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Learning Support Effectiveness in Mathematics at a Tennessee University

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Learning Support Effectiveness in Mathematics at a Tennessee University

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ABSTRACT

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Every year thousands of students graduate from high school and move on to higher education, but many of them are not yet prepared for college level courses. The Tennessee Board of Regents does not currently allow 4-year institutions to teach courses that are below college level, so many institutions are using programs such as learning support courses to assist a growing population of underprepared students. The purpose of this study was to determine if the 1-term and 2-term retention rates for students with the same ACT mathematics subsection scores were different between students who took a regular section of Probability and Statistics and students who took a learning support section of the course.

The subjects of this study were students who enrolled in a Probability and Statistics class (either regular sections or learning support sections) at a 4-year institution from the 2013 summer semester through the 2014 fall semester. The criteria used for selecting subjects included: (1) enrolled in a section of Probability and Statistics, (2) had a valid ACT mathematics subsection score on file with the institution, and (3) recorded a final grade in the course. Students were then grouped by ACT mathematics subsection score and type of course (learning support or regular).

When students were grouped by matching ACT mathematics subscores there were no real significant differences in 1-term retention, 2-term retention, or final course grade between students who took a 4-hour learning support section of probability and statistics and students who opted to take a regular 3-hour version of the same course, with one exception. Of students who scored a 17 on the ACT mathematics subsection, the students enrolled in a regular course had a 1-term retention rate that was significantly higher than the learning support course.

DEDICATION

This work is dedicated to my family Roy, Kathy, and Erin, who have always supported me honestly and enthusiastically in whatever goals I have chosen and have always been advisors and close friends. Also, to Jim Fairman who was a great inspiration for my education and remains a great friend. Finally, to my wonderful wife Taylor, my greatest ally and greatest inspiration to be a better person. Thank you and I love you all.

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CHAPTER 1

INTRODUCTION

Every spring, millions of students graduate from high schools across the country and prepare for the next step in their lives. The next step for about two thirds of high school graduates is to continue their education at a college or university (NCES, 2014a). Many of these students already have a college in mind, some have started the enrollment process, and a large number have applied for funding to pay for this venture. It may seem that these students are ready to take the step into higher education, but unfortunately, most of these students are not academically prepared; especially in the area of mathematics.

The ACT is a standardized test used nationwide as a predictor of college success and is broken down by subject area. The mathematics benchmark is set at 22 out of a possible score of 36. Based on this benchmark, a student is given a 50% chance of attaining a grade of B or higher and a 75% chance of attaining a grade of C or higher in their introductory mathematics course in higher education (ACT, 2013). At a 5-year average only 45% of our nation’s graduates are meeting this benchmark from 2009 to 2013 (ACT, 2012). To combat this under-preparedness colleges and universities have put programs in place to help bring these students up to college level; systems vary in name and execution from institution to institution. These programs have typically been called developmental or remedial classes. Some have counted as credit toward graduation while others have not. Some have been a 1-hour tutoring session per week, while others have been 5-credit-hour classes (Ayecaster, 2001). Sometimes students are charged extra tuition fees for the extra hours, and other times students pay the same tuition as they would for a regular course. Research in this area is still ongoing; therefore, no singular method has been deemed most effective. However, many of these methods have been removed as an option for 4-year universities in Tennessee (TBR, 2014).

Complete College America (CCA) conducted a 2009 study on graduation rates and student success that was broken down by state levels. A report was submitted to Tennessee's then governor, Phil Bredesen, which highlighted suggestions that projected to improve graduation rates and student success for higher education institutions in Tennessee. Removing remedial courses from 4-year universities was among the suggestions stating, "remedial and developmental instruction should be eliminated at 4-year universities and only provided at community colleges where it can be provided at a lower cost to students and the state and where new models for more effective developmental education are being required" (p. 8). This suggestion was adopted by the Tennessee Board of Regents (TBR) in 2010 with full implementation to be completed by 2013 (TBR, 2014). While this change was not important to highly selective institutions, it provided a great strain on 4-year state institutions who rely heavily on the enrollment of students from less qualified populations with lower ACT scores. Many of these state institutions have incoming classes with median ACT scores that do not reach the benchmark of 22 (About Education, 2014). These institutions would face financial hardships if they had to reduce their admitted students by 50%, so they were forced to find innovative methods to help unprepared students to succeed without using remedial or developmental courses. One of these methods was the use of "learning support" courses that is the current method at the university being studied.

Learning support is defined by TBR (2014) as “academic support needed by a student to be college ready as established by the ACT college readiness benchmarks and standards” (p. 4). One way that universities have met this guideline is by offering a 1-hour support class for freshman level courses. For example a student registering for probability and statistics who does not meet college readiness standards for mathematics may still enroll in the course but will be required to participate in a 1-hour per week mathematics support class in which fundamental concepts will be reviewed and specific deficits addressed. This concept is relatively new, and very little research exists at the University being studied on the effectiveness of such supports in both catching underprepared students up to their prepared classmates and providing enough support to retain students who are behind.

This study was designed to determine if the 1-term and 2-term retention rates for students with the same ACT mathematics subsection scores were different for students taking a regular 3-hour probability and statistics course and students taking a 4-hour learning support version of the same course.

Statement of the Problem

The problem for this study is that it is not known if the learning supports put into place at the participating university are (1) providing adequate support to ensure successful completion of a college level mathematics course for underprepared students and enable them to obtain similar grades averages as college ready students, or (2) retaining learning support students from the semester following the learning support class and into the following year. This study will serve to measure the success in one mathematics course of underprepared students who are taking a learning support mathematics class versus students not needing learning support as well as compare the retention rates of students participating in mathematics learning support to the retention rate of those students not participating in learning support.

Research Questions

An ACT score of 19 was used as the benchmark for college readiness because it is the benchmark used by the university being studied. One-term retention was used because it represents retaining a student through the semester in which they enroll in probability and statistics at the university into the next term, and 2-term retention was used because it represents retaining a student from their first year into their second, a time that has been shown to produce the highest levels of attrition (Murtaugh et al., 1999). The learning support program being studied was formed to support a first year probability and statistics course, for all students who are required to take it in their first year.

The questions included in this study are:

1. Is there a significant difference in the 1-term retention rates between students who score a 19 or greater on the mathematics section of the ACT (and take a 3-hour Probability and Statistics course) and students who score less than 19 (who take a 4-hour learning support version of the same course)?
2. Is there a significant difference in the 2-term retention rates between students who score a 19 or greater on the mathematics section of the ACT (and take a regular 3-hour Probability and Statistics course) and students who score less than 19 (who take a 4-hour learning support version of the same course)?

3. For students scoring less than a 19 on the mathematics section of the ACT, is there a significant difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?
4. For students scoring less than a 19 on the mathematics section of the ACT, is there a significant difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?
5. For students scoring an 18 on the mathematics section of the ACT, is there a significant difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?
6. For students scoring an 18 on the mathematics section of the ACT, is there a significant difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?
7. For students scoring a 17 on the mathematics section of the ACT, is there a significant difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?
8. For students scoring a 17 on the mathematics section of the ACT, is there a significant difference in the 2-term retention rates between students who take a

regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?

9. For students scoring a 16 on the mathematics section of the ACT, is there a significant difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?
10. For students scoring a 16 on the mathematics section of the ACT, is there a significant difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?
11. For students scoring a 15 on the mathematics section of the ACT, is there a significant difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?
12. For students scoring a 15 on the mathematics section of the ACT, is there a significant difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?
13. Is there a significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course?

14. For students scoring less than a 19 on the mathematics section of the ACT, is there a significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course?
15. For students scoring an 18 on the mathematics section of the ACT, is there a significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course?
16. For students scoring a 17 on the mathematics section of the ACT, is there a significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course?
17. For students scoring a 16 on the mathematics section of the ACT, is there a significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course?
18. For students scoring a 15 on the mathematics section of the ACT, is there a significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those

taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course?

Significance of the Study

More than half of United States high school graduates score below the college readiness benchmark of 22 on the mathematics section of the ACT. However, a large portion of these students are moving on into higher education. High school students in Tennessee average 19 on the mathematics section of the ACT, this is two points behind the national average of 21 (ACT, 2012). Regardless of this, thousands of these students will be accepted into community colleges and regional universities. This may not be a major concern for highly selective universities, but regional universities that have a 70+% acceptance rate and cater to local populations simply cannot afford to turn this underprepared population away. Declining enrollment can lead to major budgeting concerns, classes cut, and entire programs being discontinued at some universities (Voket, 2015).

The TBR has suggested that community colleges are better equipped to deal with underprepared students (CCA, 2014). Four year universities cannot simply refer these students to a local community college for remediation with the expectation that they will return. Members of the Community College Research Center (CCRC) discovered that students who skipped a suggested remedial course and went directly into a college level course were less likely to succeed than their college-ready peers; however, they were more likely to succeed at a college level course than the students who completed the remedial class (Bailey, 2008). The reason for this is that most students who completed the remedial class never enrolled in its college level counterpart. Many 4-year universities have implemented new ways to help students who are not performing at college-readiness levels succeedwithout using remedial or developmental courses. Institutions of higher education have an interest in retaining this population of underprepared students and seeing them graduate.

One solution is using a 1-hour learning support course, sometimes referred to as a “side cart,” to go alongside a college level course to assist in filling knowledge gaps leading up to the course and providing extra assistance for difficult concepts during the semester. Institutions use these classes to give underprepared students an increased opportunity to succeed and increase their likelihood of remaining at the university. Another solution has been to build this 1-hour course into the regular program, thus creating a 4-hour learning support course; however, only 3 hours would count for credit. Multiple programs have been implemented by the university being studied since the TBR mandate.

This study was designed to seek to determine the effectiveness of the 4-hour learning support method at a Tennessee university. If it is shown to be effective, it will be more plausible for other universities to use their own versions of this method of learning support. If it is found to be ineffective, the institution being studied or other institutions may look at this program in an effort to modify or abandon it altogether. In either scenario, this study will add to the body of knowledge currently being formed to assist 4-year universities in the selection and implementation of these important programs.

Limitations of the Study

This study was limited by the appropriateness of the theoretical framework in determining the success of students enrolled in a learning support program for Probability and Statistics. It was assumed that students who did not re-enroll in semesters following the probability and statistics course dropped out of school. However, it is possible that many of these students transferred to another institution, but those data were not available. It was assumed that the ACT mathematics subsection score was an accurate representation of a student’s ability to succeed in a college level mathematics course. It was also assumed that information gathered from the office of institutional research was valid and reliable. It was further assumed that the methodology used adequately addressed the research questions. It was assumed that the chi-square tests used were appropriate for the data and would have the power to detect significant differences in the data. Finally, it was assumed that students in the 2-year sampling frame were representative of the typical cohort of students at the university being studied.

This study was delimited to students who had a valid ACT mathematics score that had been reported to the university being studied. Students who participated in the learning support program but did not have an ACT mathematics score on file with the university were excluded from the study. This study was further delimited by isolating letter grade in the course and 1-term and 2-term retention as the only measures of student success in the learning support program. Therefore, results from this study may not be generalizable to other settings or populations.

Definitions of Terms

Essential terms are defined so that the study may be more clearly understood. The following terms are defined as used in this study.

1. 1-term retention – When students who enrolled in a section (either learning support or not) of Probability and Statistics re-enrolled in the institution the following term, then the institution has retained them for 1-term.
2. 2-term retention – When students who enrolled in a section (either learning support or not) of Probability and Statistics re-enrolled in the institution the following 2 terms, then then institution has retained them for 2-terms.
3. ACT mathematics - American College Test. The ACT is a college readiness exam whose scores are accepted across the country as a benchmark for acceptance and an identifier for knowledge deficiencies. It is split into four subsections (English, Reading Comprehension, Science, and Mathematics) and these subsections are averaged to create a Composite score. For purposes of this study, only the Mathematics subsection was used.
4. College ready - Students who scored a 19 or above on the ACT mathematics subsection are considered by this particular university to be ready for introductory college level mathematics. The benchmark for college readiness set by the ACT is 22.
5. COMPASS - The COMPASS is a diagnostic test that is used to identify specific subject areas where students may have deficiencies. It is typically used as a placement tool and at this particular university it can be used as a second option for students who have not met the college readiness benchmark to test out of a

requirement for learning support. The COMPASS diagnostic test is created by the same company that creates the ACT exam.

6. Developmental Courses – Developmental courses are courses that are taught in a higher education setting that cover concepts that are not college-level (Parmer, 2007).
7. Remedial Courses - "While some researchers have distinguished differences between all of these terms (remedial, developmental, etc.), they are typically used interchangeably to refer to the same thing; coursework offered by a postsecondary institution that is below college-level work" (Parmer, 2007). - see also Developmental Courses

Overview of Study

Chapter 1 contains an introduction to the study to include a description of its relevance and purpose, the statement of the problem, research questions, definitions of terms, limitations of the study, and a brief overview of the study. Chapter 2 provides a review of literature related to the topics of identifying the underprepared student population, common barriers to success for this population, contemporary studies in developmental education, and whether or not developmental education should be provided by 4-year institutions. Chapter 3 is a description of the study design, population, data collection methodology, and procedures for data analysis. Chapter 4 offers an analysis of the data for each research question and information on the findings. Chapter 5 contains the summary, conclusions, implications, and recommendations for further research.

CHAPTER 2

REVIEW OF LITERATURE

Introduction

Policies over the past several decades have slowly increased the accessibility of higher education to all students; however, an increase in accessibility has not also equated to an increase in preparedness. This has led to a substantial rise in the population of underprepared students in higher education. Institutions have been wrestling with the issues of identifying this population, locating particular deficits in their education, and remediating these deficits so that they can succeed on the same level as their peers who entered college ready.

Many studies have been conducted at the institutional level to determine efficient and effective methods of remediation, but no national system has been proposed. The issue that is being debated at the state and national level is whether or not developmental education should exist at 4-year universities. To eliminate remedial classes from 4-year universities, states have looked at programs at the secondary level that could eliminate the need for remediation and also move remediation to community colleges that may be better equipped to handle it. Having more college prepared students would be welcomed by 4-year universities, but losing the underprepared population of students, even for a year, may not be an option because of financial concerns. An examination of literature has shown a relative consensus of views on how to identify underprepared students, various studies on the effectiveness of remediation, and differing opinions on whether remediation should exist in higher education.

The History of Developmental Education

In 1977 the majority of discussions about developmental programs in higher education involved ways to ignore or even eliminate them (Cross, 1976; Roueche & Snow, 1977). The topic of developmental education was typically avoided and, much like current discussions, the main ideas presented were that remedial classes should be either be eliminated from 4-year institutions and handled by community college or completely eliminated from higher education. The only journal at this time dedicated to developmental education was the Journal of College Reading and Learning (JCRL). The JCRL exists today as the College Reading and Learning Association. The only professional association at the time was the National Association for Remedial/Developmental Education in Postsecondary Education; now known as the National Association for Developmental Education (Boylan & Bonham, 2007).

The most influential work in the field of developmental education was published in 1979 by Martha Maxwell. It cited a great deal of research and gave many practical examples that are still used. The most recent edition was published in 1997. In 1980 the Kellogg Institute for the Training and Certification of Developmental Educators was established at Appalachian State University in Boone, North Carolina. This was the first professional development and certification program specifically for developmental educators in the United States. It is still in operation; therefore, it is currently the longest running developmental education training program (Boyland & Bonham, 2007).

In 1984 the National Center for Educational Statistics (NCES) published a report on developmental education. This was notable because it was the first time that the U.S. Department of Education recognized developmental education as an area that was important enough to warrant research. Since that time, three more reports have been published and developmental education is now included in “The Condition of Education,” the U.S. Department of Education’s annual report.

In 1985 the National Center for Developmental Education conducted a national study of the best programs and practices in developmental education. The results of the study were used to compile a directory of exemplary developmental programs. This led to a national conference in Atlanta, Georgia on best practices in developmental education in 1986. At this time Grambling State University in Louisiana established the nation’s first doctoral program in developmental education, further legitimizing the field of developmental education (Boyland & Bonham, 2007).

The National Center for Developmental Education conducted a national study in 1990 that gathered information on 5,000 randomly selected students across 120 different colleges and universities. This study examined relationships between methods, courses, organizational structures, and student outcomes (Boylan & Bonham, 2007). The results of the study were reported at the first National conference of Research in Developmental Education in 1992. By providing empirical data, the national study validated various practices and improved the effectiveness and professionalism of developmental education.

In 1996 several of the major organizations in developmental education established the American Council of Developmental Education Associations to promote collaboration; organizations include the College Reading and Learning Association, the National Association for Developmental Education, the Midwest College Learning

Center Association, the National Center for Developmental education, and the National Tutoring Association. It presently operates under the same name and is the organization that names Fellows of the American Council of Developmental Education Association. This award is a recognition of outstanding contributions to the field of developmental education and is the highest honor in the field.

In 2004, the importance of developmental education was made clear when the field received publically stated approval and financial support. A $100 million dollar initiative named Achieving the Dream (www.achievingthedream.org) sought to improve the success of students with weak academic skills at 84 community colleges, naming developmental education as a part of its core (Bailey, 2008, pp. 27-28).

At a 5-year average, only 45% of our nation's graduates met the ACT college readiness benchmark from 2009 to 2013 (ACT, 2012), making developmental education as widespread a need today as it has ever been. Even with all of the previous research and conferences, and with research continuing to emerge, the effectiveness of developmental education is still debated and there is currently no consensus as to which practices in developmental education are the most valuable and effective (Levin & Calcagno, 2008).

The Underprepared Student Population

Millions of students are graduating from public and private high schools across the United States and are applying to and being accepted by institutions of higher education. Unfortunately, a large percentage of this population, approximately 68%, is not yet ready for college level work (Bettinger, 2013). This population of students is identified as “underprepared.”

Students can be underprepared in many areas, but the majority of this underprepared population will be deficient in mathematics and there are many different reasons. One reason is that mathematics is a stair-step subject where a deficiency in one area can affect a student’s ability to complete a task in another area. Another reason is that, similar to a foreign language, it is constant use of the concepts learned that promotes long term retention. A majority of high schools in the United States only require three mathematics courses to graduate. The typical student takes all three of these required courses by the end of their junior year of high school. This leaves an entire calendar year between when the student last applied these concepts and the start of their freshman year in higher education. This, along with the fact that many students use technology (cellular phones, calculators, etc.) to handle minor calculations needed in their day to day lives, leads to a large amount of knowledge being lost before students even enter college (Boylan, 2011).

The entry point to higher education for 80% of 4-year students and nearly all two-year students will be a nonselective university, meaning that the bulk of the responsibility of dealing with the underprepared population will fall on these nonselective universities (Bettinger, 2013). These institutions will be tasked with identifying the underprepared students and bringing them up to speed for college level courses.

Underprepared Student Identification

The tool used most often by institutions to identify deficiencies in student knowledge is the American College Testing (ACT) college readiness assessment. Students are measured on the exam as a whole using the composite score and on the subsections of the test including English, Mathematics, Reading, Science, and Writing. These subscores are used by most institutions as a baseline identifier of students who are underprepared in a certain area with the typical cut-score for preparedness being set at 19. Students who score under this threshold are typically assigned some form of remediation in that area.

The subscores are often used to identify deficiencies in particular areas; however, the composite score also has uses. Reason (2004) has shown the ACT composite score to be a powerful predictor of student retention with a one point difference in composite score equating to approximately a 1.6% increase in odds of retention. There are many factors that affect student retention, but the ACT composite score is often used as a baseline predictor of student retention in order to examine the efficiency of programs aiming to increase retention.

Unfortunately, these measures cannot be used universally as non-traditional students often have an outdated ACT score or no score at all. These students are given a wide variety of tests, the choice of which test is accepted being made by the admitting institution, to determine individual deficiencies; the most often used exams for these situations are the ACCUPLACER exam developed by College Board and the COMPASS exam developed by ACT. The COMPASS exam is also used as second chance for students who scored below the ACT benchmark to test out of required remedial courses.

Success of Underprepared Students

Critics of remediation, mandatory remediation in particular, argue that remedial classes do not advance students toward degrees (Richardson, Fisk, & Okun, 1983). Levin (1999) summarized research supporting this viewpoint stating that students who are required to take multiple remedial courses often become discouraged and drop out; further, those who complete their remedial requirements and persist to graduate do so because of prior ability and motivation, not from skills acquired in the remedial courses. Levin also stated that a lack of research following up on students who participated in remedial programs was preventing administrators from evaluating long-term success the programs were generating (Levin, 1999).

In contrast, Schoenecker, Bollman, and Evans (1998) found evidence supporting remedial education. Schoenecker et al. split community college students into two groups: those who had been recommended to a remedial class and chose to attend, and those who had been recommended to a remedial class and chose not to attend. Schoenecker et al. found that the group who actually attended the recommended remedial class had higher average GPAs and 1-term retention rates than did their counterparts who did not attend the course. Further, Schoenecker et al. found that students who participated in a recommended remedial writing class passed the following college-level composition course at a rate 5% higher than the students who opted out of the remedial course. While this second result was not statistically significant, it was seen as a minor advantage (Shoenecker et al., 1998).

Looking past the 1-term or 2-term retention rate, the outcomes for underprepared students look significantly more bleak. The National Study of Developmental Education suggests that taking fewer remedial courses increases retention rates and graduation rates (Boylan & Saxon, 1999) suggesting that remedial courses are acting as a barrier for graduation. A study on a state community college system by the Little Hoover Commission (LHC) also shows an association between remedial course placement and low probabilities for degree completion (LHC, 2000). The LHC went on to examine all public community colleges in California for the 1998-1999 academic year and found that 80% of students completed their remedial courses, but only 24% of those students went on to take even a single higher level course. Transfer rates were also found to be incredibly low. Only 3% of California public community college students transferred to a 4-year school even though all students who completed 2 years at the community college with a 2.0 or higher GPA were admissible (LHC, 2000).

Berkner, He, and Cataldi (2002) conducted a 6-year longitudinal study across the United States and found a much more favorable transfer rate of 25% from community colleges to 4-year universities. However, this transfer rate dipped considerably for students participating in developmental education. McCabe (2000) argued that remedial courses can improve a student's life in many ways that cannot be measured by GPA, retention rates, or transfer rates, and that the economic benefits of helping even a small portion of underprepared students would outweigh the costs.

Students who complete the transfer from a 2-year to a 4-year institution may still face more obstacles; it is possible that they are less prepared than they realize. Friedl, Pittenger, and Sherman (2012) took the academic transcripts of 417 students at the

University of Tennessee Chattanooga and split them into groups based upon whether they had completed their remedial intermediate (high school level) algebra course at a 2-year or a 4-year institution. Students who had transferred their intermediate algebra course credit from a 2-year institution had significantly higher grades, on average, than students who had taken the course at the University of Tennessee Chattanooga or had transferred the class credit from another 4-year institution. However, students who had transferred the credit in from a 2-year institution showed substantially less success in subsequent math courses. This result suggested that grade inflation at 2-year institutions may be allowing students who are less prepared than they seem to be to transfer to 4-year universities, leading to lower graduation rates for transfer students (Friedl et al., 2012).

In Tennessee, where essentially all students can attend their first 2 years of community college for free (through the program Tennessee Promise), there is more reason than ever for students to attend a 2-year institution. However, many states are also passing incentives for 4-year universities to raise graduation rates. This could create an atmosphere where students are encouraged by the state to attend a 2-year institution, but 4-year institutions are encouraged not to allow these students to transfer their credits as it may lower the institution's graduation numbers (Friedl et al., 2012).

Remediation

The term remediation has been used along with terms such as developmental education, learning support, and non-traditional coursework. Some researchers have distinguished differences between all of these terms, but they are typically used interchangeably to refer to the same thing; coursework offered by a postsecondary institution that is below college-level work (Parmer, 2007). Some institutions offer remedial classes and others offer developmental programs, but any difference between the two will not be found in the title. Differences found in programs are most often in how each institution is addressing the wide variety of barriers that underprepared students face.

Barriers

Minority populations have historically faced many barriers in the access to and success in higher education, and while access to higher education has increased over the last several decades, success has remained stagnant. One of the major barriers in access to higher education is financial aid which has been reformed multiple times. This barrier has led to populations that have been underrepresented due to issues of affordability and access to funds. Unfortunately, many of these students who are now able to attend a college or university find under preparedness for college level work to be an enormous barrier (Brock, 2010).

Remedial education has historically acted as "a gatekeeper and quality control mechanism in most institutions. It allows underprepared students access to campus facilities and resources, yet clearly divides them from students considered to be college ready" (Brock, 2010, p. 116). These underprepared students are attending colleges and universities, but are graduating at a much lower rate than their college ready peers. Forty-three percent of non-remedial students are attaining a 2 year degree within eight and one-half years of entry, but only 28% of remedial students are attaining their degree. These numbers change to 78% and 52% respectively when examining completion rates at 4-year institutions (Brock, 2010).

First-Year Experience

Several institutions have put programs in place to bridge this retention and completion gap between prepared and under prepared students, with many of these programs focusing on social supports. These supports have been called First-year experience (FYE) programs and focus on guiding students through their freshman year (Upcraft & Gardner, 1989). All students will necessarily have an experience, whether it is a good one or a bad one, in their first year of college. A university in California instituted a FYE program for all students, hoping to provide a more scripted experience that could help students, particularly underprepared students, persist through their first year and continue on through graduation (Barnes, 2012). These FYEs typically consist of orientation programs, freshman seminar courses, summer bridge offerings, or learning communities (Barnes, 2012, p. 28). This particular college in California, along with several other institutions using FYE type interventions, found these programs to be successful in increasing retention of underprepared students (Barnes, 2012).

Kuh, Cruce, Shoup, Kinzie, and Gonyea (2008) conducted a similar study in which the relationship between first-year student engagement, academic achievement, and retention were examined. In Kuh et al's study, engagement was defined as time spent studying, time spent in cocurricular activities, and a global measure of engagement in effective educational practices; many of these measures being points of emphasis for FYE programs. Kuh et al. found that student engagement did have a positive relationship with both academic achievement and retention, and that this effect was greater in at risk populations, one of the populations defined as at risk being underprepared students. Kuh et al. also observed that academic preparedness was a significant factor in academic achievement and retention in the beginning, but by the end of the first year it is far less significant than factors such as student engagement. This was exemplified by a surprising number of students with high ACT/SAT scores, good first year grades, and no financial barriers for re-enrolling in their second year.

Taylor (2015) focused a study specifically of freshman orientation and its effect on grade point average and retention at an Alabama community college in 2012. Taylor found that freshmen who attended orientation were more likely to have higher grade point averages, higher fall-to-spring persistence, and higher fall-to-fall persistence than freshmen who did not attend orientation. Taylor also found that placement into developmental courses had no relationship with these variables.

The United States government, as well as state governments, attempted several times to reform developmental education in an attempt to increase retention and success of underprepared students. However, these reforms have rarely been evaluated in a way that establishes relationships between the reforms and educational attainment (Brock, 2010). This is not to say that studies on developmental education do not exist, just not on a nationwide scale. Several studies have been conducted on the effectiveness of developmental classes. (Ayecaster, 2001; Bettinger, Boatman, & Bridget, 2013; Bettinger & Long, 2004; Boylan & Saxon, 2001;;). Each study points to different factors that may help or hinder developmental education. Currently, there is no consensus between policy makers, teachers, students, or scholars as to which practices in developmental education are the most valuable and effective (Levin & Calcagno, 2008, p. 132).

Contemporary Studies on Developmental Education

According to a study from 2004, although developmental education can help bridge the gap between prepared and under prepared students, it does not put them on the same level. The subjects of this study were students who enrolled in a microeconomics class (ECON 101) and were also required to take developmental math (DEV 101) at a large Midwestern university. Some had already completed DEV 101 while others had put the class off, as it was not a requirement for ECON 101. It was shown that although students who required DEV 101 did not perform at the level of students who did not require the class, of the students who required DEV 101, those who had taken DEV 101 did outperform those who had not yet taken it (Johnson, 2004). Johnson claimed that students did benefit from the developmental course; however it did not fully prepare them to perform on the same level as their peers who did not require the developmental course.

A study at a different university was performed in the same year on another microeconomics course in which 1,462 microeconomics students were examined in four categories involving mathematics to see if any were predictors of success in the course. The categories were ACT Math Score, if they had taken Calculus, if they had taken a remedial mathematics course, and a test score on basic mathematical concepts. All four were found to be significant predictors (Ballard, 2004). Being enrolled in a remedial class showed a reduction in predicted achievement. Taking calculus at the high school level showed an increase in predicted achievement.

Ballard and Johnson also used the basic math skills test in combination with class history. If a student scored poorly on the test and had taken remedial math, that student was less likely to succeed in the class (Ballard, 2004, p. 17). A comparison of students who required a remedial class but had not yet taken it versus students who had already completed the remedial class was not made at the participating university as the developmental course was a prerequisite to the microeconomics class if required.

According to Woodard (2005), simply increasing the amount of time that students spend in developmental classes does not necessarily equate to higher rates of retention and success. A community college in Southwest Virginia compared the success rates of students who took a 5-hour developmental math class to those who took a 3-hour version of the same course. The results showed no significant difference in the exit exam scores of these two classes but did show a decreased enrollment in the 5-hour course, leading Southwest Virginia Community College to cancel future sections of the 5-hour course (Woodard, 2005).

A community college in Northeast Tennessee was examined to determine how much of an impact remedial courses had on a student's chance to graduate. Yates (2010) examined 2,326 students to determine if the number or type of developmental courses they were taking significantly affected their odds of graduating within 3 years at a community college. The results showed that taking a remedial course lowered your chance of graduation. The number of developmental courses taken was also shown to have an effect on graduation to the point that only 7.2% of students studied who took developmental classes in all three areas (math, English, and reading) persisted to graduate in 3 years (Yates, 2010, p. 55).

Developmental courses have in some cases been shown to reduce the gap in knowledge between prepared and under prepared students, but they have not completely eliminated the discrepancy and in some cases have served as a grim predictor of failure. This has led some to question who should be handling remedial education, or if it should exist in higher education at all.

Developmental Education at 4-Year Universities

The majority of policy makers in the United States believe that all students should have access to higher education; however, there has recently been a movement for 4-year institutions to become more selective and thus push developmental education and underprepared students toward 2-year colleges (Brothen, 2004). This is the stance that has been adopted by the Tennessee Board of Regents in recent years. TBR has moved the responsibility of remediating underprepared students to community colleges and has ordered 4-year universities to stop teaching courses that are not college level.

Opponents of this course of action have argued that many developmental students have deficiencies in only one or two areas, that these students have been successful in 4-year educational programs, and that asking them to complete one class in a community college before entering a 4-year university would be unreasonable (Dameshek, 1999). Another issue arises in the economics of this situation. Four-year universities may not be able to afford to lose these students when it is argued that the remedial classes pay for themselves. Not all 4-year universities find themselves in the same financial position. Major and private universities such as Harvard and Duke could cut out remedial education relatively easily, but this might not be as simple a task for state universities who often serve populations that are chronically underprepared. Brothen and Wambach (2004) concluded that remediation of some form will always exist in higher education stating "it's simply a matter of how educators choose to go about handling the responsibility of seeing to it that basic skills are improved while quality content is taught and standards are maintained" (Brothen & Wambach, 2004, p. 22).

Regardless of 2-year institutions' preparedness to effectively remediate underprepared students, 4-year institutions may not be able to simply refer underprepared students to a community college with expectations that they will return. Members of the Community College Research Center (CCRC) discovered that underprepared students who skipped their suggested remedial course were more likely to succeed at a college level course than students who completed the remedial class (Bailey, 2008). On its face this would seem to point toward remedial courses being ineffective, however Bailey cited the reason for this being that a large portion of students who completed a remedial course never enrolled in its college level counterpart. Remedial students who completed the course tended not to continue on to the next course.

Another barrier between completing needed remedial work at a community college and then continuing on to attain a 4-year degree is the transfer itself. Bailey found that students who completed a remedial course possibly never transferred to the 4-year institution that likely required the course. Other studies have shown that transfer status is negatively related to persistence (Pascarella & Terenzini, 2005). An information problem exists because whether a student who does no re-enroll chose to transfer or to drop out is often not clear. Bettinger (2004) cited this issue when he found that students placed in a remedial course, particularly into remedial math, tended to be more likely to drop out, but he could not know how much of this effect was due to the "institution-transfer-swirl" phenomena in which students persist to their baccalaureate degree, but through multiple institutions, and this information never makes it back to previous institutions (Kuh, 2008).

This is a disturbing trend for most 4-year institutions as losing the underprepared population would cut down a great deal on their enrollment. With a 1 year limit on remedial work, 4-year universities in California expelled 7% of their freshman class for "failing to master basic English and Math skills" in fall of 2001 (Trounson, 2002). Many schools simply cannot afford this. Highly selective universities will suffer virtually none from losing this population as they were likely never admitted. The 25th percentile ACT score for admitted freshmen at Harvard College is 31 (NCES, 2014b), but for the nonselective 4-year institutions that make up approximately 85% of all postsecondary schools (Kirst, 2004), this loss could be devastating. Declining enrollment has led to major budget concerns for many 4-year universities. South Carolina State University has pointed to reduced enrollment as a cause to shut down the institution altogether (Voket, 2015). It is possible that barring some form of financial relief, referring underprepared students to different institutions to complete remedial work may not be an option.

Tennessee High School Math

There is no national set of standards for education in the U.S.; therefore, states are allowed to set their own standards and requirements. Tennessee, as most states, requires Algebra I, Geometry, and Algebra II (or Math I, II, and III) along with one advanced mathematics course in order to graduate high school. Math I, Math II, and Math III are referred to as the integrated curriculum as they integrate ideas from both algebra and geometry and teach them in levels of increasing difficulty. An advanced math in Tennessee can be any of the following courses: Advanced Algebra and Trigonometry, Bridge Math, Calculus, Discrete Mathematics, Precalculus, Senior Finite Math, Probability and Statistics, and most recently SAILS math (Tennessee Department of Education, 2015). Tennessee also requires students to take a math class every year, not just four math classes. For example, if a student took Algebra I and Geometry their freshman year and Algebra II their sophomore year, although this is already 3 credits, they would still be required to take an advanced math their junior year and another their senior year. The reasons for this requirement are unclear and no other high school subject area shares this requirement.

There are data supporting the requirement of an advanced math before graduation. Long, Conger, and Iatarola (2012) found that students who took rigorous courses were substantially more successful in college level courses than those who did not. The estimated effect was even greater for disadvantaged students or students who attended schools in poor neighborhoods. Belfield and Crosta (2012) found similar results. Using a statewide community college system, they were able to obtain transcripts for every community college student in their state from the fall 2008 semester to the summer 2010 semester. Belfield and Crosta found that there was a significant positive relationship between the number of honors classes that a student took in high school and both their college grade point average and number of college credits earned. They also discovered that there was a significant positive relationship between the number of math classes taken in high school and both college grade point average and number of college credits earned.

Dual-Enrollment classes, college credited higher education classes offered by institutions of higher education to high school students through a partnership, have also shown benefits to high school students (Struhl & Vargas, 2012). Jobs for the Future (JFF) followed over 32,000 Texas students from the 2004 high school graduating class. JFF used a propensity score matching model to account for students' backgrounds so that the benefits of Dual-Enrollment classes could be examined. JFF found that students participating in Dual-Enrollment programs were 2.2 times more likely to enroll in a Texas 2-year or 4-year college, 2 times more likely to return for a second year of college, and 1.7 times more likely to complete a college degree. The increase in likelihood of earning an associate's degree only went from 6.8% (non-Dual-Enrollment group) to 8.9% (Dual-Enrollment group); however, the likelihood of earning a bachelor's degree showed a drastic increase going from 30.2% (non-Dual-Enrollment group) to 47.2% (Dual-Enrollment group). These studies would suggest that students who are taking more math courses and more rigorous math courses are more likely to be successful and have higher retention rates in college.

College Remediation at the High School Level

One solution has been to provide Early Assessment Programs (EAP). In an EAP used in the state of California, students are given a diagnostic exam during the second semester of their junior year of high school. Students who fail a portion of the exam, are told that their “skills are not yet sufficiently strong to succeed in required college English courses” (CSU, 2008).

Even if the EAP indicates to students that they are not prepared for college level work before their senior year begins, it does not put a plan in place to prepare the student. Rather, it gives recommendations for ways the students can prepare themselves, some of whom, for example, are taking a senior level English or math class, the student would have already done on their own. Unfortunately, the majority of students who fail this exam are students in systems that lack quality instruction to begin with (Tierney, 2008). Asking these students to seek out their own solutions for college readiness when their system is ill-equipped to help them has shown to be ineffective (Tierney, 2008)

Another high school level solution has been to increase the number of advanced classes offered to students with the hope that taking more rigorous courses would better prepare students for the college level. Long (2008) showed this to be effective. In Long’s study, Floridian students showed a positive relationship between college readiness and highest level of mathematics taken in high school, with the largest boost coming from Algebra 2. However, this relationship was not equal among racial and socioeconomic factors; black, Asian, and low socioeconomic students saw small returns. Another shortcoming of this strategy was shown with the EAPs, in locations where quality instruction can help college preparedness, students do not have access to it. All students in Tennessee have the opportunity to take Algebra 2, shown to have the greatest effect of the math classes on college readiness. However, as of 2011, less than one half of Tennessee's students were proficient in the subject (TDOE, 2013).

One issue affecting students' preparedness for college is that there is a large gap between students' high school experience and what is expected in college. Students are finding that the work and thought processes that are required for college-level classes are fundamentally different that those that were successful at the high school level (Conley et al., 2006).

Conley (2007) suggests four improvements that could be made on the high school level to increase college preparedness:

1. Align high school curriculum and instruction with college expectations. High schools can work with local colleges to examine the content difficulty of freshman level college courses. This would be used to better pace high school curricula so that the gap from a senior high school course to a college freshman course is not so large.
2. Develop high-quality syllabi. College syllabi are subject to external review while high school syllabi rarely are. This leads to vast differences in the content covered from course to course at the high school level, even amongst courses with the same name. By requiring high school courses to present high-quality syllabi, course content could be standardized and better aligned with college expectations. Furthermore, this would encourage teacher collaboration within departments and better understanding of course expectations by both students and their parents.
3. Implement senior seminars. A senior seminar course is a high school level course that is taught with college expectations. A course such as media and culture can be offered at the high school level, but the pace, rigor, feedback, and questioning would mirror that of a college level course. Students participating typically see increases in reading comprehension, technical writing, and critical-analysis skills.

4. Add missing content to high school courses. Several skills such as increasing the amount of quality writing and requiring students to defend mathematical solutions are not a part of class expectations in many high schools. Adding these as course expectations at the high school level allow students time and practice to develop these needed skills.

One program in Tennessee is introducing the college developmental math curriculum to students during their senior year of high school. The Seamless Alignment and Integrated Learning Support (SAILS) program is essentially allowing students to take a needed college remedial math class before leaving high school. Students typically take the ACT during their junior year of high school. After receiving results, juniors will already know if they will require some form of learning support in English, mathematics, or reading at their chosen college or university. The SAILS program will allow students who are deficient in mathematics to fulfill their learning support requirements during their senior year of high school (Volunteer, 2015).

The SAILS program has shown promising results. The program pilot was in 2013 and involved 600 high school seniors in Tennessee. Of the 200 students from the Chattanooga region 83% completed their college remedial requirements. Also, 25% of those students went on to complete a credited college math course (nonremedial) before high school graduation; essentially completing all of the mathematics they would need at the college level before even arriving at their college (Fain, 2013). The program has received $1.1 million dollars in funding from the state of Tennessee and has expanded to 114 high schools serving more than 6,500 students. It is expected that the program will soon be offered by every high school in the state (Fain, 2013).

Community Colleges as a Venue for Developmental Education

Some states such as Florida have a proven track record of using community colleges for remediation, but many researchers and leaders in education have pointed out several flaws with this system (Bettinger & Long, 2004). The four most prominent points being:

1. Students who begin their education at a two-year college are far less likely to obtain a 4-year degree than students that begin at a 4-year institution.
2. Minorities have shown a smaller retention rate at two-year colleges than at 4-year institutions.
3. The preparation given at a two-year college does not necessarily equate to the preparation required to be successful at a 4-year institution.
4. As economic status is a strong predictor of under preparedness, sending underprepared students to community colleges could create an educational caste system separating students from upper and lower socioeconomic classes (Dameshek, 1999, p. 19).

Community colleges are also currently struggling between two contradicting missions; allowing access to higher education for anyone completing secondary education, and keeping standards up to what is expected from a post-secondary institution. Mandating remedial education is central to this conflict. Mandating remedial courses to students who are not yet performing at post-secondary levels protects the standards in credited courses and increases the quality of education they provide (Roueche & Roueche, 1999); however, these remedial courses decrease the likelihood that an institution will retain students enrolled in them (Boylan & Saxon, 2001; Hoyt, 1999) and thus decrease student access. To state this contradiction in an extreme form, standards goals are met when the only students admitted into an institution are those who are prepared for college level work, and access goals are met when all students regardless of academic ability are allowed to participate in the college curriculum. Expressed in this way it is not possible to achieve both goals simultaneously. One must be favored over the other (Perin, 2006, p. 369-370).

Perin found that out of 15 community colleges surveyed, 11 were using practices that would reduce remedial enrollments, allowing more unprepared students into the institution without requiring remediation; thus seeming to favor access goals over standards goals. It is understandable why many states do not want 4-year institutions to be forced to make these same compromises, but it does not appear that 2-year institutions are leading the way toward student preparedness. Further, many 2-year institutions are concerned that being on the front line of higher education preparation could earn them the reputation of being a remedial school. This reputation would not be well received by the faculty of 2-year institutions, many of whom hold advanced degrees (Perin 2006).

Summary

The population of underprepared students has been growing because of reforms that have increased the accessibility of higher education while the level of preparedness of these students has not increased. This has led to a rise in the population of students currently attending post-secondary institutions who are not yet ready for college level work in one or more subjects. The ACT has been used nearly universally as a tool to identify students that have content deficiencies and to point out where those deficiencies lie. These underprepared students have been subjected to different forms and levels of remediation. Some received counseling and remediation at the high school level while others were admitted, unprepared, into higher education with the understanding that remediation would still be required. Some forms of the remediation at the higher education level appear to have acted as barriers to student retention and graduation; others have shown small levels of success in closing these preparedness gaps. No national system for remediation currently exists.

Many believe that all students should have the opportunity to access higher education but that 4-year universities should be more selective and remediation should be provided on the community college level. Opponents to this stance cite economic (many 4-year schools may not be able to survive the large decrease in enrollment) and social issues (the creation of an educational caste system) that could arise. Venue for remediation is still being debated, but there is no argument that the population of underprepared students is rising and that effective forms of remediation need to be identified and instituted in order for these students to better succeed in higher education.

This chapter provided a review of the related literature concerning the history of developmental education, the increase of the underprepared student population, identifying this population and their content deficits, successes of underprepared students, whether remediation can act as another barrier to underprepared students, Tennessee high school math courses and graduation requirements, remediation at the high school level, whether community colleges are a better place to handle remediation than 4-year institutions, if 4-year institutions should handle any remediation at all, and contemporary studies on different remediation techniques used at the high school, 2-year institutional, and 4-year institutional level as well as the effectiveness of these strategies.

CHAPTER 3

RESEARCH METHOD

A large portion of high school graduates are entering post-secondary education underprepared by ACT assessment standards for college level work. Upon acceptance, underprepared students are typically given a diagnostic test such as the COMPASS exam to determine if students will be required to complete remedial coursework or participate in some form of learning support. Community colleges in Tennessee are still allowed to enroll students into remedial or developmental classes in which students will not earn a credit toward a degree, but 4-year universities in the state are no longer permitted this option. They must institute other measures such as learning support programs that will help students fill in content knowledge deficiencies while still moving through a credited course.

This study was conducted at a 4-year institution in the state of Tennessee. The participating university is under the governance of the Tennessee Board of Regents (TBR). The majority of the student population for this institution comes from the local area and more than half of the student population does not meet the ACT benchmark scores in mathematics for college preparedness. This study was focused on comparing 1-term retention (from one semester to the next, 2-term retention (from one year to the next), and academic achievement between students who require the institutions learning support program and students who do not.

This quantitative study was conducted to examine the difference between students who took a learning support section of Probability and Statistics and students who took a regular version of the same course. A quasi-experimental design was used because in this study an independent variable (enrollment in a learning support section of Probability and Statistics) was identified but not manipulated, groups were not randomly assigned, and pre-existing groups (based on ACT mathematics subsection score) were used (Reichardt, 2009).

Population

The subjects of this study were students who enrolled in a Probability and Statistics class (either regular sections or learning support sections) from the 2013 summer semester through the 2014 fall semester. Students had a valid ACT score on file with the university to be included. Access to the data was provided by the institution and retrieved from the Office of Institutional Research. To insure anonymity of the subjects, all personal identifiers were removed from the data before they were acquired by the researcher.

Information requested about the students who enrolled in this course was: (1) the type of course enrolled in (regular or learning support), (2) each student’s grade in that course, (3) 1-term retention (from one semester to the next), (4) 2-term retention (from one year to the next), (5) ACT mathematics subscore, and (6) COMPASS score (if applicable).

Data Collection

Data were provided by the Office of Institutional Research at the university being studied after approval was given by the Institutional Review Board. The data came from course extracts from the Banner data system. Course information came from course extracts and student information came from student enrollment extracts. Those extracts were collected at the same point each semester to form a census extract.

Research Questions and Null Hypotheses

Several research questions were addressed in this study to determine the benefit, if any, that this particular university's learning support program had on bringing underprepared students up to a level where they could succeed in a college level mathematics course. Other questions were formulated to measure this learning support program's relationship, if any, on increasing student retention from fall-to-spring and fall-to-fall, and if this relationship was greater or lesser with first-year freshmen than with nontraditional students. Fall-to-spring retention was used as it represents retaining a student through their first semester at the university into their second, and fall-to-fall retention was used as it represents retaining a student from their first year into their second. The learning support program being studied was formed to support a first-year probability and statistics course, so all students who are required to take it will have taken it in their first year.

The questions included in this study were:

1. Is there a significant difference in the 1-term retention rates between students who score a 19 or greater on the mathematics section of the ACT (and take a 3-hour Probability and Statistics course) and students who score less than 19 (who take a 4-hour learning support version of the same course)?

   $H_0 1$: There is no significant difference in the 1-term retention rates between students who score a 19 or greater on the mathematics section of the ACT (and take a 3-hour Probability and Statistics course) and students who score less than 19 (who take a 4-hour learning support version of the same course).

2. Is there a significant difference in the 2-term retention rates between students who score a 19 or greater on the mathematics section of the ACT (and take a regular 3-hour Probability and Statistics course) and students who score less than 19 (who take a 4-hour learning support version of the same course)?

   $H_0$2: There is no significant difference in the 2-term retention rates between students who score a 19 or greater on the mathematics section of the ACT (and take a regular 3-hour Probability and Statistics course) and students who score less than 19 (who take a 4-hour learning support version of the same course).

3. For students scoring less than a 19 on the mathematics section of the ACT, is there a significant difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?

   $H_0$3: For students scoring less than a 19 on the mathematics section of the ACT, there is no significant difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course).

4. For students scoring less than a 19 on the mathematics section of the ACT, is there a significant difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?

$H_0$4: For students scoring less than a 19 on the mathematics section of the ACT, there is no significant difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course).

5. For students scoring an 18 on the mathematics section of the ACT, is there a significant difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?

   $H_0$5: For students scoring an 18 on the mathematics section of the ACT, there is no significant difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course).

6. For students scoring an 18 on the mathematics section of the ACT, is there a significant difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?

   $H_0$6: For students scoring an 18 on the mathematics section of the ACT, there is no significant difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course).

7. For students scoring a 17 on the mathematics section of the ACT, is there a significant difference in the 1-term retention rates between students who take a

regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?

$H_0$7: For students scoring a 17 on the mathematics section of the ACT, there is no significant difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course).

8. For students scoring a 17 on the mathematics section of the ACT, is there a significant difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?

   $H_0$8: For students scoring a 17 on the mathematics section of the ACT, there is no significant difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course).

9. For students scoring a 16 on the mathematics section of the ACT, is there a significant difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?

   $H_0$9: For students scoring a 16 on the mathematics section of the ACT, there is no significant difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course).

10. For students scoring a 16 on the mathematics section of the ACT, is there a significant difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?

    $H_0$10: For students scoring a 16 on the mathematics section of the ACT, there is no significant difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course).

11. For students scoring a 15 on the mathematics section of the ACT, is there a significant difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?

    $H_0$11: For students scoring a 15 on the mathematics section of the ACT, there is no significant difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course.

12. For students scoring a 15 on the mathematics section of the ACT, is there a significant difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?

    $H_0$12: For students scoring a 15 on the mathematics section of the ACT, there is no significant difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course.

13. Is there a significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course?

    $H_0$13: There is no significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course.

14. For students scoring less than a 19 on the mathematics section of the ACT, is there a significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course?

    $H_0$14: For students scoring less than a 19 on the mathematics section of the ACT, there is no significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course.

15. For students scoring an 18 on the mathematics section of the ACT, is there a significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those

taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course?

$H_0$15: For students scoring an 18 on the mathematics section of the ACT, there is no significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course.

16. For students scoring a 17 on the mathematics section of the ACT, is there a significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course?

$H_0$16: For students scoring a 17 on the mathematics section of the ACT, there is no significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course.

17. For students scoring a 16 on the mathematics section of the ACT, is there a significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course?

$H_0$17: For students scoring a 16 on the mathematics section of the ACT, there is no significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course.

18. For students scoring a 15 on the mathematics section of the ACT, is there a significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course?

$H_0$15: For students scoring a 15 on the mathematics section of the ACT, there is no significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course.

Data Analysis

Quasi-experimental statistical methods were used to analyze the research questions. The data were analyzed using a series of chi-square tests of independence. Two-way contingency tables were used on all research questions pertaining to 1-term and 2-term retention (questions 1 – 12). The alpha level was set at .05 for each hypothesis. All data were analyzed using IBM-SPSS.

Summary

Chapter 1 provided background information and introduced the study, presented the problem and general research questions to be studied, described the significance of the study, stated the study's limitations, and defined the terms used in the study. Chapter 2 provided a review of the literature pertinent to the study. Chapter 3 provided the research design, population studied, procedures for data collection, research questions and null hypotheses tested, and the methodology for data analysis. Chapter 4 contains the analysis and interpretations of the data. Chapter 5 contains the summary, conclusions, implications, and recommendations for further research.

CHAPTER 4

FINDINGS

Introduction

Approximately two thirds of high school graduates decide to continue their education at a college or university (NCES, 2014a). Most of these students believe that they are prepared for this next step, but the ACT benchmark, a commonly used test to predict college success, does not support this belief, especially in the area of mathematics. An ACT mathematics subsection score of 22 predicts that a student has a 50% chance of obtaining a B or higher and a 75% chance of obtaining a C or higher in an introductory math course in higher education (ACT, 2013). Thus, a score of 22 is the benchmark for college readiness in mathematics. At a 5-year average from 2009 to 2013, only 45% of our nation's graduates are meeting this benchmark. This leaves a large population of students who are enrolling into higher education, but are not yet prepared.

To help bring this population up to speed, colleges and universities have instituted developmental and remedial programs. These programs vary in many aspects such as name, length, if credit is actually given, and cost (Ayecaster, 2001). There is not currently a program that has been recognized as most effective, so different methods are being implemented and research is ongoing; however, in Tennessee many options have been removed for 4-year universities (TBR, 2014).

In 2010, Phil Bredesen, Tennessee's then governor, suggested that remedial courses be removed from 4-year universities. This suggestion was adopted by the TBR with implementation to be completed by 2013. This provided a great strain on 4-year Tennessee institutions that rely heavily on the enrollment of students who, as shown by their ACT benchmark scores, are not yet prepared for higher education. These institutions could not afford to lose this population of students but were no longer allowed to teach them classes that were less than college level. One solution to this problem was the use of learning support courses; the method currently in place at the university being studied. The purpose of this study was to measure the success and retention rates of students who participated in this university's learning support program in mathematics versus students who were equally underprepared but did not participate in the program and opted to take a regular mathematics course.

This study was designed to determine if the 1-term and 2-term retention rates for students with the same ACT mathematics subsection scores were different for students taking a regular 3-hour Probability and Statistics course and students taking a 4-hour learning support version of the same course.

Data for this study were housed in the Banner Software System database at the office of institutional research. The population consisted of all students who enrolled in a Probability and Statistics class (either regular sections or learning support sections) from the 2013 summer semester through the 2014 fall semester. Students included in the study had a valid ACT score on file with the university. Access to the data was provided by the institution and retrieved from the Office of Institutional Research. To insure anonymity of the subjects, all personal identifiers were removed from the data before they were acquired by the researcher.

Eighteen research questions were developed to direct the study and 18 corresponding hypotheses were tested. A chi square test was used in each instance to determine if there was a significant difference in the 1-term retention, 2-term retention, and final grades between these two populations. The research questions, hypotheses, and data as well as data analysis are presented below.

Research Question 1

Is there a significant difference in the 1-term retention rates between students who score a 19 or greater on the mathematics section of the ACT (and take a 3-hour Probability and Statistics course) and students who score less than 19 (who take a 4-hour learning support version of the same course)?

$H_0 1$: There is no difference in the 1-term retention rates between students who score a 19 or greater on the mathematics section of the ACT (and take a 3-hour Probability and Statistics course) and students who score less than 19 (who take a 4-hour learning support version of the same course).

A two-way contingency table analysis was calculated to evaluate whether the 1-term retention rates were significantly different between students who scored a 19 or greater on the mathematics section of the ACT (and took a 3-hour Probability and Statistics course) and students who scored less than 19 (and took a 4-hour learning support version of the same course). The two variables were type of course (learning support with an ACT < 19 or regular with an ACT ≥ 19) and enrolled in the following semester (yes or no). Type of course and retention were found to be significantly related, Pearson χ^2 (1, N = 2,714) = 7.78, p<.01, Cramer's V = .05. Therefore, the null hypothesis was rejected. The percentages of students in the two class type categories who enrolled in the following semester were 78% (learning support) and 82.7% (regular). Students who scored an 18 or less on the mathematics section of the ACT and took a learning support section of Probability and Statistics were significantly less likely to enroll in the following semester than students who scored a 19 or greater and took a regular section of the course.

Information presented in Table 1 shows the counts of students who were enrolled at the university 1 semester after taking the Probability and Statistics course and those who were not for each of the section types. Figure 1 shows the percentages of students who were enrolled 1 semester after taking the Probability and Statistics course and those who were not for each of the section types.

Table 1

Number of Students Who Were Enrolled at the University 1 Semester after Taking the Probability and Statistics Course

	Enrolled 1 Semester after the Course		
Type of Course	No	Yes	Total
Regular (w/ACT of 19 or more)	228	1,615	1,953
Learning Support (w/ACT of 18 or less)	167	594	761

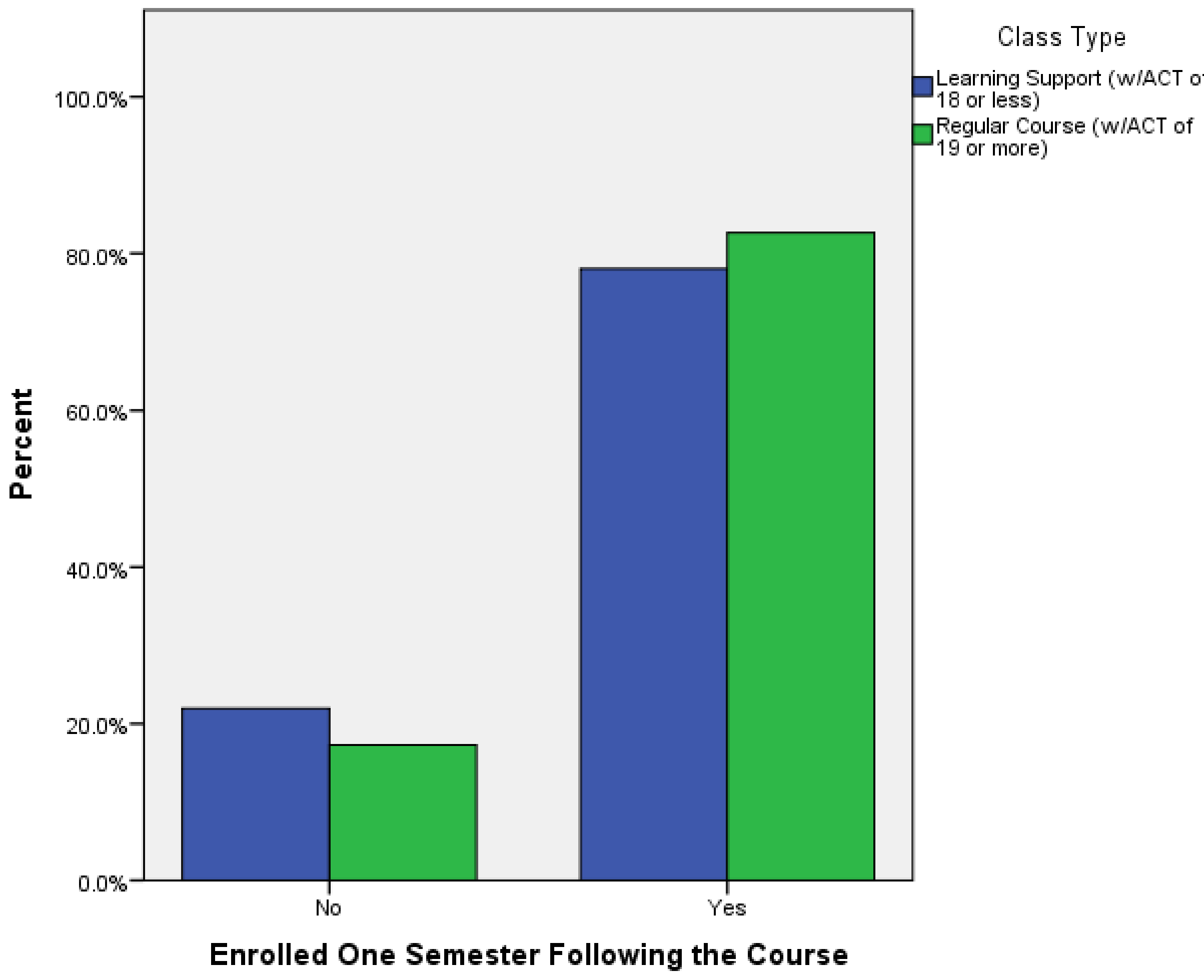

Figure 1. Percentage of Students Who Enrolled 1 Semester after Taking a Probability and Statistics Course and Type of Course Taken

Research Question 2

Is there a significant difference in the 2-term retention rates between students who score a 19 or greater on the mathematics section of the ACT (and take a regular 3-hour Probability and Statistics course) and students who score less than 19 (who take a 4-hour learning support version of the same course)?

H_02: There is no difference in the 2-term retention rates between students who score a 19 or greater on the mathematics section of the ACT (and take a regular 3-hour Probability and Statistics course) and students who score less than 19 (who take a 4-hour learning support version of the same course).

A two-way contingency table analysis was calculated to evaluate whether the 2-term retention rates were significantly different between students who scored a 19 or greater on the mathematics section of the ACT (and took a 3-hour Probability and Statistics course) and students who scored less than 19 (and took a 4-hour learning support version of the same course). The two variables were type of course (learning support with an ACT < 19 or regular with an ACT ≥ 19) and enrolled in the university two semester after taking the course (yes or no). Type of course and retention were found to be significantly related, Pearson χ^2 (1, N = 1,726) = 17.34, $p<.001$, Cramer's $V = .10$. Therefore, the null hypothesis was rejected. The percentages of students in the two class type categories who enrolled in the following semester were 60.5% (learning support) and 71.1% (regular). Students who scored an 18 or less on the mathematics section of the ACT and took a learning support section of Probability and Statistics were significantly less likely to be enrolled at the university two semesters after taking the course than students who scored a 19 or greater and took a regular section of the course.

Information presented in Table 2 shows the counts of students who were enrolled at the university two semesters after taking the Probability and Statistics course and those who were not for each of the section types. Figure 2 shows the percentages of students who were enrolled two semesters after taking the Probability and Statistics course and those who were not for each of the section types.

Table 2

Number of Students Who Were Enrolled at the University 2 Semesters After Taking the Probability and Statistics Course and Type of Course Taken

	Enrolled 2 Semesters after the Course		
Type of Course	No	Yes	Total
Regular (w/ACT of 19 or more)	366	899	1,265
Learning Support (w/ACT of 18 or less)	182	279	461

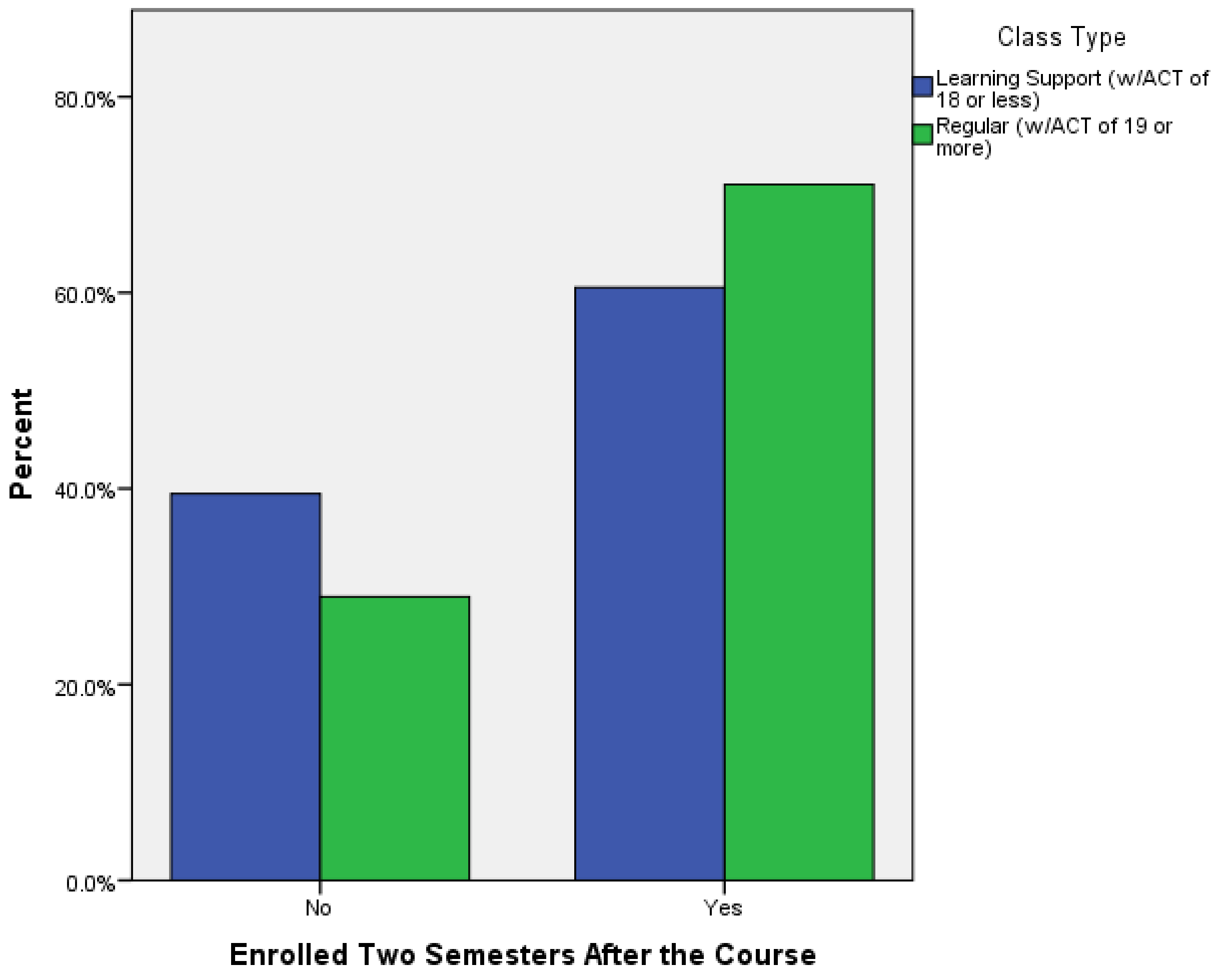

Figure 2. Percentage of Students Who Were Enrolled 2 Semesters after Taking a Probability and Statistics Course and Type of Course Taken

Research Question 3

For students scoring less than a 19 on the mathematics section of the ACT, is there a significant difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?

H_03: For students scoring less than a 19 on the mathematics section of the ACT, there is no difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course).

A two-way contingency table analysis was calculated to evaluate whether the 1-term retention rates were significantly different between students who scored less than 19 on the mathematics section of the ACT (and took a 3-hour Probability and Statistics course) and students who scored less than 19 (and took a 4-hour learning support version of the same course). The two variables were type of course (learning support with an ACT < 19 or regular with an ACT < 19) and enrolled in the following semester (yes or no). Type of course and retention were not found to be significantly related, Pearson χ^2 (1, N=1201)=.631, p=.464, Cramer's V = .023. Therefore, the null hypothesis was not rejected. The percentages of students in the two class type categories who enrolled in the following semester were 78.1% (learning support) and 80% (regular). Among students who scored less than 19 on the ACT mathematics subsection, students who took the learning support section of Probability and Statistics were not significantly more or less likely to be enrolled 1 semester after taking the course than students who took a regular section.

Information presented in Table 3 shows the counts of students who were enrolled at the university 1 semester after taking the Probability and Statistics course and those who were not for each of the section types. Figure 3 shows the percentages of students who were enrolled 1 semester after taking the Probability and Statistics course and those who were not for each of the section types.

Table 3

Number of Students with an ACT Mathematics Score of 18 or less Who Enrolled 1 Semester after Taking the Probability and Statistics Course and Type of Course Taken

	Enrolled 1 Semester after the Course		
Type of Course	No	Yes	Total
Regular (ACT<18)	228	1,615	1,953
Learning Support (ACT<18)	167	594	761

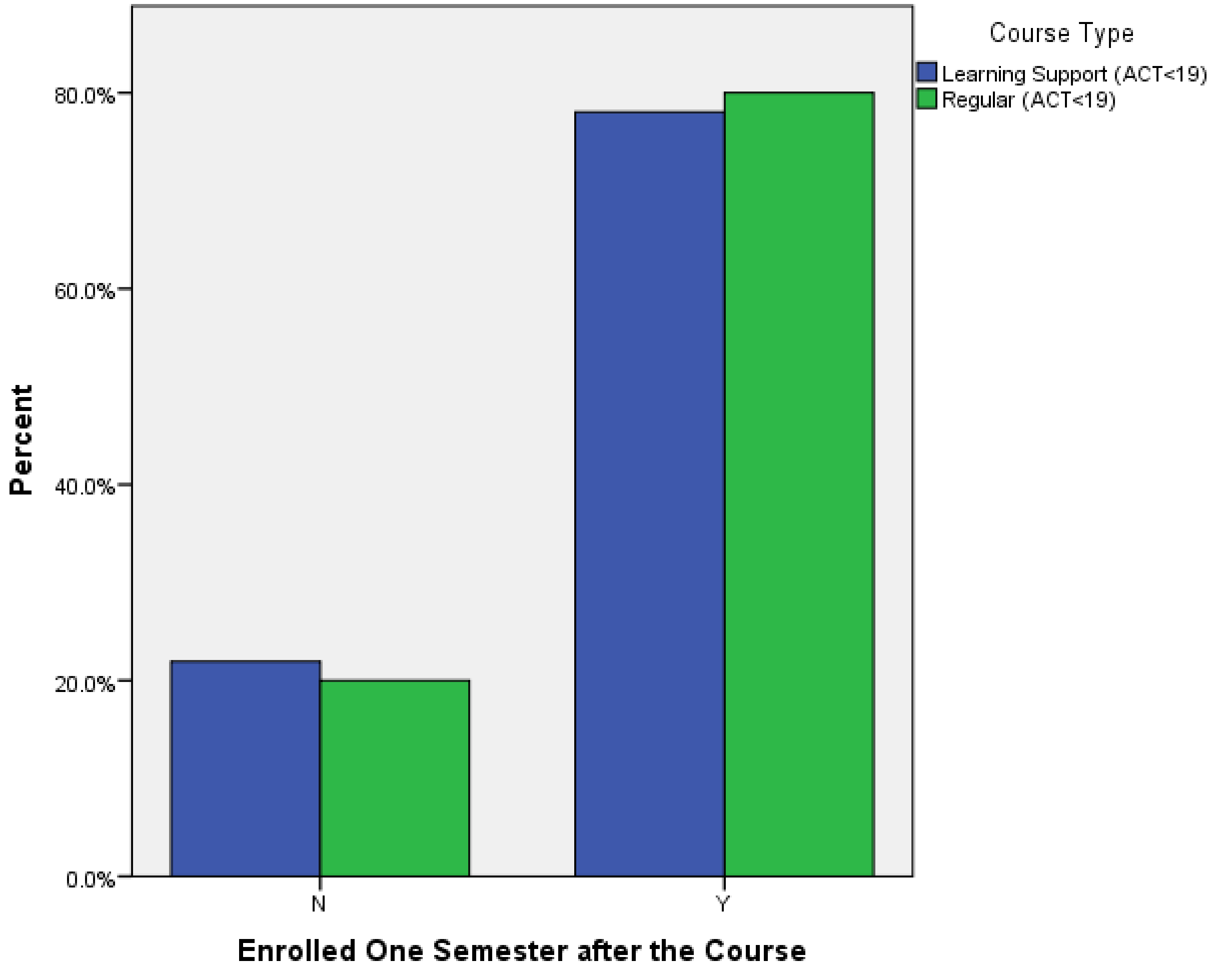

Figure 3. Percentage of Students Who Enrolled 1 Semester after a Probability and Statistics Course (ACT<19)

Research Question 4

For students scoring less than a 19 on the mathematics section of the ACT, is there a significant difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?

$H_0$4: For students scoring less than a 19 on the mathematics section of the ACT, there is no difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course).

A two-way contingency table analysis was calculated to evaluate whether the 2-term retention rates were significantly different between students who scored less than 19 on the mathematics section of the ACT (and took a 3-hour Probability and Statistics course) and students who scored less than 19 (and took a 4-hour learning support version of the same course). The two variables were type of course (learning support with an ACT < 19 or regular with an ACT ≥ 19) and enrolled in the university 2 semesters after taking the class (yes or no). Type of course and retention were not found to be significantly related, Pearson χ^2 (1, N = 803) = .06, $p = .800$, Cramer's V = .01. Therefore, the null hypothesis was not rejected. The percentages of students in the two class type categories who enrolled in the following semester were 60.5% (learning support) and 61.4% (regular). Among students who scored less than 19 on the ACT mathematics subsection, students who took the learning support section of Probability and Statistics were not significantly more or less likely to be enrolled 2 semesters after taking the course than students who took a regular section.

Information presented in Table 4 shows the counts of students who were enrolled at the university 2 semesters after taking the Probability and Statistics course and those who were not for each of the section types. Figure 4 shows the percentages of students who were enrolled 2 semesters after taking the Probability and Statistics course and those who were not for each of the section types.

Table 4

Number of Students with an ACT Mathematics Score of 18 or less Who Enrolled 2 Semesters after Taking the Probability and Statistics Course and Type of Course Taken

	Enrolled 2 Semesters after the Course		
Type of Course	No	Yes	Total
Regular (ACT<19)	132	210	342
Learning Support (ACT<19)	182	279	461

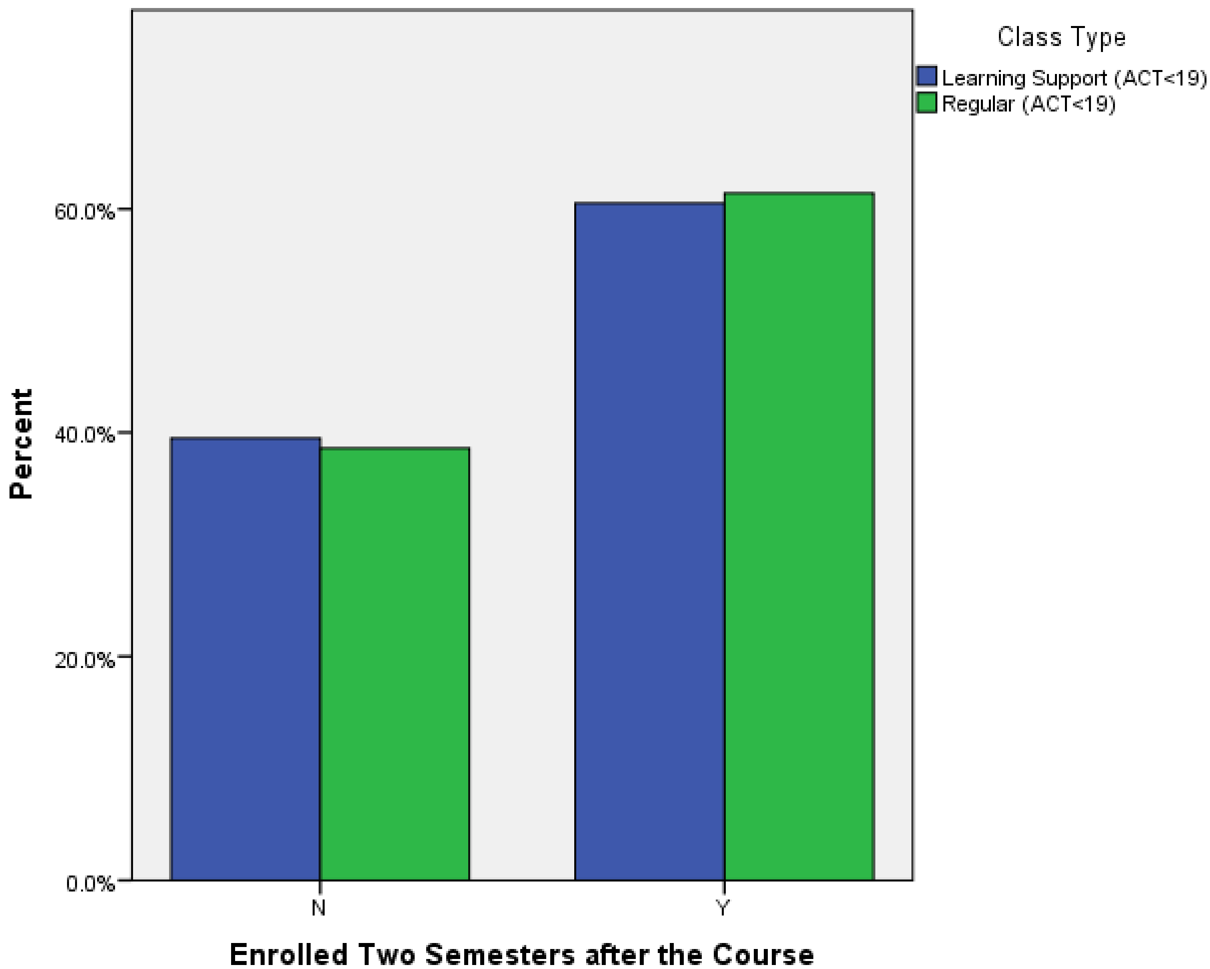

Figure 4. Percentage of Students Who Enrolled 2 Semesters after taking a Probability and Statistics Course (ACT<19)

Research Question 5

For students scoring an 18 on the mathematics section of the ACT, is there a significant difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?

H_05: For students scoring an 18 on the mathematics section of the ACT, there is no difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course).

A two-way contingency table analysis was calculated to evaluate, for students who scored an 18 on the mathematics section of the ACT, whether the 1-term retention rates were significantly different between students who took a regular 3-hour Probability and Statistics course and students who took a 4-hour learning support version of the same course. The two variables were type of course (learning support with ACT = 18 or regular with an ACT = 18) and enrolled in the following semester (yes or no). Type of course and retention were not found to be significantly related, Pearson χ^2 (1, N = 334) = 1.00, p = .317, Cramer's V = .06. Therefore, the null hypothesis was not rejected. The percentages of students in the two class type categories who enrolled in the following semester were 81.6% (learning support) and 77% (regular). Among students who scored an 18 on the ACT mathematics subsection, students who took the learning support section of Probability and Statistics were not significantly more or less likely to be enrolled 1 semester after taking the course than students who took a regular section.

Information presented in Table 5 shows the counts of students who were enrolled at the university 1 semester after taking the Probability and Statistics course and those who were not for each of the section types. Figure 5 shows the percentages of students who were enrolled 1 semester after taking the Probability and Statistics course and those who were not for each of the section types.

Table 5

Number of Students with an ACT Mathematics Score of 18 Who Enrolled 1 Semester after Taking the Probability and Statistics Course and Type of Course Taken

	Enrolled 1 Semester after the Course		
Type of Course	No	Yes	Total
Regular (ACT=18)	28	94	122
Learning Support (ACT=18)	39	173	212

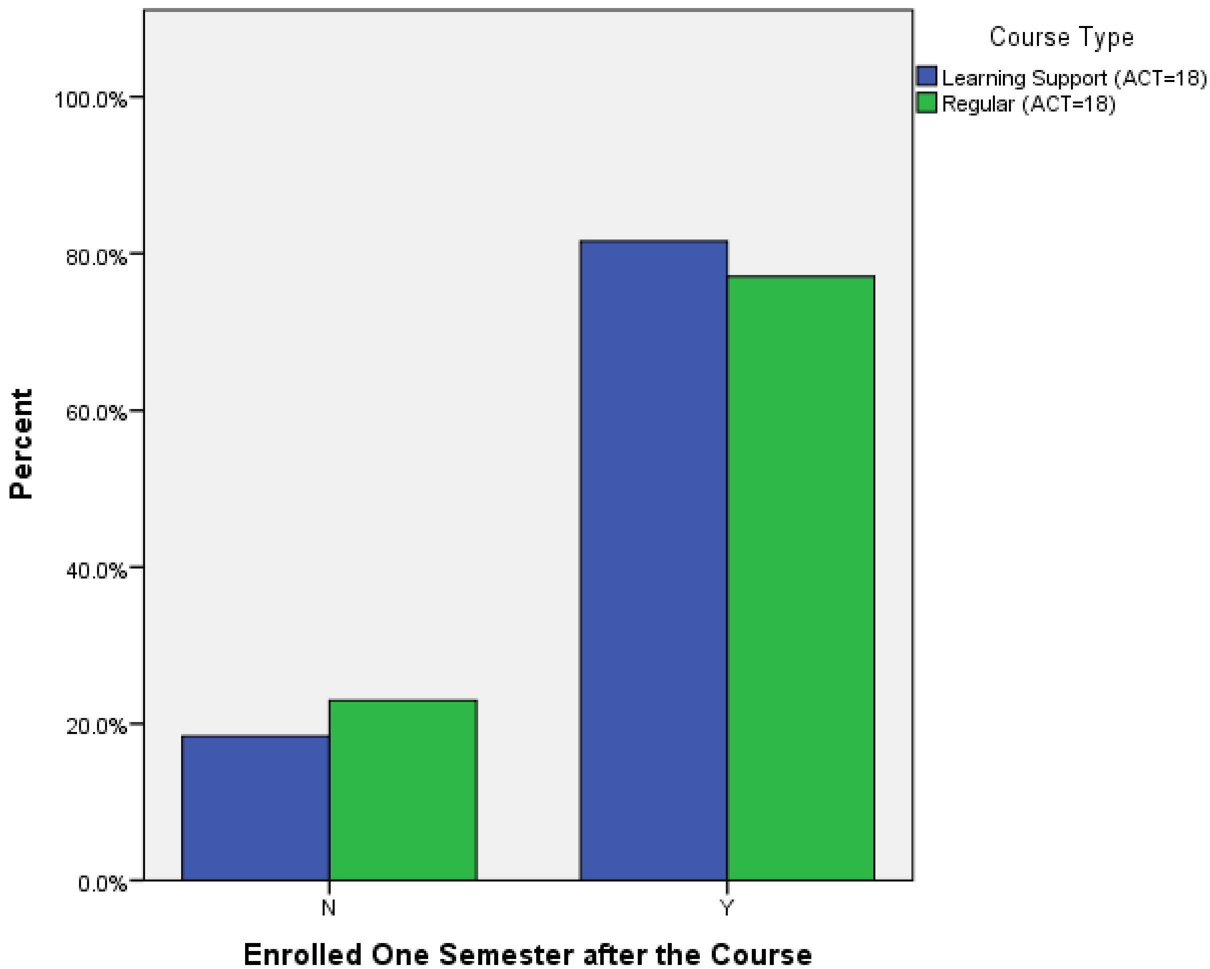

Figure 5. Percentage of Students Who Enrolled 1 Semester after a Probability and Statistics Course (ACT=18)

Research Question 6

For students scoring an 18 on the mathematics section of the ACT, is there a significant difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?

H_06: For students scoring an 18 on the mathematics section of the ACT, there is no difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course).

A two-way contingency table analysis was calculated to evaluate, for students who scored an 18 on the mathematics section of the ACT, whether the 2-term retention rates were significantly different between students who took a regular 3-hour Probability and Statistics course and students who took a 4-hour learning support version of the same course. The two variables were type of course (learning support with ACT = 18 or regular with an ACT = 18) and enrolled in the university 2 semesters after the course (yes or no). Type of course and retention were not found to be significantly related, Pearson χ^2 (1, N = 214) = .22, p = .637, Cramer's V = .03. Therefore, the null hypothesis was not rejected. The percentages of students in the two class type categories who enrolled in the following semester were 63.6% (learning support) and 60.4% (regular). Among students who scored an 18 on the ACT mathematics subsection, students who took the learning support section of Probability and Statistics were not significantly more or less likely to be enrolled 2 semesters after taking the course than students who took a regular section.

Information presented in Table 6 shows the counts of students who were enrolled at the university 2 semesters after taking the Probability and Statistics course and those who were not for each of the section types. Figure 6 shows the percentages of students who were enrolled 2 semesters after taking the Probability and Statistics course and those who were not for each of the section types.

Table 6

Number of Students with an ACT Mathematics Score of 18 or Less Who Enrolled 2 Semesters after Taking the Probability and Statistics Course and Type of Course Taken

	Enrolled 2 Semesters after the Course		
Type of Course	No	Yes	Total
Regular (ACT<19)	38	58	96
Learning Support (ACT<19)	43	75	118

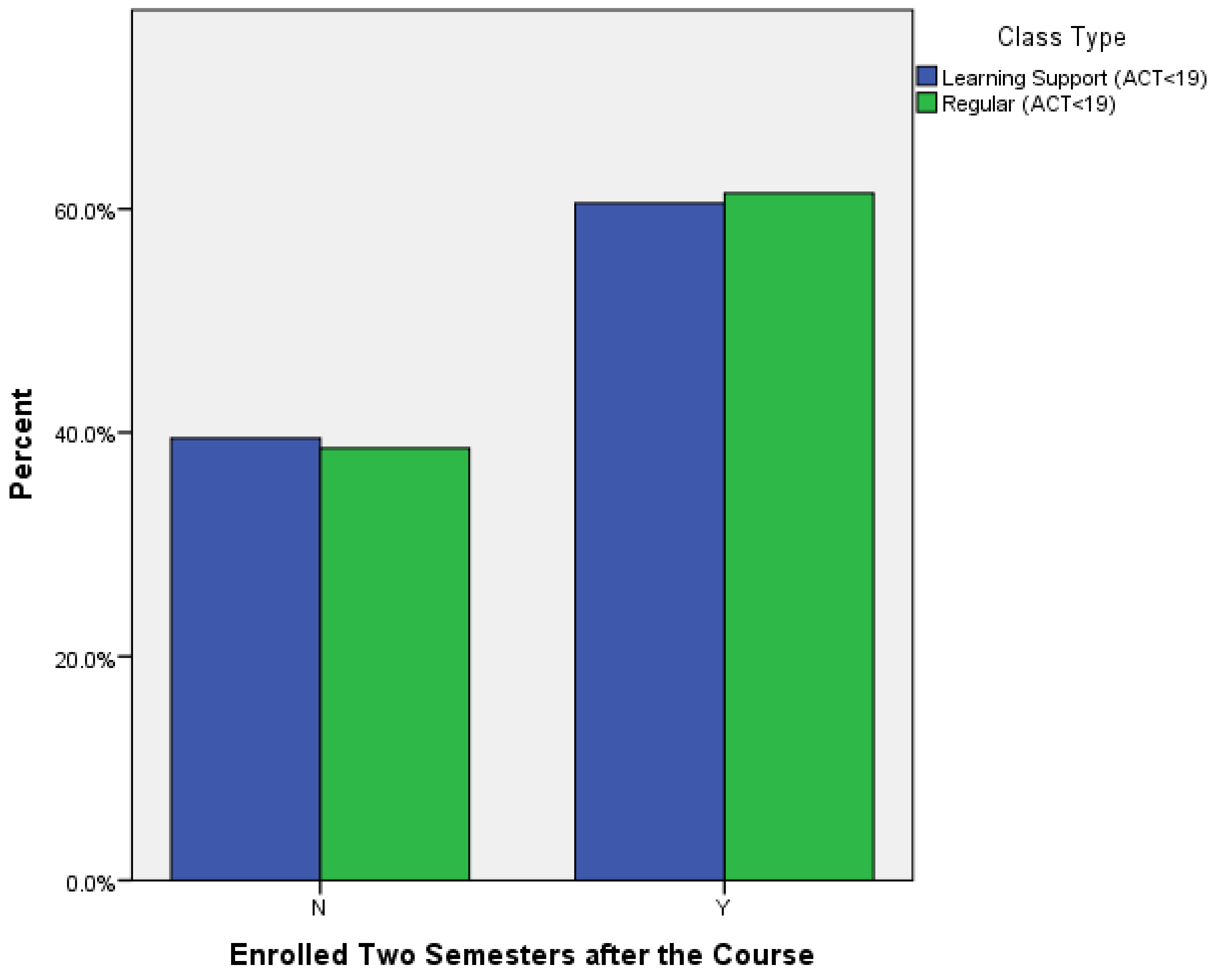

Figure 6. Percentage of Students Who Enrolled 2 Semesters after a Probability and Statistics Course (ACT=18)

Research Question 7

For students scoring a 17 on the mathematics section of the ACT, is there a significant difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?

H_07: For students scoring a 17 on the mathematics section of the ACT, there is no difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course).

A two-way contingency table analysis was calculated to evaluate, for students who scored a 17 on the mathematics section of the ACT, whether the 1-term retention rates were significantly different between students who took a regular 3-hour Probability and Statistics course and students who took a 4-hour learning support version of the same course. The two variables were type of course (learning support with ACT = 17 or regular with an ACT = 17) and enrolled in the following semester (yes or no). Type of course and retention were found to be significantly related, Pearson χ^2 (1, N = 344) = 7.70, $p < .01$, Cramer's $V = .15$. Therefore, the null hypothesis was rejected. The percentages of students in the two class type categories who enrolled in the following semester were 77.5% (learning support) and 89.7% (regular). Among students who scored a 17 on the ACT mathematics subsection, students who took the learning support section of Probability and Statistics were significantly less likely to be enrolled 1 semester after taking the course than students who took a regular section.

Information presented in Table 7 shows the counts of students who were enrolled at the university 1 semester after taking the Probability and Statistics course and those who were not for each of the section types. Figure 7 shows the percentages of students who were enrolled 1 semester after taking the Probability and Statistics course and those who were not for each of the section types.

Table 7

Number of Students with an ACT Mathematics Score of 17 Who Enrolled 1 Semester after Taking the Probability and Statistics Course and Type of Course Taken

	Enrolled 1 Semester after the Course		
Type of Course	No	Yes	Total
Regular (ACT=17)	12	105	117
Learning Support (ACT=17)	51	176	227

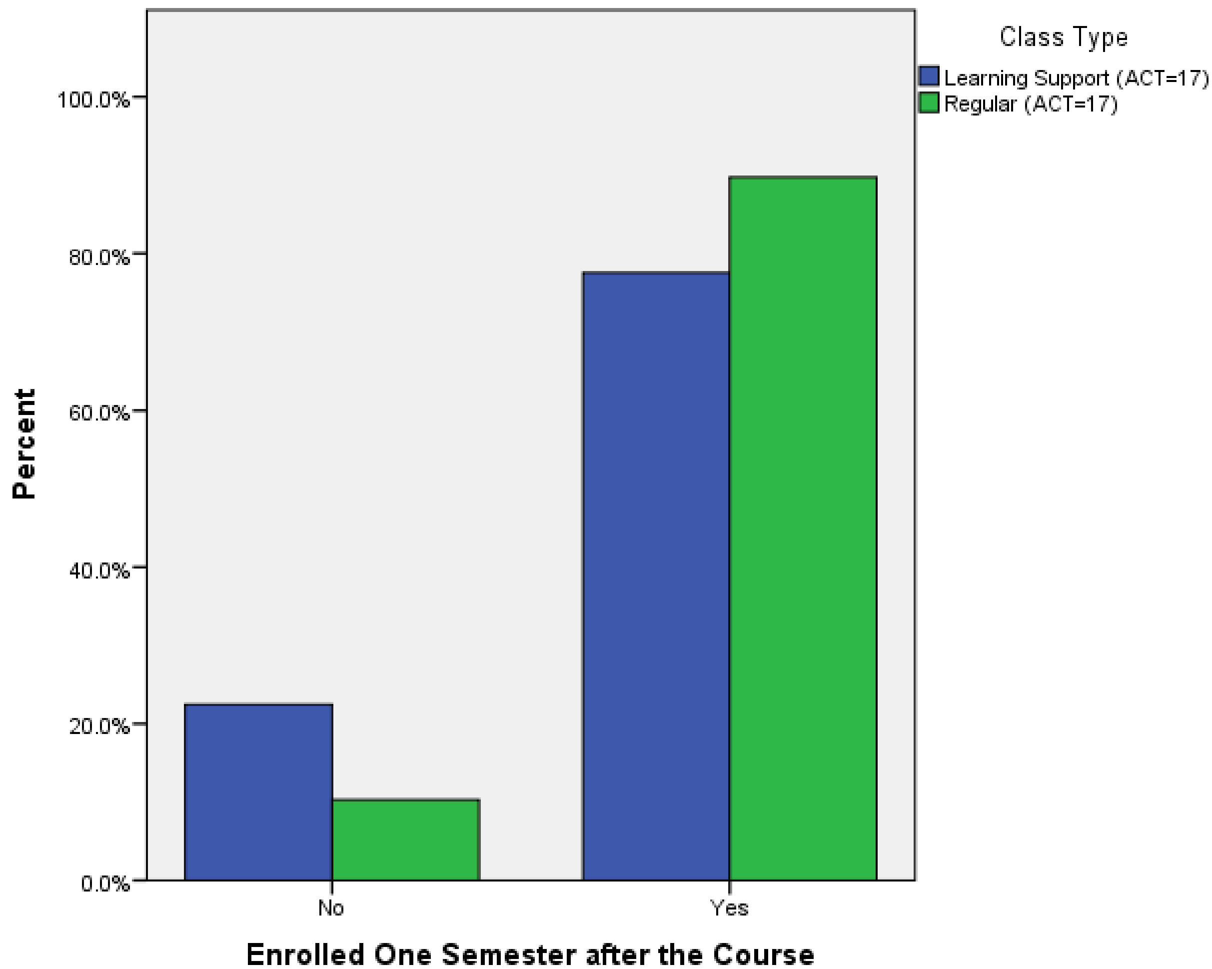

Figure 7. Percentage of Students Who Enrolled 1 Semester after a Probability and Statistics Course (ACT=17)

Research Question 8

For students scoring a 17 on the mathematics section of the ACT, is there a significant difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?

$H_0 8$: For students scoring a 17 on the mathematics section of the ACT, there is no difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course).

A two-way contingency table analysis was calculated to evaluate, for students who scored a 17 on the mathematics section of the ACT, whether the 2-term retention rates were significantly different between students who took a regular 3-hour Probability and Statistics course and students who took a 4-hour learning support version of the same course. The two variables were type of course (learning support with ACT = 17 or regular with an ACT = 17) and enrolled in the university 2 semesters after the course (yes or no). Type of course and retention were not found to be significantly related, Pearson χ^2 (1, N = 228) = .36, p = .548, Cramer's V = .04. Therefore, the null hypothesis was not rejected. The percentages of students in the two class type categories who enrolled in the following semester were 64.3% (learning support) and 68.2% (regular). Among students who scored a 17 on the ACT mathematics subsection, students who took the learning support section of Probability and Statistics were not significantly more or less likely to be enrolled 2 semesters after taking the course than students who took a regular section.

Information presented in Table 8 shows the counts of students who were enrolled at the university 2 semesters after taking the Probability and Statistics course and those who were not for each of the section types. Figure 8 shows the percentages of students who were enrolled 2 semesters after taking the Probability and Statistics course and those who were not for each of the section types.

Table 8

Number of Students with an ACT Mathematics Score of 17 Who Enrolled 2 Semesters after Taking the Probability and Statistics Course and Type of Course Taken

	Enrolled 2 Semesters after the Course		
Type of Course	No	Yes	Total
Regular (ACT=17)	27	58	85
Learning Support (ACT=17)	51	92	143

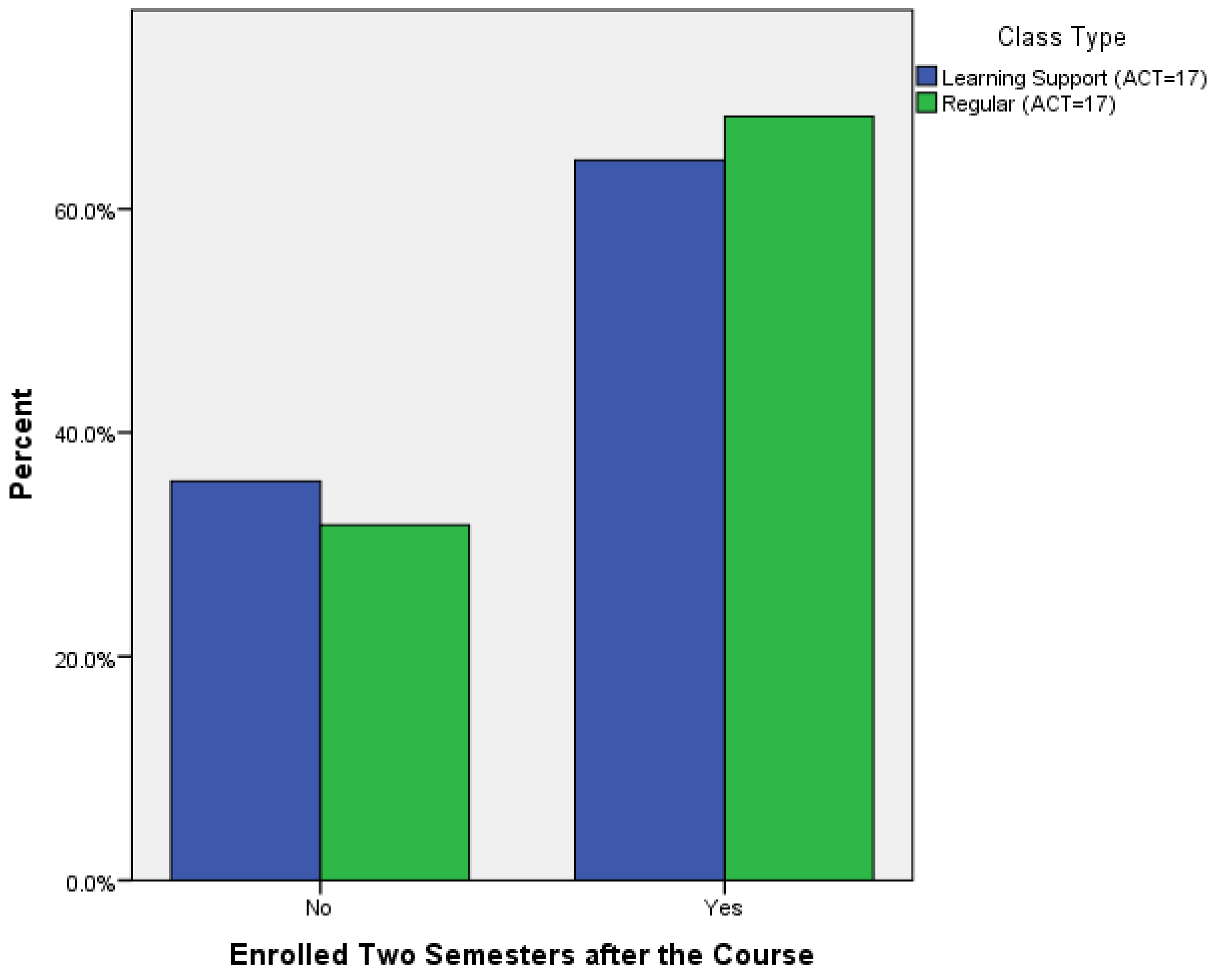

Figure 8. Percentage of Students Who Enrolled 2 Semesters after a Probability and Statistics Course (ACT=17)

Research Question 9

For students scoring a 16 on the mathematics section of the ACT, is there a significant difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?

$H_0$9: For students scoring a 16 on the mathematics section of the ACT, there is no difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course).

A two-way contingency table analysis was calculated to evaluate, for students who scored a 16 on the mathematics section of the ACT, whether the 1-term retention rates were significantly different between students who took a regular 3-hour Probability and Statistics course and students who took a 4-hour learning support version of the same course. The two variables were type of course (learning support with ACT = 16 or regular with an ACT = 16) and enrolled in the following semester (yes or no). Type of course and retention were found to be significantly related, Pearson χ^2 (1, N = 345) = .28, p = .598, Cramer's V = .03. Therefore, the null hypothesis was not rejected. The percentages of students in the two class type categories who enrolled in the following semester were 75.9% (learning support) and 78.4% (regular). Among students who scored a 16 on the ACT mathematics subsection, students who took the learning support section of Probability and Statistics were not significantly more or less likely to be enrolled 1 semester after taking the course than students who took a regular section.

Information presented in Table 9 shows the counts of students who were enrolled at the university 1 semester after taking the Probability and Statistics course and those who were not for each of the section types. Figure 9 shows the percentages of students who were enrolled 1 semester after taking the Probability and Statistics course and those who were not for each of the section types.

Table 9

Number of Students with an ACT Mathematics Score of 16 Who Enrolled 1 Semester after Taking the Probability and Statistics Course and Type of Course Taken

	Enrolled 1 Semester after the Course		
Type of Course	No	Yes	Total
Regular (ACT=16)	27	98	125
Learning Support (ACT=16)	53	167	220

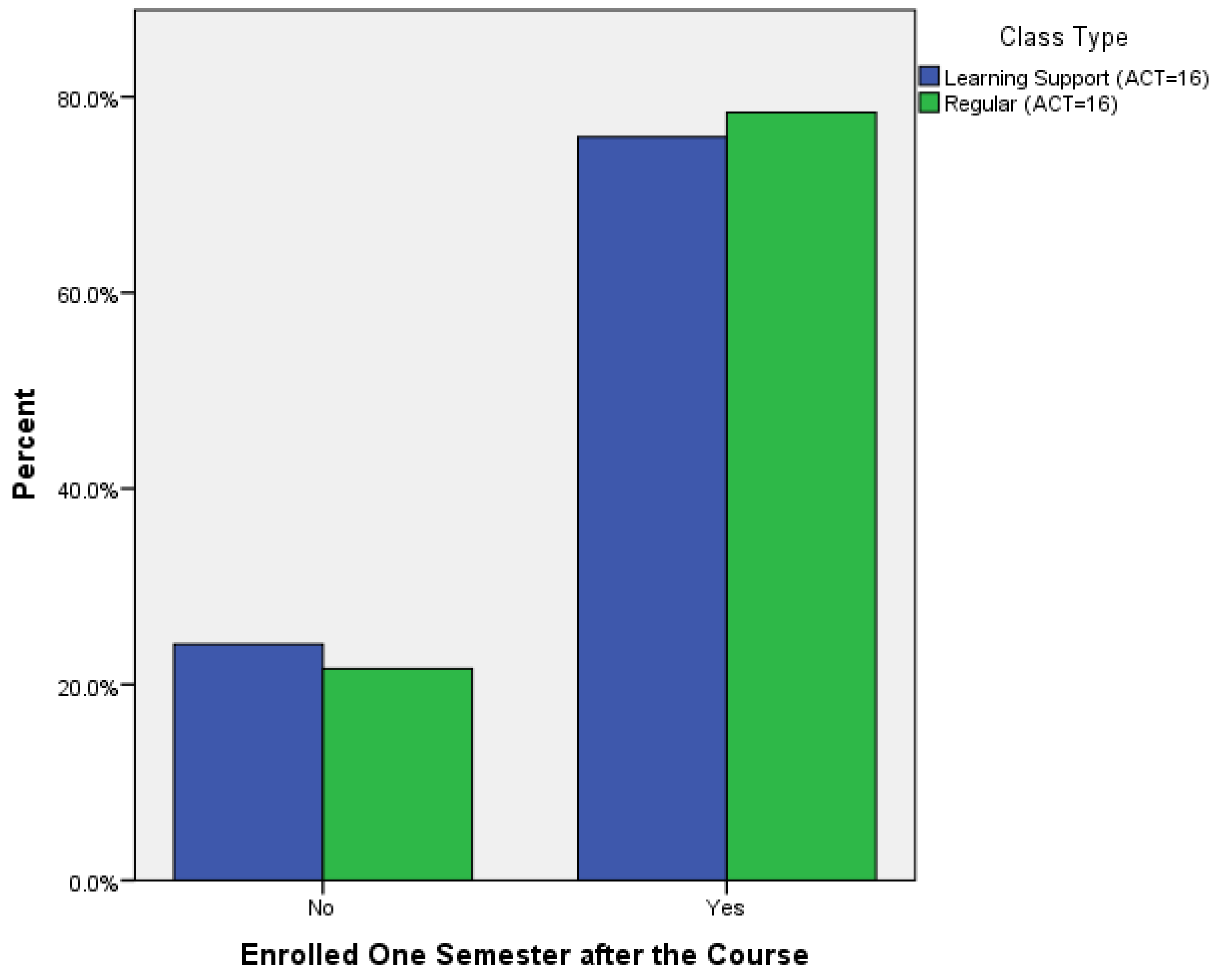

Figure 9. Percentage of Students Who Enrolled 1 Semester after a Probability and Statistics Course (ACT=16)

Research Question 10

For students scoring a 16 on the mathematics section of the ACT, is there a significant difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?

$H_0 10$: For students scoring a 16 on the mathematics section of the ACT, there is no difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course).

A two-way contingency table analysis was calculated to evaluate, for students who scored a 16 on the mathematics section of the ACT, whether the 2-term retention rates were significantly different between students who took a regular 3-hour Probability and Statistics course and students who took a 4-hour learning support version of the same course. The two variables were type of course (learning support with ACT = 16 or regular with an ACT = 16) and enrolled in the university 2 semesters after the course (yes or no). Type of course and retention were not found to be significantly related, Pearson χ^2 (1, N = 229) = .90, p = .342, Cramer's V = .06. Therefore, the null hypothesis was not rejected. The percentages of students in the two class type categories who enrolled in the following semester were 53.1% (learning support) and 59.4% (regular). Among students who scored a 16 on the ACT mathematics subsection, students who took the learning support section of Probability and Statistics were not significantly more or less likely to be enrolled 2 semesters after taking the course than students who took a regular section.

Information presented in Table 10 shows the counts of students who were enrolled at the university 2 semesters after taking the Probability and Statistics course and those who were not for each of the section types. Figure 10 shows the percentages of students who were enrolled 2 semesters after taking the Probability and Statistics course and those who were not for each of the section types.

Table 10

Number of Students with an ACT Mathematics Score of 16 Who Enrolled 2 Semesters after Taking the Probability and Statistics Course and Type of Course Taken

	Enrolled 2 Semesters after the Course		
Type of Course	No	Yes	Total
Regular (ACT=16)	41	60	101
Learning Support (ACT=16)	60	68	128

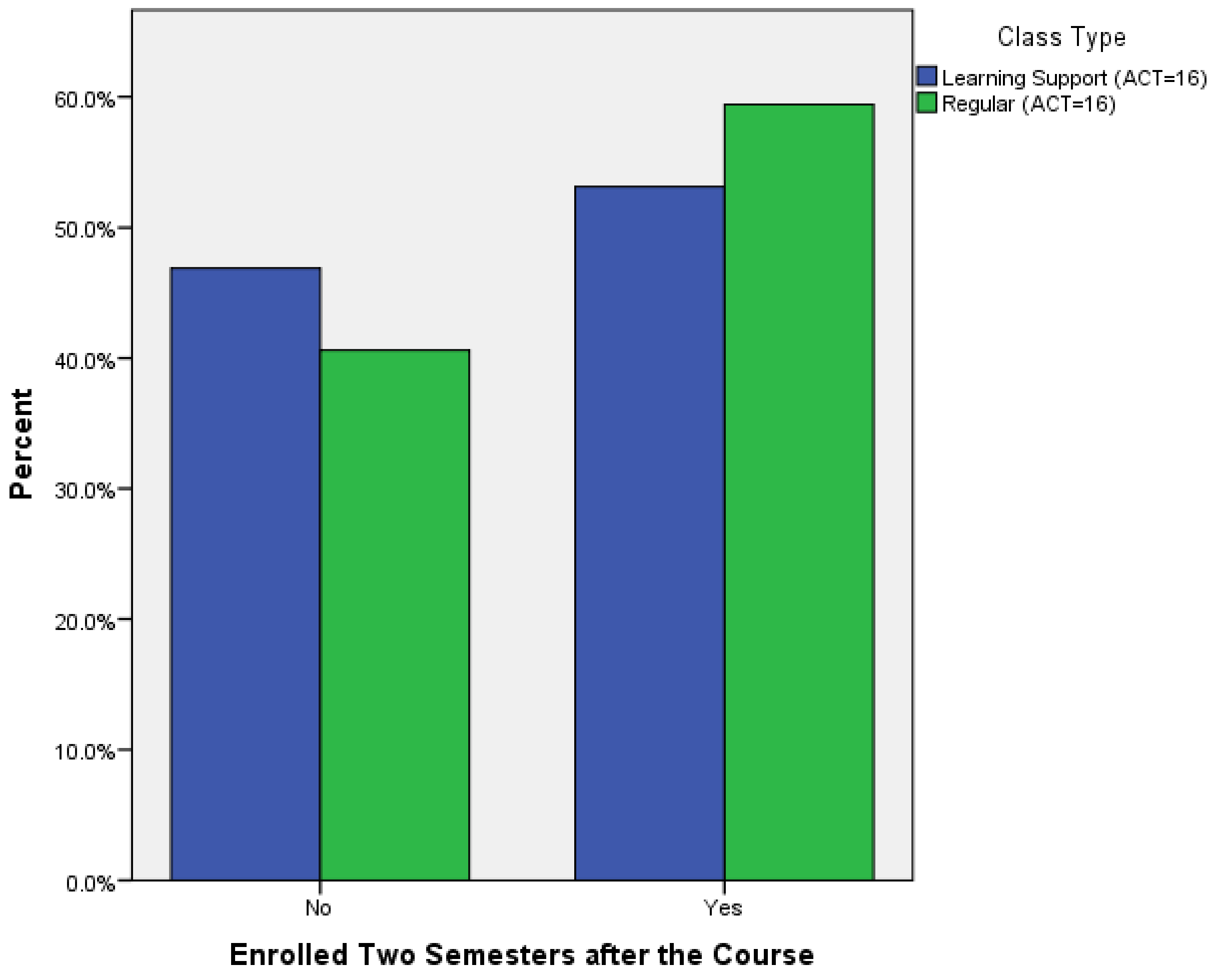

Figure 10. Percentage of Students Who Enrolled 2 Semesters after a Probability and Statistics Course (ACT=16)

Research Question 11

For students scoring a 15 on the mathematics section of the ACT, is there a significant difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?

$H_0$11: For students scoring a 15 on the mathematics section of the ACT, there is no difference in the 1-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course.

A two-way contingency table analysis was calculated to evaluate, for students who scored a 15 on the mathematics section of the ACT, whether the 1-term retention rates were significantly different between students who took a regular 3-hour Probability and Statistics course and students who took a 4-hour learning support version of the same course. The two variables were type of course (learning support with ACT = 15 or regular with an ACT = 15) and enrolled in the following semester (yes or no). Type of course and retention were found to be significantly related, Pearson χ^2 (1, N=134) = .05, p = .829, Cramer's V = .02. Therefore, the null hypothesis was not rejected. The percentages of students in the two class type categories who enrolled in the following semester were 75.3% (learning support) and 73.7% (regular). Among students who scored a 15 on the ACT mathematics subsection, students who took the learning support section of Probability and Statistics were not significantly more or less likely to be enrolled 1 semester after taking the course than students who took a regular section.

Information presented in Table 11 shows the counts of students who were enrolled at the university 1 semester after taking the Probability and Statistics course and those who were not for each of the section types. Figure 11 shows the percentages of students who were enrolled 1 semester after taking the Probability and Statistics course and those who were not for each of the section types.

Table 11

Number of Students with an ACT Mathematics Score of 15 Who Enrolled 1 Semester after Taking the Probability and Statistics Course and Type of Course Taken

	Enrolled 1 Semester after the Course		
Type of Course	No	Yes	Total
Regular (ACT=15)	15	42	57
Learning Support (ACT=15)	19	58	77

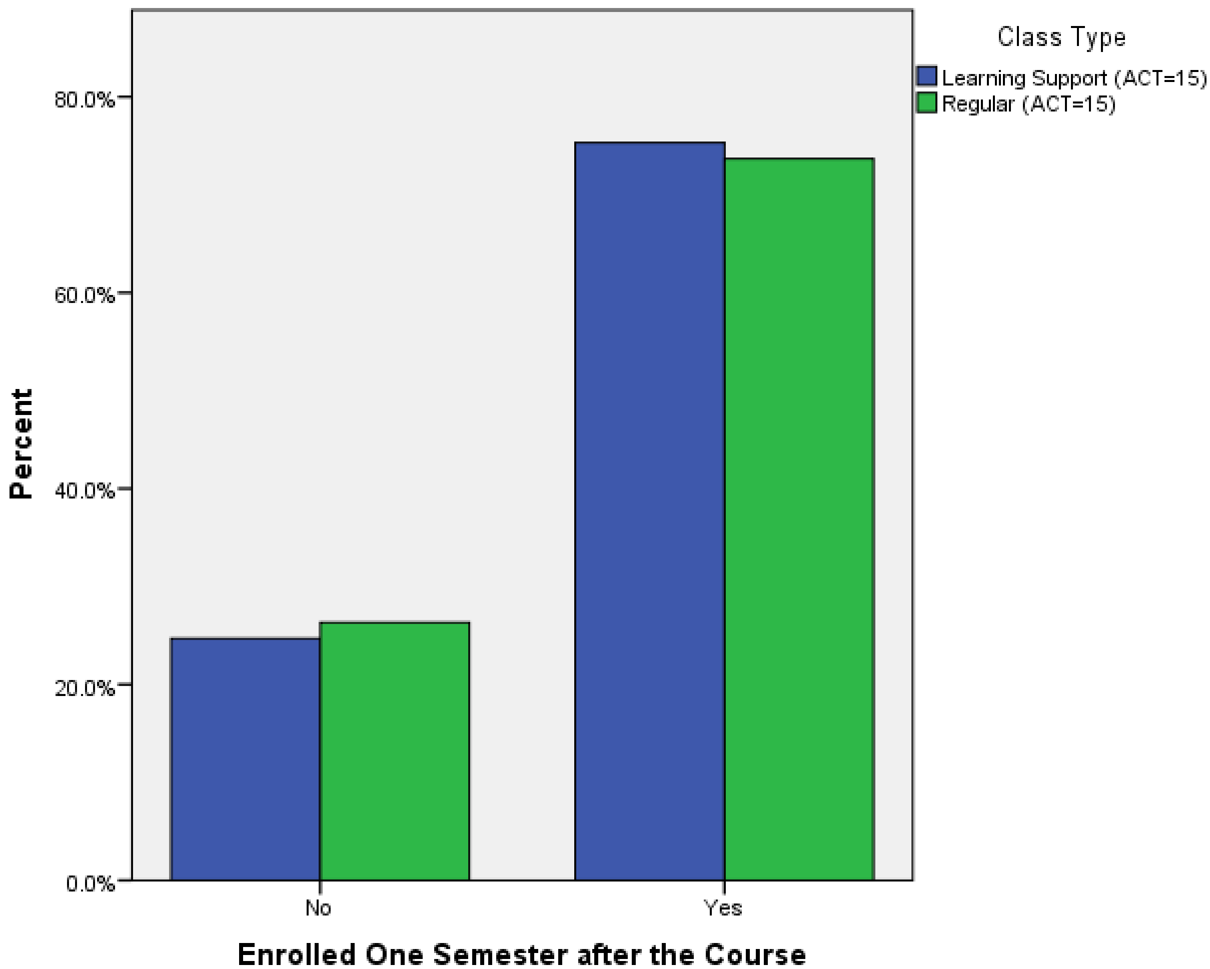

Figure 11. Percentage of Students Who Enrolled 1 Semester after a Probability and Statistics Course (ACT=15)

Research Question 12

For students scoring a 15 on the mathematics section of the ACT, is there a significant difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course?

$H_0$12: For students scoring a 15 on the mathematics section of the ACT, there is no difference in the 2-term retention rates between students who take a regular 3-hour Probability and Statistics course and students who take a 4-hour learning support version of the same course.

A two-way contingency table analysis was calculated to evaluate, for students who scored a 15 on the mathematics section of the ACT, whether the 2-term retention rates were significantly different between students who took a regular 3-hour Probability and Statistics course and students who took a 4-hour learning support version of the same course. The two variables were type of course (learning support with ACT = 15 or regular with an ACT = 15) and enrolled in the university 2 semesters after the course (yes or no). Type of course and retention were not found to be significantly related, Pearson χ^2 (1, N = 96) = 1.90, p = .168, Cramer's V = .14. Therefore, the null hypothesis was not rejected. The percentages of students in the two class type categories who enrolled in the following semester were 66% (learning support) and 52.2% (regular). Among students who scored a 15 on the ACT mathematics subsection, students who took the learning support section of Probability and Statistics were not significantly more or less likely to be enrolled 2 semesters after taking the course than students who took a regular section.

Information presented in Table 12 shows the counts of students who were enrolled at the university 2 semesters after taking the Probability and Statistics course and those who were not for each of the section types. Figure 12 shows the percentages of students who were enrolled 2 semesters after taking the Probability and Statistics course and those who were not for each of the section types.

Table 12

Number of Students with an ACT Mathematics Score of 15 Who Enrolled 2 Semesters after Taking the Probability and Statistics Course and Type of Course Taken

	Enrolled 2 Semesters after the Course		
Type of Course	No	Yes	Total
Regular (ACT=15)	22	24	46
Learning Support (ACT=15)	17	33	50

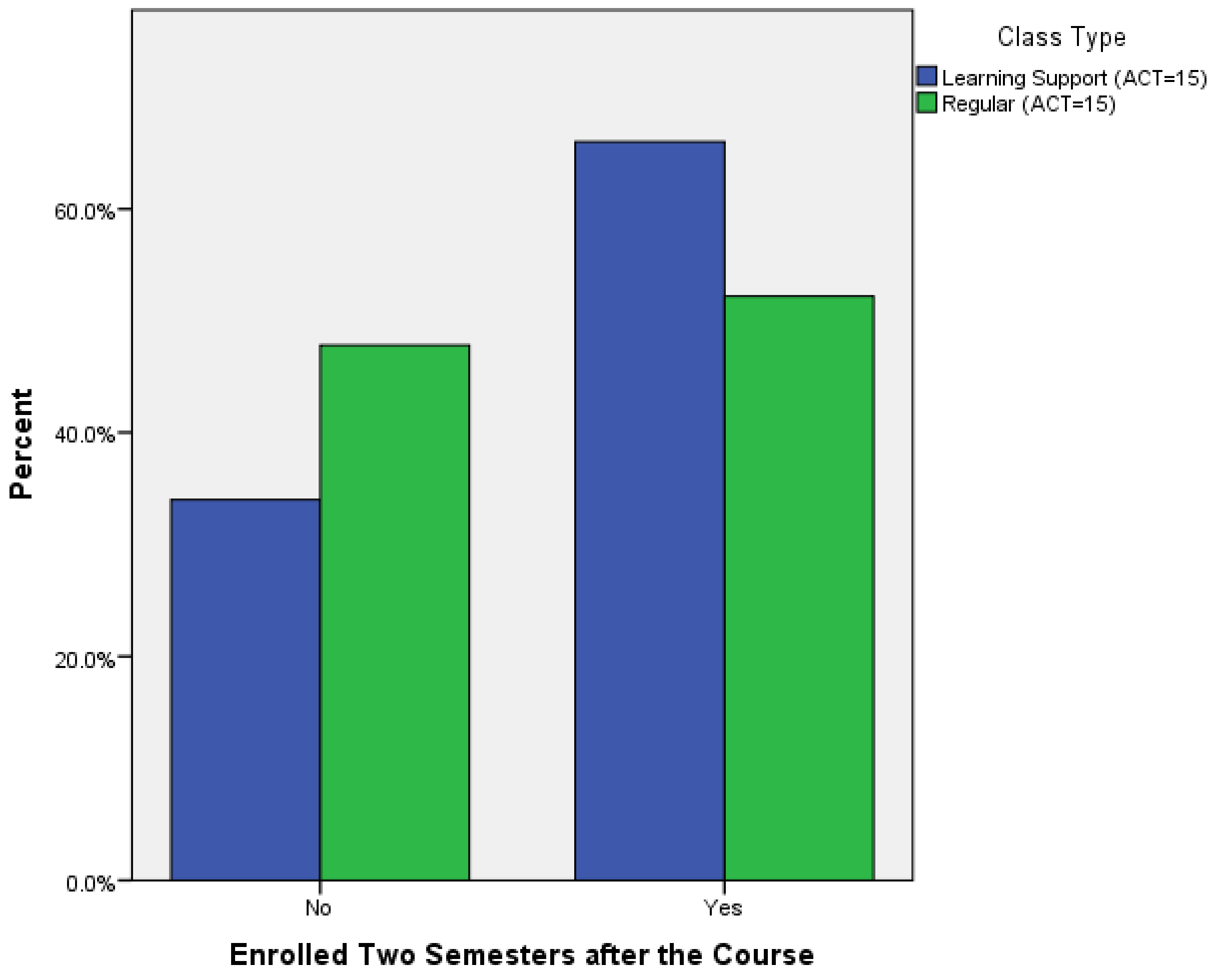

Figure 12. Percentage of Students Who Enrolled 2 Semesters after a Probability and Statistics Course (ACT=15)

Research Question 13

Is there a significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course?

$H_0$13: There is no difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course.

A two-way contingency table analysis was calculated to evaluate whether the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics was significantly different between students who took a regular 3-hour Probability and Statistics course and those who took a 4-hour learning support version of the same course. The two variables were type of course (learning support or regular) and course letter grade (A, B, C, D, and F). Type of course and course grade were found to be significantly related, Pearson χ^2 (1, N = 3,054) = 142.23, $p < .001$, Cramer's $V = .22$. Therefore, the null hypothesis was rejected. The percentage of students who made As and Fs were 9%/29% (learning support) and 26%/18.8% (regular) respectively. Students who took the learning support section of Probability and Statistics were significantly more likely to earn a lower grade in the course than students who took a regular section of the course.

Information presented in Table 13 shows the counts of grades in each category separated by type of course taken (learning support or regular). Figure 13 shows the percentages of grades in each category separated by type of course taken (learning support or regular).

Table 13

Number of Each Grade Earned Separated by Category and Course Type

	Number of Each Grade Earned					
Type of Course	A	B	C	D	F	Total
Regular	600	566	460	249	434	2,309
Learning Support	67	151	164	147	216	745

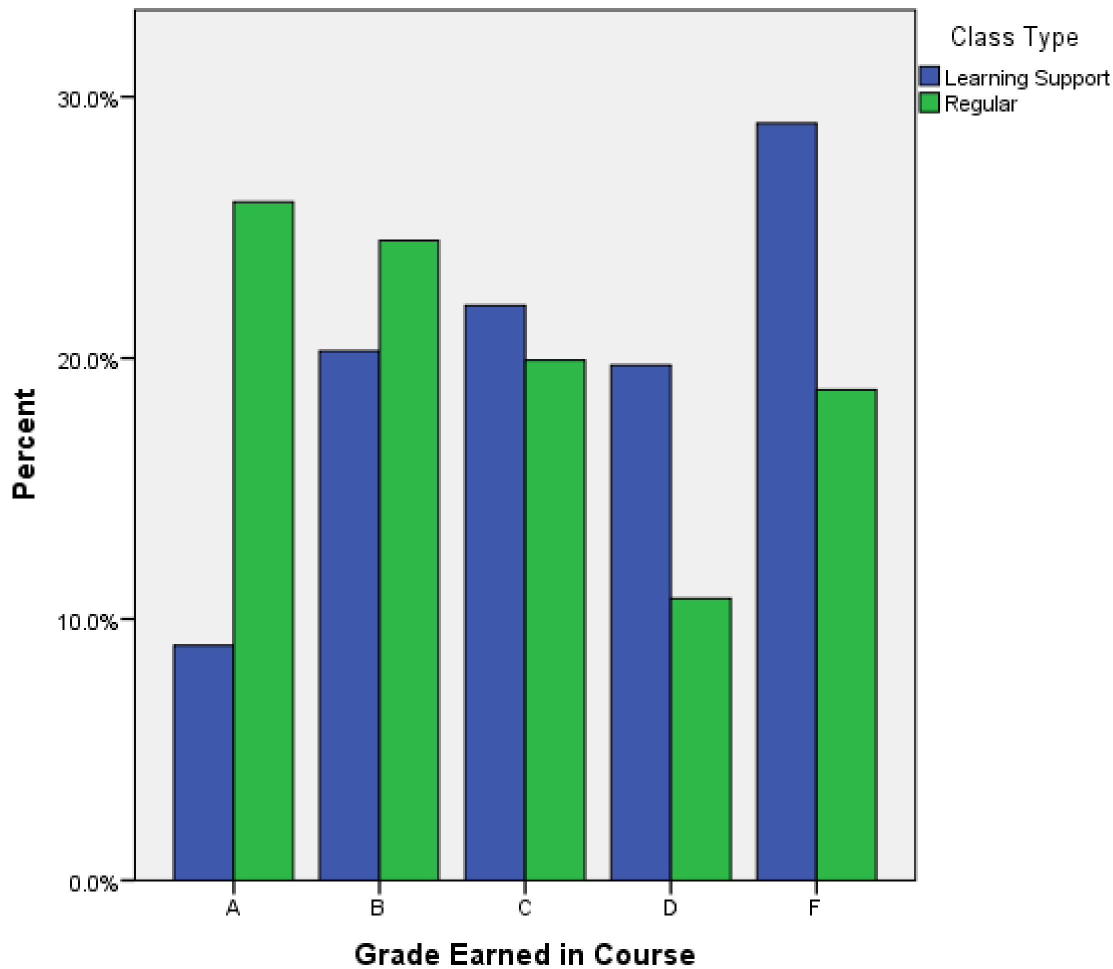

Figure 13. Percentage of Grades in Each Category Separated by Type of Course Taken

Research Question 14

For students scoring less than a 19 on the mathematics section of the ACT, is there a significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course?

$H_0$14: For students scoring less than a 19 on the mathematics section of the ACT, there is no difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course.

A two-way contingency table analysis was calculated to evaluate whether, for students scoring less than a 19 on the mathematics section of the ACT, the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics was significantly different between students who took a regular 3-hour Probability and Statistics course and those who took a 4-hour learning support version of the same course. The two variables were type of course (learning support with an ACT < 19 or regular with an ACT < 19) and course letter grade (A, B, C, D, and F). Type of course and course grade were not found to be significantly related, Pearson χ^2 (1, N = 1,151) = 3.55, p = .471, Cramer's V = .06. Therefore, the null hypothesis was not rejected. The percentage of students who made As and Fs were 8.7%/29.2% (learning support) and 8.2%/33.8% (regular) respectively. Students who took the learning support section of Probability and Statistics did not earn significantly higher or lower grades in the course than students who took a regular section of the course.

Information presented in Table 14 shows the counts of grades in each category separated by type of course taken (learning support or regular). Figure 14 shows the percentages of grades in each category separated by type of course taken (learning support or regular).

Table 14

Number of Each Grade Earned Separated by Category and Course Type (ACT<19)

	Number of Each Grade Earned					
Type of Course	A	B	C	D	F	Total
Regular (ACT<19)	34	79	92	69	140	414
Learning Support (ACT<19)	64	150	162	146	215	737

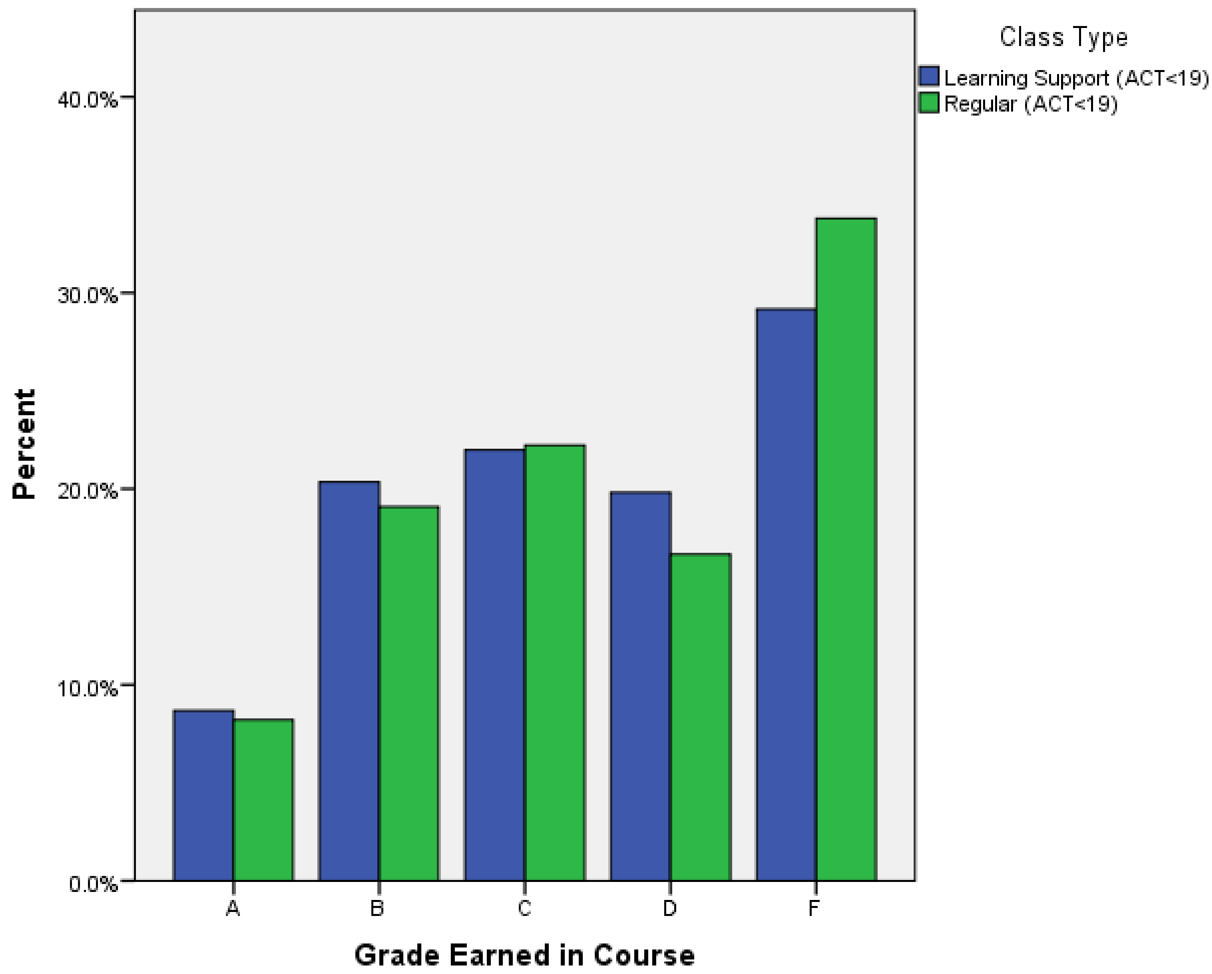

Figure 14. Percentage of Grades in Each Category Separated by Type of Course Taken

Research Question 15

For students scoring an 18 on the mathematics section of the ACT, is there a significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course?

$H_0$15: For students scoring an 18 on the mathematics section of the ACT, there is no difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course.

A two-way contingency table analysis was calculated to evaluate whether, for students scoring an 18 on the mathematics section of the ACT, the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics was significantly different between students who took a regular 3-hour Probability and Statistics course and those who took a 4-hour learning support version of the same course. The two variables were type of course (learning support with an ACT = 18 or regular with an ACT = 18) and course letter grade (A, B, C, D, and F). Type of course and course grade were not found to be significantly related, Pearson χ^2 (1, N = 322) = 1.48, p = .829, Cramer's V = .07. Therefore, the null hypothesis was not rejected. The percentage of students who made As and Fs were 14.4%/25.5% (learning support) and 10.5%/29.8% (regular) respectively. Students with an ACT mathematics score of 18 who took the learning support section of Probability and Statistics did not earn significantly higher or lower grades in the course than students with the same ACT mathematics score who took a regular section of the course.

Information presented in Table 15 shows the counts of grades in each category separated by type of course taken (learning support or regular). Figure 15 shows the percentages of grades in each category separated by type of course taken (learning support or regular).

Table 15

Number of Each Grade Earned Separated by Category and Course Type (ACT=18)

	Number of Each Grade Earned					
Type of Course	A	B	C	D	F	Total
Regular (ACT=18)	12	27	24	17	34	114
Learning Support (ACT=18)	30	48	43	34	53	208

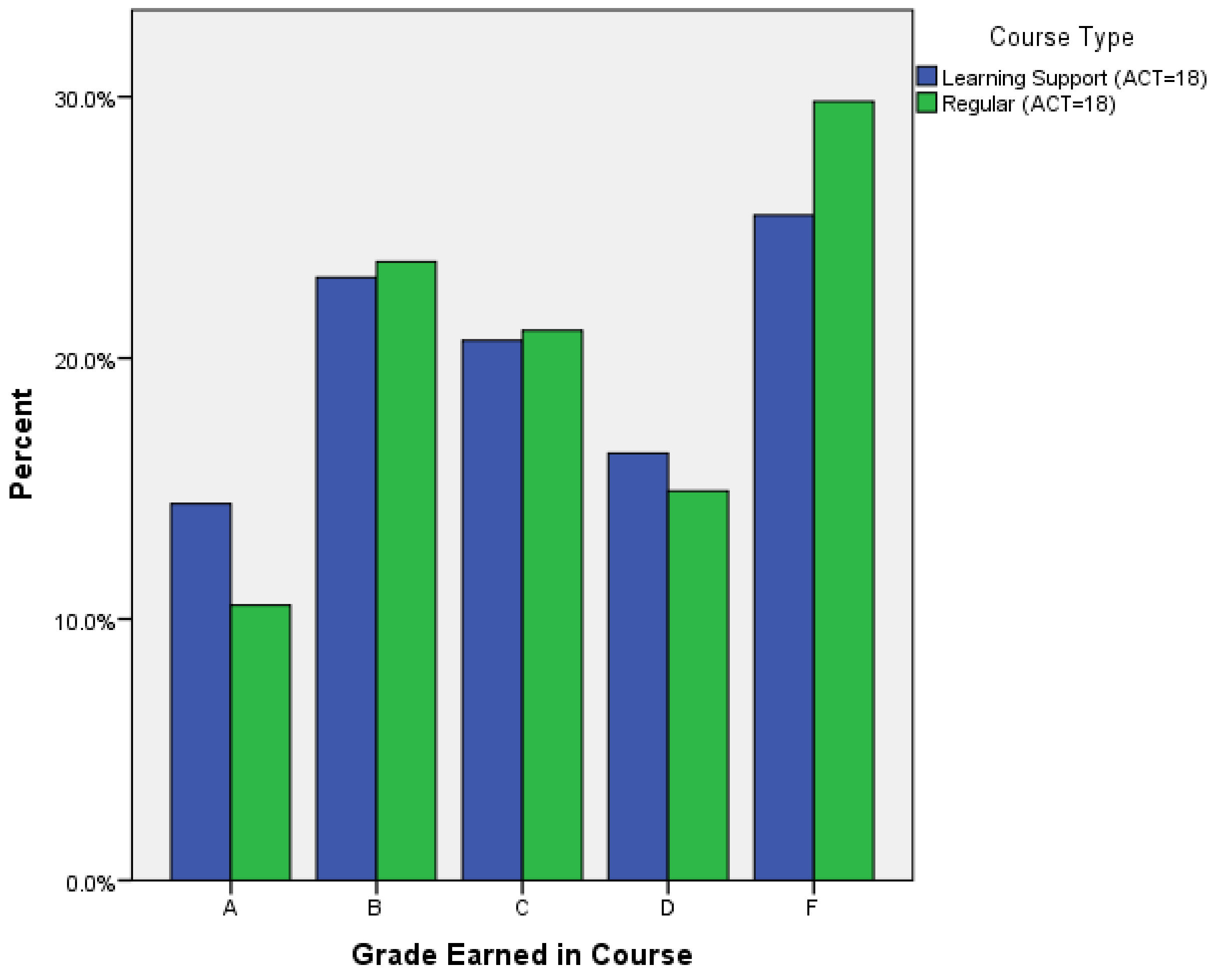

Figure 15. Percentage of Grades in Each Category Separated by Type of Course Taken

Research Question 16

For students scoring a 17 on the mathematics section of the ACT, is there a significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course?

$H_0$16: For students scoring a 17 on the mathematics section of the ACT, there is no difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course.

A two-way contingency table analysis was calculated to evaluate whether, for students scoring an 17 on the mathematics section of the ACT, the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics was significantly different between students who took a regular 3-hour Probability and Statistics course and those who took a 4-hour learning support version of the same course. The two variables were type of course (learning support with an ACT = 17 or regular with an ACT = 17) and course letter grade (A, B, C, D, and F). Type of course and course grade were not found to be significantly related, Pearson χ^2 (1, N = 337) = .71, p = .951, Cramer's V = .05. Therefore, the null hypothesis was not rejected. The percentage of students who made As and Fs were 8.5%/29.1% (learning support) and 10.5%/27.2% (regular) respectively. Students with an ACT mathematics score of 17 who took the learning support section of Probability and Statistics did not earn significantly higher or lower grades in the course than students with the same ACT mathematics score who took a regular section of the course.

Information presented in Table 16 shows the counts of grades in each category separated by type of course taken (learning support or regular). Figure 16 shows the percentages of grades in each category separated by type of course taken (learning support or regular).

Table 16

Number of Each Grade Earned Separated by Category and Course Type (ACT=17)

	Number of Each Grade Earned					
Type of Course	A	B	C	D	F	Total
Regular (ACT=17)	12	26	24	21	31	114
Learning Support (ACT=17)	19	49	44	46	65	223

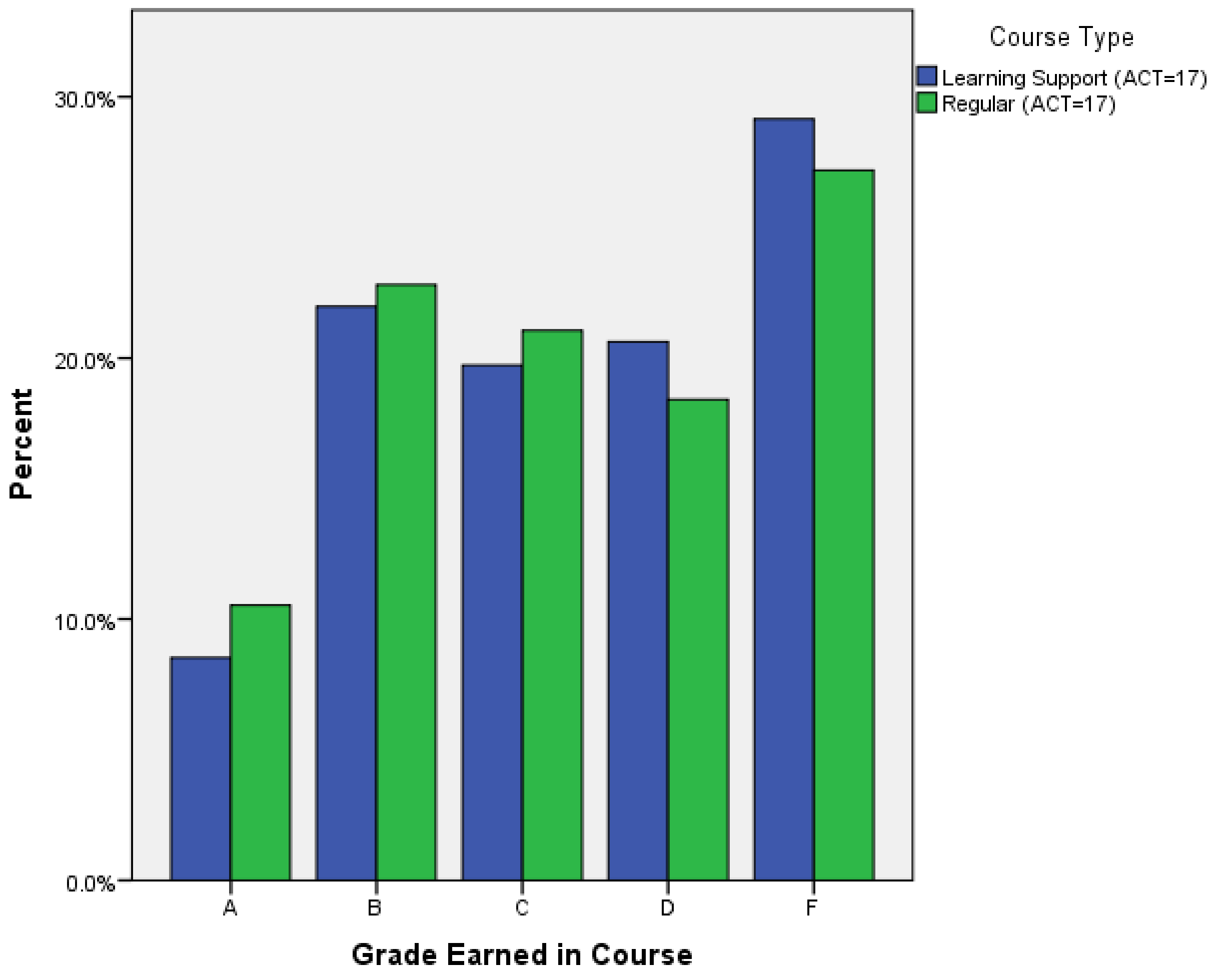

Figure 16. Percentage of Grades in Each Category Separated by Type of Course Taken

Research Question 17

For students scoring a 16 on the mathematics section of the ACT, is there a significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course?

$H_0$17: For students scoring a 16 on the mathematics section of the ACT, there is no difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course.

A two-way contingency table analysis was calculated to evaluate whether, for students scoring an 16 on the mathematics section of the ACT, the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics was significantly different between students who took a regular 3-hour Probability and Statistics course and those who took a 4-hour learning support version of the same course. The two variables were type of course (learning support with an ACT = 16 or regular with an ACT = 16) and course letter grade (A, B, C, D, and F). Type of course and course grade were not found to be significantly related, Pearson χ^2 (1, N = 323) = 2.52, p = .641, Cramer's V = .09. Therefore, the null hypothesis was not rejected. The percentage of students who made As and Fs were 6.3%/29% (learning support) and 5.2%/37.1% (regular) respectively. Students with an ACT mathematics score of 16 who took the learning support section of Probability and Statistics did not earn significantly higher or lower grades in the course than students with the same ACT mathematics score who took a regular section of the course.

Information presented in Table 17 shows the counts of grades in each category separated by type of course taken (learning support or regular). Figure 17 shows the percentages of grades in each category separated by type of course taken (learning support or regular).

Table 17

Number of Each Grade Earned Separated by Category and Course Type (ACT=16)

	Number of Each Grade Earned					
Type of Course	A	B	C	D	F	Total
Regular (ACT=16)	6	20	27	20	43	116
Learning Support (ACT=16)	13	42	49	43	60	223

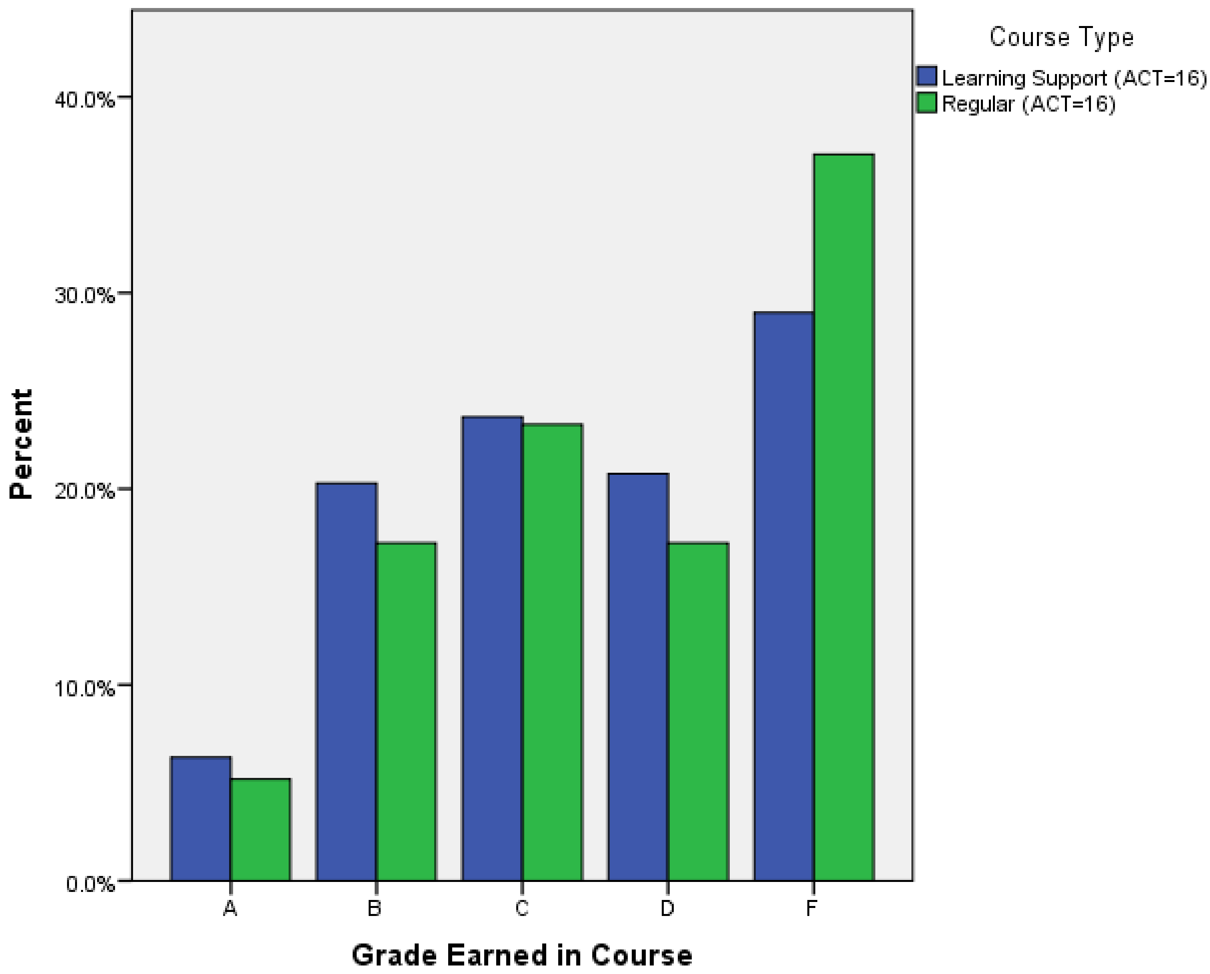

Figure 17. Percentage of Grades in Each Category Separated by Type of Course Taken

Research Question 18

For students scoring a 15 on the mathematics section of the ACT, is there a significant difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course?

$H_0$18: For students scoring a 15 on the mathematics section of the ACT, there is no difference in the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics between those taking the regular 3-semester hours version of the course and those taking the 4-semester hours learning support version of the course.

A two-way contingency table analysis was calculated to evaluate whether, for students scoring an 15 on the mathematics section of the ACT, the proportion of students falling into each of the letter grade categories (A, B, C, D, or F) for Probability and Statistics was significantly different between students who took a regular 3-hour Probability and Statistics course and those who took a 4-hour learning support version of the same course. The two variables were type of course (learning support with an ACT = 15 or regular with an ACT = 15) and course letter grade (A, B, C, D, and F). Type of course and course grade were not found to be significantly related, Pearson χ^2 (1, N = 128) = 5.46, p = .243, Cramer's V = .21. Therefore, the null hypothesis was not rejected. The percentage of students who made As and Fs were 2.7%/33.8% (learning support) and 7.4%/48.1% (regular) respectively. Students with an ACT mathematics score of 15 who took the learning support section of Probability and Statistics did not earn significantly higher or lower grades in the course than students with the same ACT mathematics score who took a regular section of the course.

Information presented in Table 18 shows the counts of grades in each category separated by type of course taken (learning support or regular). Figure 18 shows the percentages of grades in each category separated by type of course taken (learning support or regular).

Table 18

Number of Each Grade Earned Separated by Category and Course Type (ACT=15)

	Number of Each Grade Earned					
Type of Course	A	B	C	D	F	Total
Regular (ACT=15)	4	4	12	8	26	54
Learning Support (ACT=15)	2	9	20	18	25	74

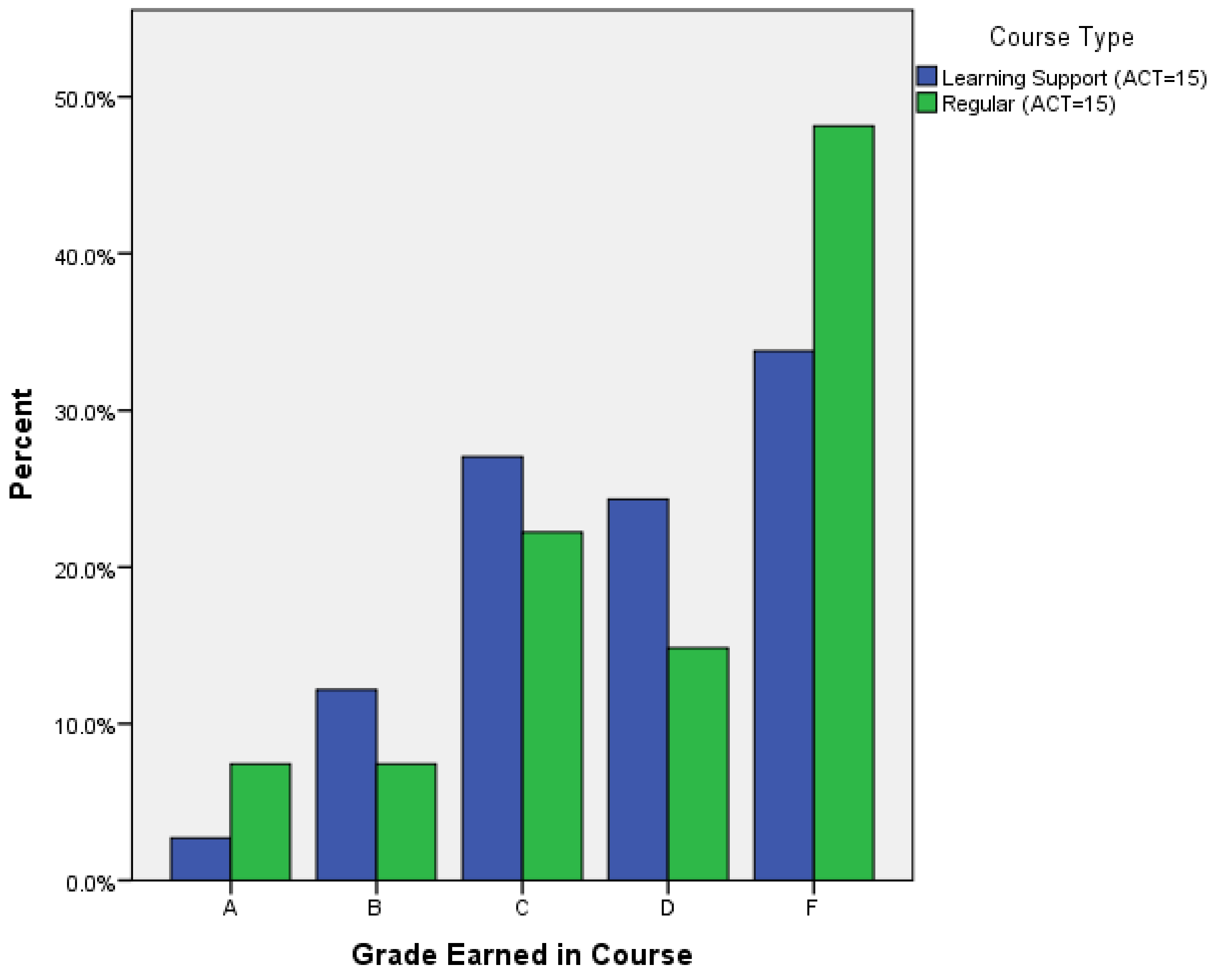

Figure 18. Percentage of Grades in Each Category Separated by Type of Course Taken

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary of the Findings

A review of literature was conducted on the uses and effectiveness of learning support programs. The review showed that a very large portion, as much as 68% of this nation's high school graduates are entering institutions of higher education without being prepared for the rigor that these classes offer (Bettinger, 2013). This population can be underprepared in many different areas, but mathematics is the trouble area for most of these students. The ACT mathematics subscore is the standard by which most institutions measure a student's preparedness for their freshman level math course. When students score below an institution's set benchmark, typically a score of 19, they are either required or advised to take a remedial class in order to bring them up to speed. In 2010 the TBR adopted a policy that would remove all remedial classes from 4-year institutions. Many of these institutions would no longer be able to operate financially if they simply turned these underprepared students away. This has led many 4-year institutions to experiment with different forms of learning support programs; programs that assist underprepared students, but are not remedial classes. Information obtained from the review of literature that was relevant to this study was presented in Chapter 2.

The problem of the study is that it is not known if the learning support program at the university being studied is having the positive effect on retention and achievement that the university intends. This study examined data from students who took the institution's Probability and Statistics course (either a regular 3-hour section or a 4-hour learning support section) from the 2013 summer semester to the 2014 fall semester. The criteria used for selecting subjects included: (1) enrolled in a section of Probability and Statistics, (2) had a valid ACT mathematics subsection score on file with the institution, and (3) recorded a final grade in the course. Students were then grouped by ACT mathematics subsection score and type of course (learning support or regular). Finally a chi square analysis was conducted to determine if there were any statistically significant differences between the retention rates and final course grades of these groups.

This study found that there was no significant difference between the 1-term retention, 2-term retention, or final course grades of between virtually any of these groups when grouped by ACT score. Significant differences in all three categories were found when students were grouped by prepared (ACT math score of 19+ and enrolled in a regular course) and unprepared (ACT math score of less than 19 and enrolled in a learning support course), but these tests were used as a precaution. Those results were to be expected.

Research Questions 5, 7, 9, and 11 were directed at observing the difference in 1-term retention rates between students with an ACT math score of 18, 17, 16, and 15 respectively who took a learning support section of Probability and Statistics and students with matching ACT math scores who opted to take a regular section of the course. Table 19 contains this information.

Table 19

Percentage of Students Who Were Enrolled at the University 1 Semester after Taking the Probability and Statistics Course

ACT Math Score	Learning Support	Regular
18	81.60%	77%
17	77.5%*	89.7%*
16	75.90%	78.40%
15	75.30%	73.70%

*significant at the p<.01 level

The two courses stayed within 5% of each other in each category except the group of students who scored a 17 on their ACT math subsection. This group of students had an enormous retention percentage of just fewer than 90% for the regular section, a statistically significant difference from the learning support section that was only 77.5%. This was the only difference that showed statistical significance, but it appears to be an anomaly as it is so greatly out of place with the other findings. These data indicate that there is no major difference in 1-term retention percentage between underprepared students who take a regular section of Probability and Statistics and those who take a learning support section of the course. Figure 19 shows this information graphically.

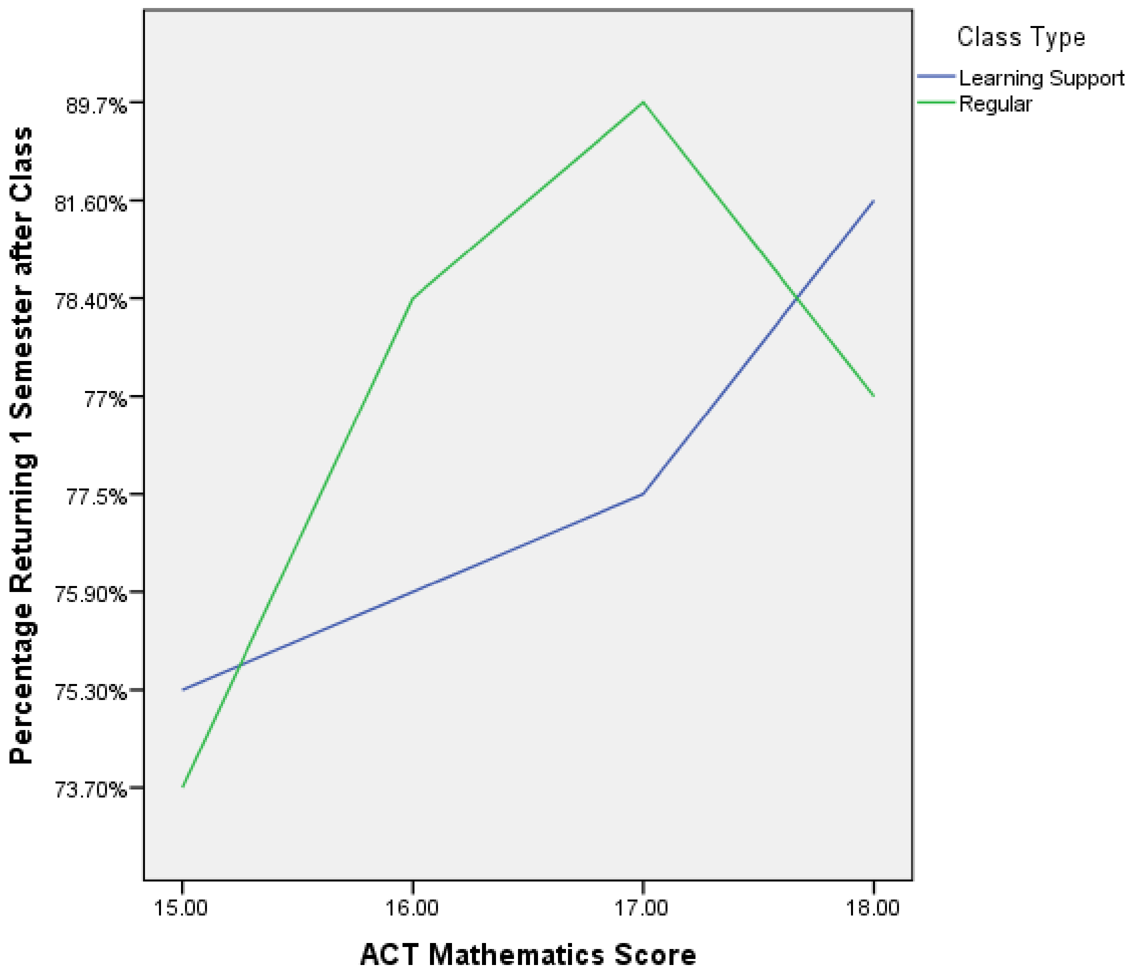

Figure 19. Percentage of Students Who Enrolled at the University 1 Semester after Taking a Probability and Statistics Course

Research Questions 6, 8, 10, and 12 were directed at observing the difference in 2-term retention rates between students with an ACT math score of 18, 17, 16, and 15 respectively who took a learning support section of Probability and Statistics and students with matching ACT math scores who opted to take a regular section of the course. Table 20 contains this information.

Table 20

Percentage of Students Who Were Enrolled at the University 2 Semesters after Taking the Probability and Statistics Course

ACT Math Score	Learning Support	Regular
18	63.60%	60.40%
17	64.30%	68.20%
16	53.10%	59.40%
15	66%	52.20%

Here, as with the 1-term retention percentage, among students who scored a 15 on their ACT math sub section the learning support shows a higher 2-term retention percentage than the regular course. In this instance the difference is much larger. However, likely due to a smaller sample, the difference is not statistically significant. Outside of the large disparity among the students who scored 15 on the ACT math subscore, these percentages stay within 7% of each other and show no statistical significance. It should be noted though, that out of all of the underprepared students, regardless of the type of course they took, 1 in 3 have dropped out of school at this point. Meaning out of all underprepared students who took Probability and Statistics in the fall semester of their freshman year, only 2 of 3 returned for their sophomore year. Figure 20 shows these percentages graphically.

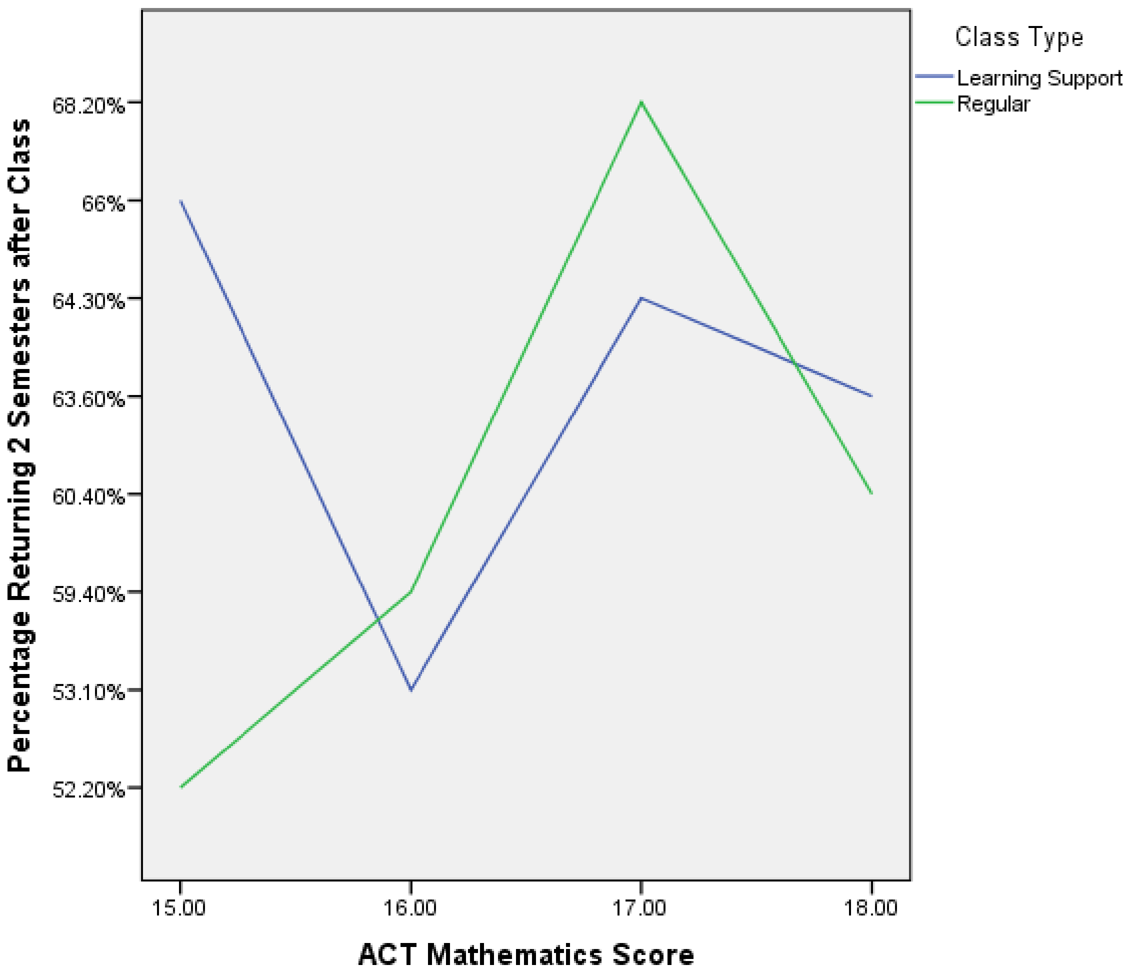

Figure 20. Percentage of Students who Enrolled at the University 2 Semesters after Taking a Probability and Statistics Course

Research Questions 15, 16, 17, and 18 were directed to determine if there was any significant difference in the final course grade between students with an ACT math score of 18, 17, 16, and 15 respectively who took a learning support section of Probability and Statistics and students with matching ACT math scores who opted to take a regular section of the course. Table 21 contains the percentage of students who failed the class.

Table 21

Percentage of Students Failing a Probability and Statistics Course Separated by ACT Mathematics Subscore and Course Type

ACT Math Score	Learning Support	Regular
18	25.5%	29.8%
17	29.1%	27.2%
16	29%	37.1%
15	33.8%	48.1%

This data progressed in the expected linear fashion with the highest percentages of students failing having scored a 15 on their ACT mathematics subsection and the lowest having scored an 18. The one exception again being the students with an ACT math subsection score of 17 in the regular course. This sample with a surprisingly high 1-term and 2-term retention percentage also showed a surprisingly low failure percentage. This anomaly has continued throughout the data and warrants further investigation. Other than this one group, the regular course consistently has a higher percentage of students failing than the learning support section, but this difference did not show statistical significance. Figure 21 shows this relationship graphically.

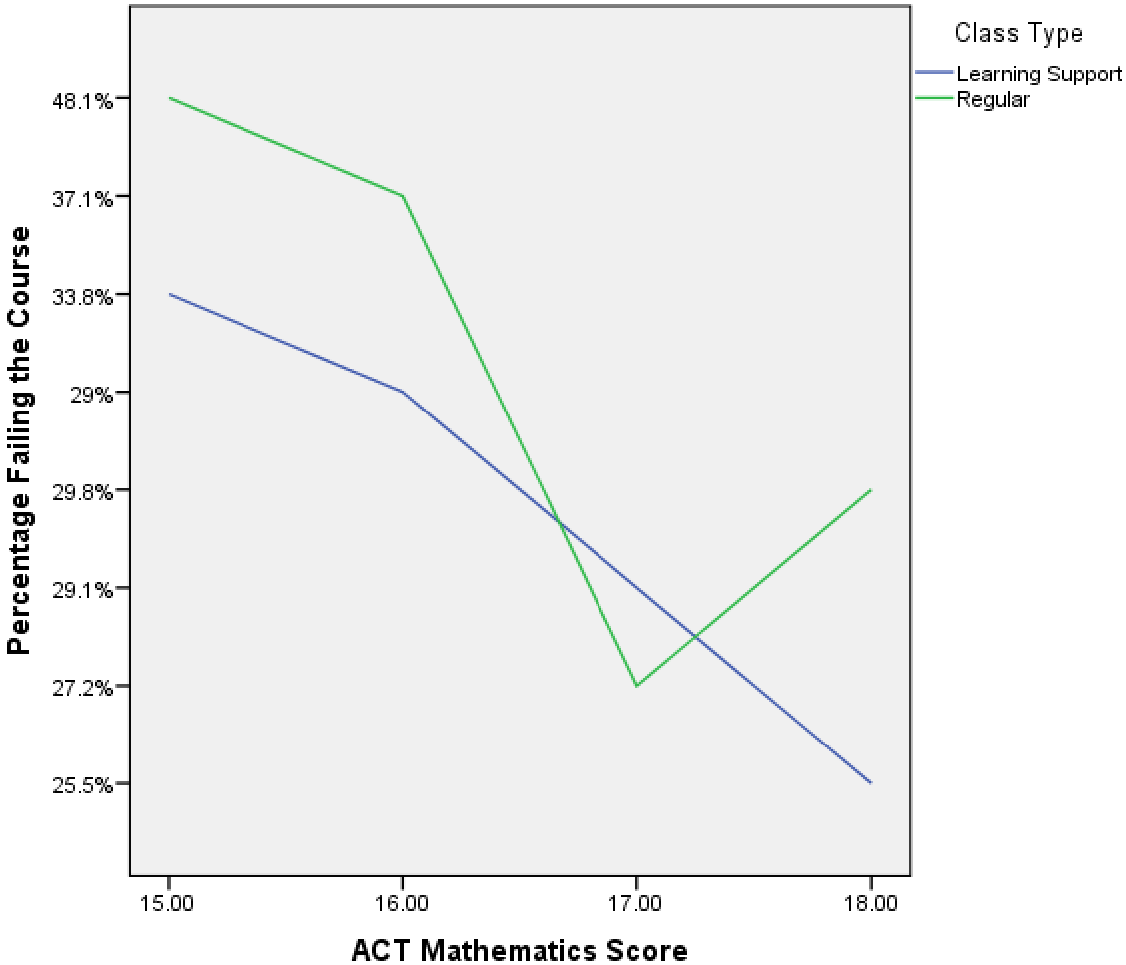

Figure 21. Percentage of Students Failing a Probability and Statistics Course Separated by ACT Mathematics Subscore and Course Type

Research Questions 1, 2, and 13 compared 1-term retention, 2-term retention, and final course grade between prepared and underprepared students. The results showed statistical significance but this is not a remarkable finding. One could have assumed that this would be the case; it was done simply to be sure. If prepared students had not shown a significantly higher retention or final grade than underprepared students, then the premise of the study would have been invalid. The exact figures for these questions can be found in Chapter 4. Table 22 provides a summary for the research questions discussed above.

Table 22

Summary of 1-Term Retention, 2-Term Retention, and Final Course Grade Separated by ACT Math Subsection Score and Class Type

	1 Term Retention		2 Term Retention		Percent Failing	
ACT Math Score	Learning Support	Regular	Learning Support	Regular	Learning Support	Regular
18	81.60%	77%	63.60%	60.40%	25.5%	29.8%
17	77.5%*	89.7%*	64.30%	68.20%	29.1%	27.2%
16	75.90%	78.40%	53.10%	59.40%	29%	37.1%
15	75.30%	73.70%	66%	52.20%	33.8%	48.1%

*significant at the p<.01 level

Conclusions

Bettinger (2013) approximated the percentage of students applying to institutions who were not prepared to be 68%. In this study, the population of students who did not meet the ACT benchmark of preparedness for mathematics was approximately 57%. This is a percentage that should be expected as Bettinger approximated the percentage of students entering all institutions and students entering 4-year institutions are typically more prepared than students entering 2-year institutions. These numbers also highlight the size of this population, showing why they are so important to less selective institutions. Voket (2015) reported that South Carolina State University pointed toward reduced enrollment as a reason to shut down their institution altogether. If the institution being studied was forced to turn away any student who did not meet the ACT benchmark, the institution's population would be cut in half; a reduction it would likely not recover from. Even setting the benchmark for learning support to an ACT mathematics subscore of 19, the unprepared population in this study would have been approximately 45%. This supports Brothen and Wambach's (2004) conclusion that remediation of some form will always exist in higher education. Institutions simply can't afford the alternative.

Existing research on learning support showed mixed results for its success. A CCRC study showed that skipping a remedial course showed higher success than taking it (Bailey, 2008). This study does not support that finding. While the course in this study was not a remedial course, it was a form of learning support, and forgoing the learning support for a regular course showed no significant long-term benefits. Woodard (2005) stated that simply increasing the amount of time that students spend in developmental classes does not equate to higher retention rates. The data in this study would support that claim as the 4-hour course did not show significantly higher rates of retention than the 3-hour course. Ballard (2004) found that simply having taken a remedial mathematics course reduced a student's predicted achievement. This study supports that claim in that students who took the regular course outperformed students who took the learning support course; however, once matched by ACT mathematics subscore, there was not a statistically significant difference in achievement between students who took the regular course and students who took the learning support course. Other studies have been conducted on the many techniques that fall under the category of learning support, but there still exists no method universally accepted as most effective or best practice.

Conclusions were drawn based on the analysis of data relevant to this study. They include:

1. Students who were academically prepared to take a college level mathematics course showed significantly higher 1-term retention, 2-term retention, and final course grade than did students who were not academically prepared.
2. When students were grouped into ACT math subscore categories, the learning support course did not show a significant improvement in 1-term retention percentage versus the regular course offering.
3. When students were grouped into ACT math subscore categories, the learning support course did not show a significant improvement in 2-term retention percentage versus the regular course offering.
4. When students were grouped into ACT math subscore categories, the learning support course did not show a significant improvement in students’ final course grade versus the regular course offering.
5. Underprepared students who opt to take the 4-hour learning support section of Probability and Statistics seem to gain no advantage over students who are equally underprepared and opt to take a regular 3-hour section of the course.

Recommendations for Practice

The findings of this study would suggest that the learning support program for mathematics at the institution being studied should be either reworked or eliminated completely. The institution used in this study would be advised to investigate different methods of learning support in mathematics or to rethink admission standards altogether.

Underprepared students who opted to take the additional hour with the learning support course fared no better in the long run than students who took the regular course. However, this does not mean that the learning support courses are completely ineffective. One major qualitative factor that was not presented in this study was why students opted to take the regular course over the learning support course. It could be that students who were more confident in their own abilities opted for the regular course, while students who were desperately in need of help asked for the learning support section. For these students to perform at the same level could be a large victory for the program. However, because the only factor used to establish groups was the ACT mathematics subscore, these factors could not be examined. But, barring further research into these factors, it does not seem advisable to place students into a learning support section of Probability and Statistics over a regular section.

Also, it seems that while the regular course was consistently failing more of its students than the learning support course, retention between the two courses was typically even. So, while learning support students were on average making slightly better grades, this success did not translate into higher retention rates. This is an unexpected result. One would assume that a class failing fewer students would lead to a higher rate of retention as students who are doing well are less likely to drop out. This could be a sign that the support is helpful but must be continued as some success is shown during the course but not after.

It may be that some students are so far behind by the time that they start higher education that no developmental program will be effective enough to warrant accepting these students into the university. In the review of literature, the dichotomy between student access to higher education and the standards at institutions was examined. States want all students to have access to higher education. Institutions of higher education also want this as increased enrollment leads to increased funding. However, incentives are also offered for higher graduation percentages. This puts institutions in a bind as they want to accept the students, and they want them to graduate, but they must play a numbers game by allowing as many students in as they can without allowing their graduation percentage to plummet.

This study would advise, under the current developmental math program, to revisit acceptance standards. Among students who scored a 15 or 16 on their ACT mathematics subscore, 1-term retention percentage was approximately 75% and 2-term was approximately 60%. With or without participating in the developmental learning program, 1 in 4 students did not enroll in the semester following the Probability and Statistics course and 1 in the remaining 3 did not enroll 2 semesters later. This is only in the first year. If the institution's graduation rate is suffering, these students could be a major reason why. Either a more effective learning support program needs to be investigated and instituted, or these students are not likely to persist to graduation.

Recommendations for Further Research

This study was not intended to be an all encompassing investigation of the learning support program at this specific institution. This study was focused only on the mathematics branch of the learning support program and only isolated for one variable when determining college preparedness. This is however the one variable used by most institutions to make the same determination. Although other studies of learning support programs may have similar findings, because this study was only conducted at a single institution, its findings may not be generalized to other institutions of higher education that provide learning support. However, institutions that are contemplating changes in their learning support program may find relevance in these results when evaluating the 4-hour versus 3-hour course method.

The population of underprepared students entering higher education is vast. If nonselective institutions are to succeed in an era where both student access and graduation percentage are being incentivized, then a learning support program that adequately prepares this population for college level work is crucial. Therefore, further research into best practices for this area is needed.

The following recommendations for further research are suggested:

1. Research to determine why some students opt to take a regular course when they are advised to take a learning support course.
2. Research to determine what factors, other than ACT subscores, should be examined when determining college preparedness.
3. Research to determine learning support effectiveness on graduation percentage.

4. Research to determine the costs of a learning support program to an institution versus the benefits.
5. Research to compare the effectiveness of multiple forms of learning support to better determine best practices.
6. Research to determine the effect that individual professors have on a learning support program as a whole.
7. Research into social and emotional effects on students who are identified as being in need of learning support.

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