressions
  - Linear Equations in Two Variables

With COMPASS, you can specify which content areas are to be included in a specific test package, and the “routing rules” which guide the adaptive nature of the test based upon student performance. The COMPASS software comes preloaded with standard test packages, and you can also build your own. This flexibility helps to ensure that your COMPASS math tests are appropriate to the mathematics courses at your institution.

**Effective Placement in Math**
The COMPASS Mathematics Test can quickly and accurately assess students’ skill levels in mathematics. Once a student completes his or her COMPASS test, the COMPASS software will immediately provide his or her results in the form of a Student Advising Report. The Student Advising Report includes the student’s score on each test area completed, and a course placement recommendation based on those scores. Typically course placement messages inform students which math course he or she should take, and how to register for it. The key to helping students achieve academic success is how to use their COMPASS scores to place them in the most appropriate mathematics courses. Most institutions make placement decisions on the basis of cut-off scores. A cut-off score for a particular course is the minimum score a student needs to be adequately prepared to succeed in the course. ACT refers to the initial cut-off scores as “Stage 1” cut-off scores. The COMPASS software comes pre-loaded with “Stage 1” cut-off scores. Please see Table 1. These default cut-off scores are based on national data, and may or may not be appropriate for your institution. Ideally, your math faculty needs to align student proficiency levels, as indicated by their COMPASS scores, with the skill levels required for entering the various courses in your mathematics curriculum. ACT recommends that you evaluate the effectiveness of your “Stage 1” cut-off scores after you have been able to collect data on students’ success in particular courses, and use this information to establish more refined “Stage 2” cut-off scores. The analyses to provide the information needed for this “Stage II” cut score adjustment process may be accomplished by local college staff or they may be completed.
through use of the Course Placement Service available from ACT. The “success rate” for a given course is the percentage of students placed into that course who received a grade of C or higher. If the success rate for a particular course is higher or lower than desired, you may consider adjusting the cut-off score accordingly. For example, if your department targeted a 60% success rate for the college algebra course (60% of enrolled students receive a C or higher grade), but the observed success rate was 48%, you may want to either raise the cut-off score or strongly recommend specific review or tutoring services to students at or slightly above the cut-off score being used. A follow-up study of the student success rate under the new cut-off score would be highly recommended.

Table One.
COMPASS Default cut-off scores that are pre-loaded in the COMPASS software, with related values on the ACT Mathematics test.

<table>
<thead>
<tr>
<th>ACT Math</th>
<th>COMPASS Scores</th>
<th>Course Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>PreAlgebra</td>
<td>0-17 0-43</td>
<td>Elementary algebra or courses with arithmetic prerequisite</td>
</tr>
<tr>
<td>Algebra</td>
<td>18-20 0-45</td>
<td>Elementary algebra or courses with arithmetic prerequisite</td>
</tr>
<tr>
<td></td>
<td>21-22 46-65</td>
<td>Intermediate algebra or courses with elementary algebra prerequisite</td>
</tr>
<tr>
<td></td>
<td>23-25 66-100</td>
<td>College algebra or courses with intermediate algebra prerequisite</td>
</tr>
<tr>
<td>College Algebra</td>
<td>23-25 0-45</td>
<td>College algebra or courses with intermediate algebra prerequisite</td>
</tr>
<tr>
<td></td>
<td>26-27 46-100</td>
<td>Trigonometry or business calculus or courses with college algebra prerequisite</td>
</tr>
<tr>
<td>Trigonometry</td>
<td>26-27 0-45</td>
<td>Trigonometry or business calculus or courses with college algebra prerequisite</td>
</tr>
<tr>
<td></td>
<td>28-36 46-100</td>
<td>Calculus I or courses with college algebra and trigonometry</td>
</tr>
</tbody>
</table>

**Effective Retention in Math**
Placing students in the proper courses is half the battle. The other half is to ensure they are aware of, and have access to, the academic and advising resources available on your campus. COMPASS can help in this regard as well. Connecting Students to the Campus Resources
In addition to advising students what courses they should take and how to register, many math departments use the course placement messages to connect students to the campus resources they need to improve their chances for success. These messages can be customized based on students’ scores. If a student’s COMPASS score falls just above a certain cut-off score (perhaps 5 to 10 score points), that student will be one of the weaker students in the course and at higher risk of failure. Messages tailored to this type of student’s needs may include information about tutorial services, the location and hours of operation of the campus math lab, on-line courseware and resources, etc. Better Advising through COMPASS Demographics COMPASS can provide
academic advisors with much more information than a single math score. The demographic section of COMPASS includes pre-formed and locally developed demographic items regarding the students’ mathematics background and needs. This information can be used to advise individual students more effectively and to evaluate and enhance advising programs through COMPASS research reports.

a. **Pre-formed Items** - individual student responses reported in the COMPASS Student Advising Report and summarized at the campus, state, and national level in the Entering Student Descriptive Report and the Returning Student Retention Report. Items particularly relevant to mathematics include the following:

- Item 8 Type of High School Certificate (includes name of high school attended and year of graduation)
- Item 11 Overall High School Grade Point Average
- Item 12 Courses Completed and Grades Earned
- Item 14 Career Goal
- Item 16 Educational Program or Major
- Item 22 Would Like Help with Study Skills and Math Skills

b. **Local Items** - you may develop up to 40 local items at no additional cost. Individual student responses are reported on the COMPASS Student Advising Report and summarized at the campus level in the Entering Student Descriptive Report and Returning Student Retention Report. Due to the local nature of the items, no national response data is available. Suggestions for items related to mathematics include the following:

Local Item 1: What is the last mathematics course you completed during high school (use local course names that area students will connect accurately to their high school mathematics courses)?
   a. Basic mathematics (fractions, decimals, %’s, etc)
   b. Introductory Algebra
   c. Intermediate Algebra
   d. Advanced Senior Math or Trigonometry or higher
   e. Not Sure

Local Item 2: What is the last mathematics course you completed after high school (use local course names that area students will connect accurately to their high school mathematics courses)?
   a. Basic mathematics (fractions, decimals, %’s, etc)
   b. Introductory Algebra
   c. Intermediate Algebra
   d. College Algebra, Trigonometry, or higher
Local Item 3: What is the final grade (approximately) you received in the last mathematics course you completed?
   a. A, A+, A
   b. B, B+, B
   c. C, C+, C
   d. D+ or lower
   e. Other or Not Sure

Local Item 4: How long ago did you complete your last mathematics course?
   a. One year ago or less
   b. One to two years ago
   c. Two to five years ago
   d. Five or more years ago

Local Item 5: For the areas that you have studied, how would you rate your mathematics skills at this time?
   a. Fairly strong, ready to go on in next course
   b. Somewhat rusty, but could rebuild with help
   c. Fairly weak, need help in rebuilding skills for next course
   d. Not sure

Local Item 6: If you were to participate in a math refresher experience, what type of approach would you prefer most?
   a. Work with a mathematics tutor at the college at my own speed
   b. Work with computer software to review math skills at my own speed
   c. Take a complete course in a regular college classroom with a group of other students working on the same skills
   d. Some other approach
   e. Not sure

Local Item 7: CCC is considering the development and delivery of a “mathematics study skills” seminar for students (2 or 3 sessions of 2 hours each; no tuition charge, text book costs of $xx). Would you be interested in participating?

**Improving Student Performance in Math**
The following suggestions may help create an overall context at your institution that is more conducive to successful course placement and retention in mathematics.

a. Deliver all new student assessment services within a “success planning” approach, as an expression of the mission and service orientation of the college. As part of the invitation to participate in the Success Planning Services for New Students, provide new students with a leaflet introducing the student to the “Success Planning Services” of the college, including the testing process and services. Include examples of COMPASS test items (available on ACT web page at http://www.act.org/compass/sample/index.html) in the leaflet, with references to the mathematics advising and instructional support services provided by your college.
b. In all communications to potential new students, actively recommend early involvement in the admissions and assessment process, to allow more time for best advising and support services, and more time for involvement in “skill brush-up” activities followed by retesting (with the aim of moving “rusty” students one course upward in the placement ladder when possible.)

c. For students whose COMPASS scores fall somewhat below the cut score selected by the college as necessary to enter the next course (perhaps 8-10 score points), include a message on the COMPASS Student Score Report which notes this fact and describes what the student could do by way of skills “brush-up” followed by retesting, with the student’s new score level being used to make a revised course placement recommendation.

d. Consider the use of the COMPASS Mathematics Diagnostics Test to point marginal students to the areas of weakness. Link the results of the diagnostics to the development of a study plan for the student (include references to local resources, such as PLATO, etc., and where they are available at your college).

e. Consider delivering “pre-planning assessment” services to juniors in targeted area feeder high schools, with the objective of maximizing the quality of career and educational planning and related senior year course choice planning by the students as they plan for their senior year of high school. Also consider similar adult outreach services perhaps in a seminar approach at area businesses which include assessment and advising services. These approaches can deliver highly supportive student development information and experiences for the participants, with positive community service and student recruitment benefits for the college.
APPENDIX C: XXX COMMUNITY COLLEGE SYSTEM 902.01 INSTITUTIONAL EFFECTIVENESS: PLACEMENT TESTING
Appendix C

XXX Community College System 902.01 Institutional Effectiveness: Placement Testing

<table>
<thead>
<tr>
<th>POLICY:</th>
<th>902.01 Institutional Effectiveness: Placement Testing</th>
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<tr>
<td>EFFECTIVENESS:</td>
<td>03-24-05</td>
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<tr>
<td>SUPERCEDES:</td>
<td>902.01 issued 08-28-08; 10-28-99; 01-28-99; 1994</td>
</tr>
<tr>
<td>COURSE:</td>
<td></td>
</tr>
<tr>
<td>CROSS REFERENCE:</td>
<td>Policy 802.01</td>
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</table>

1. Mandatory Assessment and Placement
Each institution in the XXX Community College System shall require a comprehensive assessment of students upon admission to the institution and prior to enrollment in associate degree, diploma, or certificate programs. Students shall not be allowed to enroll for more than four credit hours or eight weekly contact hours before being assessed with a comprehensive assessment instrument.

2. Assessment Instrument
Institutions shall use either the ACT/ASSET written assessment instrument or the COMPASS computerized assessment instrument. System institutions shall implement COMPASS computerized assessment by the Fall Semester 2002-2003.

3. Exemptions
The following students are exempt from the assessment requirement: any student scoring 480 or above on the SAT I verbal and 480 or above on the SAT I math, and 20 or above on the ACT English and math who enroll in a System institution within three years of high school graduation; students who have an associate degree or higher; and students who transfer degree-creditable college level English or mathematics courses with a grade of “C” or better; senior citizens, undeclared, and other non-award seeking majors who are taking classes for vocational reasons only; students in certain short certificate programs having no English or mathematics requirements; students who have completed required developmental coursework at another XXX Community College System institution within the last three years; audit students; students who can provide documentation of assessment (COMPASS or ASSET) within the last three years; and transient students. Dually enrolled high school students in English or math may be exempted from the assessment requirements.

4. Placement Counseling
Each institution is required to provide a written assessment, an individualized education plan, and appropriate guidance and counseling to any student who scores below the institution’s minimum cut score. The requirements for the standard minimum cut scores for the System shall be set forth in guidelines established by the Chancellor.

5. Evaluation
All institutions shall submit data to ACT on a term-by-term basis to validate the accuracy of the assessment and placement process.
APPENDIX D: XXXXXXXXXXXX COMMUNITY COLLEGE RESEARCH REQUEST

SUBMISSION FORM
Appendix D

XXXXXXXXXXXX Community College Research Request Submission Form

XXXXXXXXXXXX Community College Research Request Submission Form

Please provide the following information along with your letter of interest in conducting research at XXXXX State Community College. Provide as much information as possible not limited to the questions below. Be as specific as possible. If the information is provided in an existing document (for example, a thesis or dissertation proposal), you may want to copy and paste only the pertinent information.

1. Contact information
   a. Principle Investigator Information
   b. Faculty Advisor Information

2. Background and purpose of study
   a. Provide a brief description of the general purpose of the project.
   b. List your objectives/aims, hypotheses, research questions, or study questions.
   c. What do you hope to learn from the study?

3. Research methodology/Study procedures
   a. What will the subjects do or what will be done to them in the study?
   b. Describe all procedures in chronological order.
   c. Name the approach and/or design of the study.
   d. How long will each procedure take?

4. Risk assessment/Risk management
   a. Do you see any chance that the subjects might be harmed in any way?
   b. Do you deceive them in any way?
   c. How will you control for the risks you’ve identified?

5. Population enrollment/Sample size/Sample description
   a. How many subjects will be used?
   b. Number of times researcher will interact with subjects?
   c. Be sure to include all vulnerable subject populations and additional precautions being taken to ensure their protection. XXXXX State enrolls minors (under age 18).

6. Recruitment/Informed consent process
   a. How do you intend to obtain the subjects’ informed consent?
   b. Attach a copy of the consent form.
   c. How will you address participation of minors?

7. Privacy and Confidentiality of research data
   a. How will data be collected?
   b. Who will have access to data?
   c. Where will it be stored?
   d. What identifiers will be collected?
   e. Will the data be retained or destroyed (if destroyed, when and how)?
8. Incentives and Compensation
   a. Describe any incentives offered to subjects to encourage their enrollment and persistence in the study.

9. Cost to subjects
   a. Identify any costs to participants associated with the research.

10. Surveys/Questionnaires/Scripts/Debriefing
    a. Provide copies.
VITA
Susan C. Burrow

Education

University of Alabama at Birmingham, Birmingham, Alabama
   Post Graduate Family Nurse Practitioner Certification, May 1995.

University of Alabama at Birmingham, Birmingham, Alabama

University of North Alabama, Florence, Alabama
   Bachelor of Science in Nursing, December 1985.

Northwest Alabama State Technical College, Hamilton, Alabama

Professional Experience

Central Alabama Community College, Alexander City, Alabama
   Interim President – Feb 2013 to present

Bevill State Community College, Hamilton, Alabama
   Campus Dean and Dean of Academic Transfer Programs – June 2009 to Feb 2013
      Campus Associate Dean - May 2003 to June 2009
   Health Science Division Chair Hamilton and Fayette Campuses and College Wide Practical Nursing Program Coordinator – September 1, 2002 to May 2003
   Division Chair Hamilton Campus General Studies - October 2000 to August 31, 2002
   Division Chair Hamilton Campus Health Science – May 2000 to May 2003
   Hamilton Campus Practical Nursing Coordinator – August 1998 to May 2000
   Practical Nursing Teaching and Continuing Education Coordination – September 1996 to August 1998
   Practical and Associate Degree Nursing Educator - September 1993 to September 2002
Phi Theta Kappa Honor Society Faculty Advisor - February 1994 to September 2005

Phi Theta Kappa Honor Society Regional Coordinator (State of Alabama) - January 2001 to March 2004

Phi Theta Kappa Honor Society interim Regional Coordinator - July 2000 to December 2001

Northwest Alabama State Community College, Hamilton, Alabama
   Practical Nursing Educator - May 1989 to September 1993

Northwest Alabama State Technical College, Hamilton, Alabama
   Practical Nursing Educator - April 1987- April 1989

Baptist Health Center, Hackleburg, Alabama
   Family Nurse Practitioner and Facility Senior Administrator - September 1996 to June 1998

Dr. Boyde J. Harrison Medical Clinic, Haleyville, Alabama
   Family Nurse Practitioner (part-time) - June 1995 to August 1996

Haleyville Health Care Center, Haleyville, Alabama
   Assistant Director of Nursing - December 1985 to March 1987