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Custom Advising's Effect on Success and Retention of Developmental Math Students

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This is to certify that the doctoral study by

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Walden University
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Abstract

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MM, West Virginia University, 2012

BA, Marshall University, 2003

Doctoral Study Submitted in Partial Fulfillment

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Abstract

The number of high school graduates entering college needing to take developmental math courses is increasing. Gilmer State College (a pseudonym) introduced customized scheduling in which students identified as *at risk* after scoring low on the math entrance exam are placed in the developmental math course and additional courses that traditionally have a pass rate of 75% or better. The purpose of this study was to examine the difference in passing and retention rates between 1st-time college freshmen who attended Gilmer State College before the customized scheduling and after the customized scheduling was implemented. This study was based on Adelman's theoretical framework of academic momentum because students tend to continue their studies when experiencing initial success. In this causal-comparative study, archival passing and retention rates for students identified as at risk from the previous 5 years were compared to 137 students who took the developmental math as a part of the aforementioned customized schedule in the fall semester of 2017. The chi-square test indicated that there was not enough evidence to support an increase in student passing rates in developmental math courses when taken as part of a customized course schedule ($p = 0.054$) but did show a statistically significant difference in retention rates ($p < 0.001$). The results of this study might generate positive social change by providing a framework in which collegiate institutions can help to discover alternative methods of helping at risk students succeed academically.

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Section 1: The Problem

Introduction

The purpose of this project study was to investigate what effect (if any) that customizing the course schedules of students requiring developmental math as a part of their undergraduate studies had on the success and overall retention of these students. The study, which was conducted at Gilmer State College (GSC, a pseudonym) in Glenville, West Virginia, involved a departure from the traditional way of advising. In the past, each academic department (of which the college has nine) used a "one-size-fits-all" approach to advising in which each student followed a predetermined academic schedule agreed upon by the faculty members of said department in an effort to make sure that each student graduated in 4 years.

Recent research conducted by current faculty members at GSC (Evans, Daniel, & Walborn, 2014) determined that students requiring developmental math courses as determined by ACT/SAT scores were predisposed to successfully complete certain courses while other courses showed very high failure rates. This same research indicated that once developmental math courses are successfully completed, all required courses show a great increase in success. Through this project, I sought to determine whether students requiring developmental math are more successful when placed in courses that include the required math, a freshman success course, and a course load not to exceed 16 credit hours. In addition, the schedule consisted only of courses shown to have a success rate of 75% or better for these students to determine if early success led to higher retention rates among this subgroup of students.

Definition of the Problem

Over the past several years, colleges and universities have seen an increase in the number of students entering college ill prepared for collegiate-level math courses. According to Winders and Bisk (2014), almost half of the students entering college currently require a noncredit developmental math course prior to enrollment in a collegiate-level math course. Unfortunately, students who enter college requiring a developmental math course are statistically less inclined to successfully complete their degree programs (Laskey & Hetzel, 2011). Although the number of students requiring developmental math courses in college is high, the data show that successful completion of these courses via early and numerous advisor interventions leads to higher student retention and graduation rates (Silverman & Seidman, 2012). What the literature fails to show is whether developmental math, when taken as a part of a course schedule custom-designed for each student requiring developmental math, can increase student success and retention.

GSC serves a student body consisting of 70% first-time freshmen who require developmental math (G. King, personal communication, September 18, 2015). According to Chen (2016), this is almost double the national average for first-time college freshmen requiring developmental math courses. In addition, students requiring developmental math who do not successfully complete the course by the end of their freshman year are 44% more likely to leave college without completing their degree program. At GSC, of the students who enrolled in and failed developmental math during the Fall 2016 semester, 43% opted to not return for Fall 2017 (N. Benson, personal

communication, May 26, 2017). Given that GSC serves such a large population of students unprepared for collegiate-level math courses, drawing comparisons between successful completion of developmental math courses and increased student retention should prove beneficial to the institution.

Rationale

Evidence of the Problem at the Local Level

The impetus of this study was the need to discover methods for increasing college retention rates. The research was conducted at GSC, which is located in rural central West Virginia. The setting for this research was of utmost significance. According to the U.S. Census Bureau (2014), only 17.9% of West Virginia residents possess a 4-year degree, and just 10% of residents of central West Virginia, where GSC is located and from which 80% of the student population originates (P. Barr, personal communication, May 26 2017), hold a 4-year degree. This statistic means that West Virginia, and particularly rural central West Virginia, has the lowest percentage of residents with a college degree in the nation. The timeliness of the study was also important, as by 2018 it was estimated that half of the state's workforce would require a postsecondary degree (West Virginia Higher Education Policy Commission, 2013). This burden is even heavier for students identified as requiring developmental math courses, as only 27% of students entering college needing developmental math successfully complete their degree program (U.S. Department of Education, 2010). The results of this study provide significant data regarding methods by which the success rates of all first-time freshmen requiring developmental math (referred to as *at risk*) can be increased to meet the

educational demands of the evolving workforce in West Virginia as well as the rest of the nation.

As previously mentioned, lack of student success in developmental math courses increases the chances of students leaving college having not completed their intended degree program. The burden of being the first generation to attend college as well as coming from a low economic background also contribute to lack of success in undergraduate programs. According to the Postsecondary National Policy Institute (2017), the national college graduation rate for first-generation/low-income students is 11%. The average number of first-time freshmen attending GSC who are considered first generation and low income is currently 65% (P. Barr, personal communication, May 26, 2017) against a national average of 25% (Postsecondary Policy Institute, 2017). As these data illustrate, the need to research and develop methods for increasing the success of the student population at GSC is crucial.

Evidence of the Problem From the Professional Literature

According to the literature, the connection between developmental math and student success is not confined to West Virginia or rural settings. Lack of success in developmental math and its connection to low rates of college completion for students requiring these courses have been identified by Tough (2014) as representing a "devastating obstacle" (p. MM26) for college freshmen, especially those identified as low income. Low college completion rates for these students have led legislators, as well as college administrators in many states, to actively call for complete overhauls of how these courses are taught (Cafarella, 2016). Some institutions have gone so far as to

institute monetary incentives to encourage successful completion of developmental math courses. In an effort to increase completion of developmental math courses at Hillsborough Community College in Tampa, Florida, students were awarded a scholarship of $600 per semester for successful completion (Sommo et al., 2014). While much literature currently exists on possible causes and remedies for increasing the success rates of students enrolled in developmental math (Ashby, Sadera, & McNary, 2013; Cox, 2015; Davidson & Petrosko, 2015), Fong, Melguizo, and Prather (2015) brought attention to the fact that relatively little literature currently exists on the expansion of traditional college completion models in an effort to achieve the same goal. Scrivener et al. (2015) mirrored this sentiment, arguing that while much literature has been published about the need for strategies to help students succeed in developmental math, relatively little literature exists that illustrates such methods. As the literature indicates, the development and implementation of new techniques for ensuring the successful completion of developmental math will be of universal benefit.

Definitions

At-risk: Used as a reference to define students who are likely to fail in an academic setting (Wolff, Zdrahal, Nikolov, & Pantucek, 2013).

Developmental math: A math course required for students that must be completed before enrolling in a higher level math course (Marchitello & Brown, 2015). For the purposes of this study, the students for whom a developmental math course was required had an ACT math score below 19 or an SAT math score below 460 as defined by the GSC Department of Academic Affairs.

FIW: An acronym for "failure due to irregular withdrawal" (Gilmer State College Handbook, 2016).

Freshman success course: A course typically taken by first-time freshmen that is used as a means to help students transition from high school to college life (Cho & Karp, 2013). For the purposes of this study, freshman success courses were referred to as GSC 100, the course title used at GSC.

Significance

Over the past several years, colleges and universities have seen an increase in the number of students entering college ill prepared for collegiate-level math courses. According to Fong et al. (2015), over half of college students currently entering public institutions will need to enroll in at least one developmental math course. The successful completion of said course, with data that illustrate a higher percentage of student retention (Silverman & Seidman, 2015), should be viewed as integral to the successful increase of graduation rates. Nationwide, increasing graduation rates should be viewed as having the utmost importance. Economic outlooks from each state show that the labor market will be demanding more workers with college degrees over the next decade (Oliff, Palacios, Johnson, & Leachman, 2013). As previously mentioned, West Virginia, the site of this study, is currently identified as possessing a population with the least amount of 4-year degrees while at the same time witnessing an increase in the number of jobs requiring such credentials. In central West Virginia specifically, where the economy is struggling to adapt to the dwindling of the oil and gas industry it has long relied upon, it is imperative that more high school graduates successfully complete 4-year degrees in

order to successfully compete in a workforce where these qualifications are urgently needed (Hill & Tucker, 2016). Investigation into alternate techniques to help students succeed in developmental math courses could prove to be of wide-ranging significance to postsecondary institutions that seek to counter the demand for an increase in graduation rates while facing a student body that is increasingly inadequately prepared for collegiate-level math courses, which could hinder their successful completion of a college degree.

Research Questions and Hypotheses

As evidenced by the literature, a look into possible methods for increasing student success in developmental math courses at the collegiate level was warranted. It was the ultimate goal of this research to investigate what effect (if any) that customizing the course schedules of students requiring developmental math as a part of their undergraduate studies had on the success and overall retention of these students. While many changes to content and course delivery have been implemented to increase student success in developmental math courses, there is a distinct lack of literature specifically addressing student schedules. If a student frequently and consistently receives a grade of "F," "W," or "FIW" in developmental math, it could be inferred that the academic load is too great. A course load specifically created with a combination of courses that the data show results in high passing rates for at-risk students could translate into greater success rates for developmental math and, in turn, higher retention rates, and that is what this research sought to discover. I gathered data to answer the following research questions:

RQ1: Is there a significant difference in the rates of successful completion of developmental math between students who are placed in courses based on a customized schedule and those who are not?

It was hypothesized that students who were placed in the customized schedule of courses would show a higher rate of successful completion of the developmental math course than those who were not. The null hypothesis was that no difference between the two student groups would be seen in regard to the successful completion rate of the developmental math courses.

RQ2: Does early completion of developmental math courses impact student retention?

It was hypothesized that students who successfully completed developmental math courses early in their collegiate career would show a higher rate of retention than those who did not. The null hypothesis was that there was no difference in the retention rates of students based on when they passed developmental math courses.

Review of the Literature

There has been much literature published recently regarding the increase in the need for developmental math courses at postsecondary institutions. The number of students who enter 4-year institutions and community colleges requiring developmental math courses has seen a significant increase over the past decade (National Association for Developmental Education, 2013). Unfortunately, the literature indicates that while the number of students requiring developmental math courses is on the rise, the number of students requiring these courses who successfully complete their degree programs is

significantly less than the number of those entering college able to enter collegiate-level math courses (Cafarella, 2016; National Center for Education Statistics, 2015; Silverman & Seidman, 2015). In addition, many of these students fail and repeatedly enroll in these courses, causing financial strain not just for the students, but also for the institution (Acosta, North, & Avella, 2016).

Student Placement

Problems regarding student success in developmental math are not a new phenomenon. In higher education, developmental math has been under scrutiny from college administrators and legislators alike for many years (Cafarella, 2016). The idea behind developmental courses is to allow students an opportunity to better prepare themselves in a certain subject area prior to enrolling in a course for college credit (Marchitello & Brown, 2015). The past two decades have seen a great increase in students requiring developmental math courses upon entering college, which has led to an increase in the amount of time and attention spent on this topic. The past 20 years have seen a great deal of published research regarding improvements at the grade school level, a review of best practices currently in use at various colleges, and systematic policies to improve the skills of these students (Melguizo, Kosiewicz, Prather, & Bos, 2014). The past decade, however, has seen the focus narrowing on the assessment and placement of the students requiring these courses (Melguizo et al., 2014; Ngo, Kwon, Melguizo, Prather, & Bos, 2013; Zeintek, Schneider, & Onwuegbuzie, 2014).

The most common tools used for determining appropriate math levels for first-time freshmen are standardized test scores such as ACTs or SATs (Kosiewicz, Ngo, &

Fong, 2016). Should a student enroll in a community college or open-enrollment institution without having taken one of the aforementioned tests, the institution will often have the student complete a similar placement test using programs such as Accuplacer, the Computer-Adaptive Placement Assessment and Support System (COMPASS), or the Mathematics Diagnostic Testing Project (MDTP). According to Melguizo et al. (2014), accurate placement in a math course is simply too complex to be based on a test score. The authors argued that one reason for this complexity is the variance allowed by institutions across the country. There is no "magic number" to determine the cutoff score indicating whether or not a student can enroll in a for-credit math course; therefore, each college is able to determine what it deems an appropriate test score. Additionally, who is to say whether or not the individual institutions are setting accurate cutoff scores? Some research indicates that a systematic, universal set of scores should be used to determine accurate placement in math courses (Melguizo et al., 2016).

It has also been discovered that placement in what has been deemed an appropriate math class is based on a decision made by parties who do not possess appropriate knowledge regarding content. This has been exposed in places such as the Los Angeles Community College District, where a 2014 study determined that both the faculty members and administrators assigned to the task of ensuring that students were placed in the appropriate math classes were woefully under qualified to make such decisions (Melguizo et al., 2014). In addition, the standardized test scores that are often used as a key indicator of which math would be best appropriate for each student are often not reliable. Hodara and Cox (2016) instead argued that reliance on test-based

measures for determining whether or not a student could benefit from a developmental math course should be abandoned in favor of high school grade point average (GPA). According to the authors, high school GPA serves as a much more reliable indicator of success, as not only does it serve to illustrate the cognitive ability of the student but also, when viewed as an aggregate of academic achievement across many disciplines, should be considered a more accurate predictor of college readiness.

Best Practices

Despite the frustration developmental math courses bring with them, it is important to note that a great deal of successful teaching methods do exist. According to Cafarella (2016), cooperative learning environments have exhibited many benefits in the developmental math classroom. By definition, cooperative learning involves both formal and informal activities that entail and encourage interaction among peers (Arendale, 2016). Typically, students enrolled in these courses enter the classroom already anxious and nervous at the thought of being in a course in which they lack the necessary skills (Cafarella, 2016; Hogan, 2016). Cooperative learning not only allows these students to feel more at ease with the content, but also places emphasis on mastery of skills as opposed to academic performance (Hogan, 2016). This focus on individual student mastery associated with cooperative learning is often preferable with students. According to Mesa (2012), developmental math students show significantly higher motivation toward mastering skills as well as greater appreciation for teachers who facilitate this type of learning environment.

Expanding the use of technology in developmental math courses has proven to be a very successful method for delivering instruction as well. As recent literature has made evident (Desy, Reed, & Wolanskyj, 2017; Gibson & Sodeman, 2014; Holland & Piper, 2016; Oh & Reeves, 2014), the majority of first-time freshmen are much more fluent in the use of technology than they were a generation ago. The increase of technology use in the classroom at the grade-school level as well as society's increased reliance on technology to get information has led to a generation of college students who are much more willing to use and adept at using many forms of technology. In turn, this has led to increased success in developmental math courses when appropriate software, computer programs, and websites are added as a supplement to instruction (Saxon, Martirosyan, Wentworth, & Boylan, 2015). In addition, the frequency of online learning programs in postsecondary education has led to nontraditional students becoming more comfortable with using educational technology. According to Okimoto and Heck (2015), traditional developmental math classes that have evolved into more technology-based learning over the past decade have witnessed dramatic improvements in course completion rates.

Another approach to teaching developmental mathematics that has witnessed much success is based on the concept of course structure. Professor Selina Vasquez, a developmental math professor at Southwest Texas State University, expanded on the concept of course structure by basing her course delivery on an algorithmic instructional technique (AIT) in which both fundamental and problem-solving skills are addressed in a steady four-phase progression (Cafarella, 2016). The first phase, *modeling*, involves traditional instruction from the instructor. The next phase, *practice*, involves students

attempting to interpret these concepts on their own while incorporating frequent feedback from the instructor. *Transition* is the next phase, which involves students gradually becoming less reliant on the instructor's guidance before entering the final phase, *independence*. Similar instruction in developmental math courses involving changes to course structure such as comprehension monitoring (Lein, 2016) has been implemented as well with varying results.

Alternatives to Traditional Developmental Math Courses

Changes to the delivery of developmental math courses have seen much attention in the literature as of late. In one of the most often cited sources on this topic, Rutschow and Schneider (2011) reported grouping various attempts at alternative approaches to developmental math into four extensive categories: alternatives that significantly lessen the time a student spends in developmental math courses, courses that combine developmental coursework with the attainment of college credit, programs that require supplements to instruction such as labs and/or tutoring, and finally intervention-based strategies that target these students prior to entering college. Kosiewicz et al. (2016) further investigated the concepts illuminated by Rutschow and Schneider by analyzing how community colleges in California, an area with a particularly high rate of students entering institutions requiring developmental math, used various alternatives to traditional developmental math instruction to increase student success in these courses. It was ultimately discovered that while alternative methods to teaching developmental math courses did yield positive results, student success was often stifled by the unwillingness of senior faculty members to embrace these alternative methods.

According to Grubb and Gabriner (2013), the resistance to alternative methods of teaching developmental math is unfortunate for two reasons. First, the enrollment of a student in developmental math not only increases the amount of time the student spends working on a degree program, but also increases costs for the student. These two burdens often result in the student becoming frustrated and disinterested in the collegiate experience and increase the likelihood of the student not enrolling in subsequent semesters (Melguizo et al., 2016; Ngo & Kosiewicz, 2017; Okimoto & Heck, 2015). Second, the more traditional approaches to developmental math instruction are often lecture based and employ teaching methods with a foundation in drill-based learning exercises that often have very little in common with application in the real world and therefore do not respond adequately to the academic demands of developmental math students (Grubb & Gabriner, 2013). Ngo and Kosiewicz (2017) echoed this sentiment by asserting that while less skilled math students might require more time to remediate skills necessary for college-level coursework, this approach is actually more beneficial in pedagogical practices for middle- and high-school-level students as opposed to the more andragogical approaches that are better understood by adult learners.

Reducing the amount of time that students must take part in developmental math courses has proven especially effective. This approach is a direct response to what the data show regarding the attrition rates of students requiring developmental math courses. The more remediation that is required of students entering college, the less likely these students are to successfully complete their degree programs (Bettinger, Boatman, & Long, 2013; Fong et al., 2015; Kosiewicz et al., 2016). In addition, the semester-to-

semester enrollment of students requiring developmental math courses declines dramatically the longer it takes these students to successfully complete said courses (Fong et al., 2015; Ngo & Kosiewicz, 2017).

Further indications of the burden of developmental math students in relation to college completion are data showing that students who enter postsecondary institutions requiring developmental courses are often already predisposed to not completing their intended degree programs. According to Crisp and Delgado (2014), students requiring developmental math, when compared to students who are able to enter postsecondary institutions prepared to enroll in college-level math courses, often differ by gender and ethnic background, represent the first generation in their family to attend college, are less academically prepared, have had different and negative academic experiences prior to enrollment, and enter college later than traditional college students. Each of these characteristics increases the likelihood of dropout on its own, without the added burden of required developmental math courses (Nakajima, Dembo, & Mossler, 2012).

Attempts to increase the overall success rate in developmental math courses have yielded varied results. It has been difficult to discover a universal method to increase success because there is so much variance in requirements for developmental math students from state to state and institution to institution (Bettinger et al., 2013). Several colleges have made investments in teaching software, such as specific, measurable, attainable, results-based, and time-based (SMART) math programs, as a means to help students complete required developmental math courses (Silva & White, 2013). The

implementation of such software has shown varying results, and the purchase of such software programs places a financial burden on institutions (Crisp & Delgado, 2014).

Redesigned math is another method for completing math requirements. This approach, which focuses on math that is best suited for each individual student's program of study, has seen tremendous success, with 3 to 4 times more students successfully completing their required math courses in some cases (Burdman, 2015). That being said, redesigned math courses are not without flaws. While this approach does exhibit evidence of helping students complete required math courses, student feedback also indicates certain barriers that are embedded within the structure of redesigned math courses that can hinder student progression in these courses (Fay & Cormier, 2014). In addition, the workload associated with redesigned courses is often more than the students can handle, especially when compared to traditional math courses that students are used to taking (Ariovich & Walker, 2014).

Despite various attempts to increase student success in remedial math courses, many college administrators and legislators view developmental courses as ineffective and costly (Bettinger et al., 2013; Goudas & Boylan, 2012). Current research indicates that placing students in a noncredit remedial math course as a prerequisite to a collegiate-level math course for which they do receive credit typically results in increased failure rates and lower student retention (Hagedorn & Kuznetsova, 2016; Scott-Clayton, 2012; Tolley, Blat, McDaniel, Blackmon, & Royster, 2012; Vandal, 2014). In an attempt to help students progress through their degree programs in a timely manner without being stifled by non-credit-bearing developmental math courses, many institutions are

implementing corequisite math courses (Bracco, Austin, Bugler, & Finklestein, 2015). Corequisite math courses are courses in which students identified as requiring developmental math take a college-level math course for credit while at the same time receiving the same remedial academic support that they would receive in a traditional developmental math course (Complete College America, 2016). According to Belfield, Jenkins, and Lahr (2016), pass rates increase substantially for students using this model. Despite these findings, corequisite instruction has some drawbacks. While this approach may allow students to progress at a quicker pace through their degree requirements, very little is achieved to increase students' confidence in their math skills (Campbell, 2015). Further, in that corequisite math courses allow the entire student body of an institution to take college-level math courses, the need for full-time math instructors increases, greatly increasing the cost to the institution (Belfield et al., 2016).

Importance of Early Success

Upon reviewing the various methods implemented by postsecondary institutions to increase student success in developmental math courses, it is important to understand how early success in these courses benefits students. In other words, simply passing these courses is not enough; they must be passed early in students' collegiate experience. Beyond the fact that failing these courses results in students having to repeat them, which in turn increases the financial burden for students, having to repeatedly take a course greatly reduces the persistence of students and therefore leads to an overall decrease in student retention (Reilly, 2015).

In comparison, early success in developmental math shows to have the opposite results. According to Attewell, Heil, and Reisel (2012), students who successfully attempt and pass a full course load at the beginning of their collegiate studies tend to continue their academic success in subsequent semesters, a phenomenon termed by Adelman (2006) as "academic momentum" (p. 6). More specifically, students who successfully pass developmental math in their first semester show much higher success rates in regards to completing their degree programs than those who do not (Boatman, 2012). Unfortunately, less than 20% of students requiring developmental math courses successfully complete these courses within three years (Charles A. Dana Center, 2012).

It would seem that rather than focusing on changes to course content, a larger focus should be placed on setting up the developmental math student for early academic success. One such strategy that should be considered is immediate enrollment in said course. Mentioned earlier, Hillsborough Community College recently started an initiative titled Mathematics Access Performance Scholarship (MAPS) in an effort to encourage early success in developmental math courses (Sommo et al., 2014). Focusing on students who had been identified as underprepared for credit bearing collegiate math courses, the MAPS program encourages freshmen to enroll and pass their required math courses early and consecutively in exchange for a $600 per semester scholarship. Besides the financial incentives enjoyed by these participants, after two years it was concluded that students enrolled in the MAPS program saw a statistically significant increase in the amount of credit hours earned overall.

Starting in 2007, the City University of New York also implemented a program with the goal of getting students requiring developmental math to enroll and pass the course early in their collegiate studies. The Accelerated Study in Associate Programs (ASAP) was designed to help support students identified as being less likely to complete their degree programs (low income, first generation, etc.) and offer guidance to help them succeed (Scrivener et al., 2015). Included, as a part of this program, was an offering of what was referred to as blocked courses. Blocked courses were courses that were reserved for ASAP students in an effort to provide support and encouragement for each other. These blocked courses typically included the required developmental math courses as well as freshman success courses. Students were required by advisors to enroll in these courses in their first semester. Over a three-year period, ASAP students earned nine credits more than control group students and saw the graduation rates of this student group increase from 22% to 40%.

In addition to completing developmental math courses early for the sake of academic success, it is important that succeeding for financial purposes also be taken into account, both on the part of the student as well as the institution. The enrollment of students in developmental math courses includes a disproportionately high percentage of students from low socioeconomic backgrounds nationwide (Matthew, 2014). Placing these students into a non-credit bearing course that they are obligated to pass and pay for prior to enrolling in a credit bearing course that they will also be obligated to pay for is a key reason as to why the college graduation rates for students from low socioeconomic backgrounds is so much lower than their wealthier counterparts (Morales, Ambrose-

Roman, & Perez-Maldonado, 2016). Should these students require multiple attempts at developmental math courses, the debt accrued often leads to more financial strain than the student is willing to take on. In addition, the financial burden of the academic institution has seen great increases in recent years. The current estimate for funding developmental education in postsecondary institutions in the United States currently sits at approximately $2 billion, roughly double what the cost was a decade ago (Fong et al., 2015).

Implications

As the literature indicates, increasing the success rates of students requiring developmental math is of great interest to a variety of stakeholders. For state legislators, the lack of academic preparedness in students entering college has been acknowledged and efforts to bridge this academic gap are currently receiving warm receptions at the legislative level (Mann & Martin, 2016). While increasing the academic success in any sector of postsecondary education is also advantageous to college administrators, in a climate where fiscal responsibility is almost eclipsing academic success (Murphy & Katsinas, 2014). Finding a way to alleviate the rising costs associated with developmental math courses by increasing student success should be a detail not lost on these administrators (Winders & Bisk, 2014). Finally, at the epicenter of this research are the students themselves. As the literature frequently cites, early enrollment and success in developmental math courses positions underprepared college students for successful completion of a degree program. As Crisp and Delgado (2014) mentioned, the majority of developmental math students also share the burden of being low income, first

generation, and various other attributes that make them predisposed to not completing a degree program. This connection alone should illustrate how researching and developing new methods for increasing the success rates in developmental math courses could have far reaching effects beyond simply remediating students for collegiate level math studies.

The purpose of this literature review was to explore the methods and strategies developed and implemented in an effort to support success for students requiring developmental math at the postsecondary level. By identifying both the success and drawbacks of each strategy, a better understanding of how to continue to improve student success rates can be achieved. The goal of this project study is to contribute to the existing literature by offering an alternative strategy to the success of developmental math students that has been absent in the literature. Should the results of this project study illustrate significant results regarding the ability of students to successfully complete developmental math courses, it will serve as one of the many strategies currently existing in the literature as a new method from which institutions wishing to increase the success rates of their developmental math students can investigate.

Summary

As evidenced by the literature, the demand for methods in which postsecondary institutions can increase the rate of student success in developmental math courses is great. The sheer number of current articles on this topic (Melguizo et al., 2014) should serve as a strong indicator that further research is warranted. That being said, much of the published literature places the focus on identification of students needing remedial education, the reliability on placement tests, costs of remedial education, and assessment

of remedial education (Melguizo et al., 2014). What is lacking from the current available scholarship are specific methods and techniques to assist college students requiring developmental math courses for success. With such a strong correlation existing between success in developmental math and college completion, the increase of student success in developmental math courses should be viewed as a duty to all involved in higher education and therefore will serve as the foundation of this project study.

Section 2: The Methodology

Introduction

The purpose of this project study was to investigate what effect (if any) that customizing the course schedules of students requiring developmental math as a part of their undergraduate studies had on the success and overall retention of these students as per approval from Walden University IRB 01-22-18-0517980. For the purpose of this study, success was defined as a grade of D or better, and retention was defined as subsequent enrollment the following semester at the institution. This research was guided by the following research questions:

RQ1: Is there a significant difference in the rates of successful completion of developmental math between students who are placed in courses based on a customized schedule and those who are not?

RQ2: Does early completion of developmental math courses impact student retention?

Research Design and Approach

Quantitative methodology, specifically a causal comparative design, was used for this study. This design was appropriate for this study because it allowed for observing current academic conditions regarding developmental math in postsecondary education and attempting to identify possible causes for these conditions (Patten, 2016). The success rate and subsequent retention rates of students enrolled in developmental math as part of a custom schedule of courses were compared, using archival data, to the developmental math success and retention rates of past students who were not placed in

such customized schedules. In this case, the research focused on the success rates of students enrolled in developmental math and how the difficulty of their schedules might be affecting the success rate. Because causal comparative designs do not identify a specific explanation for the relationship between what is being compared, this design actively suggested whether or not students' schedules had an impact on their successful completion of developmental math courses and retention (Atchley, Wingenbach, & Akers, 2013). Additionally, because causal comparative designs analyze data ex post facto, the individuals were placed into groups naturally, eliminating any manipulation of the independent variables on my part as the researcher (Mills & Gay, 2015).

Settings and Participants

The setting for the study was a small, rural public college in central West Virginia. Of the 280 to 310 full-time, first-time freshmen who arrive on campus each fall to begin their studies, approximately 60% require developmental math courses and are therefore described as *at risk* (P. Peck, personal communication, March 13, 2017). The at-risk students who were part of the Fall 2017 freshman cohort served as the sample for this study. At the start of the 2016-2017 academic year, the Curriculum Committee of GSC put into effect a new academic policy regarding students identified as at risk, titled *At-Risk Academic Advising Policy*. This policy was created and implemented based on 12 years of institutional research. According to the data gathered from this research (Evans et al., 2014), students requiring developmental math showed very high rates of success in certain classes while showing very high failure rates in others. Using these data, the course schedules at GSC were divided into three distinct categories. Tier 1

courses were those that, according to the data, led to 75% of students making a grade of C or better when taken at the same time as developmental math (see Appendix A). Tier 2 courses led to less than 75% but greater than 60% of at-risk students attaining a grade of C or better when taken at the same time as developmental math (see Appendix B). Tier 3 courses showed a failure rate of over 50% for all first-time freshmen when taken at the same time as developmental math (see Appendix C).

Beginning in the fall semester of 2015, an ad hoc committee was created on the campus of GSC called the *Academic Advising Task Force*. Meeting bimonthly, the task force involved a faculty representative from each of the nine academic departments on campus as well as the developmental math faculty in its entirety. This group met for the sole purpose of deciding how to proceed with the aforementioned data. After much discussion, it was decided to create an At-Risk Academic Advising Policy that would be implemented campus wide. In the spring semester of 2016, a final draft of said policy was agreed upon by members of the task force and presented to the GSC Academic Policy Committee. In April 2016, the policy was voted on and approved by said committee. Once it was approved, the GSC Office of the Registrar began implementing the guidelines of this new policy into Banner, the software used by students and faculty members for class scheduling. These changes included labeling which courses were Tier 1, Tier 2, and Tier 3. GSC faculty members were made aware of this new policy via the Department for Academic Affairs and were highly encouraged to implement this policy in their advising.

In accordance with the At-Risk Academic Advising Policy, all first-time freshmen students identified as at risk were enrolled in no more than 16 credit hours comprising the appropriate math and English courses, GSC 100, and courses within the Tier 1 designation. At the conclusion of the Fall 2017 semester, the grades for students identified as at risk were requested from the office of the registrar. Additionally, the retention rates of these students between the Fall 2017 and Spring 2018 semesters were requested from the Director of Institutional Research and Reporting for GSC. These data were placed in an Excel spreadsheet for the purposes of analysis. These grades and retention rates were then compared to past grades and retention rates of previous student populations prior to the implementation of this policy. Statistical methods, specifically a chi-square test, were used to calculate significance due to the size of the sample used (Moss & Pini, 2016). The statistical tests necessary for the purposes of this study were analyzed using SPSS version 24. I chose to use the statistical method of chi-square tests. Raw values were used in addition to means, percentages, and reported measures of variability using standard error (SE), *p*-value, and 95% confidence interval (CI). These statistical analyses allowed me to determine if differences existed between the two groups. Because both variables were categorical, chi-square was the appropriate test for this study (California State University, 2014).

Instrumentation and Materials

In an effort to ensure that students were placed in classes that adhered to the aforementioned At-Risk Academic Advising guidelines, ACT scores (or equivalent test scores) were obtained from each freshman entering GSC for the fall 2017 semester.

Based on this method of placement, 197 students were identified as at-risk. At the end of the semester, final grades were collected, and those students who adhered to the At-Risk Academic Advising Policy had their grades compared to those identified as at-risk from previous academic semesters. These archival data, obtained from the GSC Registrar's Office, included the average pass rate of first-time freshmen in developmental math courses for fall semesters from 2011-2015. This was done in an effort to determine whether or not the placement of at-risk students into classes in accordance with the At-Risk Academic Advising Policy had any effect on their successful completion of developmental math. In addition, the retention rate of those who adhered to said policy was recorded. These numbers were then compared to students identified as at risk from previous academic semesters to determine if the aforementioned policy had any effect on the retention rate of this student group.

Data Collection and Analysis

Once students were placed in the correct math course based on ACT (or equivalent test) score, a total of 165 students were categorized as at risk based on the criteria described by the At-Risk Academic Advising Policy. It should be noted that being identified as at risk does not necessitate a schedule that adheres to the At-Risk Academic Advising Policy. Each student at GSC is assigned to an academic advisor based on his or her major, regardless of whether the student requires developmental math courses. Placement in all courses is the responsibility of the academic advisor. Many factors (described in detail in the next section) prevent uniform adherence to this policy by all at-risk students. For the purposes of this study, the data were based on the 137

first-time freshmen identified as at risk who did adhere to the At-Risk Academic Advising Policy in the Fall 2017 academic semester as a result of the schedules designed by the students' individual academic advisors.

At the end of the Fall 2017 semester, grades for all students enrolled in developmental math courses were requested from the department of institutional research. Prior to obtaining these grades, each class section was carefully inspected by the director for institutional research and again by me to eliminate students who were not first-time freshmen and students who had taken the course multiple times. The students were then divided into two categories based on whether or not their schedule of courses adhered to the At-Risk Academic Advising Policy. The final grade averages for these courses served to determine if those students placed in courses based on the aforementioned policy showed a higher rate of success than those students who preceded them prior to the implementation of such a policy. Additionally, the retention rates for this group of students were requested from the GSC registrar at the beginning of the Spring 2018 semester as an interval scale variable to be compared to those who did not pass math in an effort to determine the retention rate for these students.

Assumptions/Limitations/Delimitations

Based on the aforementioned research conducted at GSC (Evans et al., 2014), it was assumed that students identified as at risk would experience early success when placed in courses from the Tier 1 category of courses. In addition, should this assumption prove true, it can also be concluded based on previous research (Adelman, 2006; Attewell, Heil, & Reisel, 2012; Boatman, 2012) that early success in

developmental math will then translate into continued collegiate success and an increase in degree completion for this student group. Students placed exclusively in Tier 1 courses in their first semester in college should have an environment that acts as impetus for the academic momentum described by Adelman (2006).

Although the At-Risk Advising Policy had the endorsement of the administration including the Office of Academic Affairs for GSC, there were limitations to this study. One such limitation was that this study could not be truly experimental. For ethical reasons, students cannot be intentionally placed in courses that, according to the data, will not allow them to be successful. This lack of randomization as well as controlled and experimental groups caused this study to be quasi-experimental, thus possibly limiting the generalizability of the study and reducing the internal validity of the results (Campbell & Stanley, 2015). Also creating a potential limitation to the study was student advising. GSC had no central advising department, and each professor was assigned a group of student advisees. While the office of academic affairs endorses the At-Risk Academic Advising Policy, there was nothing in place holding advisors accountable for the courses in which they chose to enroll their advisees. While the participants were limited to first-time freshmen, it was beyond my control as to whether or not these students were considered traditional. This may have affected the results of this study, in that nontraditional students, while technically considered first-time freshmen, could be far removed from their most recent math course, which could hinder their success in a developmental math course. The semester (fall, spring, summer) in which Tier 1 courses were offered was also beyond the control of the researcher. Finally, each student

identified as at risk was also at the mercy of the schedule of courses. Students requiring developmental math courses who enrolled in classes close to the beginning of the semester ran the risk of having to enroll in Tier 2 and Tier 3 courses if all Tier 1 courses were filled to capacity.

Regarding delimitations, one of the major variables under the researcher's control was what determines whether a student is considered "at risk." For the purpose of this study, any student entering GSC with an ACT math score below 19 or an SAT math score below 460 was considered at risk. If a student entered GSC without ACT/SAT scores, I, in cooperation with the GSC Department of Math and Science, used the appropriate placement test score to determine whether or not the student was at risk. Additionally, the exclusive use of first-time freshmen was under my control. The requirements that at-risk students needed to complete to no longer be required to adhere to the policies set forth by the At-Risk Academic Advising Policy were at my discretion and the Academic Advising Task Force.

Protection of Participants

As with all academic research, protection of those involved must be made a priority. Because this research involved first-time college freshmen, if a student entered the institution below the age of 18, parental consent was obtained, which included documentation that no harm would come to the participant. The anonymity of those involved was also considered, along with the fact that participation had no academic consequences. The right to withdraw from said research was clearly articulated. In

addition, I had undergone extensive ethical training to help protect the institution that I represented as well as the participants.

Threats to Validity

One of the most common threats to validity regarding causal comparative research designs is selection bias (Fraenkel, Wallen, & Hyun, 2016). For the purposes of this study, this threat to validity was minimized due to the fact that the subjects were matched naturally by ability. It should be noted that for ethical purposes, students were not intentionally placed in Tier 3 courses for this study; student advisors still had the final say in what courses each student was enrolled in. All of the subjects involved in this study were determined to require developmental math courses and therefore were enrolled in these courses at the start of their collegiate studies. This type of matched subject design minimized the chances of skewed data. Additionally, because the students were naturally grouped according to ability, the lack of manipulation, control, and randomization often considered a detriment to this type of research design was lessened (Gay, Airasian, & Mills, 2015).

Data Analysis Results

Research Question 1

Of the students who successfully completed developmental math courses in the Fall 2017 semester, 70.19% adhered to the At-Risk Academic Advising Policy. The statistical tests used for the purposes of this study were analyzed using SPSS version 24. I chose to use the statistical method of chi-square analyses. Raw values were used in addition to means, percentages, and reported measures of variability using standard error

(SE), *p*-value, and 95% confidence interval (CI). These statistical analyses allowed me to determine if differences existed between the two groups. Because both variables were categorical, chi-square was the appropriate test for this study (California State University, 2014). Based on the chi-square analysis, there is not sufficient evidence to reject the null hypothesis, as the *p*-value is greater than 0.05 (X^2 (1) = 3.171, $p = 0.054$); please refer to Table 1.

Table 1

Chi-Square Analysis

Variables	Passing developmental math<-Dependent variable			
		Coefficients		
	Value	*df*	*n*	*p*
Policy adherence	3.171	1	162	0.054

Research Question 2

The retention rate for the group of students who passed developmental math while adhering to this policy was 86%, compared to 59% for those who did not pass developmental math or passed developmental math but did not adhere to the policy. Based on the chi-square analysis, there is a statistically significant association between students passing developmental math and retention in college (X^2 (1) = 13.219, $p < 0.001$); please refer to Table 2.

Table 2

Chi-Square Analysis

Variables	Enrollment status Coefficients			
	Value	*df*	*n*	*p*
Passing developmental math	13.219	1	137	0.000

Based on this analysis, with $p<0.05$, there is enough evidence to reject the null hypothesis. According to the data, simply passing developmental math while not adhering to the policy did not lead to an increase in retention rates among those students. The average GPA for students who adhered to the At Risk Academic Advising Policy and passed math was 2.86. The GPA for students who passed developmental math but did not adhere to said policy was 1.26. It can be inferred that, while successfully completing their developmental math course, the fact that these students had Tier 2 and Tier 3 courses as a part of their schedule resulted in reducing or even halting the academic momentum described by Adelman (2006).

Conclusion

Through the comparison of the percentage of students successfully completing developmental math courses when taken as a part of a customized schedule of courses to those who enrolled in developmental math when no such policy was in existence, it was the goal of this project to determine if difficulty of schedule was a contributing factor to student success. Additionally, the data sought to discover if this early success in

developmental math could then be transferred to increased rates of retention as a result of the academic momentum described by Adelman (2006). The employment of the causal comparative research design was appropriate specifically for this project as the data gathered sought to determine possible reasons for an identified existing condition, specifically lack of success in developmental math courses. Ultimately the data collected was compared to archival data but without attempting to seek out a relationship, in which case a correlational approach would have been more apropos (Gay et al., 2015). It is with this research methodology that was employed as an investigative tool in an effort to discover whether or not a customized schedule of courses could increase students' chances for success in said course and, in turn, increase the retention rates of these students.

Section 3: The Project

Introduction

This section of the project study begins with a brief description of how lack of success in developmental math courses for first-time college freshmen can potentially be addressed and improved upon. Within this description are specific details pertaining to the overall goals of this project and how the lack of success in developmental math described in Section 1 can potentially be remedied. Ways in which this project implemented strategies for addressing the aforementioned problem follow, along with how the content of this project study can offer improvements to academic advising to ensure student success in developmental math courses. After a thorough review of the literature pertaining to theories and analysis of current research addressing this subject, a description of the implementation of the project is provided. Within this description, barriers, resources, timetables for implementation, and the roles of all participants are addressed. This section concludes with an evaluation of the overall project as well as its potential use as an impetus for social change, both locally and on a larger scale.

Description and Goals

It was the overarching goal of this project to assist first-time college freshmen in successful completion of developmental math courses. Additionally, this project sought to discover if the successful completion of developmental math courses translates to higher retention rates. As described within the literature review in Section 1 (Charles A. Dana Center, 2012; Reilly, 2015; Scrivener et al., 2015), early success in college often lends itself to a lower dropout rate. The timeliness of this topic should be viewed as

especially important as the number of first-time college freshmen entering postsecondary institutions unprepared for college-level math courses is showing a consistent increase (Winders & Bisk, 2014). This project was developed to discover whether the passing rate for developmental math for first-time college freshmen can be increased when included as part of a schedule of courses that data show have high completion rates when taken in tandem with developmental math. Because the data showed such an increase, this project also sought to discover if the retention rate for these students also increased from semester to semester.

Rationale

According to the data described previously (Bettinger et al., 2013; Evans et al., 2014; Fong et al., 2015; Kosiewicz et al., 2016), it was suggested that students requiring developmental math courses experience increased academic success and degree completion once these courses are successfully completed. Using this data as a catalyst for augmenting student success, it would stand to reason that successful completion of developmental math courses can be increased when these courses are included as part of a load that includes courses that have high pass rates when taken in tandem with developmental math. This project involved placing students identified as requiring developmental math in a semester schedule of courses that included developmental math as well as only courses that archival data show have high success rates when taken at the same time as developmental math. Because the results of this project indicated a higher overall success rate in developmental math courses, the retention rate of participants between the Fall 2017 and Spring 2018 semesters was tracked in an effort to indicate

whether semester-to-semester retention is also increased. Should this project yield data suggested by the literature, the increase in students entering postsecondary institutions requiring developmental math courses (Winders & Bisk, 2014) can be countered through course schedule adjustments, thus enhancing academic success and increased retention rates for these students already predisposed to academic difficulties and lower degree attainment rates (Laskey & Hetzel, 2011).

Review of the Literature

As illustrated in Section 1, concerns regarding developmental math at the collegiate level have served as a catalyst for a great deal of scholarly research. Much of the existing literature discusses topics such as course redesign, implementation of various learning software, as well as a multitude of other methods aimed at increasing student success in these courses (Ariovich & Walker, 2014). The motivation behind such research is equally varied. According to Williams and Siwatu (2017), increases in students graduating from public high schools ill-prepared for college-level math courses, educational policy changes, and demands from state legislatures have all been responsible for continued research on how to increase success in developmental math courses. While research on this topic continues to produce a plethora of suggested approaches to improving developmental math success, this research has yet to yield a definitive, universal solution.

Discrepancies in the Literature

The abundance of approaches to developmental math coursework is possibly a result of inconsistencies on the topic. Regarding correlation between developmental

coursework and student retention at postsecondary institutions, DiNicco, Harrington, and Fogg (2015) contended that no such correlation exists. According to the authors, there is no discernable relationship between successful completion of developmental courses and student retention; they further illustrated their point by citing many scholarly works (Roska, 2009; Scott-Clayton & Rodriguez, 2012) as attestation to this claim. This was at odds with research published by Pruett and Absher (2015), who argued that placement and consequent success in these courses showed a significant positive effect on student retention as well as engagement and overall GPA. Fong et al. (2015) took this claim one step further and made the argument that not only do developmental math courses have an effect on student retention, but failure to successfully complete these courses shows a direct correlation to increased student dropout rates.

Current publications also disagree on best teaching practices to encourage success for students enrolled in developmental math courses. Cafarella (2016) claimed that the sequence in which topics are presented in developmental math courses creates a natural hindrance to successful completion and argued that the most viable solution is a reorganization of the content. In contrast, Fong et al. (2015) asserted that the order in which concepts are presented has less to do with successful completion of these courses than with how low pass rates are a result of poor academic advising, citing how low pass rates are more a result of low attempt rates. Quarles and Davis (2017) argued that focus should be placed less on content and more on the long-term goals associated with successful completion of developmental math courses. The authors contended that if the ultimate goal of developmental math courses is to enhance the skillset necessary for

successful completion of college-level courses, then individual learning objectives should be viewed as secondary concerns while the identification and enhancement of the skills necessary to succeed in college-level coursework should be the focal point of these courses. While much of the existing literature agrees that students requiring developmental math courses are on the increase and states are investigating new and novel ways to approach this increase, the literature also boasts a myriad of different and often contradictory solutions to this conundrum.

GSC and Open Enrollment

It should be noted that while much scholarly literature exists on the topic of developmental math and 4-year institutions, the same could also be said regarding developmental math and community colleges. Much of the research and publications used to inform this project were based on data obtained through research conducted at community colleges. The reason for this is that GSC, the site at which this research was conducted, is a 4-year institution but is an open enrollment institution and therefore has a student body similar to that of a community college (Bailey, Jaggers, & Jenkins, 2015). According to Schak, Metzger, Bass, McCann, and English (2017), 33% of all students entering public 4-year institutions require developmental math courses, compared to 59% entering 2-year institutions. At GSC, 70% of the current student body requires developmental math courses (P. Peck, personal communication, February 9, 2018), which obviously places the college closer to the makeup of a 2-year community college.

The importance of approaching this research from the community college perspective has much to do with placement in developmental math courses. There is

currently no nationwide policy regarding how and why students are placed in developmental math courses as many states opt to leave these kinds of decisions in the hands of individual institutions (Ngo & Kwan, 2015). The primary reason for not having a universal policy regarding placement in developmental math courses is that state colleges are having to tread a fine line between maintaining acceptable standards for collegiate-level coursework and ensuring an acceptable policy for admittance (Hersh & Marrow, 2015). This balancing act is made even more challenging for community colleges because most have traditionally had an open enrollment policy (Melguizo et al., 2014). Such a policy, which allows educational access to all high school graduates, places a much greater burden on instructors at these institutions than at 4-year institutions, where the number of students requiring developmental coursework often gets diluted with more selective admissions (Allen, 2013).

Financial Factors

As already discussed, students entering college requiring a developmental math course begin their collegiate careers at a distinct disadvantage. Having to enroll in these courses adds to students' educational costs, slows their academic progress toward degree completion, and brings unwanted stress and frustration (Bettinger et al., 2013). Adding to this burden are current changes to financial aid policies. Developmental math courses are typically not considered part of a student's degree requirements; these courses only serve to better prepare students for collegiate-level math courses that are required for graduation (Fong et al., 2015). In other words, developmental math courses are not

required for degree completion but are required prior to entering a math course that is required for graduation.

According to the U.S. Department of Education (2017), federal regulations are now in place that prohibit students from receiving financial aid funds with the intention of applying these funds toward courses that do not count toward degree completion. Out-of-pocket costs for a course that is, at least indirectly, required for successful degree completion significantly increase the financial burden for these students, especially when successful completion requires multiple attempts. Add to this the fact that the majority of students entering college requiring developmental courses will need to enroll in multiple courses designated as developmental (Fong et al., 2015), and the cost of a college degree can quickly become out of reach. Such financial considerations are especially consequential to a college whose student body includes a high number of students from low to moderate economic backgrounds. Given that GSC serves a student body containing more than double the national average number of Pell Grant recipients (M. Carver, personal communication, February 9, 2018), finding new approaches to getting students successfully through developmental math courses should be viewed as both academically and financially advantageous.

Developmental Student Characteristics

According to Chen (2016), students requiring developmental math courses are found in all student subgroups but are especially prevalent among students who come from lower economic backgrounds, as well as students who represent the first generation in their families to attend college. Findings such as this served to inform this project, as

75% of GSC students carry the burden of being from low economic backgrounds and are the first generation in their families to attend college (M. Carver, personal communication, February 9, 2018), compared to a national average of 24% (Opidee, 2015). Before even enrolling in a college course, this student subgroup is already at a disadvantage, in that the national graduation rate for low-income/first-generation students is a dismal 11% (Educational Advisory Board, 2016). Year-to-year retention rates for this student subgroup are equally discouraging. Nearly 60% of low-income/first-generation students opt not to return to school after their first year—more than double the year-to-year retention rate for this group (Stebleton, Soria, & Huesman, 2014).

GSC Students

To summarize, GSC finds itself in a unique, albeit highly negative, disposition. Situated in rural West Virginia, the majority of the student body of this institution is battling what seems to be a trifecta of academic detriment. In addition to the burden of low economic status and first-generation college student status, the majority of this student body must enroll in developmental math courses. Any one of these three hardships makes degree completion exceptionally more difficult (Bettinger et al., 2013). For many students on GSC's campus, being in the unfortunate position of having to bear all three burdens makes graduation an almost herculean goal. It is fair to say that the goal of educators is to help their students become successful. That being said, the literature indicates that many student characteristics, such as those previously mentioned, are directly linked to lack of success. Such findings prompted the current research. Although students' first-generation status and/or low economic backgrounds are beyond

the control of educators, the development of methods to increase student success in developmental math courses is not.

Project Description

Beginning in the Fall 2017 semester, first-time freshmen matriculating to GSC who were identified as at risk were placed in a schedule of courses that included the appropriate math course and other courses as described in the At-Risk Academic Advising Policy. All grades were closely monitored at the conclusion of each quarter. At the end of the Fall 2017 semester, grades for these students were recorded and made accessible to me.

Once access to these grades was obtained, each student was placed into one of four categories:

1. Adhered to policy/passed math
2. Adhered to policy/did not pass math
3. Did not adhere to policy/passed math
4. Did not adhere to policy/did not pass math

Once the students were separated into these four groups, the differences in passing rates were calculated. Each category was then compared to the pass rate of previous fall semesters using archival data for the past five academic years. The pass rates for students who adhered to the policy were compared to the pass rates of those identified as at risk before such a policy existed at GSC. These differences were calculated using chi square. Any statistical significance was recorded.

Following the analysis of math grades, retention information between the Fall 2017 and Spring 2018 semesters was requested from the director for institutional research. Once obtained, the retention rates for each of the four aforementioned categories were calculated and compared. As before, the retention rates were then compared to the retention rates of students identified as at risk from the previous five fall semesters using archival data. These differences were calculated using a chi-square, and any statistical significance was recorded.

Project Evaluation Plan

Following the conclusion of this project, assessments were made in an effort to determine the effectiveness of the various project components. Specifically, a summative assessment's goal is to determine whether or not a project reached its goals as described (Spector, 2014). This evaluation addressed the following questions:

- Did the project adequately answer the aforementioned research questions?
- How can the results of this research be used to implement campus-wide change?
- Are the methods implemented for this project able to be sustained?

Once results from this project were disseminated, the provost and senior vice president for academic affairs at GSC was asked to help evaluate the project as an outside evaluator. According to Spector (2014), employing an evaluator in this manner allows for a review of a project from an unbiased yet experienced source. Special attention was paid to any unforeseen results yielded by the data. Following the review, the GSC provost will work with me in an effort to determine how the project results can be used to

create long-range goals for the institution. As the chief academic officer for GSC, should the provost agree that the project yields data that prove advantageous to the institution, an advising workshop will be planned each semester as a means to educate the rest of the faculty members about the data and to aid in academic advising that the data show increases student success and retention.

Project Implications

As previously stated, it was the goal of this project to increase student success in developmental math courses as well as to determine whether that success, in turn, yields higher student retention rates. As research indicates (Dasinger, 2013; Methvin & Markham, 2016; Quarles & Davis, 2017), the number of students entering postsecondary institutions underprepared for collegiate-level math coursework has increased steadily and is continuing to increase. Additionally, colleges nationwide are furiously attempting to discover alternative pathways or approaches to meeting this increased demand for math remediation (Hodara & Jaggars, 2014). The data illuminated by this project should serve as a catalyst for curriculum changes, or at the very least serve as an opportunity for college administrators to review the course schedules and programs of study at their institutions in an effort to discover alternative pathways for students to successfully pass developmental math courses without being overwhelmed with other coursework. Historically, postsecondary institutions have often been resistant to change, opting instead to continue with teaching strategies and approaches that they are comfortable with and expecting students to alter their approach to learning once inside their classrooms (Yılmaz & Kılıçoğlu, 2013). Through this project, I sought to provide data that would

inspire buy-in from college faculty members and administrators to review their current plans of study to determine if and how changes can be made to not only increase student success, but in turn increase student retention.

Section 4: Reflections and Conclusions

Project Strengths and Limitations

The primary strength of this project had much to do with the location of the research. Specifically, the fact that GSC's freshman population includes a large number of students who are inadequately prepared for college-level math courses allowed for a large sample size. The size of the institution was also shown to be advantageous. As this project study dealt directly with student scheduling, buy-in from the faculty members was not only necessary, but also vital to its implementation. The small faculty size at GSC allowed for faculty member buy-in to be secured with minimal concerns or delays. The support of the administration at GSC also helped to garner faculty member support.

The biggest limitation that this project study faced was the fact that it could not be a truly experimental research design. As this project study involved student success rates, test scores, and other sensitive information, possible ethical implications dictated that a quasi-experimental design be used (Ary, Jacobs, Sorenson, & Walker, 2018). It would have been preferable to conduct the research with two separate and randomly selected groups. However, as the purpose of this research was to study possible increases in student success and retention, it would have been unethical to intentionally place students in collegiate-level coursework that data show have very low student pass rates.

Recommendations for Alternative Approaches

As discussed previously, the bulk of the research on the topic of developmental math courses and student success and retention relates to community colleges rather than 4-year institutions. While considered a state funded 4-year institution, GSC shares many

attributes with community colleges due to its status as an open enrollment institution. That being said, because the literature places a great deal of focus on the need for curriculum change as it pertains to developmental math, this project study could yield significant data for community college campuses.

Another approach to consider would be a qualitative study. Research on this topic using a qualitative approach could help to provide some context beyond pass/fail rates. As the research stands now, lack of preparedness is the primary reason that students do not pass collegiate math courses. A qualitative research approach might help in discovering other reasons for lack of student success beyond academics. Patterns such as domestic commitments, lack of motivation, or many other reasons for not being prepared for postsecondary math courses could be illuminated through the interviews and observations typically associated with qualitative research.

Another approach that should be considered involves test data. As of 2017, the vast majority of college-bound high school students in West Virginia took the ACT (Quinn, 2017), and therefore the vast majority of the students involved in this study were chosen based on ACT scores. Starting in 2018, high school juniors in West Virginia will be taking the SAT prior to applying to college, as the SAT will be replacing the Smarter Balanced standardized test for all high school juniors. This study should be conducted again once this transition has taken place so that data can be compared to data gathered when most students were placed in math courses based on ACT scores.

Scholarship

This project study allowed for an intensive investigation into what the literature presented as a universal problem in higher education. Additionally, the amount of research on this topic required to complete such an exhaustive study helped to provide this situation with some context. As the literature review illustrated, the topic of student success in developmental math is not new, and several approaches have been taken to address it, each with varying degrees of success. Knowledge about the history of the research topic as it appears in scholarly literature helps to provide new research attempts with some direction.

The presented project also forces many variables to be considered, not just the obvious ones. It would be easy to argue that students entering college requiring developmental math courses are predisposed to failure due to lack of adequate academic preparation, and there is an abundance of existing literature that claims this. Once data have been gathered, it can provide unexpected results, often the consequence of an overlooked variable that did not manifest itself early in the research process.

Project Development and Evaluation

The design of this project study worked as successfully as possible given the limitations. As stated before, a truly experimental design would have been preferable, albeit unethical in some regards. With the large population of freshmen requiring developmental math courses at GSC, the appeal for faculty member buy-in was met with some resistance, but ultimately this was overcome by the campus-wide desire for GSC students to do well academically.

The project also led to the discovery of how important varied resources can be to research such as this. The utilization of resources such as registrars and faculty members from academic affairs can yield not only useful information, but also information specific to the institution. Much of the data required for this project, while not specifically viewed for the same purposes, are constantly being gathered by the director for institutional research. This individual is able to provide a wealth of data and also uses software that can eliminate unwanted variables from the requested data that could ultimately skew the research results.

The amount of planning that is required prior to conducting research cannot be overstated. Although it was exciting to begin the research process, a very clear plan of action allowed me to maintain focus on what I ultimately wanted to prove. With so many variables able to alter the results of the research, I came to the realization that, as long as I adhered to my originally conceived plan, I would have less chance of getting sidetracked on topics that had little or nothing to do with the purpose of this project.

Leadership and Change

As an educator whose area of expertise is primarily the fine arts, I found that the completion of this project allowed me to broaden my scope in terms of student success. Although math is an academic area that I previously had little experience with, the vast amount of research and preparation required for this project granted me the opportunity to explore possible remedies to a problem that I otherwise would not have known to exist. One major realization that I have come to is that educators should not be as territorial about subject areas as they often are. Developing methods to retain students at the

postsecondary level by any means—even outside one's subject area—will ultimately yield results that are beneficial to the entire institution.

This project also illuminated just how prevalent the problem of underprepared students entering college actually is. In music, students wishing to study at the collegiate level are often asked to undergo a rigorous audition process where less prepared students are often weeded out prior to enrollment. As math is a general education requirement of most community colleges and 4-year institutions, successful completion of this course is necessary whether or not the student currently possesses the needed skills. The research conducted for this project alerted me to how educators need to be aware of academic hindrances such as this. Whether they are aware of it or not, lack of adequate preparation at the high school level directly affects the success of students in all academic areas.

Reflection on Importance of the Work

Developmental math courses at the postsecondary level continue to be an oft-researched topic. What makes this study significant is that it was an attempt to find a solution to an existing problem. That may seem like an arbitrary statement, but as individuals in the field of education may be aware, assigning blame often seems to replace problem solving. In my experience, this process proves cyclic; secondary teachers blame students' lack of preparedness on middle-grade teachers, who in turn blame elementary teachers. Meanwhile, administrators blame colleges for graduating students who are unprepared for the profession, and then colleges blame secondary teachers for graduating students who are unable to pass collegiate math courses.

This project allowed me to focus solely on finding a solution to a problem that, according to the literature, continues to serve as a considerable stumbling block for many college students. With data also illustrating a low portion of the population in West Virginia obtaining college degrees, the timing and location of this research were certainly apropos. Occupations in timber, coal mining, gas, and oil that dominated the West Virginia workforce in the past required little to no collegiate experience. These jobs are quickly disappearing, and there is now a need for discussion, research, and action on how to successfully get more high school graduates through college degree programs in West Virginia in an effort to make them more viable for future jobs. This project allowed me to be part of the solution to this problem.

Implications, Applications, and Directions for Future Research

This project indicated that college students, when put in a situation that places significance on the successful completion of developmental math courses, show a significant increase in student retention. These results should be of interest to postsecondary instructors as well as college administrators. Instructors should be able to use these data as guides in the scheduling of advisees, in that these data may make them aware of what classes to avoid enrolling students in based on statistical evidence that shows low success rates when combined with required developmental math courses. The data from this project should be used as a catalyst for faculty development workshops in successful student advising.

On a broader level, this project study should be considered when developing curricula for new majors or when revisiting the curriculum for existing majors at all

institutions of higher learning. The research present herein could prove beneficial when creating plans of study to make sure that developmental math courses appear early in a student's collegiate career. Additionally, this research can be used when creating a schedule of courses for each semester at postsecondary institutions. Identifying which students require developmental math courses and making a campus-wide commitment to success in these courses should be seen as a first step. Once that is accomplished, making sure that enough sections of these courses are offered to accommodate this number should follow.

In the future, I will continue to monitor the scheduling and retention rates of developmental math students at GSC. In addition, the GSC administration is currently using the data from this project study as an impetus for a complete overhaul of the current advising system. As the Higher Education Policy Commission continues to pursue its goal of increasing West Virginia college graduation rates, this information should be made readily available as a resource for increased student retention. As research continues on the topic of developmental math, I will continue to stay aware of current research and methods as they develop. Although a universal approach to ending the struggles that many college students have with collegiate-level math courses remains to be developed, staying abreast of current research on this topic will ensure that a diverse aggregate of teaching methods exists for an increasingly diverse body of developmental math students.

Conclusion

This study was created as a means to bridge the gap between students who are ill prepared for collegiate math courses and successful college completion. As it stands, the data brought forth as a result of this project should be viewed by college administrators and faculty members alike as a guide for the scheduling of freshman college students requiring developmental math courses. The project allowed me the opportunity to not only develop as a scholar of education, but also to seek solutions to dilemmas that appeared, on the surface, to be beyond my typical area of expertise. If applied, this project should serve to bring significant improvements for underprepared college students. In addition, this work should be viewed as a useful contribution to current literature on this topic.

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Appendix A: Tier 1 Courses

ACCT 231	MRKT 202
ART 201	MSL 102
BIOL 110	MSL 104
BUSN 193	MUSC 105
BUSN 270	MUSC 107
BUSN 296	MUSC 111
CRJU 193	MUSC 112
CRJU 199	MUSC 116
CRJU 215	MUSC 167
CRJU 232	MUSC 168
CRJU 251	NRMT 125
CRJU 293	NURS 110
CSCI 201	PED 106
CSCI 267	PED 119
EDUC 205	PED 120
ENGL 102	PED 121
LAND 121	PED 124
LAND 123	PED 129
LAND 125	PED 232
SOCL 209	

Appendix B: Tier 2 Courses

BUSN 100

BUSN 230

CRJU 223

EDUC 207

ENVR 101

FRST 216

LAND 101

LAND 124

LAND 193

MGMT 201

MGMT 202

MRKT 201

MSL 151

MUSC 114

MUSC 180

NURS 100

SMGT 130

SOCL 105

Appendix C: Tier 3 Courses

BIOL 101

BIOL 102

CHEM 101

ENGL 205

HIST 201

HIST 202

PHYS 209

POSC 203

SCNC 101

SCNC 199