Author: **Stancher, Amber L.**

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STUDENT:

NAME: Amber Stancher **DATE: 7-29-19**

ADVISOR: (Committee Chair if MS Plan A or EdS Thesis or Field Project/Problem):

NAME: Deanna Schultz **DATE: 7-29-19**

This section for MS Plan A Thesis or EdS Thesis/Field Project papers only

Committee members (other than your advisor who is listed in the section above)

1. **CMTE MEMBER'S NAME:** **DATE:**
2. **CMTE MEMBER'S NAME:** **DATE:**
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Stancher, Amber L. ***The Impact of a Holistic Admissions Process on College Math Completion Rates at a Wisconsin Technical College***

Abstract

The purpose of this study was to research whether the new admissions process at Mid-State Technical College had an impact on College Math completion rates for students who would have been referred to remedial coursework under previous policies. It also examined the impact of supplemental instruction attendance on completion rates. Prior to this research, Mid-State had not completed an internal data review to assess the effectiveness of the admission policy on predicting the success of students directly placed into College Math and the effectiveness of the supplemental course instruction. Ex post facto data from the Fall 2018 and Spring 2019 semesters was used to complete this research, including Accuplacer/ACT math scores, College Math grade rosters, and student attendance records. Pearson correlation analysis was used to identify if relationships existed between the data selected for this study and successful course completion.

Results of the study indicated that students directly enrolled in College Math based on their high school transcript had a slightly higher completion rate than students enrolled based on meeting the Accuplacer/ACT cut score. Additionally, students enrolled based on high school data who regularly attended the additional hour of instruction had higher completion rates than students who did not attend.

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Chapter I: Introduction

The use of entrance requirements to ensure the success of students within a college course or program has evolved throughout the years. According to Hughes and Scott-Clayton (2011), standardized placement tests were most commonly used after World War II due to the fact that cut scores gave a clear benchmark, and standardized tests were less time consuming and labor intensive for college admissions staff than essay evaluations and interviews. This has become especially true after the development of online testing. Based on research by Furuta (2017), there is a current initiative in the United States to create a more diverse population in regards to college enrollment by adapting admission policies that are more inclusive.

This push for inclusion was spearheaded by advocacy groups for underrepresented minority populations that were not properly course-placed by standardized testing alone (Bahr, Perry, Rosin, & Woodward, 2010). To create an inclusive admissions process, educational institutions are taking a more holistic approach. Killgore (2009) considers student admission policies as holistic if the process includes special talents, personality traits, and extracurricular activities, in addition to academic abilities. Using Killgore's (2009) definition, admissions policies that depend on a high school grade point average or standardized test cut scores must also include a personal interview, an essay, or another method to obtain additional student information to be considered holistic. The personal interview or essay is the opportunity for admissions teams to obtain all-inclusive information on students.

Admissions policies that determine program acceptance and course placement vary by institution. Due to the negative psychological impact of being referred to a remedial course, Kwon and Ngo (2014) found a trend of colleges providing a general summary of admissions results with course recommendations in lieu of giving students their full results. Students were

then enrolled in selected classes without knowing why and without knowing what could be done to improve scores or course placement. Colleges also use varying remedial processes for students who are considered underprepared for college: required retakes of entrance exams, passing of remedial courses, required sections of first semester courses, or nothing at all (Edgecombe, 2011).

Remediation processes have a proven negative impact on student completion rates. According to Dadgar and Xu (2018), being referred to a remedial course has such a negative psychological impact that it outweighs the benefits of the additional skill attainment. It has also been found that students referred to a course that is below their academic level are more susceptible to drop out due to the feeling that they are wasting time and money (Jaggars, Hodara, Cho, & Xu, 2014). Time and relevancy is an important factor for adult students. Students who enroll in a two-year institution have a 29% program completion rate (Ferguson, Schwarz, & Symonds, 2011); that percentage decreases to 8% for those students who are referred to remedial courses (Chen & Simone, 2016).

In the state of Wisconsin, Lopukhova (2012) reports that mathematics was the subject area in which most students were placed in remedial courses based on entrance requirements in 2004. Lopukhova (2012) also determined that the trend continued in 2011 when approximately 46% of students did not meet the ACT College Readiness Benchmark in mathematics. The Wisconsin Technical College System (WTCS) also focused on math placement and completion rates during the Common Grounds Conference in 2018; Dr. Hilary Barker presented data at the conference regarding factors that impacted successful completion rates in general education math courses, which includes the College Math commonly used by colleges throughout the WTCS (WTCS, 2018). The data showed that the Adult Basic Education (ABE) and the Pre-Algebra

remedial courses used by WTCS colleges did not have a significant impact on student outcomes, but the following student demographics showed a decrease in completion rates in general education math courses: minorities, economically disadvantaged, part-time, students with disabilities, males, and students without pre-college momentum (WTCS, 2018). The WTCS Student Success Center (2019) has emphasized the importance of general education math courses in their Scale of Adaption Assessment required of the 16 technical colleges within the WTCS. The following are two of the five essential practices listed under the "helping students choose and enter a program" category that focuses on math completion: special supports are provided to help academically underprepared students succeed in their gateway courses, and required math courses are appropriately aligned with the student's field of study. The WTCS Student Success Center (2019) has teamed up with Achieve the Dream (ATD), a national organization, to provide the technical colleges within the WTCS with resources to help increase student retention and completion rates; as part of this partnership, ATD has provided resources for colleges to implement a more holistic student support design.

Due to this push by the WTCS, Mid-State Technical College has recently decided to utilize a more holistic admissions process. Prior to 2018, Mid-State students were required to achieve a cut score on either the ACT or Accuplacer for program and course placement (B. Smith, personal communication, July 10, 2018). These cut scores were placed as prerequisites at the course level, preventing students from being able to self-enroll in courses determined by standardized testing to be at a higher academic level. Specifically for College Math, if the cut score was not achieved, the student was required to take a three-credit remedial course, Pre-Algebra, with the requirement of earning a C or better to be eligible to enroll in the College Math course (L. Hassett, personal communication, June 6, 2018). College Math is a college-level

mathematics course that is a requirement in the majority of programs at Mid-State. The process of required cut scores to enroll in College Math changed during the Spring 2018 semester.

In spring of 2018, an admissions policy using testing exemptions for course placement into College Math was implemented (B. Smith, personal communication, July 10, 2018). During a new student's required advisor meeting prior to course enrollment, additional holistic factors from a grit assessment are discussed, as well as transcripts and/or test scores for course placement (C. Lorge, personal communication, July 18, 2018). The grit assessment measures the student's feelings towards the following components: seeking growth, resilience, determination to achieve long-term goals, and tenacity (C. Lorge, personal communication, July 18, 2018). With the updated test exemption admissions policy, fewer students are required to enroll in Pre-Algebra based on one of the following conditions: math courses completed at the high school level, overall high school GPA of 2.6 or higher, or a positive grit test result.

Identifying underprepared students at the time of admissions allows for proactive identification of support services needed for student success. For example, according to the Stevens Point Area School District (2018), the high school has a mathematics achievement rate of 61.8% based on its report card. This results in potentially 38.2% of graduates from the largest high school within Mid-State's district being referred to remedial math courses. Traditionally, Pre-Algebra has been used as the remedial course that ensures students have the skills needed to pass College Math. Mid-State's updated admissions policy could potentially place a portion of that 38.2% of students directly into College Math based on the students' high school GPA or the grades earned in their high school math courses.

As colleges move to using multiple measures for college admissions, varying accelerated math remediation models have been implemented. The model that Mid-State chose to

implement was an additional one hour of scheduled class time for certain sections of in-person College Math classes. The assumption was that the additional hour would provide the support needed for underprepared students. Even though the additional hour per week is available to all students enrolled, it is encouraged but not a requirement to attend.

Statement of the Problem

Mid-State had not completed internal data reviews to assess the effectiveness of the new admissions policy on predicting the success of students enrolled in College Math. This lack of data analysis created a gap at the college in the admissions policy review process. Without this analysis, it is unclear whether student admitted under the new policy are being successful in college level math courses.

Purpose of the Research

The purpose of this study was to research whether the new admission process and class structure had a positive or negative impact on College Math completion rates for students who would have been referred to remedial coursework under previous policies. Based on the data, this study will determine whether the process should remain the same, or if additional research is needed to ensure students are properly placed directly into College Math.

Research Questions

The following are the research questions that guided this study:

1. What impact did the updated admissions policy have on student success in College Math?
2. What impact did the additional supplemental instruction have on College Math completion rates?

Significance of Study

This study addressed the lack of internal data indicating the effectiveness of the new admission policy. This study directly aligns with the following Mid-State core values: accountability by taking responsibility of how the admission process impacts the students' success in College Math; student centeredness by providing research that could be used to support and improve the learning experience for students previously identified as underprepared based on math test scores; and exceptional service by examining whether the updated process provides a positive experience for students who previously would have been referred to remedial coursework, but were instead placed directly into College Math (Mid-State Technical College, 2019).

In addition to upholding Mid-State's core values, the concentration of College Math completion rates in this study will be useful for occupational programs when reviewing program completion data. College Math is not only a requirement for many programs at Mid-State, it has also been identified by faculty as a course that predicts success in occupational coursework and program completion rates. Program completion is directly related to meeting the needs of the workforce. According to Carnevale, Smith, and Strohl (2013), 65% of all jobs by 2020 will require some sort of college education; job growth and vacancies due to retirement will increase the total jobs available by 55 million between 2010 and 2020. According to the National Skills Coalition (2015), key industries are unable to find enough middle-skill workers to sufficiently fill jobs. Middle-skill requirements include education beyond high school but less than a four-year degree. Successful completion of programs is directly related to filling demand.

Another reason for the importance of this study was the connection with the National Career and Technical Education research agenda (Elliot, Lambeth, & Jaerger, 2009), which

identified the following research problems area: best practices and transition to postsecondary education. One of the activities in best practices is focused on student retention. The proper placement in College Math is directly related to retention of students. The activity in transition to postsecondary education that relates to this study is the alignment of secondary and postsecondary education standards. Ideally, secondary education prepares students to meet the admission requirements of postsecondary education; this includes the factors taken into consideration for direct placement into College Math.

Limitations

There are additional factors that could potentially impact a student's success in College Math that were not addressed in this study. For example, according to De Paola and Scoppa (2015), students who demonstrated procrastinating tendencies were proven to have a lower success rates in college-level math courses. This current study used the data available through Mid-State and measures like procrastination have not been included.

Another limitation of the study was working with data that was already reported on students during the 2018-2019 academic year. Mid-State currently does not have a consistent process for capturing a student's high school GPA or the number of math classes completed at the high school level. If the math scores reported did not meet the requirement, this study assumed that the student was admitted by either the high school GPA or math courses completed in high school. For that reason, those data points were combined into one grouping.

Another limitation of this study was that the data used was from two semesters at one college. Results may not be generalizable. Additionally, similar data and research from subsequent years would be needed before being able to identify trends.

Definition of Terms

The following definitions provide clarifications of terms used throughout this paper.

ACT/Accuplacer. The ACT and Accuplacer are standardized tests used throughout the United States. Most educational institutions use the following test results for entrance requirements: reading, math, language, and composite scores (Dadgar & Xu, 2018).

College Math. College Math is a state-approved course in the WTCS. It is the lowest college-level math course that can be included in associate degree programs (WTCS, 2019).

Cut score. A cut score is a benchmark score on a standardized test commonly used by colleges and universities as a way to measure a student's readiness to take college-level courses (College Board, 2019).

Grit assessment. An assessment used to measure a person's motivation, perseverance, and dedication to meeting long-term goals (Hussain & Wolters, 2015).

Multiple measures. According to Mark Johnson, Education Director-Adult Secondary Education (personal communication, February 4, 2019), WTCS defines multiple measures as the following: standard admissions testing plus other measures or using multiple measures in lieu of standardized testing.

Pre-Algebra. Pre-Algebra is a state-approved course in the WTCS. It is a three-credit course, but it cannot be counted as earned credits towards a technical diploma or associate degree program (WTCS, 2019).

Test exemption. A test exemption admissions process is a policy that waives the requirement of submitting and/or completing a standardized test to meet entrance requirements. The following are common exemptions used by various educational institutions: high school

GPA, completion of a technical or associate degree, and college GPA (M. Johnson, personal communication, February 4, 2019).

Wisconsin Technical College System (WTCS). The WTCS is made of 16 technical colleges throughout the state of Wisconsin; the 16 colleges are divided by district lines (Wisconsin Technical Colleges, 2019).

Methodology

This was a quantitative study and *ex post facto* data was used to complete this research. Graded class rosters, ACT/Accuplacer test scores, and attendance records were collected for students enrolled in College Math at Mid-State during the Fall 2018 and Spring 2019 semesters. Relationships between entrance test scores and course grades were investigated. Completion rates of students admitted based on high school GPA or high school course completion were compared to students admitted by test score data. Attendance records of the additional hour of support were examined to identify if students took advantage of the availability of the faculty and if that attendance showed a relationship with overall course completion.

Chapter II: Review of Literature

In January 2018, Mid-State Technical College (Mid-State) updated the admission process to a more holistic approach. Through this initiative, a multiple measure admission policy was adapted giving students the opportunity to meet entrance requirements in multiple ways. The options to meet requirements by achieving a test score remained the same, but using a student's overall grade point average or the grade point average in math-specific courses was new to the college. The hope was to increase enrollments and student success. Mid-State also implemented an additional hour of instruction per week in January 2018 to help students that were underprepared be successful.

The purpose of this study was to research whether the new admission process and class structure had an impact on College Math completion rates for students who would have been referred to remedial coursework under previous policies. The following review of literature provides the context for the study by discussing admission policy trends, remediation trends, math course and program completion, along with theory related to these factors.

National Admission Policy Trends

Admission policies, program/course completion rates, and student retention are often discussed together due to the impact that admission policies have on student outcomes. This is especially true for two-year institutions. According to Bragg and Durham (2012), the U.S. Commission on Higher Education report of 1948 identified two-year institutions as the primary source of expanding access to education. Two-year institutions have a diverse student population including more first-generation, part-time, non-traditional, low-income, minority, and female students compared to four-year universities (Bragg & Durham, 2012). Oftentimes, funding for two-year educational institutions is tied to certain outcomes identified by legislation.

To continue to offer educational services, policies at two-year institutions must meet the needs of their students and promote success (Bragg & Durham, 2012). As legislation changes, polices adapt to align with the desired outcomes. This process begins with the colleges' admissions policy.

The use of admission requirements began with the establishment of Harvard University in 1635. According to Berger, Ramirez and Lyons (2012), there are nine eras of admission requirements: Retention Pre-History (1600s-mid 1800s); Evolving Toward Retention (mid 1800s-1900); Early Developments (1900-1950); Dealing with Expansion (1950s); Preventing Dropouts (1960s); Building Theory (1970s); Managing Enrollments (1980s); Broadening Horizons (1990s); and Current and Future Trends (early twenty-first century).

During the first era, potential students were interviewed to determine if the student's character and background were right for the college. These interviews were either completed by the president of the university or a distinguished faculty member, and this subjective type of admission policy continued throughout the next era (Beale, 2012). Completion and retention rates were not examined during the first two eras due to the fact that degree attainment was rare; multiple specialized colleges opened to meet the needs of the workforce, but oftentimes closed before having a graduating class (Berger, Ramirez, & Lyons, 2012). The second era, Evolving Toward Retention, concentrated more on providing the resources needed for educational institutions to remain open.

During the third era, admission policies were still subjective and caused confusion at the secondary level on how to prepare students for college (Beale, 2012). The National Education Association called for cooperation between the secondary and postsecondary institutions in hopes that college preparation and admission requirements would be consistent throughout the

states (Beale, 2012). With this initiative, the College Entrance Examination Board (College Board) was created in 1900 (GuideStar, 2019).

By the middle of the 20th century and the Early Developments era, there were six factors that were commonly used for college acceptance: high school graduation, minimum number of high school credits in designated subject areas, rank in graduating class, recommendation from the principal, personal interview, and aptitude and achievement on test scores (Beale, 2012). During the fourth and fifth eras, Dealing with Expansions and Preventing Dropouts, there was a significant increase of federal funding given directly to the student to fund a college education. According to Berger et al. (2012), such funding sources included: National Youth Administration; G.I. Bill; National Defense Education Act; and, the Higher Education Act. To keep up with the increase in enrollment, colleges moved toward the use of entrance exams for college admissions taking college administration and faculty out of the process and allowing admission departments to emerge with staff that required less training (Hughes & Scott-Clayton, 2011).

The sixth era, Building Theory, began in the 1970s. During this time, students began to protest that they had the right to fail a class because it was a service that they were paying for (Headden, 2011). Students of this era did not feel they should be required to meet entrance requirements because no matter the outcome of the class, they were paying the tuition. These protests followed the reauthorization of the Higher Education Act (HEA) in 1968, which added Special Services for the Disadvantaged, Upward Bound, and Talent Search. The programs came to be known as the TRIO programs (Gladieux, 1995), and provided additional funds given directly to students for payment of tuition and fees. With the increase of student aid available

and student demand for self-selection into courses, placement test requirements were dropped in the admissions process.

The seventh and eighth eras, Managing Enrollments and Broadening Horizons, saw yet another significant change in admissions policies. By 1983, the majority of postsecondary institutions added placement tests back into the admission requirements after *A Nation at Risk* was published, documenting how underprepared high school graduates were for college; this trend continued through the 1990s (Headden, 2011). New Jersey was the first to implement placement testing again and found that 40% of students did not meet requirements (Headden, 2011). Another reason for the focus on admission policies and retention was the realization by college leadership that the enrollment boom from the previous two eras was going to level out. To maintain an ideal student body, colleges had to ensure processes and policies were in place that increased student retention and graduation rates (Berger et al., 2012).

The ninth and current era, Current and Future Trends, saw an increased analysis of data to update educational policies. Various theories are associated with this trend that focuses on student success. One such theory is Tinto's Theory of Student Retention (Bean, 2001). This theory includes the following concepts: college processes should demonstrate a commitment to the students, colleges need to show a commitment towards educating all (not some), and colleges should commit to development of both social and educational communities that support and integrate all students (Tinto, 1993). Another theory used by colleges of this era was David Conley's College Readiness model that includes the following key components needed for student success: key cognitive knowledge, key content knowledge, academic behaviors, and contextual skills and awareness (Baber, Bragg, & Castro, 2010). In this model, remediation prior

to enrollment (done at the high school or pre-college level) and resources available at the college both play a role in student retention and graduation rates.

Both theories aligned with the shift from open access admission policies to credential completion with the passing of President Obama's American Graduation Initiative (Bragg & Durham, 2012). Policies no longer focused on getting students in the door; admission policies were now seen as the first step of ensuring that students had the resources and ability to complete their program of study. With program completion being a new focus of two-year colleges, remediation and retention became a focus of colleges nationwide. According to Chen (2016), the Federal Beginning Postsecondary Students data reported that 68% of students beginning in a two-year college in 2003-2004 were referred to at least one remedial course; only 49% of those students completed all of the remedial requirements. However, studies suggest that a significant number of students enrolled in two-year colleges are erroneously placed into developmental education. A study conducted by the Community College Research Center found that two placement exams, Accuplacer and Compass, widely used by two-year colleges, misplaced 33% and 27% of entering two-year college students, respectively (Belfield & Crosta, 2012). Of the students that completed all of the remedial courses, only 26% continued on to earn an associate degree; approximately 8% of the students originally referred to at least one remedial course obtained an associate degree within six years (Chen & Simone, 2016).

Remedial courses vary by institution, and studies have found that students referred to remedial coursework have a lower retention and completion rate. According to Edgecombe (2011), institutions have up to three levels of remedial courses within reading, writing, and math. Edgecombe (2011) found that at each level, a percentage of students either did not enroll in the required course, did not pass the required course, or did not enroll in the subsequent course. The

reasons for the drop in enrollment were not conclusive, but financial constraints, work, lack of time, discouragement, or a differing in opinion of the need of the remedial work itself was discussed. Jaggars et al. (2014) found that students referred to a course below their academic level were more susceptible to drop out due to the feeling that they were wasting time and money. They also found the remedial courses have to provide an added value to students for them to be considered a worthwhile addition to their academic career. The low completion rate of remedial students has institutions examining their current entrance requirements and the developmental education model used for students who truly do need remediation to be successful.

Wisconsin is included in this trend to update admission policies so that course/program completion and retention rates increase. The WTCS has shown this commitment with its partnership with Achieve the Dream (ATD) (WTCS Student Success Center, 2019). ATD is a national, nonprofit organization that uses an evidence-based process to help community colleges better serve students (ATD, 2019). Admission policies are one of the key focuses of the toolkit provided to community colleges by ATD; this includes all of the 16 WTCS colleges. Utilizing the toolkit, WTCS colleges were expected to complete a Scale of Adoption Assessment in 2017 that outlined areas of strengths, weaknesses, and next steps towards improvements; as part of the scale of adaption, all WTCS colleges are required to document their progress towards updating admission policies to be more holistic (WTCS Student Success Center, 2019). According to Christina Lorge, Dean of Student Support (personal communication, July 18, 2018), as part of Mid-State's scale of adoption, the admissions policy was updated to include a multiple-measures approach to reduce barriers for students.

Current Trends in Predicting College Readiness and Course Placement

Math remediation and course placement have been examined at both the national and state level and have evolved throughout the years. Nationally, Headden (2011) found that 62% of community colleges used the Accuplacer for course placement and 46% used the Compass test; there were also self-developed assessments and policies used for course placement. Misplacements in development education occur because not all assessments are predictive of student performance (Headden, 2011).

A recommended strategy according to Bailey et al. (2016), is the implementation of multiple measures. Applying multiple measures to place students "could reduce severe misplacements by about 15 percent without changing the remediation rate, or could reduce the remediation rate by 8 to 12 percentage points while maintaining or increasing success rates in college-level courses" (Scott-Clayton, 2012, para. 3). Types of measures include high school grade point average, a specific grade in a gate-keeper course such as math or English, a score on a college readiness test, work and life experiences, and non-cognitive measures. Bailey et al. (2016) recommend postsecondary institutions explore measures that are realistic and can be reliably measured, then pilot methods to understand placement rates and success rates.

In the state of Nevada, one such pilot occurred. The Regional Educational Laboratory Program (2008) examined math course placement in more detail when Nevada's two-year college institutions put an emphasis on other variables that could be used to predict a student's success in college-level math courses. At the time of the study, the state of Nevada adopted a universal policy of placing newly admitted college students in Pre-Algebra, Elementary Algebra, or Intermediate Algebra when required cut scores were not met. The study found that 70.1% of first semester students attending a two-year college were referred to remedial math courses based

on ACT or Accuplacer results. The study also found that percentage significantly decreased to 19.6% for students who completed a math course during their senior year in high school (Regional Educational Laboratory Program, 2008). The results suggest that the courses taken at the high school level could be an accurate indicator for course placement at the college level.

In addition to examining predictors of success at the time of admission, models of accelerated learning strategies are being piloted at two-year colleges to shorten the sequences of developmental education with the intent to improve credential completion (Jaggars et al., 2014). There are numerous models of accelerated learning strategies, including, but not limited to, the following: stacked remedial courses with college-level courses, combining multiple remedial course content into one course, and shortened number of weeks to complete coursework. Bailey et al. (2016) reported that participation in accelerated remediation reduced the negative effects of being enrolled in remediation. It further noted, "Acceleration may promote persistence and academic success because the reduced time in developmental education also reduces the opportunity for external factors, such as work or family responsibilities, to hinder students' success" (Bailey et al., 2016, p. 35).

Jaggars et al. (2014) researched the impact of two differing accelerated remedial programs: combining two three-credit courses into a six-credit remedial course and pairing college-level courses with tailored supports, much like the technical college in this study is doing for math. Jaggars et al. (2014) investigated the impact of pairing English 101 with an additional hour taught by the same instructor covering supplemental writing concepts previously taught at the remedial level at the Community College of Baltimore County. The study found that students enrolled in the accelerated program were 28% more likely to complete the college-level course over students that completed the remedial course (Jaggars et al., 2014). Students enrolled

in the accelerated model at the Community College of Baltimore County also experienced an increase in the following areas for students with low test scores: gate keeper course completion, gate keeper course enrollment, gate keeper pass rates, and college-level credit accrual (Jaggars et al., 2014).

Studies such as the ones conducted in Nevada and Baltimore have prompted states throughout the country to review admissions policies and how students are placed in math courses (Kwon & Ngo, 2014). In their research on admissions within the Los Angeles Community College District, Kwon and Ngo (2014) found that students placed in the higher level math course based on high school GPA or high school math credits had similar college-level math completion rates as students who were admitted based on higher test scores.

The WTCS also conducted research regarding variables that colleges could use in the admissions process to predict successful completion of a college-level math. Based on data from the 16 schools within the technical college system, WTCS (2018) identified the following factors as having a positive association on College Math completion rates: full-time status, age 25 or older, female gender, pre-college momentum (obtained credit for prior learning, high school dual credit, or transfer credit), and concurrent enrollment in ABE support services. At the 2018 Common Grounds Conference, many WTCS general education and ABE deans shared their respective college's progress on using multiple measures for placement into College Math, with many colleges focusing on high school GPA for course completion. The WTCS Education Director – Performance Analysis and Continuous Improvement, announced at the same conference that high school GPA could not be reviewed due to WTCS colleges not being required to submit GPA results to the system office (personal communication, October 24,

2018). Additional research is needed to review whether high school GPA truly is a measure that predicts students' success

The WTCS has also identified measures that are hard to obtain at time of admission, but could potentially have an impact. These measures include, but are not limited to, procrastination tendencies, determination, feeling connected to the college, health, and external support system (WTCS, 2018). Studies have shown that student effort in particular can be measured and impact student success. Based on a study conducted by Acton et al. (2013) it was a combination of math readiness and a student's effort level (attendance and on-time homework submittals) that contributed to math completion rates. Students with a low math readiness score and a high effort level had a 74% completion rate; that rate decreased to 19% for students with a low math readiness score and a low effort level (Acton et al., 2013). Grit assessments have also been used at time of admissions in an attempt to predict a student's effort level. According to a study by Hussain and Wolters (2015), the grit assessment successfully predicted submitting schoolwork in a timely manner and utilization of college resources. Grit assessments have not only been used to predict successful completion of courses, they have been used to predict a student's determination to complete a program (Hussain & Wolters, 2015).

Math and Program Completion

The connection between math ability and course/program completion can be seen at the high school level as well as the college level. Williams (2009) found that 81% of high school students who were successful in the dual credit Accounting 1 and 2 courses at Sheboygan South High School also earned a letter grade of A or B in their high school Algebra 1 course. A study conducted by Shotwell (1999) showed that the levels of high school math course completed impacted core accounting course completion at the college level. In her study, 88% of students

who completed Calculus prior to enrolling in Financial Accounting successfully completed the course, compared to 62% of students who only completed Pre-Calculus (Shotwell, 1999). This connection of math course completion and core program course completion can be contributed to the amount of mathematical reasoning involved in solving theoretical and practical problems in business related programs (Arivarignan & Bharati, 2015).

The impact of math ability and course completion can also be seen in other fields. In a study by Alameida and Dunham (2017), students enrolled in California Community College's nursing programs achieving the required math cut score were 6.45 times more likely to complete the entire program than students scoring below the cut scores on the first attempt. For science, technology, engineering, and math (STEM) programs at a large university in the southeastern United States, Belser, et al. (2018) found that for each point increase on the math algebra placement test, retention rates increased by 1.005 times. Belser et al. (2018) also found that completing higher-level math courses resulted in higher completion rates in STEM programs.

In another study, the following factors were analyzed for predicting retention and program completion: high school GPA, math/science self-efficacy, and college GPA during the first semester. In the study of 280 university students (Bonitz et al., 2014), results showed that using high school GPA alone accurately predicted the student dropout rate by 36%; the percentage increased to 40.5% when math/science self-efficacy was taken into consideration. The accuracy of predicting dropout rates increased to 42% when the first semester college-GPA was included with high school GPA and math self-efficacy scores. On the other hand, the study found that math self-efficacy did not increase or decrease the accuracy of predicting student success rates (Bonitz et al., 2014). The study measured math self-efficacy using math ACT scores taken when the students were in high school. Based on this study, math self-efficacy could

be used to proactively identify students with a higher risk of dropping out so that the proper remediation, support, and resources can be offered to promote success. One such support is the offering of supplemental instruction. In a study conducted by BrckaLorenz et al. (2012), students were surveyed at 48 institutions offering supplemental instruction and the following benefits with regards to the student satisfaction rating were found: level of academic challenge, amount of student-faculty interaction, supportive campus environment, high order thinking, integrative learning, reflective learning, gains in practical competence, and gains in general education.

The need for mathematical ability at the college level relates to the mathematical reasoning needed in the workplace.

> What we do know is that mathematics outside of school arises from a context that often has ambiguous elements. There is no label at the top of a page giving a clue, such as "Solving Two Equations in Two Unknowns." Adults in numerous fields have to develop the problem that needs solving, make the measures or collect the data that might be needed, put together a strategy for attacking the problem, carry out the strategy, and then ask if the solution makes sense in the real context of the problem. If not, they try again. Clever, creative strategies count in the real world, but what counts even more is good solutions. (Lappan, 1999, para 8)

Employers expect this mathematical ability from program graduates due to the many tasks that use various components of mathematical reasoning: controlling machines, analyzing data sets, ensuring quality control, and multi-step problem solving (Lappan, 1999). For students to master the abstract concepts of mathematics and utilize them in real-life situations, instruction has to go beyond learning just the fundamentals, but students need the fundamentals to understand how to apply mathematical strategies and techniques in the workplace.

Summary

It is clear from a review of existing literature that admission policies have adapted throughout the years to meet the needs of the student population and respond to policy changes. Two- and four-year institutional admission policies balance the need to keep new tuition revenue coming in each year, and the college's overall outcomes needed to receive federal and state aid. Nationally and locally, there is a legislative focus on program completion with the passing of President Obama's American Graduation Initiative. Tinto's theory stresses the need for colleges to develop policies that meet the needs of all students, in order to increase student retention and completion rates. Trends in admission policy changes reflect this and research results indicate use of multiple measures for college admission has improved course and program completion rates. The research also suggests that math ability is connected to program completion. The focus of this research at Mid-State will add to the literature on the impact of multiple measures for admissions on completion rates for students enrolled in college math.

Chapter III: Methodology

In January 2018, Mid-State Technical College (Mid-State) updated the admission process to include the use of high school GPA and math course specific high school GPA as a measure to allow enrollment into College Math. Previously, students were required to achieve an Accuplacer arithmetic score of 55 or an ACT score of 17 or higher prior to enrolling in College Math. With these updates, the purpose was to increase enrollment and student success. In reaction to the admission update, Mid-State also implemented an additional hour of instruction per week in College Math to help underprepared students succeed.

The purpose of this study was to research whether the new admission process and class structure had an impact on College Math completion rates for students who would have been referred to remedial coursework under previous policies. More specifically, it focused on the following questions:

1. What impact did the updated admissions policy have on student success in College Math?
2. What impact did the additional supplemental instruction have on College Math completion rates?

This chapter describes the research design, as well as the data collection and analysis process.

Research Design and Data Collection

The quantitative research design selected for this study was non-experimental. According to Jurs and Wiersma (2009), non-experimental quantitative research is one of the most used research designs in education because it can be used to identify relationships between variables as they occur in a natural setting. Ex post facto data was used to complete this research. Data was requested from and provided by Mid-State's Institutional Research &

Quality Department. Using data that was reported in Peoplesoft (the software system used by Mid-State to collect data and maintain student records), the Data Reporting Specialist provided graded class rosters, ACT/Accuplacer test scores, and attendance records. To protect the privacy of the students involved in the study, the names and student identification numbers were replaced with "Student XXX" with "XXX" representing a numerical value assigned at random to each student. Even though the multiple measures policy was implemented during the Spring 2018 semester, data was requested for students enrolled in College Math at Mid-State during the Fall 2018 and Spring 2019 semesters to make it less likely that students completed previous remedial coursework under the old admission policy.

Data Analysis

Descriptive statistics were used for analyzing data in this study. Frequencies and percentages were used to describe the characteristics of the sample: demographics (ethnicity, income status, disability status, and sex), College Math grades, and attendance hours of supplemental instruction. Based on the data, relationships between entrance test scores and course grades was investigated. Course completion rates of students admitted based on high school GPA or high school course completion were compared to students admitted by test score data. Only attendance records of the additional hour of support were examined to identify if students took advantage of the faculty availability, and if that attendance showed a relationship with overall course completion. A Pearson correlation coefficient analysis was conducted to measure the strength of the relationship between two quantitative variables: College Math GPA and attendance hours. Scatterplots were included to provide a general illustration of the direction, form, and strength of the relationship.

Data was provided and analyzed using Excel. The Excel data analysis add-on tool called Analysis ToolPak was selected for use due to the initial data being provided in an Excel format, and the results produced by the tool were clear and easy to understand by the researcher. Analysis ToolPak allowed for parameters to be selected and output tables to be generated by the program using statistical functions within Excel. This allowed for relationships to be identified between admission criteria, supplemental attendance records, and College Math completion rates.

Limitations

A limitation of the study was working with incomplete data that was reported on students during the 2018-2019 academic year. Mid-State currently does not have a consistent process for capturing a student's high school GPA or the number of math classes completed at the high school level. If the math Accuplacer or ACT scores reported did not meet the previous admission policy's cutoff score requirement, this study assumed that the student was admitted by either the high school GPA or math courses completed in high school. For that reason, those data points were combined into one grouping.

Another limitation that this study did not address was potential inconsistency in GPAs and course completions from varying high schools. The admissions data used could be from high schools within the technical college district, but it could also be from anywhere in the United States. The rigor and academic preparation of students from different high schools could impact whether GPA or course completions are an accurate measurement to use for College Math placement.

Chapter IV: Results

In January 2018, Mid-State Technical College (Mid-State) updated the admission process to include the use of cumulative high school GPA and high school math course GPA as a measure to allow enrollment into College Math with the intention to increase enrollment and student success. College Math is the first course of college-level math and is required in the majority of associate degrees offered at Mid-State. Previously, students were required to achieve an Accuplacer arithmetic score of 55 or an ACT math score of 17 or higher prior to enrolling in College Math. Along with the admission update, Mid-State also implemented an additional hour of instruction per week in College Math to help underprepared students be successful. This study sought to identify whether there was an impact on success rates in College Math as a result of updated processes, including the use of multiple measures at time of admission, and supplemental instruction offered by faculty beyond the traditional class time and office hours. More specifically, it focused on two research questions.

1. What impact did the updated admissions policy have on student success in College Math?
2. What impact did the additional supplemental instruction have on College Math completion rates?

Ex post facto data from Mid-State's Fall 2018 and Spring 2019 semesters were compiled and analyzed using College Math .grade rosters, supplemental course attendance hours, and math ACT/Accuplacer scores. This chapter discusses the results of the data analysis and identifies the relationships found. In this chapter, students who met the previous test score requirements are identified as Group A. Students who were admitted based on updated admission requirements, high school data, are identified as Group B.

Demographics

The College Math student demographics provided in this study came from the demographics provided by the Wisconsin Technical College System's (WTCS) Student Success Dashboard. The dashboard was developed in collaboration with the WTCS system office and leaders from the 16 WTCS colleges to provide a one-stop resource to assess student academic progress towards completion, and as a resource to identify college-wide completion gaps (WTCS Student Success Center, 2019). Demographic information is for all students enrolled in College Math during the Fall 2018 and Spring 2019 semesters. All demographic information was self-reported by the students and was optional for students to provide.

The following were the ethnicity demographics for the 155 students included in the sample of this study: 74% White, 10% Hispanic, 8% Asian, 5% two or more races, 2% American Indian, 1% Black, and 1% not reported. There were 65% of students who identified themselves as being economically disadvantaged; 8% of students reported to have a disability. The sample was made up of 46% females and 54% males.

Research Question 1: What Impact did the Updated Admissions Policy have on Student Success in College Math?

For the purpose of this study, a grade of D or higher was considered successful completion of College Math, to align with Mid-State's graduation policy. During the Fall 2018 and Spring 2019 semesters, 155 students were enrolled in College Math. Of those 155 students, 37 would have been referred to remedial coursework under the previous admissions policy, Group B. Table 1 breaks down the successful completion rates of students in Group A and Group B.

Table 1

Successful Completion of College Math During Fall 2018 and Spring 2019 Semesters

Admission Criteria Used	# of Students with D or Higher		Total
	Fall 2018	Spring 2019	
Group A: Met Previous Requirements: (n=118)	62	35	97 82.2%
Group B: Met New Requirements (n=37)	18	13	31 83.8%

The results show that students who did not meet the previous test result requirements but demonstrated ability through their high school coursework had a 1.6% higher completion percentage than group A.

This study also found that students in Group A outperformed students in Group B when grade distributions were examined (Table 2). The most common grade for students in Group A was a grade of A earned by 38.1%. The next most common grades for Group A were B and F with both grades having 13.6% of the sample. The distribution of grades in Group B were more dispersed. The most common grade in Group B was the grade B earned by 27% of the students. The next most common grade in Group B with 18.9% was the grade C. In Group B, the letter grades of A and F both had 10.8%. Another difference was the grade point average. Using a 4.0 grading scale, the students in Group A had a mean grade point average of 2.8; the students in Group B had a mean grade point average of 2.3. When calculating the grade point average, the W grades were removed due to the fact that a W grade counts as a course attempt, but it does not impact the students' grade point average.

Table 2

Grade Distribution of Students That met Test Results and Students who Were Admitted Based on High School Data

	Group A: Met Previous Requirements (n=118)			Group B: Met New Requirements (n=37)		
Grade	Fall 2018	Spring 2019	Percent	Fall 2018	Spring 2019	Percent
A	30	15	38.1%	1	3	10.8%
A-	2	2	3.4%	1	2	8.1%
B+	2	5	5.9%	0	0	0.0%
B	11	5	13.6%	9	1	27.0%
B-	7	2	7.6%	0	1	2.7%
C+	2	2	3.4%	1	2	2.7%
C	5	0	4.2%	3	3	18.9%
C-	0	1	0.8%	0	0	0.0%
D+	3	1	3.4%	1	0	2.7%
D	0	2	1.7%	2	1	8.1%
F	12	4	13.6%	0	4	10.8%
W	3	2	4.3%	1	1	5.4%

Research Question 2: What Impact did the Additional Supplemental Instruction have on College Math Completion Rates?

This study also analyzed the impact of the supplemental course instruction offered by the faculty throughout the term. Similar to the analysis of the grade impact of the admission policy, the attendance at the supplemental support sessions was broken down between the group that met the traditional test requirements, Group A, and the group that would have been referred to

remedial coursework under the previous admissions policy, Group B. Students with a W grade were removed from this data analysis due to the fact that they were not enrolled throughout the entire semester and did not have the opportunity to attend all of the supplemental class hours. Results are shown in Table 3.

Table 3

Average Supplemental Attendance Hours During the Semester by Grade Distribution

	Group A: Met Previous Requirements (n=118)			Group B: Met New Requirements (n=37)		
Grade	Fall 2018	Spring 2019	Average	Fall 2018	Spring 2019	Average
A	11.4	10.2	11	49	14.3	23
A-	4	10.8	7.4	11	7.5	8.7
B+	14	10	11.1	N/A	N/A	N/A
B	7.3	9.3	7.9	11.3	18	12
B-	6.7	12.5	8	N/A	20	20
C+	12.5	12.5	12.5	15	11.5	12.7
C	10.2	N/A	10.2	6	4.3	5.2
C-	N/A	24	24	N/A	N/A	N/A
D+	3.7	0	2.6	19	N/A	19
D	N/A	4.5	4.5	14.5	14	14.3
F	4.8	1.9	4	N/A	1.9	1.9

When the hours of supplemental instruction was averaged for the 118 students included in Group A, this study found that the sample attended 8.9 hours of supplemental instruction during the semester that they were enrolled in College Math. The 37 students in Group B attended an average of 11.3 hours of supplemental instruction.

There were students in both groups that did not utilize the supplemental instruction offered who successfully completed the College Math course with a D grade or higher. The completion rate of students that attended zero hours of supplemental instruction is shown in Table 4.

Table 4

Successful Completion of College Math During Fall 2018 and Spring 2019 Semesters for Students With Zero Hours of Supplemental Attendance

Admission Criteria Used	# of Students of D or Higher With 0 Hours of Attendance		Total Percentage
	Fall 2018	Spring 2019	
Group A: Met Previous Requirements (n=19)	9	6	15 78.9%
Group B: Met New Requirements (n=7)	1	3	4 57.1%

The results of Table 4 shows that the completion rate of students in Group A with zero hours of attendance (78.9%) was similar to the completion rate of the entire population of students in Group A (82.2%). On the other hand, Group B shows a lower completion rate for students that had zero hours of supplemental instruction attendance (57.1%) when compared to the overall completion rate (83.8%).

A Pearson product-moment correlation coefficient analysis was conducted to determine the relationship between students' grade point average and supplemental attendance hours for students in Group A and Group B. Group A showed a positive correlation between the two variables, $r = 0.4022$, $n = 113$, $p < .05$. Results were summarized in a scatterplot (Figure 1). Due to the r value being between 0.3 and 0.5, this is considered to be a somewhat weak correlation (Balentyne & Mindrila, 2013) and the dispersion in the scatterplot is evidence of this.

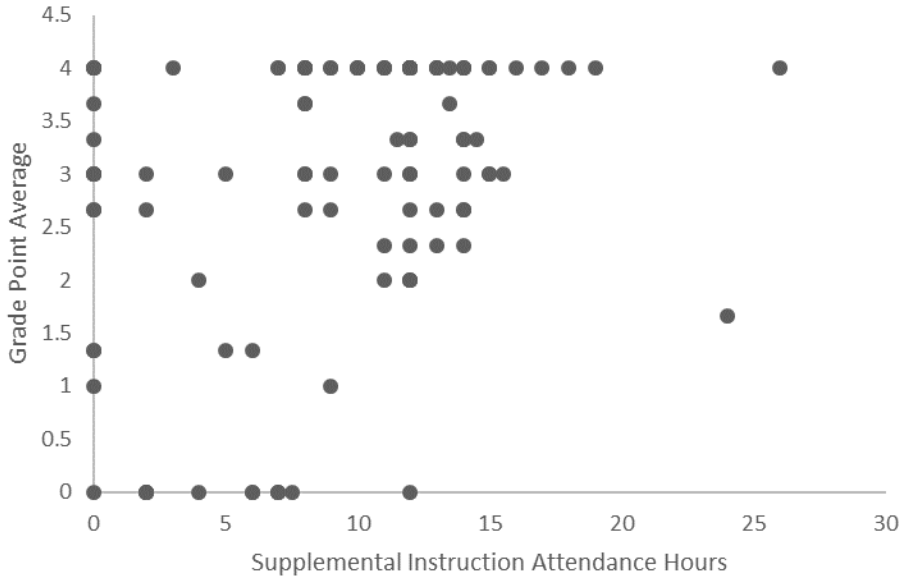

Figure 1. Group A: Previous requirements – correlation of GPA and supplemental attendance hours.

Group B showed a positive correlation between the two variables, r = 0.4803, n = 37, p<.05. Results were summarized in a scatterplot (Figure 2). Due to the r value being between 0.3 and 0.5, this is considered to be a somewhat weak correlation (Balentyne & Mindrila, 2013) and the dispersion in the scatterplot also indicates this.

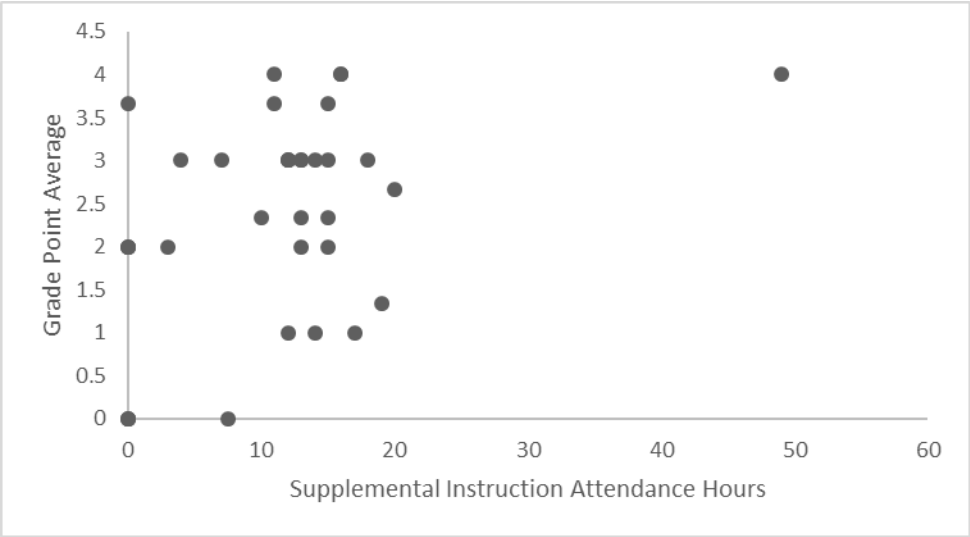

Figure 2. Group B: New requirements – correlation of GPA and supplemental attendance hours.

The scatterplot shows that there was an outlier data point. When this outlier was removed from the Pearson product-moment correlation coefficient calculation, the relationship between the two variables weakened; the r-value decreased to 0.4606 compared to the r-value of 0.4803 calculated when the entire Group B sample size was included.

Chapter V: Discussion, Conclusion and Recommendation

In recent years, there has been a shift from open access admission policies to credential completion with the passing of President Obama's American Graduation Initiative (Bragg & Durham, 2012). Policies no longer focus on getting students in the door; admission policies now are seen as the first step of ensuring that students have the resources and ability to complete their program of study. With program completion being a new focus of two-year colleges, remediation and retention have become a focus of colleges nationwide. Based on the research by Furuta (2017), there is also an initiative in the United States to create a more diverse population in regards to college enrollment by adapting admission policies to be more inclusive. This push for inclusion was spearheaded by advocacy groups for underrepresented minority populations that were not properly course-placed by standardized testing alone (Bahr, Perry, Rosin, & Woodward, 2010). To create an inclusive admissions process, educational institutions are taking a more holistic approach. The updated admission policy at Mid-State Technical College (Mid-State) follows this national trend.

In spring of 2018, an admissions policy at Mid-State was updated to include the use of high school GPA and math specific high school course GPA to waive test requirements (arithmetic Accuplacer score of 55 or math ACT score of 17 or higher) previously needed to enroll in College Math. With the updated test exemption admissions policy, fewer students were required to enroll in the remedial course, Pre-Algebra. At the same time, Mid-State also implemented an additional hour of instruction per week to ensure that underprepared students had the resources needed to be successful.

The purpose of this study was to research whether the new admission process and class structure had a positive or negative impact on College Math completion rates for students who

would have been referred to remedial coursework under previous policies. The questions that guided this research were:

1. What impact did the updated admissions policy have on student success in College Math?
2. What impact did the additional supplemental instruction have on College Math completion rates?

Ex post facto data from Mid-State's Fall 2018 and Spring 2019 semesters were provided by Mid-State's Institutional Research & Quality Department. The following data was included in this study: College Math grade rosters, supplemental course attendance hours, and math ACT/Accuplacer scores. Random numbers were assigned to each student to maintain their anonymity. This chapter addresses the research questions and discusses the findings. It also discusses how the results relate to the literature reviewed. Recommendations are also included for consideration of future research.

Discussion

This research had a sample from one college during a two semester timeframe. The results discussed cannot be generalized, but could be used as initial results that to be built upon in future research projects.

Research question 1: What impact did the updated admissions policy have on student success in College Math? The research showed that students enrolled in College Math based on the new admission policy using high school data had a slightly higher completion rate of 83.8% compared to a 82.2% completion rate of students enrolled based on the previous admission policy of meeting required test scores. This result is similar to the one found by Kwon and Ngo (2014) that found students placed in the higher level math course based on high school

GPA or high school math credits had similar college-level math completion rates as students who were admitted based on higher test scores. The successful completion rate of students admitted by the updated admission policy exceeded the results found by Acton et al. (2013) that showed students with a low math readiness score and high effort level had a 74% completion rate.

Even though this study considered a grade of D or higher as successful completion, it also reviewed the data drilled down by grade to determine if there was a difference between the two sample groups. The most common grade for students that met the traditional test score requirement with 38.1% of students earning a letter grade of A. For the 118 students included in the sample that met the previous test requirements, the average grade point average was 2.8. On the other hand, the most common grade for the students that were enrolled based on the new requirements of using high school data was the 27% of students earning a grade of B. For the 37 students included in the sample that were admitted under the new policy, the average grade point average was 2.3. So even though the completion rate only differed by 1.6%, the difference in the most common grade and mean grade point average showed that the students that met the test requirements that were from the previous admission policy were able to demonstrate higher math ability.

The initial data supports the use of high school data as another way of measuring student readiness. It indicates that using high school data at time of admissions can be a way of predicting a student's effort level, and it can be deduced that students included in this study with low test scores and high grade point averages at the high school level put in additional time and utilized the resources necessary to be successful at the high school level. It can then be concluded that such effort continued at the college level.

Research question 2: What impact did the additional supplemental instruction have on College Math completion rates? The results related to Research Question 2 supported the thought that students enrolled in College Math based on high school data were willing to put additional time and effort into completing the course successfully compared to students enrolled based on test scores alone. Based on the data, students enrolled using high school data who were included in this study averaged an additional 2.4 hours of supplemental attendance compared to students enrolled based on test results.

Students enrolled based on high school data who had a low math score and demonstrated a low-effort level (zero hours of supplemental attendance) had a 57% College Math completion rate; 26.8% lower than all of the students enrolled based on high school data. The results were similar to the results found by Jaggars et al. (2014), whose study found that students enrolled who would have been enrolled in remedial course work were 28% more likely to complete the college-level course when placed in an accelerated course model that offered supplemental instruction. Comparatively, students who were enrolled based on test results and attended zero hours of supplemental instruction had a completion rate of 78.9%, only 3.3% lower than the entire population of students enrolled based on test results. The results would indicate that the supplemental instruction had a positive impact on students enrolled based on high school data who had low test scores. On the other hand, the supplemental instruction had minimal impact on students who were enrolled based on test results.

When a Pearson product-moment correlation coefficient analysis was conducted on both student groups, a positive correlation resulted between students' grade point average and supplemental attendance, but the relationship was weak in both cases ($r=0.4022$ and $r=0.4803$). Even though there was only a weak correlation between the two variables, the fact that students

continued to attend the supplemental instruction indicate that the students thought that the additional support was beneficial. Students could potentially be utilizing the supplemental instruction due to benefits that go beyond the math support. Similar to the findings by BrckaLorenz et al. (2012), supplemental instruction could also have the following effects: development of stronger relationship between students and faculty, students' feeling of being supported by the college, development of study skills, and gains in student confidence.

Conclusions

The sample group of students who would have been referred to remedial math and were directly placed into College Math was taken from two semesters at one college. The findings from this group resulted in completion rates that only differed by 1.6% compared to the students that were directly placed into College Math based on the previous test score admission requirement. This initial data supported the use of multiple measures to determine student readiness for college math course placement. To determine if these results are part of a trend or an exception, additional data in subsequent years needs to be collected and evaluated.

Another aspect of this study that needs data from subsequent years is the grade dispersements of each group to determine if the initial findings are the start of a trend or an exception. The percentage of students that earned a B or better were the following percentage for each group: 61% for Group A and 45.9% for Group B. The percentage of students that earned a C or better were the following percentage for each group: 76.2% for Group A and 70.2% for Group B. Even though students in Group A had a higher percentage of students in the B or above grade range, the difference in percentages decreased when the grade range of C or above was calculated. The majority of students in each group earning a C or better could be due to faculty influence on and student perceptive about the definition of a passing grade. Even

though this study considered a grade of D or better as being considered successful completion, there could be the perception of the grade of C or better as being considered successful completion.

Additionally, this study found that students who would have been referred to remedial courses averaged 2.4 additional hours of supplemental instruction compared to students who met the test results required under the previous admission requirement. This difference could be due to multiple factors. Students who met the previous test score requirement might have had a higher confidence level in their math ability or they might not have known who/how to ask for help. Another potential reason for the lower attendance hours from Group A could be that advisors and instructors did not target that group of students for promotion of the supplemental instruction due to the previous policy considering that group as being ready for course enrollment.

There was also a difference in supplemental instruction attendance hours found in students that did not successfully complete College Math for both groups. The 16 students in Group A that failed College Math averaged only 4.0 hours of supplemental attendance. The five students in Group B that failed College Math averaged only 1.5 hours of supplemental attendance. This lack of attendance might be due to a low effort level by the students included in this sample who were not successful. Another potential cause for the lower attendance hours could be external barriers. Of the entire sample, 65% indicated that they were economically disadvantaged. Due to that fact, students could potentially be working multiple part-time jobs and did not have the additional time to commit to supplemental support or did not have the technological resources required by the course (i.e. computer/internet access and calculator).

In conclusion, based on the initial results, the study supported Mid-State's decision to implement a multiple measures admissions process and the addition of the supplemental instruction in College Math to help support underprepared students. The students who would have previously been referred to remedial math based on test scores, but were enrolled based on high school data, had a slightly higher completion rate than students enrolled based on the previous policy of test requirements. The supplemental instruction was utilized by both groups of students, but it had a greater impact on completion rates for students that were enrolled directly into College Math based on high school data.

Recommendations

Additional research is needed to know the full impact of the updated admission policy to include high school data for course enrollment and the additional supplemental instruction hour included in the College Math class structure. The following future research is needed to fully understand the impact of these updates:

1. Similar research is needed in subsequent years to determine if the initial results were the start of a trend or an exception. As the college and staff adapt to the new process and a new group of students are admitted, results may vary or stabilize.
2. The research included in this study could be expanded to include a focus on student demographics. Data provided by the WTCS showed a decrease in completion rates in general education math courses for the following demographics: minorities, economically disadvantaged, part-time, students with disabilities, males, and students without pre-college momentum (WTCS, 2018). Based on the results of this study, it is unknown if the results at Mid-State would be similar.

3. A qualitative study to gain an understanding of student utilization of the supplemental instruction could help explain the impact of the additional instructor support. It is unclear why some students took more advantage of the resource compared to others. It is unknown if all students felt that the additional support was beneficial. By knowing the student perspectives, the supplemental support could be enhanced and strategically promoted.

College Math is only one course that was impacted by the updated admission process and supplemental instruction course structure. To gain a full understanding of the impact of the updates, the following research is recommended:

1. This research could be replicated to analyze the impact of the admission process on the completion rates of additional general study courses. General studies courses that are commonly taken by students at Mid-State to meet associate degree requirements that could be the focus of future studies include: Oral Communication, Speech, English Composition I, Intro to Sociology, Intro to Psychology, and Ethics.
2. This research could be replicated to analyze the completion rates of occupational courses. Including occupational courses in similar research could verify whether the impact of the updated admission process differs with occupational courses compared to general study courses. It would also show whether the results of this type of research differs between the different occupational areas. This information would allow Mid-State to determine if the admission process by program promotes student success.
3. Mid-State also implemented an additional hour of supplemental instruction to the communications gate-keeper course, English Composition I. Similar to this study,

research is needed to analyze the impact of the supplemental instruction offered by the English Composition I faculty.

4. If the supplemental instruction model is proven to be successful, additional research is needed to identify additional courses should have the supplemental instruction included in the course structure.

Ultimately, on-going research will benefit the students enrolled and aligns with Mid-State's core values: student centeredness, integrity, commitment, accountability, respect, and exceptional service.

References

Achieving the Dream. (2019). About us. Retrieved at https://www.achievingthedream.org/about-us

Acton, T., Allen, J., Beckman, R., Buonaguidi, L., Casillas, A., Crouse, J., Hanson, M., Li, K., Robbins, S., & Zelenka, R. (2013). Readiness, behavior, and foundational mathematics course success. *Journal of Developmental Education, 37*(1), 14-16.

Alameida, M. & Dunham, M. L. (2017). ATI TEAS V cut score for the California Community College nursing programs. *Teaching and Learning in Nursing, 12*(2), 89-94.

Arivarignan, G. & Bharati, R. (2015). Mathematics in business management. *Annals of Operations Research, 233*(1), 1-2.

Baber, L. D., Bragg, D. D., & Castro, E. L. (2010). Measuring success: David Conley's college readiness framework and the Illinois College and Career Readiness Act. Retrieved from https://files.eric.ed.gov/fulltext/ED513397.pdf

Bahr, P.M., Perry, M., Rosin, M., & Woodward, K. M. (2010). Course-taking patterns, policies, and practices in developmental education in the California community colleges. Retrieved from http://files.eric.ed.gov/fulltext/ED512364.pdf

Bailey, T., Bashford, J., Boatman, A., Squires, J., Weiss, M., Doyle, W., Valentine, J. C., LaSota, R., Polanin, J. R., Spinney, E., Wilson, W., Yeide, M., & Young, S. H. (2016). *Strategies for postsecondary students in developmental education – A practice guide for college and university administrators, advisors, and faculty*. Washington, DC: Institute of Education Sciences, What Works Clearinghouse.

Balentyne, P. & Mindrila, D. (2013). Scatterplots and correlation. Retrieved from https://www.westga.edu/academics/research/vrc/assets/docs/scatterplots_and_correlation_notes.pdf

Beale, A. V. (2012). The evolution of college admission requirements. *Journal of College Admission, 214*, 20-22.

Belfield, C. R., & Crosta, P. M. (2012). *Predicting success in college: The importance of placement tests and high school transcripts*. Retrieved from http://www.cfder.org/uploads/3/0/4/9/3049955/predicting_success_in_college_the_importance_of_placement_tests_and_high_school_transcripts.pdf

Belser, C. T., Daire, A. P., Dagley, M. A., Prescod, D. J., & Schillingford, A. (2018). Factors influencing undergraduate student retention in STEM majors: Career development, math ability, and demographics. *The Professional Counselor, 8*(3), 262-276.

Berger, J. B., Ramirez, G. B., & Lyons, S. (2012). A historical look at retention. In A. Seidman (Ed.), *College student retention: Formula for student success* (pp. 12-34). Lanham, MD: Rowman & Littlefield Publishers

Bonitz, V. S., Larson, L. M., Pesch, K. M., Surapaneni, S., Werbel, J. D., & Wu, T. (2014). Predicting graduation: The role of mathematics/science self-efficacy. Retrieved from https://pdfs.semanticscholar.org/e97b/965453eb4c99dab911098dcf917480603c52.pdf

Bragg, D. D. & Durham, B. (2012). Perspectives on access and equity in the era of (community) college completion. Retrieved from https://journals.sagepub.com/doi/pdf/10.1177/0091552112444724

BrckaLorenz, A., Ribera, A. K., & Ribera, T. (2012). Exploring the fringe benefits of supplemental instruction. Retrieved from http://cpr.indiana.edu/uploads/AIR%202012%20(SI%20Final).pdf

Carnevale, A. P., Smith, N., & Strohl, J. (2013). Recovery job growth and education requirements through 2020. Retrieved from https://cew.georgetown.edu/wp-content/uploads/2014/11/Recovery2020.FR_.Web_.pdf

Chen, X. (2016). Remedial coursetaking at U.S. public 2- and 4-year institutions: Scope, experiences, and outcomes. Retrieved from http://nces.ed.gov/pubsearch.

Chen, X. & Simone, S. (2016). Remedial coursetaking at U.S. public 2- and 4- year institutions: Scope, experiences, and outcomes. Retrieved from https://nces.ed.gov/pubs2016/2016405.pdf

College Board. (2019). K-12 educator brief the college and career readiness benchmarks for the SAT suite of assessments. Retrieved from https://collegereadiness.collegeboard.org/pdf/educator-benchmark-brief.pdf

Dadgar, M. & Xu, D. (2018). How effective are community college remedial math courses for students with the lowest math skills?. *Community College Review, 46*(1). doi:10.1177/0091552117743789

De Paola, M. & Scoppa, V. (2015). Procrastination, academic success and the effectiveness of a remedial program. *Journal of Economic Behavior and Organization, 115.*

Edgecombe, N. (2011). Accelerating the academic achievement of students referred to developmental education. *CCRC Working Paper No. 30.* Retrieved from http://ccrc.tc.columbia.edu/publications/accelerating-academic-achievement-developmental-education.html

Elliot, J., Lambeth, J. M., & Joerger, R. M. (2009). Implications for focusing research I career and technical education and workforce development. *Career and Technical Education Research, 34*(3), 137-153.

Ferguson, R., Schwarz, R. B., & Symonds, W. C. (2011). Pathways to prosperity: Meeting the challenge of preparing young Americans for the 21st century. Retrieved from https://www.gse.harvard.edu/sites/default/files/documents/Pathways_to_Prosperity_Feb2011-1.pdf

Furuta, J. (2017). Rationalization and student/school personhood in the U.S. college admissions: The rise of test-optional policies, 1987 to 2015. *Sociology of Education, 90*(3). *doi:10.1177/0038040717713583*

Gladieux, L. E. (1995). Federal student aid policy: A history and an assessment. Retrieved from https:www2.ed.gov/offices/OPE?PPI/FinPostSecEd/gladieux.html

GuideStar. (2019). College Entrance Examination Board. Retrieved from https://www.guidestar.org/profile/13-1623965

Headden, S. (2011). How the other half test: Millions of Americans are denied the chance to take college-level courses by a downscale version of the SAT. *Washington Monthly, 42*(9-10), 32.

Hughes, K.L. & Scott-Clayton, J. (2011). Assessing developmental assessment in community colleges. *Community College Review, 39*(4), 327-351.

Hussain, M. & Wolters, C. A. (2015). Investigating grit and its relationship with college students' self-regulated learning and academic achievement. *Metacognition and Learning, 10*(3), 293-311.

Jaggars, S. S., Hodara, M., Cho, S., & Xu, D. (2014). Three accelerated developmental education programs: Features, student outcomes, and implications. Retrieved from http://ccrc.tc.columbia.edu/publications/three-accelerated-developmental-education-programs.html

Jurs, S. G. & Wiersma, W. (2009). *Research methods in education: An introduction.* (9th ed.). Boston, MA: Pearson.

Killgore, L. (2009). Meri and competition in selective college admissions. *Review of Higher Education, 32*(4), *469-488.*

Kwon, W. W. & Ngo, F. (2014). Using multiple measures to make math placement decisions: Implications for access and success in community colleges. *Research in Higher Education, 56*(5), 442.

Lappan, G. (1999). Mathematics and the workplace. Retrieved from https://www.nctm.org/News-and-Calendar/Messages-from-the-President/Archive/Glenda-Lappan/Mathematics-and-the-Workplace/

Lopukhova, O. (2012). *The influence of developmental mathematics classes on the successful completion of the higher level mathematics courses*. (Master's thesis). University of Wisconsin-Stout, Menomonie, WI.

Mid-State Technical College. (019). Mission, vision, & core values. Retrieved from http://www.mstc.edu/mission-vision-core-values

National Skills Coalition. (2015). *Wisconsin's forgotten middle*. Retrieved from http://www.nationalskillscoalition.org/resources/publications/2017-middle-skills-fact-sheets/file/Wisonsin-MiddleSkills.pdf

Regional Educational Laboratory Program. (2008). Examining the links between grade 12 mathematics & remedial courses in Nevada public colleges & universities. Retrieved from http://ies.ed.gov/ncee/edlabs/projects/index.asp

Scott-Clayton, J. (2012). Development, discouragement, or diversion? New evidence on the effects of college remediation (*National Bureau of Economic Research*). Retrieved from National Bureau of Economic Research website: http://www.nber.org/papers/w18328.pdf

Shotwell, T. (1999). Comparative analysis of business and non-business students' performances in Financial Accounting: Passing rates, interest and motivation in accounting, and attitudes toward reading and math. *College Student Journal, 33*(2), 181.

Stevens Point Area Public School District. (2018). School accountability report cards. Retrieved from https://www.pointschools.net/Page/5082

Tinto, V. (1993). *Leaving College: Rethinking the causes and cures of student attrition.* Chicago, IL: University of Chicago Press.

Williams, T. (2009). *Analysis of the relationship of math ability and success in accounting 1 and 2 at Sheboygan South High School.* (Master's thesis). University of Wisconsin-Stout, Menomonie, WI.

Wisconsin Technical College System. (2018). 2018 Common Grounds Conference handouts. Retrieved from https://mywtcs.wtcsystem.edu/student-success/adult-basic-education/resources

Wisconsin Technical College System. (2019). General college developmental remedial. Retrieved from https://mywtcs.wtcsystem.edu/student-success/adult-basic-education/general-college-developmental-remedial

Wisconsin Technical Colleges. (2019). Who we are. Retrieved from https://www.wistechcolleges.org/get-know-wisconsin%E2%80%99s-technical-colleges

WTCS Student Success Center. (2019). Scale of adoption assessment resources. Retrieved from https://mywtcs.wtcsystem.edu/student-success/wtcs-student-success-center