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DUAL ENROLLMENT STUDENTS PLACING PERSPECTIVE ON THE ACT MATHEMATICS BENCHMARK

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DUAL ENROLLMENT STUDENTS PLACING PERSPECTIVE ON THE ACT MATHEMATICS BENCHMARK

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DUAL ENROLLMENT STUDENTS PLACING PERSPECTIVE ON THE ACT MATHEAMTICS BENCHMARK

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Abstract

For high school students achieving high ACT/SAT scores is crucial for admittance, scholarships, and coursework requirements. Dual enrollment students still have to meet the admittance and coursework requirements to be enrolled in a dual enrollment course even though the class could be scheduled for more time than the traditional course taught on campus. The purpose of this study was to determine if ACT predictors closely align to student success for dual enrollment students who complete a college algebra course in a high school setting with an adjunct professor who is a full-time high school teacher. Archival data from 188 dual enrollment students were analyzed using multiple regression, analysis of variance, and one-way analysis of variance (ANOVA). The results displayed the mathematics ACT subscore does correlate to the dual enrollment student's final college algebra grade and is statically significant. Additionally, the results revealed dual enrollment students with an ACT mathematics subscore below the ACT mathematics Benchmark, 22, can achieve a final grade of a C or better in college algebra.

TABLE OF CONTENTS

CHAPTER I: INTRODUCTION

As a result of more and more people every year having earned at least a high school diploma there has been an increased demand for postsecondary education in order for individuals to meet their future well-being comfort levels. For example, in 2010 the Alliance for Excellent Education found that at least 60% of jobs required some form of postsecondary education and about 90% of higher wage careers require at least a bachelor's degree (Jones, 2017). Many high school students realize this truth and set their goal to pursue a college degree. According to An (2015), roughly 68% of high school graduates in 2011 immediately enroll into postsecondary education following graduation. Even with the increase of enrollment, many students do not attain a college degree. An (2015) noted that only 59% of students graduate from a four-year institution within six years of starting.

How can educators provide additional support for high school students that are "at risk" in postsecondary education completion? One possibility is dual enrollment programs. Dual enrollment is a program that allows high school juniors and seniors to take college courses while still in high school and earn both high school and college credit with successful completion (An, 2013). Dual enrollment programs have been found to provide a diverse population of students greater opportunities to enter and excel in postsecondary education (Kanny, 2015). Participation in dual enrollment programs provides a wide variety of benefits ranging from short to long term positive outcomes. Additionally, dual enrollment programs provide opportunities and encouragement for high school students who are at risk to pursue postsecondary education (Jones, 2017). Dual enrollment programs create opportunities for high schools and colleges to better prepare students for postsecondary success as a result of introducing the skills and rigor

required to complete college level work without being a full-time college student (Hofmann & Voloch, 2012).

One concern is students who participate in dual enrollment programs still have to meet the ACT required subscore set by the postsecondary institution for the dual enrollment course even though many times dual enrollment courses meet more days each week and for longer periods of time each day. In addition, many dual enrollment courses are taught by adjunct professors who are full-time high school teachers with an additional degree in education. Plus, most of these students are not provided with the opportunity to take different placement exams to see if they can meet the required score to take the course. In response, this study will investigate if ACT predictors closely align to student success for dual enrollment students who complete a college algebra course in a high school setting with an adjunct professor who is a full-time high school teacher.

CHAPTER II: REVIEW OF THE LITERATURE

College admission exams are one of the first crucial hurdles students have to overcome in the road to taking college courses and over the past century standardized testing for college admission has witnessed extraordinary growth. The first "College Boards" test took place in 1901 with less than 1,000 examinees and now close to three million high school seniors take the SAT and/or ACT every year (Atkinson & Geiser, 2009). The SAT which was then known as the "Scholastic Aptitude Test" first appeared in 1926 as an alternative to the "College Boards" (Atkinson & Geiser, 2009). Atkinson and Geiser (2009) stated the SAT was developed based on the IQ tests during the First World War when intelligence was assumed to be a unitary, inherited attribute and could not be changed over time. This was later identified to be a problem and progressed the evolution of how we know the SAT to be today.

In 1959 the ACT emerged as a competitor to the SAT (Atkinson & Geiser, 2009). From the beginning, the ACT has always been strongly related to the high-school curriculum especially when compared to the SAT, as a result of its founder E. F. Lindquist views (Atkinson & Geiser, 2009). The early ACTs included the four subsections English, mathematics, social-sciences reading, and natural-sciences reading based on the state's high school curriculum (Atkinson & Geiser, 2009). Atkinson and Geiser (2009) noted as the ACT grew to a national test, the content present on the test reflected the results of the national curriculum surveys. According to Atkinson and Geiser (2009) the ACT had a major revision conducted in 1989 which introduced the four subsections we know today (English, mathematics, reading, and science). Shortly after in 2005 the ACT also included the optional writing exam subsection (Atkinson & Geiser, 2009). According to Atkinson and Geiser (2009), both the ACT and SAT are a norm-referenced test which are primarily used by postsecondary education institutions to

compare students against one another instead of assessing their mastery of the high school curriculum. It is widely known that the SAT is scored based on producing a bell-shaped curve distribution, but the ACT is also scored in a similar manner which creates a similar bell-curve distribution (Atkinson & Geiser, 2009).

ACT has identified certain scores in each of its four subsections that are important for a student to achieve. These are the ACT's College Readiness Benchmarks which are the minimum ACT test scores required for students to have an increased probability of success in first year courses, such as English Composition, Biology, and College Algebra (ACT, 2010). These Benchmarks signify a standard for success for a typical student at a typical college; therefore, the Benchmarks provide students, parents, and counselors information on if the student has attained the necessary skills in order to be successful in college (ACT, 2010). Recently, the ACT has added two more Benchmarks, one in STEM and the other ELA which means now there are a total of six Benchmarks for students to reach (ACT, 2017). ACT's College Readiness Benchmarks were empirically derived based on student's actual performance in college collected from 98 institutions and over 90, 000 were included which was weighted nationally to represent both two- and four-year colleges (ACT, 2010). The ACT states students who met the Benchmarks on the ACT have approximately a 75% chance of earning a C or higher and approximately have a 50% chance of earning a B or higher in the corresponding college courses (ACT, 2010).

As more time has passed the focus and stress on attaining a good score on the ACT and/or SAT has dramatically increased especially with the inclusion of the ACT's Benchmarks, but many studies have found that college admissions exams might not be the best predictor of college success. A study conducted at the University of California by Geiser and Santelices

(2007) observed the long-term outcomes to determine if high school GPAs or standardized tests, like ACT and SAT, were predictors for cumulative college GPAs as well as four-year graduation. The results from this study showed that high school GPAs were a far better predictor than standardized tests in predicting future success in both of these categories. Testing agencies have also gathered research throughout the years in various "predictive-validity" studies and have also found cumulative high school GPAs in academic areas consistently are the best indicator of student overall performance in college (Atkinson & Geiser, 2009). Researchers are still not fully aware to why high school grades possess a predictive advantage over standardized testing, since grading standards are different across the nation, but they believe it is because standardized tests results are based on a single test taken in a three to four hour setting whereas a high school GPA is based on the student's academic performance over a period of several years (Atkinson & Geiser, 2009).

With more and more students attending college every year there has been an increase in opportunities for students to get a head start on postsecondary education. The general population has heard of the Advanced Placement program in high schools across the nation and associates this program to service the top 5-10% of the student population. In Advanced Placement (AP) and College Level Examination Program (CLEP) a student can only earn the college credit if they have obtained a certain score on a single test. These types of programs are more widely known and are considered exam-based programs (Young, Joyner & Slate, 2013). Whereas dual enrollment programs and courses, also frequently known as dual-credit or concurrent-enrollment courses, permits students to earn college credit that can also be calculated towards a high school diploma (Zuidema & Eames, 2014).

Towards the end of the 1970s, dual enrollment programs started emerging around the United States in order to provide opportunities for academically driven high school students to begin their college careers while still attending high school (Hebert, 2001). Dual enrollment programs initially started for high achieving students, like the Advanced Placement program, but as dual enrollment programs have grown around the nation its focus now is to support the postsecondary preparation of average achieving students as well (Johnson & Brophy, 2006). As a result of an increase in students attending postsecondary education establishments and the rising expense of college tuition, dual enrollment programs have started to become more and more popular across the nation (Zuidema & Eames, 2014). In the 2002-2003 school year about 71% of high schools in the United States allowed their students to participate in dual enrollment courses (Karp et al., 2008). Also, from 2002-2003 school year to 2010-2011 school year, the participation of students involved in dual enrollment courses almost doubled from 1.1 million to 2 million in public schools across the nation (An, 2015).

Dual enrollment programs are not intended to provide high school students with the college experiences; it's intended to present college-level material to academically prepared high school students (Hebert, 2001). Many state legislatures have created policies to support the expansion of dual enrollment programs to encourage not only participation from high school students who are high academic achievers but also to students who are average to low achievers (Young, Joyner & Slate, 2013). Students who participate in a dual enrollment program take college courses which are either taught on college campuses by college professors or taught on a high school campus by college adjuncts who are full-time high school teachers (Karp et al., 2008).

As the dual enrollment program grew throughout the United States, scholars started examining the effectiveness of the program. These studies repeatedly displayed positive results. Many methodical studies have revealed that dual enrollment increases postsecondary enrollment and success (Allen & Dadgar, 2012). Swanson (2008) studied the nationally representative sample "National Education Longitudinal Study:88/00" and discovered that dual enrollment increased college persistence. Allen and Dadgar (2012) found students who completed one or more dual enrollment courses also had a positive association with earning more credits during their first semester of college and attaining a higher college GPA.

Along with providing high school students with exposure to more rigorous curriculums, dual enrollment programs also provide financial assistance by reducing college costs (Young, Joyner, & Slate, 2013). The reduced cost is a major bonus but there are other positive outcomes that are sometimes overlooked. Dual enrollment programs can shorten the time required to obtain a degree and increases the number of students who graduate from high school with subsequent enrollment in postsecondary education (Young, Joyner, & Slate, 2013). The study conducted by Allen and Dadgar (2012) also found students who completed one or more dual enrollment course were also 5% more likely to reenroll in their third semester. Thus, students who had successfully completed one or more dual enrollment courses were also more likely to continue attending college after their freshman year. Additionally, former dual enrollment students maintained as high or higher college GPAs when compared to all other transfer students (Hebert, 2001).

After researching how many students take remedial coursework in college, ACT (2017) found about 68% of students who attend a two-year college and about 39% of students who attend a four-year college are required to take at least one remedial course. Remedial courses are

classes designed to prepare students for college level coursework, who have not met the required ACT Benchmark, and do not provide students with credits towards their degree. As a result, this increases the cost for these students because they are paying for a class, they are required to take but will not provide them with any credit along with potentially increasing the time required for the student to complete their degree. A study conducted in New York by Kleiman (2001) found students who completed at least one dual enrollment course were less probable to need remedial courses and when compared to non-dual enrollment students they were twice as likely to graduate from college on time. Many other studies have shown that dual enrollment programs can decrease the number of remedial courses needed by a college freshman as well as increase the student's aspirations and, at times, reduce high school dropout rates (Karp et al., 2008).

Recently more researchers have started looking into the long-term effects dual enrollment programs can provide students as they progress into their postsecondary career and how dual enrollment courses measure up to traditional college courses. Hebert's study (2001) found students who had taken dual enrollment mathematics courses instructed by adjunct professors, who were full-time high school teachers, had significantly higher grades in subsequent coursework at the universities than students who had full-time college faculty for dual enrollment mathematics courses. Hebert's study (2001) also noted dual enrollment students earned more A's and B's in courses who were taught by adjunct professors who were full-time high school teachers than when instructed by full-time college professors, which had significantly more D's and F's. The study concluded dual enrollment students instructed by adjunct professors who are full-time high school teachers were better equipped for subsequent coursework at the university level than were those instructed by full-time college professors (Hebert, 2001). Hebert (2001) did note high school classes are typically scheduled for more time

than traditional college courses so if the course was taught by a high school teacher the students were provided more time to comprehend the material which resulted with the opportunity to attain a higher level of mastery of the content.

Research conducted by Karp et al., (2008) also learned that students who participated in a dual enrollment program were more likely to continue to a second semester of college. In this study they also noted dual enrollment students' college GPAs one year after high school graduation were higher with statistical significance (Karp et al., 2008). Additionally, Karp et al., (2008) study of college students reported, students who participated in dual enrollment programs were 5.4% more likely to have remained enrolled in postsecondary education two years after graduating high school than compared to students who did not participate in dual enrollment programs. Windham discovered similar results in his study of dual enrollment programs. Windham (1997) conducted a study to determine if dual enrollment programs had positive effects at preparing students for subsequent coursework as well as producing higher achievement in the initial dual enrollment course. He discovered that dual enrollment students did achieve higher grades in the initial dual enrollment course, and this translated to a positive association of higher grades in the subsequent course as well.

Zuidema and Eames (2014) shared some major concerns that dual enrollment courses were being "dumbed down" to make the content accessible for high school students and as a result, in other studies, the dual enrollment students had performed better than regular college students. Therefore, the study conducted by Zuidema and Eames (2014) utilized a full-time tenured chemistry professor who also teaches chemistry part-time at a high school. This professor taught both the traditional chemistry college course as well as the dual enrollment course. This study compared college students to their dual enrollment counterparts which

unveiled dual enrollment students had a higher chance of completing the course for credit as well as achieved similar or higher levels. Zuidema and Eames (2014) also wanted to compare dual enrollment student achievement to traditional college student achievement level on the American Chemistry Society (ACS) standards examination which measures student's mastery of General/Organic/Biochemistry (GOB) course. They discovered dual enrollment students outperformed traditional college students on the ACS GOB exam (Zuidema & Eames, 2014).

Many studies have reported positive effects of students participating in dual enrollment programs, but there have also been studies that have reported no effects existed. In Andrews (2004) study he took results collected from dual enrollment students at Clear Lake High School and matched them to regular college students in the same course and his results exhibited that no difference in success rate in college existed.

In Tennessee, the Dual Enrollment Grant Program is funded by the Tennessee Lottery and is awarded to junior and senior students who are Tennessee residents for at least one year prior to enrollment, have met admissions criteria for dual enrollment at the postsecondary institution and are also enrolled in college courses at eligible postsecondary institutions (Tennessee State Government, 2020). The Dual Enrollment Grant pays for one course per semester, but there is an opportunity for students to receive funding for two additional courses per semester if the student has met the minimum Tennessee HOPE Scholarship academic requirements at the time of dual enrollment (Tennessee State Government, 2020). Students who receive the Dual Enrollment Grant will earn both postsecondary and high school credits for the same course. Dual enrollment students still have to meet the required ACT Benchmarks in order to take courses at most postsecondary establishments. There are a few colleges that will allow the students to take different placement exams to determine if they will allow them to take the

course without having met the corresponding ACT Benchmark. The College Readiness Benchmark in mathematics is a 22 (ACT, 2010). This is the score students need to achieve in order to have a 75% chance of earning a C or better in College Algebra and a 50% chance of earning a B or better (ACT, 2010). The literature has not investigated if dual enrollment students taught on a high school schedule with an adjunct professor who is a full-time high school teacher have to meet the ACT Benchmarks in order to achieve at a high level.

The purpose of this study was to determine if ACT predictors closely align to student success for dual enrollment students who complete college courses in a high school setting, 90-minute block, with an adjunct professor who is a full-time high school teacher. Most of the studies regarding dual enrollment students analyze the student's success as they progress through their postsecondary educational career and/or to compare their success versus a traditional college student. What is lacking in the literature is research towards how accurate ACT's claim is when considering dual enrollment courses on a high school schedule. Therefore, conducting a study that focuses on dual enrollment students meeting or not meeting the ACT Benchmark to determine if students can be successful displays a need for this research.

CHAPTER III: METHOD

Research Questions and Hypothesis

This study attempts to address the following questions: Does ACT mathematics subscore predict dual enroll student's final grade in college algebra? Do dual enrollment students need to meet the ACT mathematics Benchmark, a score of 22, to attain a C or better in college algebra?

ACT (2010) and (2017) states that ACT mathematics subscore is linked to traditional college student success in college algebra. This is believed to hold true as well for dual enrollment students which this study will investigate further. The hypothesis for the second research question is dual enrollment students can possess a lower score than a 22 on the ACT mathematics subsection and can still be successful in college algebra.

Participants

Student data was collected from a rural Tennessee high school which partnered with a local community college for dual enrollment coursework from Spring 2018 to Spring 2019 was utilized in the study. 188 students were included in the study and had either taken college algebra in their junior or senior year of high school. There were 84 male students (44.7%) and 104 female students (55.3%), with the demographics 168 Caucasian (89.4%), 11 African American (5.9%), 3 Asians (1.6%), and 6 Hispanics (3.2%) (See Table 1 for demographics).

All students represented in the study were instructed by the same experienced adjunct professor who is a full-time teacher at the high school. Students enrolled in this dual enrollment college algebra course met daily Monday thru Friday for a ninety-minute block. The same curriculum, grading policies, and equivalent assessments were used in each course for all three

semesters. Thus, all students received the same material and were held to the same level of expectations. Additionally, the community college requires uniformity for all courses; therefore, dual enrollment students in college algebra were held to the same criteria, grading policies and exit exams regardless of location and status of instructor. This was also the case in Hebert's study (2001) which compared types of instructors and dual enrollment student's success.

Procedures

The data were provided by a rural high school, after permission to conduct the research study was procured from the Director of Schools. A volunteer administrative assistant removed all personal identifiable information from the data before the researcher obtained the data to insure confidentially for all participants. The administrative assistant made the data confidential by assigning a random generated identification number that bore no relation to the participant in any way. The Institutional Review Board reviewed the study and determined the study does not involve activities and/or subjects that would require IRB review and oversight since the individuals are not identifiable. Thus, IRB granted approval for the research to be conducted. The data collected included the student's biological gender, ethnicity, ACT Composite score, ACT mathematics score, and the student's final grade for the course. This data was entered into an excel spreadsheet and uploaded to SPSS for analysis.

CHAPTER IV: RESULTS AND DISCUSSION

Results

After investigating and reporting some statistics on the data several stimulating details emerged from the analysis. In table 2, all of the students have been sorted by their ACT mathematics score which you can see how many students fall into each category by looking in the frequency column. The Mean and Standard Deviation columns in table 2 (M and SD), have recorded the students' average final grade (Mean) for each of these ACT mathematics scores categories and their standard deviation. The standard deviation indicates the spread of the data, the larger the standard deviation value the further apart the student's final grades were from one another and the smaller the standard deviation value displays the student's final grades were closer to each other. The mean final grade for students with a math ACT subscore of a 26-34 was mostly mid-to-high A. Students with a math ACT subscore of a 23-25 had a mean final grade of a low-A to a mid-B. Students who scored between 17-22 on the mathematics ACT averaged a low-B to high-C for their final grade. Students who scored a 16 on the math ACT averaged a lower mid-C final grade and students with a 15 math ACT subscore averaged a mid-D. This shows that as a student's ACT mathematics subscore decreases the average overall final grade decreases as well.

Notice the standard deviation for the 26-31 mathematics ACT subscore groups are all relatively small and when using Table 3 with this knowledge it is easy to see why. Table 3 displays the total number of each letter grade scored within each ACT mathematics subscore group. When analyzing the ACT mathematics subscore groups 26-31 every student earned an A or B. Therefore, their final grades in each of these subgroups are closer together. In the 25 mathematics ACT subgroup the standard deviation is 19.57, which is the largest of any of the

subgroups (from Table 2). With further inspection students who scored a 25 in the mathematics section of the ACT also earned a wide range of final grades with the majority earning A but also having students earn from a B to F as well (from Table 3). Another trend to notice, from Table 3, is as the ACT mathematics subscore increases, the number of lower grades (D's and F's and middle grades C's) decreases and the number of higher grades (A's and B's) increases.

Table 3 and 4 provide a better picture of how the data breaks down within each mathematics ACT subscore. Table 3 displays the number of each letter grade earned within each subscore, while Table 4 displays one of the demographic characteristics, gender, within each subscore. Table 4 reveals that there is at least one male student who scored in each of the mathematics ACT subgroups, while females are only included in 15-29 mathematics ACT subgroups. The highest quantity of males, 13, scored in the subgroup 19 on the ACT mathematics portion and the highest number of females is in two subgroups, 18 and 19, with a count of 16 each. When examining each of these subgroups further, by using table 3, no student within either of these subgroups failed the course and the majority of them earned B's. Also, out of 46 students only eight of them score a D with 38 of the students earning a C or above. After inspecting all of the subgroups below a 22, the mathematics ACT benchmark, 81.8% scored a C or better as their final grade for the course. This shows that dual enrollment students with a mathematics ACT subscore below a 22 (the ACT math Benchmark) can be successful in the course.

Table 5 is a cross tabulation of the student's gender and the student's final grade. After viewing Table 5 some interesting statistics surface, such as, more females earned an A than males. About 62.5% of the A's were earned by females. The number of males and females earning B's, C's, and D's were basically equal. However, the number of students failing the

course was small at six, but of the six, five of them were male. This information starts to shed some light on a student demographic characteristic that could be related to student performance in dual enrollment courses.

Figure 1 provides a visual representation, boxplot, for the spread of the dual enrollment students final college algebra grade. A boxplot breaks up the data into quartiles which illustrates each 25% set of the data along with the median, mean, maximum, minimum and outliers. The maximum final grade earned in the college algebra dual enrollment course was 99.50, the minimum was 33.86, the median was 89.32, and the mean was 85.46. Notice at the bottom of the boxplot there are five points, these points are the visual representation of the outliers for the data which the indicated values for each are listed in Figure 1 by each point. Each of these outliers affect the mean of the data more than the median because of how each is calculated. These outliers, from least to greatest, are located in the corresponding mathematics ACT subgroups 25, 21, 23, 20, 16. The two of the three lowest final grade outliers were earned by students who scored above the ACT mathematics Benchmark.

The boxplot represented in Figure 1 also provides a visual representation of how much of the data lies between certain scores. For example, 75% of the 188 students' final grades in this study were between 79.56 to 99.50, which is a high C (almost a low B) to a high A. That reveals that at least 75% of the students that took the dual enrollment college algebra earned at least a C or better. Inferences about the descriptive statistics of the data reveals several key aspects that sheds light on the research questions.

Next, a multiple regression with direct entry was conducted to explore how well the overall ACT score variable and the mathematics ACT subscore variable predicted college algebra final grade. Multiple regression is a type of linear regression that is used to determine

whether a continuous dependent variable can be predicted from a set of independent variables. Preliminary analyses indicated that the assumptions of multicollinearity, normality, linearity, homoscedasticity, and independence of residuals were met. Table 6 presents the means, standard deviations, and intercorrelations for the college algebra final grade variable, the overall ACT score variable and the mathematics ACT subscore variable. The analysis of variance (ANOVA) revealed that the regression model was statistically significant, $F(2, 185) = 22.98$, $p < 0.001$. The R^2 value was 0.199, which indicated that the model explained approximately 19.9% of the variance in the college algebra final grade variable.

The regression analysis summary for the overall ACT score variable and the mathematics ACT subscore variable predicting the college algebra final grade variable is reported in Table 7. The mathematics ACT subscore predictor variable was statistically significant at the 0.05 level. It had a standardized β coefficient of .29 and unstandardized coefficient (B) of 0.899 ($p = 0.012$; 95% confidence intervals for $B = 0.20, 1.60$). However, when we apply the Bonferroni adjustment, the adjusted alpha value is 0.025 instead of 0.05. The mathematics ACT subscores predictor variable was statistically significant at 0.025 level. The overall ACT scores predictor variable was not statistically significant at the 0.025 level.

When considering the second research question a one-way analysis of variance was conducted to evaluate the relationship between mathematics ACT subscore and college algebra final grade. A one-way analysis of variance (ANOVA) compares the means of three or more independent groups and determines whether any of the means are statistically significantly different from one another. We are interested in knowing how students who scored 17, 18, 19, 20, 21, 22, 23, and 24 on the mathematics subpart of the ACT would differ in their college algebra final grade. The independent variable, mathematics ACT subscore, included 8 levels: the

17, 18, 19, 20, 21, 22, 23, and 24 mathematics ACT subscore groups. The dependent variable was the college algebra final grade. The ANOVA was not significant, $F(7, 120) = 1.89$, $p = 0.08$. The strength of relationship between mathematics ACT subscore and college algebra final grade, as assessed by partial eta squared, was medium, with the mathematics ACT subscore variable accounting for 9.9% of the variance of the dependent variable. In other words, a score of 17 which is below the ACT mathematics Benchmark may not necessarily lead to failure in college algebra.

Discussion

The results of the study did confirm some of the previous literatures' findings. In this study, 74.5% of the dual enrollment students (140 out of 188 students) earned an A or B which is a high level of achievement for college algebra. In Hebert's study (2001), she also noticed similar results when dual enrollment students were instructed by adjunct professors who are full-time high school teachers. Windham (1997), Zuidema and Eames (2014) also noted similar higher achievement results from their dual enrollment studies as well.

The initial multiple regression analysis shows that both independent variables composite ACT score and mathematics ACT subscore both correlate to dual enrollments student's final college algebra grade. However, after further analysis using Bonferroni adjustment, the mathematics ACT subscore remained statistically significant but the student's composite (overall) ACT score did not. Therefore, the mathematics ACT subscore does correlate to the dual enrollment student's final college algebra grade and is statically significant. This confirms ACT's (2017) findings that ACT subscores are correlated to college success.

The evaluation of the relationship between the mathematics ACT subscore and college algebra final grades using the one-way analysis of variance (ANOVA) determined the ANOVA was not significant. Meaning the average college algebra final grade of each subscore 17-24 where not statistically significantly different from each other. Thus, a student possessing an ACT mathematics score below the benchmark, in the 17-21 range, does not mean they are necessarily going to perform low (D or F) in the college algebra course. This shows that dual enrollment students with an ACT mathematics subscore below the ACT mathematics Benchmark, 22, can achieve a final grade of a C or better in college algebra.

One possible source for dual enrollment students' success with or without meeting the mathematics ACT Benchmark for college algebra is more instructional time with the professor. As a result of having 90 minutes Monday-Friday, the instructor has more time to provide the students with in-depth instruction of the material and more opportunities for the students to attain mastery of the content. Additionally, an adjunct professor, who is a full-time high school teacher, not only as a master's degree in their discipline (mathematics) but also possesses a degree in education. This provides them with background knowledge in students' learning styles, teaching strategies, being proactive in addressing misconceptions, and formative and summative assessments. Hebert (2001) also mentioned this as a consideration for why dual enrollment students on a high school schedule with an adjunct professor, who is a full-time teacher, outperformed dual enrollment students who were instructed by a full-time college professor.

Another possible cause for dual enrollment students' success with or without meeting the mathematics ACT Benchmark for college algebra is typically dual enrollment students are more motivated students as noted by Zuidema and Eames (2014) and Hebert (2001). Therefore, these

students are normally more accountable for their own learning. As a result of dual enrollment students still attending high school, attendance is more controlled, and parents have the opportunity to be more involved in their child's grades. Many high schools provide their parents with live access to their child's grades, which if the student was a typical college student the parents would not have this access available. So, with parents being provided live access to their child's grades and possibly being more involved in their child's learning, they assist in providing an additional level of accountability for the dual enrollment students. Zuidema and Eames (2014) also noted increased parent involvement could result in their findings of a higher level of success for dual enrollment students when compared to traditional college students.

Summary

Throughout the data analysis and results, it was made clear that the ACT mathematics subscore is an indicator of college algebra final grades for dual enrollment students; however, ACT composite score is not. The data analysis also discovered that dual enrollment students with an ACT mathematics subscore below the benchmark are also successful in dual enrollment college algebra coursework. This displays that ACT subscores are still vital when determining if a student can be successful in a certain course but needs caution when considering refusal of enrollment into dual enrollment courses taught on a high school schedule with an adjunct professor.

CHAPTER V: CONCLUSIONS

Most universities still require dual enrollment students to meet the required Benchmark in order to take dual enrollment courses even when these students are being instructed every day for 50-90 minutes by an adjunct professor with an additional background in teaching. Some colleges will allow the students to take different placement exams to determine if they will allow them to take the course without having met the corresponding ACT Benchmark, but this still, in most cases, costs the students money. Additionally, many dual enrollment students do not have the opportunity to take different placement exams to see if they can still enroll into the course. Hopefully with the addition of this study and future studies, colleges and universities will become more open to lowering the ACT subscore required for dual enrollment students when instructed on a high school schedule with an adjunct professor who is also a full-time high school teacher. Thus, allowing average to lower achieving students a better opportunity to enroll in postsecondary courses with the additional supports to have success.

Limitations

One limitation of this study was it was conducted in a one rural high school with a predominantly Caucasian sample size. Further investigation is needed at other high schools across the state and the nation, in both rural and urban areas with a variety of ethnicities included to see if similar results are found. Further research is also needed to determine if there are any performance differences with students located in different areas and environments as well as different demographics of students. Socioeconomic status was not considered in this study, but future studies should consider investigating this as a possible factor that can affect dual enrollment student success.

Another possible limitation of this study is all of the dual enrollment students were instructed face-to-face on a 90-minute block, so the same results might not occur if students are instructed for a smaller block of time each day. This also needs further research conducted because not every high school that offers opportunities for students to enroll in dual enrollment college algebra have the same amount of time for instruction. Not to mention, time could be a large factor for dual enrollment success when a student possesses a score below the required benchmark. Additionally, this study used a relatively larger sample size, but more investigation and research are needed to prove these results.

Recommendations for Future Research

An extension of this study would be to compare academic GPA along with mathematic ACT subscores to determine 1) if cumulative academic GPAs are a predictor of dual enrollment student success (attaining a C or higher) and if so 2) which one of them is a better predictor of student success in dual enrollment coursework. This investigation could provide students, high schools, colleges and universities more information on characteristics students might possess which results in providing them better opportunities to be successful in dual enrollment programs.

An additional possibility for further research into this topic would be to analyze dual enrollment student success by determining if grade level, junior or senior, is a significant factor. Along with studying if grade level as a possible factor to dual enrollment student success in dual enrollment coursework, a survey could be conducted to determine how the students felt about their own success in the course. The survey could also include questions that inquire about the student's level of motivation and effort placed into the course. This research could expand

educators' knowledge of factors that contribute to dual enrollment student success and possibly traditional college student success as well.

Another possible extension of this study is investigating if dual enrollment students need to meet the ACT Benchmarks for other corresponding courses, such as English and Biology, in order to be successful when instructed by an adjunct professor who is a full-time high school teacher. This information would provide colleges and universities a better comprehension of what to set the minimum required ACT subscore to be for dual enrollment courses taught on a high school schedule. Not to mention it furthers the opportunity for average to low achieving students to enroll in postsecondary courses while still in high school. This topic still possesses room for future researchers to expand in many directions which ultimately will provide better opportunities to future students to succeed in dual enrollment programs across the nation.

In conclusion, the results of this study provide evidence for colleges and universities to consider lowering the required mathematics ACT subscore for dual enrollment college algebra courses when taught on a high school schedule. Even though more research is needed around ACT subscore requirements and dual enrollment student's success, more average to lower achieving students need to take dual enrollment courses if graduating from college is one of their aspirations. As students discover the additional supports in place to provide them opportunity to be more successful in dual enrollment courses the demand for dual enrollment programs will continue to increase, not to mention, the overall academic readiness of high school graduates will also increase.

TABLES AND FIGURES

Table 1

Dual Enrollment Student Demographics

		Frequency	Percent
Gender	Male	84	44.7
	Female	104	55.3
	Total	188	100
Ethnicity	Caucasian	168	89.4
	African American	11	5.9
	Asian	3	1.6
	Hispanic	6	3.2
	Total	188	100

Table 2

Descriptive statistics for each dual enrollment student's Mathematics ACT subscore

		M	SD	Frequency
Mathematics ACT Subscore	15	64.2168	6.26447	3
	16	77.2630	9.15683	10
	17	83.2240	10.10795	13
	18	81.8808	11.35323	17
	19	82.7272	10.23286	29
	20	83.9652	13.28763	11
	21	79.0389	14.06153	16
	22	83.0129	11.86516	12
	23	88.5604	10.91929	15
	24	91.2858	7.45154	15
	25	85.9559	19.56784	12
	26	94.7702	3.03272	10
	27	92.5494	4.24106	11
	28	96.5613	2.84736	5
	29	96.9882	0.84470	5
	31	94.3991	2.75903	2
	32	96.8000		1
	34	96.0093		1
	Total	85.4623	12.09035	188

Table 3

Frequency Count of Dual Enrollment Students Letter Grades Sorted by Mathematics ACT Subscores

		Mathematics ACT Score																	
		15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	31	32	34
Letter Grade Frequency	A	0	0	4	4	7	4	5	5	11	10	8	9	7	5	5	2	1	1
	B	0	4	6	7	12	5	2	3	3	4	1	1	4	0	0	0	0	0
	C	1	5	1	2	6	0	6	1	0	1	1	0	0	0	0	0	0	0
	D	1	0	2	4	4	1	2	3	0	0	1	0	0	0	0	0	0	0
	F	1	1	0	0	0	1	1	0	1	0	1	0	0	0	0	0	0	0

Table 4

Dual Enrollment Student Demographic Categorized by Mathematics ACT Subscore

		Mathematics ACT Score																		
		15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	31	32	34	Total
Gender	Male	2	4	8	1	13	7	9	5	7	4	3	5	6	3	3	2	1	1	84
	Female	1	6	5	16	16	4	7	7	8	11	9	5	5	2	2	0	0	0	104
	Total	3	10	13	17	29	11	16	12	15	15	12	10	11	5	5	2	1	1	188

Table 5

Dual Enrollment Student Demographics Categorized by Final College Algebra Grade

		Letter Grade					
		A	B	C	D	F	Total
Gender	Male	33	25	11	10	5	84
	Female	55	27	13	8	1	104
	Total	88	52	24	18	6	188

Figure 1

Dual Enrollment Students Final Grade in College Algebra

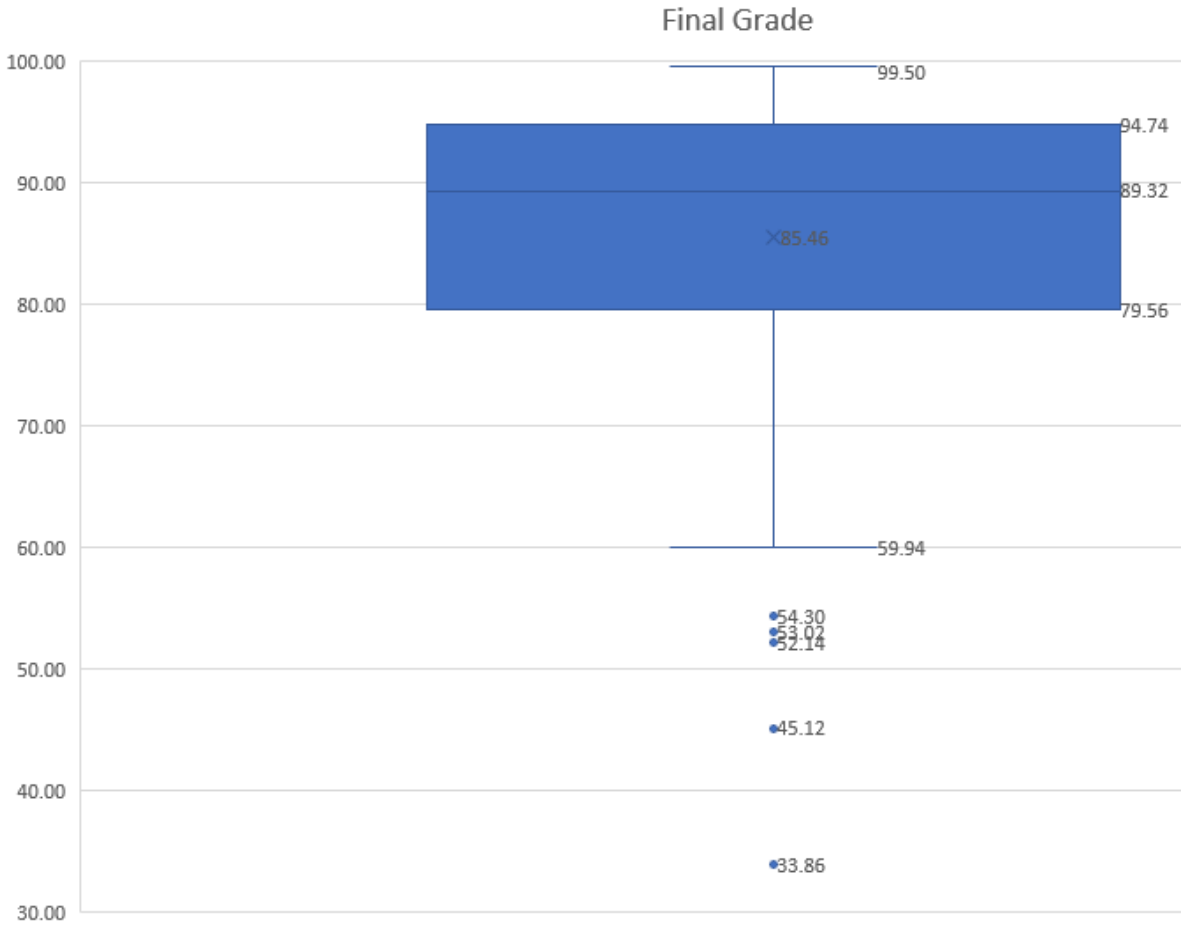

Table 6

Means, Standard Deviations, and Intercorrelations for the college algebra final grade variable, the overall ACT scores variable and the ACT Math subscores variable

	M	*SD*	1	2	3
1. College algebra final grade	85.46	12.09	-		
2. Overall ACT score	22.56	3.81	0.41*	-	
3. ACT Math subscore	21.69	3.91	0.43*	0.82*	-

n = 188

* Correlation is statistically significant at the .001 level (2-tailed).

Table 7

Regression Analysis Summary for the Overall ACT Scores Variable and the ACT Math Subscores Variable Predicting the College Algebra Final Grade Variable

Variable	*B*	95% CI[a]	β	*t*	*p*
Overall ACT scores	0.559	[-0.16, 1.28]	0.18	1.54	0.13
ACT Math subscores	0.899	[0.20, 1.60]	0.29	2.54	0.01

[a] CI = confidence interval
Note. $R^2 = 0.199$ ($n = 188$, $p < .001$)

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