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The Correlation Between Level of Athletic Motivation in High School Students and their Academic Success in Mathematics

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The Correlation Between Level of Athletic Motivation in High School Students and their Academic Success in Mathematics

A Thesis

By

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The thesis entitled '**The Correlation Between Level of Athletic Motivation in High School Students and their Academic Success in Mathematics**' presented by Courtney Bradford and Grace Franjesevic, candidates for the degree of **Master of Science in Mathematics,** has been approved and is worthy of acceptance.

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ABSTRACT

In the current study, researchers investigate if there is a correlation between the level of athletic motivation in high school students and their academic success in mathematics. Motivation for this study is due to the lack of research in the field of motivation and mathematics. In order to conduct the study, researchers used a modified version of the Sports Motivation Scale which can identify if student-athletes identify with intrinsic, extrinsic, or amotived motivation. Between Coventry High School and Lake Middle High School, 142 student-athletes responded and accurately answered each of the 28 statements on the SMS while stating their grade, race, course, and sport(s). Researchers also had math teachers complete another portion on the modified SMS that asked for student cumulative GPA, as well as, math course semester grade, quarter two overall grade, formative assessment grade and summative assessment grade. Researchers entered all data into an Excel document. In order to answer the primary research question and the additional research questions, researchers used ANOVA, Multiple Regression, and ANCOVA techniques. After running the appropriate data through each test, researchers found interesting results. The current study discovered that if you break down motivation type into the seven different subcategories (intrinsic motivation - to know, intrinsic motivation - to accomplish, intrinsic motivation - to experience stimulation, extrinsic motivation - external regulation, extrinsic motivation - introjection, extrinsic motivation - identification, amotivation) then it is possible to predict academic success in mathematics ($F(7, 134) = 2.336$, $p = .02787$). Even more so, researchers found that if students identify with external motivation - regulation, they are likely to have lower academic mathematical success ($\beta = -1.82$, $p < .05$). One model showed that semester course grade could be predicted from the three athletic motivation scores ($F(6, 135) = 2.28$, $p < .05$). Researchers found that mathematics course

summative assessment grade can be predicted from formative assessment grade, however, motivation type has no effect. This implies that students who put forth more effort on homework, class participation, and other assessments would do better on tests and quizzes. Researchers hope further investigation is done using the SMS when it comes to mathematics education and athletics.

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-Grace

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-Courtney

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CHAPTER I: Introduction

Introduction

The first chapter will provide an introduction to the study of motivation as related to athletics and academics in high school students. Chapter 1 will also address the research problem being investigated, the purpose of the study, the research hypotheses, the significance of the present study, and an overview of the organization of this thesis. Motivation is a desirable quality in both academics and athletics. The study seeks to explore how levels of motivation in high school varsity-level athletes and various levels of success in the mathematics classroom affect each other. Through this study, researchers will attempt to determine if there is a correlation between the level of athletic motivation in school-sponsored athletics for high school students and their academic success in mathematics.

Background of the Problem

Prior studies have shown that there is a relationship between participation in athletics and academic success, whether academic success is defined by standardized test scores, overall grade-point averages, or mathematics specific grades (Selgo, 2016; Bowen & Greene, 2012; White, 2005). Few studies have looked at this correlation for individual students, often looking at school-wide data comparisons. Many studies use standardized tests, such as the ACT, or broad academic indicators, such as grade-point average, as indicators of academic success, rather than examining mathematics performance specifically. Additionally, there is a lack of research on how motivation types specifically relate to academics.

Research has shown that when exercise routines are incorporated into secondary school education, significant differences in student self esteem and academic

performance for certain subject areas can be observed (Calik et al., 2018). This study examined adding exercise routines for students who did not currently participate in athletics and included only students in families willing to participate in the study. They used a self-esteem pre- and post- assessment along with grade-point averages for the students over a 14-week time period.

Researchers at The University of Arkansas looked at high school data in order to determine if various high schools had correlations between athletic and academic success (Bowen & Greene, 2012). Specifically, the study considered the number of athletic options, winning sports teams, and student participation in athletics compared to standardized test scores and graduation rates. The researchers used data on per pupil spending, size, and student demographics to attempt to control their study for these variables. The study was conducted using data from 657 Ohio public high schools. The statistical method used was a multiple regression using ordinary least squares. The study concludes that high schools that have high athletic success and participation also have higher levels of success academically. The study attempts to suggest reasons for why and notes that the correlation does not give specific information about whether or not there is causation between athletic and academic success.

This study shows that for high schools as a whole, athletic success and academic success are correlated. It raises questions to be addressed in the current study about whether or not the same is true for individual students. Do high schools that have the resources to have high levels of participation and success in athletics also have the resources for successful academic programs? Is there a correlation between the students that are creating the athletic and academic success or are these successes coming largely from different groups of students within the high school as a whole?

A University of Findlay study looked at how student involvement in school-sponsored athletics affected student achievement, including considering whether particular sports changed the impact or if considered other factors such as socioeconomic status and race (Selgo, 2016). The study used a survey given to willing student participants at five high schools in Northwest Ohio that considered demographics, academic data, and athletic participation. The researcher found a statistically significant impact of athletics on student achievement. The researcher found variations in average grade point average for different sports, but not that represented a statistically significant difference. The researcher felt that this could be in part due to the low sample size used for this portion of the research since the researcher removed all multi-sport athletes and all non-athletes. The researcher also found that many other variables had a significant effect on athletes' academic performance including gender, grade level, race, economic background, and time spent practicing.

This study supports the idea that participation in athletics correlates with higher achievement academically. This study leaves open the interest of a future study considering how specifically the motivation of athletes correlates with academic performance.

A study completed at Marietta College looked at the differences of athletes and nonathletes when considering personality qualities along with academic performance (White, 2005). The researcher proposed students participating in athletics would not only perform at higher academic levels, but also display personal qualities believed to be beneficial in life success. The data was collected by a survey distributed to teachers at two different high schools that asked a qualitative, open-ended question about their personal beliefs about the effect of academic participation on students' lives. The survey also asked seven questions that teachers had to answer from 1 to 5 with 1 being

negative and 5 being positive. The participants were all of the teachers in Marietta High School and Warren High School. The results of the study found that looking both qualitatively and quantitatively, athletic participation had a positive impact on student life and academic performance.

White's study touches on areas of interest for this study such as taking personality qualities into consideration. However, the Marietta College study looked at how participating in athletics affected these qualities, where the current study will consider how athlete motivation levels in their sport affect their academic performance. The current study will also be more quantitative than the study conducted by White.

Data will be collected at Lake High School and Coventry High School. Data about motivation in sports will be provided from athletes who participate in the Sport Motivation Scale survey. The surveys will be given to mathematics teachers to administer to varsity athletes in their classes. Teachers will be asked to fill in the student's semester grade, quarter 2 formative grades (homework, classwork, etc.), and quarter 2 summative grade (tests, quizzes, etc.), and course level.

Researchers will record anonymous subject scores from the Sport Motivation Scale. Using the key provided in the scale, researchers will be able to tell if the athletes have intrinsic motivation broken into the three categories: to know, to accomplish, to experience stimulation, or extrinsic motivation broken down into the categories: identified, introjected, external regulation. The other category student athletes could fall under is amotivation. The dataset would include these anonymous scores along with teacher-reported data about the student-athlete's level of math course and semester grade. By the time the data would get to the researchers, it will have no student, coach, or teacher identifiers.

Surveys will be given to teachers in January 2021 and researchers will begin compiling data in February 2021.

Statement of the Problem

A significant amount of research supports the concept that partaking in school-sponsored athletics benefits students all around; from having better grades, attendance, and attitudes to helping them develop people skills for the real world (Selgo, 2016; Bowen & Greene, 2012; White, 2005). With all of the broad investigations on education and athletics, researchers are curious as to what specific part of athletics is connected to their academic success in mathematics which tends to be one of the more challenging subjects. Researchers will specifically collect data on the motivation type of varsity level student athletes. The question observed is: Is the level of athletic motivation in school-sponsored athletics for high school students predictive of academic success in mathematics?

Prior studies have found data supporting how exercise positively impacts student academics, high schools with athletic success also have academic success, and athletics correlates with higher academic achievement. A study that incorporated athletics training programs into the curriculum found an increase in mental, emotional and academic development of students (Calik et al., 2018). Other studies including those using techniques such as teacher surveys and grade-point-averages, have found that athletic participation benefits students not only academically, but also in social-emotional development (Bowen & Greene, 2012; White, 2005). A study through the University of Findlay found that athletic participation correlated with not only higher GPAs, but also lower dropout rates for the student athletes (Selgo, 2016). None of the previously stated research hones in on how athletic motivation levels in specific sports will affect their

academic performance. One study appears to have similar intent as this current study because it looked at how participating in athletics positively affected personal qualities needed to be successful in life (White, 2005). White found that athletic participation had a positive effect on academic achievement, attitude, work-ethic, self-esteem and behavior (2005). White's study made use of teacher evaluations of students and did not offer the quantitative analysis this study intends to utilize. There is not enough research to know if there is a correlation between how students motivate themselves in their sport and how they motivate themselves to do well in one of the more difficult subjects of math.

Purpose of the Study

The purpose of the study is to examine the relationship between athletic motivation in school-sponsored athletics and mathematics performance. The study will involve four independent variables and two dependent variables. Independent variables used in the current study are the specific types of athletic motivation measured by the Sport Motivation Scale, race, gender, and the varsity school-sponsored sport in which each athlete participates. The Sport Motivation Scale (Pelletier et al., 1995) will tell researchers if student-athletes have amotivation, extrinsic motivation, or intrinsic motivation when playing their sport. Student-athletes will state their gender and race on their anonymous, individual, surveys. The varsity sport in which athletes partake in must be of the following: baseball, girls and boys basketball, girls and boys bowling, girls and boys cross country, football, girls and boys golf, girls and boys soccer, softball, girls and boys tennis, girls and boys track and field, volleyball, and wrestling. The varsity sports chosen were based on the sports that are offered at both schools in which researchers

are studying. These stated independent variables will be analyzed when looking at comparisons amongst the dependent variables.

Dependent variables in the current study are mathematics performance and academic performance overall. The varsity student-athlete mathematics performance will be based on their specific math course' semester grade, second quarter formative and summative grades, second quarter grade overall, and the course level. Formative assessment grades would be a percentage of points students receive on homework, exit slips, or any practice they are to turn in for their course. Summative assessments, also a percentage, would report how students have done on quizzes or tests throughout the quarters/semester. Course level may vary based on on-level, honors, College Credit Plus, or Advanced Placement courses. The academic performance of varsity student-athletes will also be measured by their cumulative GPA. Using a variety of independent variables as well as two dependent variables will be best in maximizing sample size for researchers.

Researchers will specifically consider varsity level student-athletes since making the varsity team represents a level of success in their sport. With this in mind, researchers are receiving data from two public high schools; Lake High School and Coventry High School. The overall population of data being collected are high school students who partake in varsity athletics and are registered in math courses. All of these specificities will assist in closing the research gap on athletic motivation in school-sponsored athletics and mathematics performance.

Significance of the Study

The current study is compelling because the majority of previous studies conducted only observe the relationship between participating in athletics and academic

success. Prior research results indicate a significant relationship between the positive effects that athletics/exercise has on academic success. However, there is a gap in the research examining the level of motivation in athletics. Not only that, but there are little to no studies that dig deeper into the science behind academic success of specific high school subjects; in this case mathematics. Therefore, researchers are trying to find out if there is a correlation between those two previously stated concepts.

Researchers are intrigued to examine the relationship between student athletic motivation and their mathematics success. If there is a positive correlation between the two, math teachers will be able to better serve their student-athletes. This would allow math teachers to understand what distinctly motivates their student-athletes and use this information to guide their future lessons. Furthermore, if there is statistical evidence to support the claim that athletic motivation in school-sponsored athletics for high school students is predictive of academic success in mathematics, then schools may heavily encourage non-student-athletes to partake in some kind of school-sponsored sport. There are various ways this research could open doors for the future of teaching and further research in mathematics.

Primary Research Questions

Researchers will be answering their primary research question:

- Is athletic motivation in high school sponsored athletics predictive of academic success in mathematics?

This broad question will then be broken down into additional research questions dealing with the previously stated independent and dependent variables. Additional research questions are:

- Are athletic motivation, gender, type of sport in which the student athlete competes, and race predictive of course success in mathematics?
- Is type of athletic motivation predictive of summative grades when controlling for formative grades?

With these questions in mind, researchers hope to find statistically significant results through their corresponding hypotheses.

Hypotheses

Each research question previously stated has an interrelated hypothesis which allows researchers to test multiple predictions.

Hypothesis 1: There is not a significant relationship between level of athletic motivation in school-sponsored athletics and academic success in mathematics.

Hypothesis 2: There is not a significant relationship between level of athletic motivation, gender, sport in which the student athlete competes, race, and academic success in mathematics.

Hypothesis 4: Athletic motivation is not predictive of summative grades when controlling for formative grades.

To ensure each hypothesis is tested, researchers will collect data through specific participants, instrumentation, and procedures.

Research Design

It is imperative to the study that researchers use the correct participants, instrumentation, and procedure in order to find accurate results. The participants involved in this study will be varsity student-athletes from Lake High School or Coventry High School. Math teachers at both schools are to give any of their varsity athletes the

survey provided with the goal that researchers will have a sample size of over 150 (approximately 75 completed surveys from each school). The surveys will be printed by the researchers and provided to the teachers. The anonymous survey will include the Sport Motivation Scale (Pelletier et al., 1995) and ask the student to state their race, gender, and math course level. Teachers will be asked to record specific students' cumulative GPA and their math course semester grade, second quarter formative grade, second quarter summative grade, and second quarter overall grade. All surveys will remain anonymous and will then be returned to researchers.

The Sport Motivation Scale was originally developed in French as a way to categorize the motivation types of athletes. Two studies were conducted in order to translate and validate this scale in English. The Sport Motivation Scale consists of 28 statements about why an athlete may practice their sport. The athlete is asked to rank how well the statement corresponds to their feelings about why they currently practice their sport on a likert scale from 1 to 7 with 1 meaning "does not correspond at all" and 7 meaning "corresponds exactly." Four of the items from the survey fit with each of seven categories of motivation: intrinsic motivation - to know, intrinsic motivation - to accomplish, intrinsic motivation - to experience stimulation, extrinsic motivation - identified, extrinsic motivation - introjected, extrinsic motivation - external regulation, and amotivation. Studies both in French and English verified the validity of the Sport Motivation Scale and its seven factors (Pelletier et al., 1995). Results from this study will consider the three overarching factors developed from this survey: intrinsic motivation, extrinsic motivation, and amotivation. Researchers will consider an average ranking from all of the categories that correlate to each type of motivation for each subject.

With the completed surveys, data will be compiled in Excel and converted to a .csv file which allows researchers to analyze data through R. All data will remain

anonymous. Researchers will run appropriate tests on the data to test each of the research questions posed.

Theoretical Framework

Social Cognitive Theory, developed from Social Learning Theory by Albert Bandura, describes that learning occurs due to observations of people, relationships with the environment, and social interactions (Stajkovic et al., 2019). Social Cognitive Theory focuses on the interactions between the learner, their behaviors, and the environment. This theory suggests that the key to a person learning a behavior is the response the person receives to the behavior along with the environment in which the person successfully completed the behavior. As the current study will look at students participating in school-sponsored athletics and their mathematics course in that school, both behaviors are occurring in the same environment. If a student has received positive reinforcement in this environment, it could be argued that there will be a correlation between the individual's behavior, attitude, and subsequently performance, in each athletics and mathematics. Social Cognitive Theory also considers the expected consequences, both positive and negative, for a behavior a learner performs and how that influences the learner. If a student has experienced positive reinforcements from dedication and motivation in athletics, the student may seek to experience similar reinforcements through academics.

Motivation has been studied and theorized about by a variety of people across various fields. Operant theory suggests that behavior is a result of a reward or a punishment for a given behavior (Skinner, 1953). Applied to this study, that would suggest that student athletes are motivated by a certain consequence of their behaviors, both athletically and academically, rather than an internal drive. Berlyne (1971)

suggested that intrinsic motivation for behaviors are internal and only the cognitive response is important in driving these. This means that when a person is intrinsically motivated, the thoughts that accompany an activity are enough of a motivator. This raises questions that may be addressed in the current study. Will intrinsic motivation in athletics correlate to success in the mathematics classroom due to the cognitive behaviors of student-athletes?

Self-Determination Theory divides types of motivation into autonomous and controlled (Deci & Ryan, 2012). Autonomous motivation, closely related to intrinsic motivation, is where a person is driven by internal rewards such as an increase in things such as knowledge, enjoyment, health, or independence. Controlled motivation, closely related to extrinsic motivation, is driven by external rewards and punishments. Deci and Ryan suggest that people who are self-determined, or autonomously motivated, lead to long term success (1990). In terms of this study, researchers will consider whether those that align with autonomous motivation are more successful academically. Student-athletes that have a higher level of autonomous motivation may have higher levels of perseverance across aspects of their life that include education, work, and sports.

Assumptions, Limitations, and Scope

This study will use data from student-completed surveys. This opens questions about the validity of the data. The sport motivation scale is a tested survey for evaluating student motivation in engaging in athletic activities (Pelletier et al., 1995). The study will give the survey anonymously in order to encourage students to be honest in their responses. The survey will be given by math teachers, so students should feel they have the ability to be honest in their responses. Other data such as mathematics grades and

course level will be provided by the students' teachers and therefore should be accurate. The researchers are dependent on these mathematics teachers to complete this information accurately and honestly. Researchers will also need to consider the validity of current course grades since the school district and teacher could have an effect. In order to account for this, the sample will include students from a variety of teachers in each district, and will also include cumulative GPA as an indicator of academic performance.

The study is limited to the student population of two high schools due to the researchers' professions. This leads to a relatively small sample size, along with issues of demographic information that cannot be considered due to the limited student populations. There is also a possibility of variation in math performance due to the school district the student attends rather than data gathered in the study. Variation in teacher methods of instruction and evaluation could have an affect on student grades as well.

This study will provide information about student athletes in these two high schools. Although some conclusions may be able to be drawn about the data collected, this information cannot necessarily be generalized for all categories of high school. This study will also only consider high school age students and school-sponsored athletics at the varsity level. This leaves out participation in school sports at a lower level, club sports, and other extracurricular activities. This study will also not allow consideration of athletics for younger students or student-athletes at the collegiate level.

Definitions of Terms

In order to make clear vocabulary used in the study, a few terms need to be defined. The first is *amotivation*. Amotivated individuals do not perceive contingencies

between their actions and the outcomes of their actions; they experience feelings of incompetence and lack of control (Pelletier et al., 1995). The next term is *extrinsic motivation* which refers to a wide variety of behaviors that are engaged in as a means to an end and not for their own sake (Pelletier et al., 1995). *Intrinsic motivation* is engaging in an activity purely for the pleasure and satisfaction derived from doing the activity (Pelletier et al., 1995). These three different types of motivation will be determined for each student from the results of the Sport Motivation Scale.

Academic success will be measured by grade-point average ranking on a scale of 0.0 to 5.0. *Mathematical success* in this study will be defined by a combination of measures including course grade at the end of semester 1, summative grades for Quarter 3, formative grades for Quarter 3, overall grades for Quarter 3, course level; range 0-100%. *Varsity sports* will be defined by the Ohio High School Athletic Association and includes the following sports in which an athlete has achieved the varsity level at their school: baseball, boys and girls basketball, bowling, cross country, field hockey, football, boys and girls golf, gymnastics, ice hockey, boys and girls lacrosse, boys and girls soccer, softball, swimming and diving, boys and girls tennis, track and field, volleyball, and wrestling. The two high schools that will be surveyed do not offer all of these sports, so not all will be represented in this study.

Summary

Chapter 1 introduced the problem statement to be investigated as well as the main purpose of the study: to quantitatively research the relationship between athletic motivation in school-sponsored athletics and mathematics performance. There is a gap in previous research that does not focus on specific traits student-athletes possess and how that can lead to their success in a mathematics classroom. Chapter 1 allowed

researchers to share their primary research question along with additional research questions that will be discussed later in this study.

In future chapters, the literature review, methods in which data was collected and analyzed, results of data collected, and discussion of the research will be elaborated on. Chapter 2 will cover the literature review which will provide sufficient and significant fundamental background information about the current study, including gaps in the research that is currently available. Chapter 3 will provide specific objectives and an overview of researchers' methodical approach in carrying out their research. In Chapter 4, the results, findings and discussions of the results from this study will be presented. Lastly, Chapter 5 will conclude the study with a brief overview of the results.

CHAPTER II: Background and Literature Review

Introduction

A number of studies have been conducted correlating athletic participation to academic success. Some of these have focused on how athletes versus non-athletes compare when considering grade-point-average, standardized test scores, and high school dropout rates (Selgo, 2016; Stucko, 2018). Others considered how athletes and non-athletes compared when considering feedback about classroom behavior and performance from their teachers (White, 2005). Motivation in academics, mathematics, and sports is also an area that has been fairly well researched. Researchers have found that the reasons athletes have for practicing their sport varies and can be affected based on whether the athlete participates in an individual or a team sport (Pelletier, et al., 1995; Fatih Kucukibis & Gul, 2019). In terms of academics, correlations have been found between level of motivation and academic performance, both as a whole and in the mathematics classroom (Suraya & Ali, 2009). This study will incorporate many of these key components in a way that has not been studied previously. The research is lacking in how the type of athletic motivation affects the performance of student athletes in the mathematics classroom and as a whole.

Effects of Motivation on Behavior

Motivation has a significant effect on the behavior of individuals. Studying the types of motivation, such as intrinsic, extrinsic, and amotivation has led researchers to realize that the way people are motivated can affect their decisions in various aspects of life.

In 1990, Edward L. Deci and Richard M. Ryan developed the Self-Determination Theory of motivation which considered the motivation and personality of individuals. In

their article, “A Motivational Approach to Self: Integration in Personality”, Deci and Ryan defined the self to be the process by which an individual relates to others in their environment through motivational processes. The development of a person’s “self” is through both cognition and the interaction of that person with their environment and other people. When a person is able to integrate experiences in their environment with their intrinsic internal cognition, Deci and Ryan defined this as being self-determined (1990).

In its simplest form, when a person is intrinsically motivated, the reward for the activity is internal, rather than provided by an external source (Deci & Ryan, 1990). Deci and Ryan reference a second definition which classifies intrinsic motivation as performing behaviors out of interest. Deci and Ryan also present the idea that intrinsically motivated activities must have a perfect balance of difficulty in order for people to feel successful in completing the challenge while the challenge is still reachable. In contrast, extrinsically motivated behaviors are the result of some external reward or consequence. Amotivated behaviors occur without intentionality and are not regulated by the individual performing the behavior (Deci & Ryan, 1990).

Deci and Ryan proceed to identify intrinsically motivated behaviors as being self-regulated while amotivated behaviors are not self-regulated (1990). Extrinsic behaviors can be self-regulated but are not always. This distinction of self-regulated extrinsic behavior differs from other psychological theories. Previous theories suggested that extrinsic behaviors occurred only due to the external rewards and consequences associated with them (Decharms, 1968). Deci and Ryan suggest however that some people are able to internalize societal responses to their behaviors and through this internalization regulate behaviors that are extrinsically motivated (Deci & Ryan, 1990). Deci and Ryan argue that behaviors that are self-regulated or “self-determined” are able

to be adjusted by an individual in a more effective manner (1990). This suggests that when people are able to self regulate their behaviors, they will be more successful in accomplishing their goals related to that behavior.

Bandura also was an important contributor in the field of behavior and motivation, largely through his work on the social cognitive theory (Bandura, 2005). Bandura posits that people are influenced both by their own agency in their personality and by the social environment they are in. Learning occurs from a combination of observing others in a social context along with self regulating behaviors. Although environmental factors affect people's behavior, they are also able to self-regulate their learning and behaviors in certain situations. This agency over one's actions comes from the ability to regulate behaviors based on moral standards. People, however, sometimes choose to block out this ability to self-regulate for a variety of reasons and therefore may not be able to make adjustments for certain behaviors or in particular scenarios (Bandura, 2005). Bandura's social cognitive theory supports much of what is stated in the self determination theory (Bandura, 2005; Deci & Ryan, 1990). The idea that people are motivated both by their own cognition and by external factors while sometimes being able to regulate these thoughts and behaviors is reflected in both influential psychological theories.

In terms of the current study, self-determination theory and social cognitive theory support the concept that student athletes who are intrinsically motivated may see more success in academics since they are able to regulate their behaviors to meet the expectations in the classroom. This also suggests that amotivated student athletes may be less successful in the mathematics classroom due to a lessened ability to regulate behaviors. According to the self determination theory from Deci and Ryan (1990), extrinsically motivated students would tend towards success if their behaviors are self determined, which may not be evident through this study. Bandura's social cognitive

theory would also support the idea that people who do not have the ability to regulate their behaviors based on their moral standards may not be able to adjust to meet academic goals (Bandura, 2005). The work of Bandura and Deci and Ryan leaves open many opportunities for empirical studies of motivation and effects on various behaviors, including motivation related to student athletes.

Effects of Attitude and Motivation on Academics

Attitude towards academia can have an effect on the achievement of students. Studies have shown that students who are more motivated or have a more positive attitude towards school achieve at higher levels than less motivated peers (Mata et al., 2012; Saraya & Ali, 2009). This research is a driving factor in the current study, suggesting that motivation may have an impact in mathematical performance of student athletes.

A study from the Universiti Putra Malaysia investigated the relationship between motivation and mathematical achievement (Saraya & Ali, 2009). The study was driven by prior research related to motivation defined as the structures of an individual's goals and the importance of a person's beliefs (Ames, 1992). This motivation determines the extent to which an individual will participate in a given task.

Saray and Ali studied the relationship between effort and motivation with mathematics problems solving and achievement (2009). The study considered such factors as gender, cumulative grade point average, and year of study. Research was conducted at four Malaysian universities from surveys with 22 items that measured three categories of motivation: self-efficacy, effort, and worry. The surveys were collected from a sample size of 195 final year students, with 31 male and 164 female students (Suraya & Ali, 2009).

The Universiti Putra Malaysia conducted t-tests to determine the relationship between motivation and gender. The study found that there was no significant difference between male and female subjects when considering each type of motivation individually, but did find a statistically significant difference between male and female students when considering total scores for motivation. Additionally, researchers conducted an ANOVA which resulted in statistically significant differences in total motivation scores for students falling into three different cumulative grade point average brackets (Below 3.00, 3.00 - 3.49, Above 3.50). Students with higher cumulative grade point averages tended to have higher scores in motivation (Suraya & Ali, 2009).

Results from Suraya and Ali's study showed that students responding to the questionnaire tended to have high levels of motivation in all three categories. Additionally, students with higher cumulative grade point averages tended to have higher levels of motivation, suggesting a correlation between academic performance and level of motivation. The researchers acknowledge that their study can only report a correlation between motivation and academic performance, and not a causation in one direction or the other (Suraya & Ali, 2009).

The study is isolated to a relatively small population of students that are at the university level of education in Malaysia. This means that there are gaps in terms of whether there would be a correlation between motivation and academic performance in other populations, such as high school students in the United States. Additionally, the study leaves open the possibility for motivation levels for certain categories of students, such as student athletes. FInally, the Universiti Putra Malaysia study only considered cumulative grade point average when considering academic achievement. This study will consider the current mathematics course and grade along with the cumulative grade point average.

A study by Mata, Monteiro, and Peixoto researched the effects of motivation and attitude towards mathematics on achievement in Portuguese students (2012). Part of the motivation for the study was prior research which found that students' negative attitudes towards mathematics was a result of repeated failure in experiences with mathematics (Nicolaidou & Philippou, 2003). Another motivation for this study was prior research on the relationship between gender and mathematical performance. Specifically, despite the fact that females and males tend to achieve at similar levels in mathematics (Lindberg, et al., 2010), females tend to have lower opinions of themselves in terms of mathematics ability than males (Skaalvik & Skaalvik, 2004). Additionally, studies have shown that students who have positive attitudes towards mathematics have higher rates of mathematics success on average (Nicolaidou & Philippou, 2003). Other studies, however, have shown that achievement is predictive of attitude in mathematics, but attitude cannot predict higher levels of performance (Georgiou, et al., 2007).

Mata, Monteiro, and Peixoto studied 1719 participants in fifth through twelfth grade students in the Lisbon area of Portugal. Researchers used a five point scale to rank student achievement in mathematics based on recent assessments in the mathematics classrooms. Researchers administered questionnaires in the classroom that used the Intrinsic Motivation Inventory directed towards mathematics. The survey included items in three categories: perceived competence, value/utility, and perceived choice (Mata, et al., 2012).

The results of the study were analyzed through an ANOVA. No significant differences in mathematics achievement for male and female students were reported through this study. One significant result from the study was that as schooling became more advanced, attitudes towards mathematics declined. Specifically, female students tend to decline steadily in attitude towards mathematics as schooling continues, whereas

male students' mathematics attitudes tend to decline in the early years of schooling and then remain constant throughout later years. Additionally, the results reaffirmed the correlation between positive attitudes towards mathematics and achievement in mathematics (Mata, et al., 2012).

Mata, Moneiro, and Peixoto's study of attitude on mathematics achievement outlines a correlation between mathematics achievement and attitude towards mathematics. The study looked at a very broad range of students and leaves a gap for research about student athletes specifically. Additionally, it raises questions about whether attitude and motivation in mathematics is the only indicator of mathematical success, or if the motivation of a student overall can affect their mathematics performance. The study used similar methods to what will be used in this current study in terms of distributing surveys to collect motivation/attitude data, and to collect academic achievement data (Mata, et al., 2012). The current study will use a different form of evaluation for levels of motivation, namely the Sport Motivation Scale which categorizes motivation into different categories than the Intrinsic Motivation Inventory and focuses on the motivation of athletes in their sports (Pelletier, et al., 1995). While the study by Mata, Monteiro, and Peixoto looked only at performance in the mathematics classroom, the current study will also consider athletes' feelings towards their sports when considering their motivation type (2012).

A study from Kent State University researched how motivation affected the academic performance of collegiate students (Burgess, 2016). The study was driven by psychological research in the field of motivation such as self-determination theory (Deci & Ryan, 2012), intrinsic and extrinsic motivation research (Cersoli, et al., 2014; Amabile, 1993), and effects of intrinsic motivation on academic performance (Shia, 1998). Specifically, self-determination theory fits with the types of motivation researched in the

study and suggested to the researcher that respondents who align with motivation types that demonstrate self-regulation of behaviors may be more successful academically (Deci & Ryan, 2000; Burgess, 2016). Research has also shown that students who are intrinsically motivated are more successful in developing academic goals, which could lead to higher rates of academic success (Shia, 1998; Burgess, 2016). Other researchers have shown that extrinsic motivation does not always undermine intrinsic motivation, and rather can be additive in order to create higher levels of success (Amabile, 1993).

Burgess (2016) used the Academic Intrinsic Motivation inventory which includes 81 questions fitting under six subscales to evaluate the motivation of students. Two of these subscales fit with intrinsic motivation (need to know, need to achieve) and four of them align with extrinsic motivation (authority expectation, peer acceptance, power motivation, fear of failure). Surveys were given electronically to willing participants at Kent State University with 528 students responding to the survey (Burgess, 2016).

The researcher analyzed how students ranking high in each of these subscales correlated to academic achievement. Burgess (2016) created test variables for each of the six categories of motivation by summing respondents' scores for each of the questions that aligned with that category of motivation. Burgess also paired each of these six categories of motivation in order to align with research on the self-determination theory (Deci & Ryan, 2010). The three categories used by the researcher were competence, social belonging and autonomy which correspond to intrinsic motivation, extrinsic motivation without self-regulation, and extrinsic motivation with self-regulation respectively (Burgess, 2016). The researcher conducted a Pearson Correlation on each of the subscales and found significant correlation between the

various subscales of types of motivation, which fit with previous validation of the scale used (Burgess, 2016).

Burgess (2016) found that there was a correlation between academic performance measured by cumulative grade point average and high compared to low levels in the following categories of motivation: need to know, need to achieve, peer acceptance, fear of failure, competence, and need for autonomy. The results were also significant when comparing levels of intrinsic motivation to academic performance, with higher levels of intrinsic motivation correlating to higher grade point averages. Burgess's findings which show a significant correlation between only certain factors and academic performance demonstrate that each factor individually may or may not affect academic performance. By grouping factors into broader categories, such as intrinsic motivation, a correlation can be seen in this research (Burgess, 2016).

Burgess's study was able to reach a relatively large population (n = 528) of post-secondary students through an anonymous survey (Burgess, 2016). Because the survey was sent out to all students and only willing participants responded, it is possible that the data was biased towards students who were motivated to complete the survey. Additionally the survey included a large number of questions, which could have discouraged some students from participating. This study also engaged only post secondary students, which may or may not be reflective of the patterns seen for high school level students (Burgess, 2016).

A study from Virginia Polytechnic and State University examined how motivation, attitude, and academic engagement affected eight grade student achievement in mathematics and science (Singh, et al., 2002). Motivated by observations that achievement in grades five through eight is predictive of future success in mathematics, researchers investigated eighth grade students from 1057 schools. Researchers

surveyed 26 randomly selected students from each of these schools through a 45 minute survey. Researchers then selected 25 percent of the surveys for a final sample size of 3227 students. The survey corresponded to four factors including attendance, preparedness, attitude towards mathematics and science, and time spent on mathematics and science work. These factors were compared to the grades earned in mathematics and science along with standardized test scores for math science. While each factor considered did not have a statistically significant effect on mathematics and science achievement, researchers found that overall motivation and attitude scores were correlated to achievement in mathematics and science (Singh, et al., 2002).

Singh, Granville, and Dika's study (2002) had issues in the reliability and validity of the survey given to participants. The survey pulled questions from multiple prior motivation scales and the researchers chose the four factors related to attitude and motivation (Singh, et al., 2002). The current study will instead use the Sports Motivation Scale which has been tested for validity and reliability and includes researched factor analysis (Pelletier, et al., 1995). The Virginia Polytechnic and State University study supports the claim that higher levels of motivation may correlate to higher levels of achievement academically (Singh, et al., 2002). The current study will consider subjects at a higher level academically, high school students rather than middle school students. Additionally, the current study will examine only student athletes and use the level of mathematics courses as another indicator of success mathematically in addition to course grade.

Motivation and Athletics

The motivation to participate in sports includes factors such as socializing with friends, staying physically fit, learning, developing skills, etc. Some factors might be

more obvious than others or they could depend strictly on the type of sport athletes participate in. It is common knowledge that both team sports and individual sports are offered at public high schools throughout the U.S.

A study done by Hüseyin Fatih Kucukibis and Mehmet Gul aimed to determine if student-athletes had different types of motivation based off of if they played a team sport or individual sport. This was an interesting topic for them due to the lack of research that discusses how athletes perceive the environment in their respective sports fields. Fatih Kucukibis and Gul used the Achievement Motivation Theory and Achievement Goal Theory to fuel their argument that student-athletes in team sports might have different motivational reasoning compared to those in individual sports. Similar to the current research, the study by Fatih Kucukibis and Gul used the Sport Motivation Scale (translated and validated in Turkish.)

In a sample size of 110 student-athletes between the ages of 14 and 18, 55 students participated in the individual sports of either table-tennis, weight-lifting, or judo and the other 55 students participated in the team sports of either basketball, handball and volleyball. These students took the SMS survey. However, the questions for “amotivation” were not included in the survey in order to determine the motivational factors, either intrinsic or extrinsic, of male and female students. This could be seen as a limitation to their study. To determine the differences between the variables, an independent sample t-test was used and a 0.05 significance level was accepted in the analyses.

When comparing the results from the SMS of students that participate in individual vs. team sports, Kucukibis et al. only found statistical significance for between the two groups in terms of “Amotivation.” Another conclusion from their research was that students doing individual sports or team sports both had intrinsic motivations for

doing so. Also, when the data was broken down across gender, both female and male student-athletes had mainly intrinsic motives as well. In contrast, the males' intrinsic motivation differs from females' in the sense that the prestige of being an athlete, discovering new training techniques and the pleasure of mastering their skills were important to them. The females intrinsic motivational factor that differed from the males was that they found learning useful information more important. Overall, researchers found that the reasons there was a difference between the students doing team sports and students doing individual sports in terms of amotivation are: 1) the students cannot reach their goals, 2) they do not know why they do sports, and 3) they have become pessimistic about continuing to do sports.

The results of Fatih Kucukibis and Gul's study is related to the current study because they are both analyzing the types of motivation in athletics. This study paved the way for the current study because Fatih Kucukibis and Gul provided evidence that athletes in both team and individual sports share intrinsic motives. Also, a pertinent part of both the study by Fatih Kucukibis and Gul and the current study is the use of Pelletier's Sports Motivation Scale. In order to address the gap in the literature, the current study will use the Sport Motivation Scale to specifically measure the motivation of varsity-athletes.

Luc G. Pelletier, Michelle S. Fotier, Robert J. Vallerand, Kim M. Tuson, Nathalie M. Brierère, and Marc R. Blais were aware of the cognitive evaluation theory and the hefty amount of laboratory and field research that supports it. However, there was a gap in the research that connected the cognitive evaluation theory to sport. This enticed the researchers to investigate the French scale that can measure an athletes motivation toward sport. The French scale is composed of Deci & Ryan's seven subscales that measure the different forms of motivation. Many previous ways of measuring motivation

in sport did not assess all seven constructs of motivation and have weak factorial structures. Pelletier et al. focused their research on translating and validating the Echelle de Motivation vis-à-vis les Sports (EMS) in English, and naming it the Sports Motivation Scale (SMS.) Multiple purposes of their first study were: to examine the factor structure of the Sports Motivation Scale, to assess the internal consistency of the seven subscales, and to assess the construct validity of the scale.

It took researchers time to consistently translate the scale from French to English. They followed a parallel back-translation procedure in which one creditable bilingual individual translated the scale to English, and another bilingual individual translated it back to French without knowing the original wording. Using a committee of individuals who participated in the back-translation procedures and some of the authors of the original version of the scale, an assessment of each item took place. The same methods took place in order to successfully translate the instructions for the scale. Lastly, researchers pre-tested the experimental version of the SMS by having eight junior-college athletes read the English scale and express any questions they had in regards to the instructions or the items. After a few minor modifications, the English version of the SMS was ready to use in research.

In the first study, 593 university athletes with a mean age of 19.2 years were given the experimental version of the SMS. Student-athlete responses to each item were assessed on a 7-point scale in which a response of “1” meant that the statement did not correspond at all and a “7” would mean the statement corresponds exactly. If students chose the mid-way response of “4” it would insinuate the statement corresponds moderately. With this data, researchers began their analysis of the SMS and found appealing results.

Pelletier et al. ensured their survey was accurate and consistent with the EMS using five different analyses. First they confirmed the factor structure with factor analysis, next they observed that the interaction between the subscales were computed to test for a simplex pattern, then they used Cronbach's alphas to assess the internal consistency of the subscales. Fourth, Pelletier et al. evaluated the correlations in gender differences among the subscales and last, the validity of the SMS was tested by analyzing the correlations between the seven subscales and all variables. The univariate distributions for all variables were normally distributed with low degrees of skewness and the covariance matrix was administered to a confirmatory factor analyses with LISREL 7 (Jöreskog & Sörbom, 1989) applying a maximum likelihood method of estimation.

Testing a CFA model that gauged the competence of the factor structure allowed researchers to observe how the measured variables were predicted to portray the hidden suppressed factors. In the model, seven factors were theorized analogous with the seven subscales and consisted of the four comparable items. Researchers were satisfied with their chi-squared: degrees of freedom ratio considering it was an acceptable 1.94. Also, the goodness of fit index was .94, adjusted goodness of fit index was .92, the root mean square residual was .048 (adequate rating if less than .10) and normed fix index was .92 showing that the bulk of the variation was accounted for by the model. Because their results confirmed the SMS was accurate, researchers conducted a second study in order to assess the temporal support of the survey.

Using a group of fifty soccer players from the Ottawa region, Pelletier et al. were able to test the temporal stability of the SMS. This group of 31 females and 19 males, with a mean age of 18.4 years old, completed the SMS twice five weeks apart. In order to keep their pre-test and post-test anonymous, they told athletes to use their birthdates. The Cronbach Alpha values for the pre-test and post-test as well as the test-retest

correlations were very similar to those noticed in the French Canadian version. Furthermore, the internal consistency values and test-retest correlations of the SMS Subscales were very similar to the outcome of the first study. Both of these observations provide support for the reliability and stability of the subscales.

Due to the encouraging results from Pelletier et al.'s research, the current study is able to utilize the Sports Motivation Scale. This scale is necessary to accurately measure varsity athletes' motivation levels when partaking in their sport. Researchers will be able to use the seven subscales to further explore the correlation between level of athletic motivation in school-sponsored athletics and academic success in mathematics.

Rebecca Lee Jelenc of Hamline University studied the correlation between athletic intrinsic motivation and academic intrinsic motivation of student athletes at the secondary level. Jelenc was intrigued by the growing number of student-athletes at the secondary level and decided to research if there is a correlation between intrinsic motivation of student athletes in their sport and level of intrinsic motivation of their academics.

With respectable coaches directly impacting athletic intrinsic motivation (Fransen et al.,) Jelenc hypothesizes that it must be the student-athlete's individual motivation to obtain success. Intrinsic motivation can be used as a beginners tool for higher achievement and success. Athletes and students with intrinsic motivation are more likely to accept challenging tasks, to promote greater creativity and better conceptual learning, to find greater pleasure in activities (Reeves, 2005). Jelenc utilized the Sports Motivation Survey as well as the Academic Motivation Survey in order to answer her research question.

Jelenc modified the Sports Motivation Survey and the Academic Motivation Survey so that they were just one whole survey on a four-point Likert scale. Surveys

were given to 78 participants and the results showed a strong negative correlation between athletic and academic student motivation. This means that student athletes are more intrinsically motivated by athletics than they are intrinsically motivated toward academics. Researchers in the current study plan on exploring Jelenc's research topic.

The current study will not only look at the intrinsic motivation of student athletes, but also the extrinsic motivation and amotivation of them as well. It is important for researchers to know Jelenc's previous work because it shows that overall athletes are more intrinsically motivated by their sport than their academics. For the current study, researchers want to specifically analyze the correlation between motivation of Varsity athletes and if that is predictive of their mathematics performance.

Athletic Incorporation in Academics

Studies have found that the incorporation of physical education routines into education can improve the academic achievement of students who otherwise would not participate in a fitness routine. Incorporation of athletics and academics has also been proposed as a way to engage and increase the achievement of at-risk students.

A variety of studies have been conducted in terms of examining the positive effects of exercise and academics. In the U.S., the California Department of Education has done multiple studies pertaining to the benefits of physical exercise on academic performance. One specific study of 954,000 fifth, seventh, and ninth graders done by the CDE in 2002, observed the correlation between standardized test scores and student fitness scores based on six fitness standards (cardiovascular endurance, body composition, abdominal strength and endurance, trunk strength and flexibility, upper body strength and endurance, and overall flexibility.) The results of the study showed a definite positive correlation between higher academic performance and higher levels of

fitness. Dwyer, Sallis, Blizzard, Lazarus, & Dean (2001); Dwyer et al. (1983); Linder (1999); Linder (2002); Shephard (1997); Tremblay et al. (2000); and more have found evidence backing the theory that when a decent amount of physical activity is done during the school day, student academic performance is either met or exceeds that of students without physical activity (Shephard, 1997). Using a questionnaire/fitness test to measure physical activity/fitness, Dwyer et al. (2001) completed a study on 7,961 Australian schoolchildren (7-15 year olds.) Researchers then had an administrator fill out a 5-point scale (illustrating excellent, above average, average, below average, or poor ratings) to represent student academic performance. Dwyer concluded from statistical analysis that principal academic ratings were strongly, positively correlated with questionnaire measures of student physical activity. A great deal of research has been done to support the evidence that athletic incorporation positively affects academic performance.

Research done by Suat Utkan Calik, Haci Ahmet Pekel, and Latif Aydos provides evidence that the concept of implementing exercise enhances student academic achievement. The goal of the study was to analyze the effects of a kids' athletic training program on their academic achievement and self-esteem. Calik et al., implemented a 14 week training program for an experimental group consisting of 95 participants and a control group consisting of 148 participants. In said training program, secondary school students went through 60 minutes of lessons per day for three days a week. Students in both the control group and experimental group took the Coopersmith Self-Esteem Scale-Children's Form, validated by Piskin (1996), in the beginning and the end of the study. In order to measure academic achievement, researchers used student grade-point averages and teacher-given exams in the subjects of Turkish, math, social, foreign language, religion, culture and ethics, Physical Education and Sports, Information,

Technologies, and Software, and Music. Students who volunteered to participate in the study had their academic achievement based off of the 2016-2017 school year.

In order to evaluate course grades for the experimental and control groups, researchers analyzed data using a non-parametric Mann-Whitney test. The Mann-Whitney test was used because the data is not normally distributed and there are different sample sizes between the two groups. With a confidence interval of 95% (.05 significance level being accepted), the null hypothesis that there is no difference between the two distributions was rejected. Physical Education and Sports (0.0030), Music (0.0448), Turkish (0.0094) and Foreign Language (0.0000) all showed statistical significance in rejecting the null hypothesis. Another Mann-Whitney test was run in order to confirm that it is a positive change in grades of students in the experimental group. Calik et al.'s study confirmed that participation in exercise enhances student academic achievement and opened the door for LaTreese V. Hall's research on increasing positive outcomes of alternative high school students.

Hall of Florida International University was intrigued by the lack of research on the educational interventions that prepare alternative high school students for life after graduation. Therefore, using previous research done on the sociology, psychology and athletics of students, Hall believes an "Athedemic" (Authentic Athletic-Academic) model would improve the experiences of youth in the alternative educational setting. Hall states: "This authentic integrative model is a) situated within a pervading athletic context, b) implemented through authentic interdisciplinary projects, c) integrates sustained authentic SEL, health education and practice aimed at preparing students for tasks relevant to the project through transferable life skills, and d) underscores the deliberate and sustained strengthening of student self-efficacy" (p. 43). This hypothetical model is based off of research linking athletics with enhanced social and emotional skills (Bean et

al., 2014; Broh, 2002; Eime et al., 2013; Gordon et al., 2016; Samalot-Rivera & Porretta, 2013; Van Boekel et al., 2016), educational fulfillment (Broh, 2002; Fredricks & Eccles, 2006; Shifrer et al., 2015; Snyder & Spreitzer, 1990), and overall health benefits (Eime et al., 2013). Theoretically, Hall believes the Athedemic model could assist in strengthening the success of individuals at alternative schools.

Calik et al., as well as many other researchers have assisted in making the current study worthwhile. With all of the research surrounding the idea that exercise enhances academic performance, it is no wonder why school sponsored athletics would essentially have the same effect on student-athletes. The current study will use this information in order to determine if exercise in the form of school-sponsored athletics is predictive of mathematics performance.

Athletic Participation and Academics

The correlation between athletic participation and academics has been studied fairly extensively. Researchers have found that students who participate in athletics tend to achieve at higher levels than their non-student-athlete peers. Furthermore, research points to athletes having higher grade point averages (GPA), personality qualities that are beneficial to life, graduation rates as well as many other positive perks in comparison to non-athletes.

Researchers at The University of Arkansas looked at high school data in order to determine if various high schools had correlations between athletic and academic success (Bowen & Greene, 2012). Specifically, the study considered the number of athletic options, winning sports teams, and student participation in athletics compared to standardized test scores and graduation rates. The researchers used data on per pupil spending, size, and student demographics to attempt to control their study for these

variables. The study was conducted using data from 657 Ohio public high schools. The statistical method used was a multiple regression using ordinary least squares. The study concludes that high schools that have high athletic success and participation also have higher levels of success academically. The study attempts to suggest reasons for why and notes that the correlation does not give specific information about whether or not there is causation between athletic and academic success.

This study shows that for high schools as a whole, athletic success and academic success are correlated. It raises questions to be addressed in the current study about whether or not the same is true for individual students. Do high schools that have the resources to have high levels of participation and success in athletics also have the resources for successful academic programs? Is there a correlation between the students that are creating the athletic and academic success or are these successes coming largely from different groups of students within the high school as a whole?

A University of Findlay study looked at how student involvement in school-sponsored athletics affected student achievement, including considering whether particular sports changed the impact or if considered other factors such as socioeconomic status and race (Selgo, 2016). The study used a survey given to willing student participants at five high schools in Northwest Ohio that considered demographics, academic data, and athletic participation. The researcher found a statistically significant impact of athletics on student achievement. The researcher found variations in average grade point average for different sports, but not that represented a statistically significant difference. The researcher felt that this could be in part due to the low sample size used for this portion of the research since the researcher removed all multi-sport athletes and all non-athletes. They also found that many other variables had a significant effect on athletes' academic performance including gender, grade level,

race, economic background, and time spent practicing.

This study supports the idea that participation in athletics correlates with higher achievement academically. It coincides with many other studies that observe the differences between athlete and non-athlete GPA, state assessments, and both graduation and dropout rates.

A study completed at Marietta College looked at the differences of athletes and nonathletes when considering personality qualities along with academic performance (White, 2005). The researcher proposed students participating in athletics would not only perform at higher academic levels, but also display personal qualities believed to be beneficial in life success. The data was collected by a survey of teachers at two different high schools that asked a qualitative, open-ended question about their personal beliefs about the effect of academic participation on students' lives. The survey also asked seven questions that teachers had to answer from 1 to 5 with 1 being negative and 5 being positive. The participants were all of the teachers in Marietta High School and Warren High School. The results of the study found that looking both qualitatively and quantitatively, athletic participation had a positive impact on student life and academic performance.

White's study touches on areas of interest for this study such as taking personality qualities into consideration. However, the Marietta College study looked at how participating in athletics affected these qualities, where the current study will consider how athlete motivation levels in their sport affect their academic performance. The current study will also be more statistically motivated than the study conducted by White.

There are many other supporting pieces of research that use GPA and graduation rates as means of gauging academic performance of athletes and

non-athletes. In 2012, Kathy Boone-Ginter, Tonya Gimbert, Jolynn Kuhlman, and Thomas Sawyer sent out surveys to approximately 8,000 NIAAA members in 238 high schools. The surveys asked students for GPA, gender (M/F), and number of school-sponsored sports they play. Aside from that, each school gave their graduation rates comparing males and females, as well as the number of sports those males and females play. Results showed a significant difference between overall graduation rates and student-athlete graduation rates. Other findings from the study showed that three-sport athletes graduated at a higher rate than students that only played one, two or no sports. Another study, done on 9-12 graders in Kansas during the 2008-2009 school year, provided evidence that among 139,000 student athletes and non-athletes, 80.5% of athletes reported having a 3.0 GPA or higher (Lumpkin & Favor, 2012). This study also found that among athletes, 87% of females reported a 3.0 GPA or above compared to 74% of male non-athletes. Following the same pattern, Ryan Stegall (2012) researched if student-athletes have higher GPAs than non-athletes. In his study of 207 students, 75 of them being athletes, he found that student-athletes had an average GPA of 3.25 where their non-athlete peers had an average GPA of 3.01. With a considerable amount of research using GPA and graduation rates as their way of measuring, it is clear that student-athletes perform better academically than non-athletes.

The majority of studies that measure student academic performance use data such as school GPA or graduation rates. However, the current study will use student's mathematics first and second quarter grades, semester grade, and quarter two formative and summative assessment grades. Researchers will involve cumulative GPAs in the data as well. The previous studies have portrayed the need for the current study because there is a lack of studies linking mathematics performance to athletics.

Summary

Psychologists have shown that motivation and attitude have a significant impact on the behavior of individuals of all ages in a variety of fields (Deci & Ryan, 1990; Bandura, 2005). Based on the important work in the development of the self-determination theory (Deci & Ryan, 1990) and social cognitive theory (Bandura, 2005), other researchers have found correlations between higher levels of motivation and academic achievement for students at diverse levels of learning (Mata et al., 2012; Saraya & Ali, 2009; Singh, et al., 2002; Burgess, 2016). In addition to motivational effects on academics, motivation has also been studied in athletes. Specifically, studies have shown that the ways in which an athlete is motivated can follow certain trends based on the type of sport the athlete participates in and the gender of the athlete (Pelletier, et al., 1995; Fatih Kucukibis & Gul, 2019). Athletics have been shown to correlate with an increase in academic achievement whether the student participates in a sport outside of the school day or the exercise and athletic routines are incorporated into the curriculum (Selgo, 2016; Stucco, 2018; White, 2005). Each of these components of motivation, athletics, and academics are important contributors to the current study. Many of these trends suggest that the motivation type of a student athlete may be predictive of the student's success in the mathematics classroom. The current study will incorporate many of these components into a single study considering high school age student athletes, their motivation types, and their academic performance, especially in the mathematics classroom.

CHAPTER III: METHODOLOGY

Introduction

In Chapter 2, prior research related to motivation and student athletes was studied in order to develop a foundation for the current study. In this chapter, researchers will describe the methods and procedures used to address the research questions. The purpose of this study is to examine how levels of motivation in varsity-level high school student athletes correlate to levels of achievement in mathematics and overall academics. Researchers will survey high school varsity student athletes using the Sport Motivation Scale (Pelletier, et al., 1995) to assess the type of motivation the athlete has for continuing to practice their sport. Researchers will gather demographic data from participants and data provided by mathematics teachers about academic performance. Chapter 3 will describe the methods used in collecting and analyzing the data from the current study and justify their use. Chapter 4 will present the results of the research using the research methods and statistical tests described in this chapter.

The primary research question addressed in this study is, “Is athletic motivation in high school sponsored athletics predictive of academic success in mathematics?”. Researchers will also investigate several other research questions branching off of the primary question and related to the research. The additional research questions are:

- Are athletic motivation, gender, type of sport in which the student athlete competes (individual, team, both), and race predictive of course success in mathematics?
- Is there a statistically significant difference in mean summative grades across types of athletic motivation when controlling for formative grades?

Subsection 1: Setting and Participants

The study will take place at Lake Middle High School and Coventry High School. Lake High School is located in Uniontown, Ohio. Lake Middle High School has a population composed of 94.7% White students, 3% Multiracial students, and 1.8% Hispanic students. Populations with less than 10 students are not counted in this data. According to this report, 11.2% of students at Lake Middle High School have a disability while 13.6% are considered to have an economic disadvantage. Under the category of chronic absenteeism, Lake Middle High School had 6.0% of students. In this building, 100% of teachers have at least a Bachelor's Degree and 74.2% of teachers have at least a Master's Degree. The operating spending per pupil in the district was $10,192 at the time of this report during the 2019-2020 school year ("Ohio School Report Cards", 2020).

The Ohio Department of Education reports that Coventry High School is composed of students who are 86.5% White, 4.9% Black non-Hispanic, 4.4% Multiracial, 2.2% Hispanic, and 2% Asian or Pacific Islander. Coventry High School has 37.5% of students that are considered economically disadvantaged and 17.3% of students that have disabilities. There were 13.7% of students reported to have chronic absenteeism. In this building 100% of teachers have a Bachelor's Degree or higher and 73% have a Master's Degree or higher. The spending per pupil in the district for the 2019-2020 school year was $9,634 ("Ohio School Report Cards", 2020).

The population will include student athletes at the varsity level for their high school sport who willingly respond to the survey. The population will be limited to student athletes who are currently enrolled in a mathematics course at Lake Middle High School or Coventry High School. These student athletes may range in age from 15 to 18 in grades 9, 10, 11, and 12. The sports that will be considered varsity level for this study are based on those recognized as sports by the Ohio High School Athletic Association

and include: Baseball, Basketball - Boys, Basketball - Girls, Bowling, Cross Country, Field Hockey, Football, Golf, Gymnastics, Ice Hockey, Lacrosse - Boys, Lacrosse - Girls, Soccer, Softball, Swimming & Diving, Tennis - Boys, Tennis - Girls, Track & Field, Volleyball, and Wrestling (“Sports and Tournaments”, 2021). Of those recognized by the Ohio High School Athletic Association, Lake Local Schools offers the following varsity sports: Baseball, Boys Basketball, Girls Basketball, Boys Bowling, Girls Bowling, Boys Cross Country, Girls Cross Country, Football, Boys Golf, Girls Golf, Gymnastics, Boys Lacrosse, Girls Lacrosse, Boys Soccer, Girls Soccer, Softball, Boys Swimming, Girls Swimming, Boys Tennis, Girls Tennis, Boys Track & Field, Girls Track & Field, Girls Volleyball, Boys Wrestling, and Coed Wrestling (“Blue Streaks Athletics”, 2021). Of those recognized by the Ohio High School Athletic Association, Coventry Local Schools offers the following varsity sports: Baseball, Boys Basketball, Girls Basketball, Boys Bowling, Girls Bowling, Boys Cross Country, Girls Cross Country, Football, Boys Golf, Boys Soccer, Girls Soccer, Softball, Boys Tennis, Girls Tennis, Boys Track & Field, Girls Track & Field, Girls Volleyball, and Boys Wrestling (“Coventry Athletics”, 2021).

The study seeks to examine the correlation between motivation in athletics and academic success in mathematics for high school age, varsity level student athletes. Because the study takes place at two suburban school districts in Northeast Ohio, generalization of the results may not be appropriate for student athletes in all geographic locations and socioeconomic status in which a school is located. Additionally, the study will only be able to reach participants who are willing to complete a survey in their mathematics classroom. This indicates that data may not be collected on students who are less motivated since they may be unlikely to complete the surveys.

The primary research question for this study is “Is athletic motivation in high school sponsored athletics predictive of academic success in mathematics?”. To test the

primary research question researchers will implement ANOVA techniques grouping students across three different types of motivation (intrinsic, extrinsic, and amotivation). The mean semester mathematics grades will be compared across the three types of motivation. An ANOVA is an appropriate test since it will compare the mean values of semester mathematics grade across our three factors for motivation type (Selgo, 2016; Poyraz et al., 2020). This will be discussed in more detail later in this chapter. A priori statistical power calculation was conducted using a moderate effect size (f = 0.25), an alpha value of 0.05, and a power of 0.8. Using G*Power, researchers found a desired sample size of 159.

Subsection 2: Instrumentation

The researchers will use the Sport Motivation Scale, which is a survey that measures types of motivation in athletes (Pelletier, et al., 1995). The Sport Motivation Scale was originally developed in French, the Echelle de Motivation vis-h-vis les Sports (EMS), and was later translated to English. Both the EMS and the Sport Motivation Scale have 28 questions that align to seven subscales falling under three types of motivation. The seven subscales include intrinsic motivation (to Know, to Accomplish Things, to Experience Stimulation), three types of extrinsic motivation (External Regulation, Introjection, Identification), and amotivation (Pelletier et al., 1995).

Intrinsic motivation occurs when an individual participates in an activity for the rewards of the activity itself (Deci & Ryan, 1990). *Intrinsic motivation to know* refers to motivation based on the satisfaction of learning or experiencing new things (Pelletier et al., 1995). *Intrinsic motivation toward* accomplishments is when an individual is driven by a desire to feel competent and accomplished in a certain field. *Intrinsic motivation to*

experience stimulation is motivation based on the pleasure an individual experiences by being engaged in the activity itself (Pelletier et al., 1995).

When an individual makes decisions based on external factors or consequences, they are considered to be *extrinsically motivated* (Deci & Ryan, 1990). *Extrinsic motivation from external regulation* is the most traditional form of extrinsic motivation with the individual being motivated by external factors such as rewards or restrictions (Pelletier et al., 1995). *Introjection* is when an individual internalizes previously external rewards or consequences in order to drive decision making. *Identification* is a self-regulated type of extrinsic motivation where the individual makes their own determination for the behavior but it is still motivated by external sources (Pelletier et al., 1995).

Amotivation occurs when an individual has neither intrinsic or extrinsic motivation. The individual participates in the activity despite seeing no purpose or connection between the behavior and internal or external consequences. This has been compared to the concept of learned helplessness in which an individual behaves as though they are incapable of changing their actions (Pelletier et al., 1995).

A study was conducted in order to translate the Sport Motivation Scale from French to English, conduct confirmatory factor analysis, analyze the internal consistency of the scale, and assess the validity of the scale (Pelletier et al., 1995). The survey was completed anonymously by 593 collegiate athletes from a variety of sports on a volunteer basis in Ontario, Canada. The confirmatory factor analysis aligned with the results from the French version of the Sport Motivation Scale and verified that the questions accurately tested the seven motivation type factors. The seven subscales showed adequate levels of internal consistency when tested using cronbach's alpha

(mean alpha score of 0.75), although the internal consistency was slightly lower than that of the French version of the scale (mean alpha score of 0.82) (Pelletier et al., 1995).

A second study was conducted in order to retest participants and compare scores from the original to the retest. This study was conducted with fifty soccer players from Ontario, Canada completing the survey twice, five weeks apart. Results showed reasonable consistency between the pretest and posttest scores for each motivation type with an average cronbach's alpha value of 0.70. These results once again align closely with the results of the studies done on the French survey (Pelletier et al., 1995).

Overall, the two studies conducted demonstrate adequate levels of validity and reliability for the Sport Motivation Scale in English (Pelletier et al., 1995), which is the scale that will be used for the current study. As with previous studies listed here, all 28 questions across the seven factors are included in the survey used in this project.

Subsection 3: Procedure

Researchers distributed a modified version of the Sport Motivation Scale to all math teachers at Lake Middle High School and Coventry High School. The modified version had all of the original statements developed by Pelletier et al., but also includes a space for individuals to state their Varsity sport, grade level, current math course level, race, and gender. At the very end of the survey, math teachers completed details about the specific students' mathematics semester grade, quarter 2 formative grade, quarter 2 summative grade, quarter 2 overall grade, and their cumulative GPA. The current study underwent an Exempt IRB Approval through Shawnee State University in order to successfully and cautiously collect data. The IRB application and additional documents are included in Appendix.

Researchers completed an application for an Exempt IRB Review that focused on the safety of participants being used in the study. Due to stating that participants will remain anonymous throughout the study, researchers were able to bypass using a consent form. Also stated in the application was the fact that participants are at minimal risk for partaking in the study. With the approval of the current study, researchers began distributing and collecting the surveys.

After receiving paper copies of the Sports Motivation Survey, math teachers were expected to ask each class period if there were any varsity athletes who would voluntarily and anonymously partake in a study. Athletes that volunteered to take the Sports Motivation Survey remained anonymous due to teachers filling out specific student grades prior to handing out the blank survey. When students were done completing the 28 question survey, they returned it to their teacher. Teachers were asked to give completed surveys to researchers at both Coventry and Lake Middle High Schools.

Researchers of the current study gave a timeline of around one month for teachers to complete student-athlete grade data and to have student-athletes complete the survey. When the one month deadline approached, researchers had 142 completed surveys. The data from the surveys, including all the other information aside from the 7 Likert scale statements, was then entered into an Excel sheet. Students remained anonymous and were entered as subjects 1-142 in the Excel sheet. Once all statistical tests are conducted and the results reported, the survey results will be shredded to reassure the anonymity of the subjects who participated in this study.

Subsection 4: Data Processing and Analysis

Due to researchers having a primary research question and a few additional research questions, three types of statistical tests will be used to analyze the collected data. For each question, researchers will either use one or more ANOVA tests, multiple regression, or an ANCOVA test depending on what is being measured. Each of these tests have specific assumptions that must be met in order to be used successfully. Other research pertaining to academic success have used ANOVA, multiple regression, and ANCOVA methods in order to test certain hypotheses as well. The current study will investigate the main research question using an ANOVA test.

ANOVA techniques will be used to examine the primary research question: Is athletic motivation in high school sponsored athletics predictive of academic success in mathematics? Assumptions for implementing ANOVA techniques include normality and homogeneity of variances which will be tested using Shapiro-Wilk's method and Levene's test respectively. For example, in a study investigating if student success in math is related to overall success in life (Poyraz et al. 2020), researchers used an ANOVA to determine whether students' scores in mathematics made a difference according to their father's education level. Additionally, in a study from The University of Findlay, the researcher used multiple single factor ANOVA tests to compare a variety of variables including gender, specific sport in which an athlete participates in, race, grade and income, to academic achievement as defined by cumulative grade point average (Selgo, 2016).

In relation to the current study, researchers will use ANOVA techniques to compare mean student-athlete semester mathematics grades across the type of motivation (intrinsic, extrinsic, amotivation). Researchers are using student-athlete semester mathematics grade as an indicator of success in mathematics. When implementing ANOVA techniques, the level of statistical significance will be .05.

The researchers also analyzed the question: “Are athletic motivation, gender, type of sport in which the student athlete competes (individual, team, both), and race predictive of course success in mathematics?” For this question, the researchers will implement multiple regression techniques to examine athletic motivation (intrinsic, extrinsic, and amotivation), gender (identified by participants), sport (all sports recognized by the Ohio High School Athletic Association), and race (identified by participants) as predictors. Researchers will use multiple regression with these independent variables to determine if they are predictive of mathematics success as a dichotomized variable of mathematics course grade (C and higher or D and lower). The assumptions for multiple regression are multivariate normality and no multicollinearity of the variables. Additionally, researchers will use a chi-square test of independence in order to consider if type of sport (individual, team, both) correlates to type of motivation. In addition, researchers will run a t-test in order to compare motivation scores across male and female student-athletes.

In a study from Kent State University which considered the effects of academic motivation on academic performance at the collegiate level. The researcher used multiple regression in order to determine if academic motivation type was predictive of academic performance. The researchers used scores in each of six types of academic motivation determined by a survey in order to predict academic success as defined by cumulative grade-point average (Burgess, 2016). Additionally, in a study from the Universiti Putra Malaysia, researchers used t-tests to compare motivation scores across genders when studying the effects of motivation on mathematics performance (Suraya & Ali, 2009).

The last research question researchers are interested in analyzing is “Is there a statistically significant difference in mean summative grades across types of athletic

motivation when controlling for formative grades?" Researchers will implement ANCOVA techniques to examine this research question. Prior research completed by Yi-Hsiang Pan et al. (2019) used an ANCOVA to compare the two different physical education curriculum models (Sport Education Model (SEM) and Traditional Teaching Model (TTM)) while implementing the Teaching Personal and Responsibility (TPSR) method. Students' learning effects were observed in high school physical education classes through a 16-week program in which three teachers implemented the TPSR-SEM and TPSR-TTM. Researchers specifically used a univariate ANCOVA to compare the pre-test scores for the various aspects of sport passion for the experimental and control groups. From the ANCOVA, researchers found that the TPSR-SEM group was better than the TPSR-TTM group in terms of effort, self-direction, and cooperation with p-values all significant at the 0.05 level. As for the current study, the ANCOVA will assist in comparing student-athlete summative math grades across types of athletic motivation when controlling for formative grades.

Implementing ANCOVA techniques will allow researchers to test how the categorical variable of athletic motivation (intrinsic, extrinsic, or amotivation) is predictive of summative mathematics grade, a quantitative variable. The covariate will be formative grades for the participant in quarter two of their mathematics course. The assumptions for an ANCOVA test are normal distribution of variables, homogeneity of variances, and homogeneity of regression slopes.

Researchers will use R to conduct each statistical test previously discussed. Knowing the appropriate tests to use for each question will allow researchers to receive the most accurate data for the current study. Results of the statistical analysis will be revealed in Chapter 4.

Summary

The research design for the current study would not have been possible if it weren't for prior studies done in the same field of athletics and education. Pelletier et al. paved the way for researchers of the current study by producing the English version of the Sports Motivation Survey. Researchers asked for voluntary, anonymous participation from varsity student athletes when distributing the surveys to math teachers at Coventry and Lake Middle High Schools. Volunteers were asked to state their sport, grade level, current math course level, race, and gender at the top of their survey. Math teachers of student-athletes were expected to complete the portion of the survey that asked about student mathematics semester grade, quarter two formative grade, quarter two summative grade, quarter two overall grade, and cumulative GPA. After surveys were given back to researchers, all data was entered into an excel sheet keeping each individual anonymous by listing voluntary participants as subjects 1-142. ANOVA tests will be used to test for statistical significance at the .05 level for the primary research question as well as a couple of the additional research questions. An ANCOVA will be used for the additional research question of "Is there a statistically significant difference in mean summative grades across types of athletic motivation when controlling for formative grades?"

Chapter Three produced the guidelines for researchers to have a valid study as well as protect the identity of participants involved in the study. In Chapter Four, results of the tests described in Chapter Three will be discussed in detail. Researchers will be able to answer each research question with evidence from the statistical tests. Chapter Five will involve a brief summary of the study and the most important findings researchers discovered.

CHAPTER IV: RESULTS

Introduction

In Chapter 3, researchers described the procedure for completing this study including data collection, population sampled, instruments used, and how data will be analyzed. This study is seeking to compare motivation levels in varsity student athletes to their performance academically, specifically in the mathematics classroom. Researchers collected data from student athletes and their math teachers including the Sport Motivation Scale (Pelletier, et al., 1995). This chapter will present the results of the research and use appropriate statistical analysis to address the research questions. Chapter 5 will summarize these results.

Materials and Methods

The study took place at Lake Middle High School in Uniontown, Ohio and Coventry High School in Akron, Ohio. Surveys were distributed to varsity level student athletes in their mathematics classrooms by teachers that were willing to distribute and help complete the surveys. Student athletes who were willing to complete the survey, completed some demographic information and completed the Sport Motivation Scale (Pelletier, et al., 1995). The student-athletes' mathematics teachers then filled in additional information related to mathematics course level, mathematics grades, and cumulative grade-point average.

The anonymous surveys were then returned to the researchers from the mathematics teachers. Researchers compiled the data in an Excel document. Averages were calculated for each item on the Sport Motivation Scale (Pelletier, et al., 1995) aligning to each type of motivation (intrinsic motivation - to know, intrinsic motivation - to accomplish, intrinsic motivation - to experience stimulation, extrinsic motivation - external

regulation, extrinsic motivation - introjection, extrinsic motivation - identification, amotivation). Researchers coded each student athlete by the type of motivation in which they received the highest average score (intrinsic, extrinsic, amotivation) (Pelletier, et al., 1995). Researchers also created averages for each item aligning to the three broader categories of motivation (intrinsic, extrinsic, amotivation). The researchers also assigned each student the appropriate type of sport (individual, team, both). This document was saved as a ".csv" file and analyzed using the statistical software R. After the data analysis was completed the surveys were shredded in order to keep the information about the participants secure.

The sample included 142 varsity student-athletes with 76 (53.5%) subjects from Lake Middle High School and 66 (46.5%) from Coventry High School. The participants included 70 (49.3%) females and 72 (50.7%) males. Of these participants, 83 (58.5%) participated in team sports (baseball, basketball, football, lacrosse, soccer, softball, volleyball), 41 (28.9%) participated in individual sports (bowling, cross country, golf, gymnastics, tennis, track and field, swimming, wrestling), and 18 (12.7%) participated in both types of sports. The participants for the study were in a variety of mathematics courses: Algebra 1, Algebra 1 Honors, Geometry, Geometry Honors, Advanced Geometry, Algebra 2, Algebra 2 Honors, Senior Level Math, Statistics, Precalculus, Precalculus Honors College Credit Plus, Calculus, Calculus Honors College Credit Plus, AP Calculus AB. The average semester course grade for the population was 87.93 percent. Of the participants in the study, one (0.7%) identified as American Indian, two (1.4%) identified as Biracial, two (1.4%) identified as Black, one (0.7%) identified as Chinese, one (0.7%) identified as Hispanic, and 135 (95.1%) identified as White.

The participants in the study were placed into three categories for motivation type: intrinsic motivation, extrinsic motivation, and amotivation. Researchers assigned

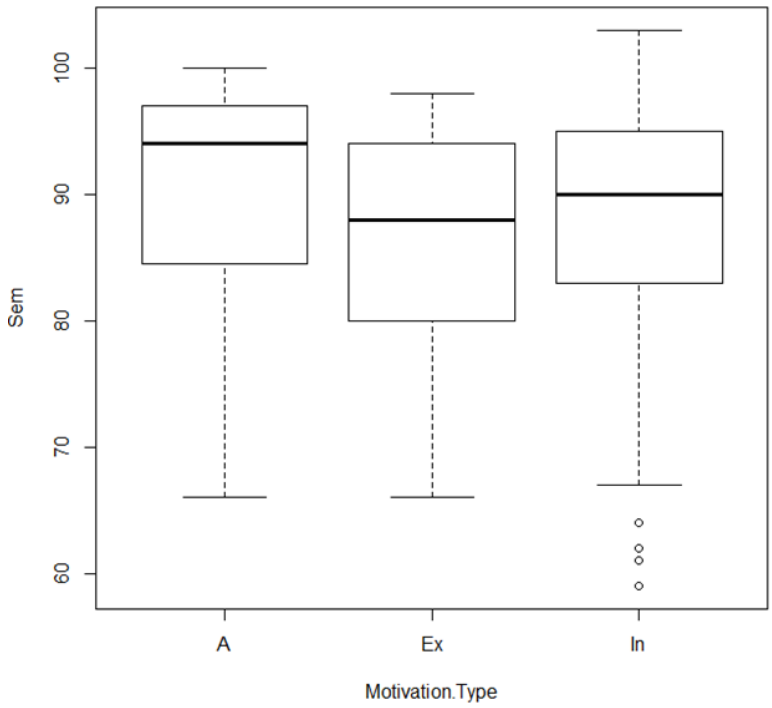
each participant a type of motivation based on the highest average score from the items aligned to that motivation type on the Sport Motivation Scale (Pelletier, et al., 1995). Items 1, 2, 3, 8, 12, 13, 15, 18, 20, 23, 25, and 27 aligned to intrinsic motivation. Items 6, 7, 9, 10, 11, 14, 16, 17, 21, 22, 24, and 26 aligned to extrinsic motivation. Items 3, 5, 19, and 28 aligned to amotivation (Pelletier, et al., 1995). Of the 142 participants, 110 (77.5%) had the highest average in intrinsic motivation, 21 (14.8%) had the highest average in extrinsic motivation, and 11 (7.7%) had the highest average in amotivation. Students who were primarily extrinsically motivated were found to have the lowest mean semester math course grade (M = 85.38, SD = 9.93), followed by students who were primarily intrinsically motivated (M = 88.20, SD = 9.17), and students who fell primarily into amotivation had the highest mean semester mathematics grade (M = 90.09, SD = 9.93). The table below shows the mean semester math course grade by motivation type for the participants. The boxplot below shows the semester mathematics course grades across the three types of motivation.

Table 1. Descriptive Information of Student-Athletes

(Mean ± Standard Deviation)

Primary Athletic Motivation Type	**Mean Semester Math Course Grade**
Intrinsic	88.20 ± 9.17
Extrinsic	85.38 ± 9.93
Amotivation	90.09 ± 9.93

Figure 1. Semester Mathematics Course Grade across Athletic Motivation Type



A concern for this study is the independence of semester mathematics course grade, cumulative grade-point average, and motivation type between the two school districts studied. In order to test this, researchers conducted t-tests to compare the mean values in each of these categories between the two school districts. Researchers found that there was a statistically significant difference in mean semester mathematics course grade across the two school districts ($t(140) = -3.8307, p < .05$) with the mean value of semester mathematics course grade at Lake Middle High School being 90.60526 (6.493235) percent and the mean semester mathematics course grade at Coventry High School being 84.84848 (11.098499) percent. There was also a statistically significant difference in mean cumulative grade-point average across the two school districts ($t(140) = -4.504, p < .001$) with the mean cumulative grade-point average at Lake Middle High School being 3.911579 (0.5239950) and the mean cumulative grade-point average at Coventry High School being 3.462273 (0.6635541).

The table below shows the mean value for student-athletes in the three broad categories of motivation between the two school districts. There was not a statistically significant difference in mean intrinsic motivation score between the two school districts ($t(140) = 1.595, p = .113$). There was also not a statistically significant difference in mean extrinsic motivation score between the two school districts ($t(140) = -0.30713, p = .7592$). There was a statistically significant difference in mean amotivation scores between the two school districts ($t(140) = -2.1453, p = .03366$).

Table 2. Motivation Scores between School Districts

(Mean ± Standard Deviation)

Motivation Type	**Mean Score for Lake Middle High School Student Athletes**	**Mean Score for Coventry High School Student Athletes**
Intrinsic	5.107105 ± 1.089882	5.396818 ± 1.067528
Extrinsic	4.336974 ± 1.028644	4.278939 ± 1.222974
Amotivation	2.496711 ± 1.456876	1.981061 ± 1.395260

Next, researchers ran a baseline model with a single intercept for semester mathematics course grade and compared this to a random intercept model for semester mathematics course grade. An ANOVA comparing these two models resulted in statistically significant evidence to reject the null hypothesis that the difference in the fixed intercept model varies from the random intercept model ($p < .05$).

This suggests that the independence assumption has been violated in this study. Despite this violation, researchers proceeded with standard statistical techniques using multiple regression. This is a large limitation to the study as multilevel modeling should have been used at this point. When independence assumptions are violated in a nested design, multilevel modeling is the appropriate statistical technique to use (Field, et al.,

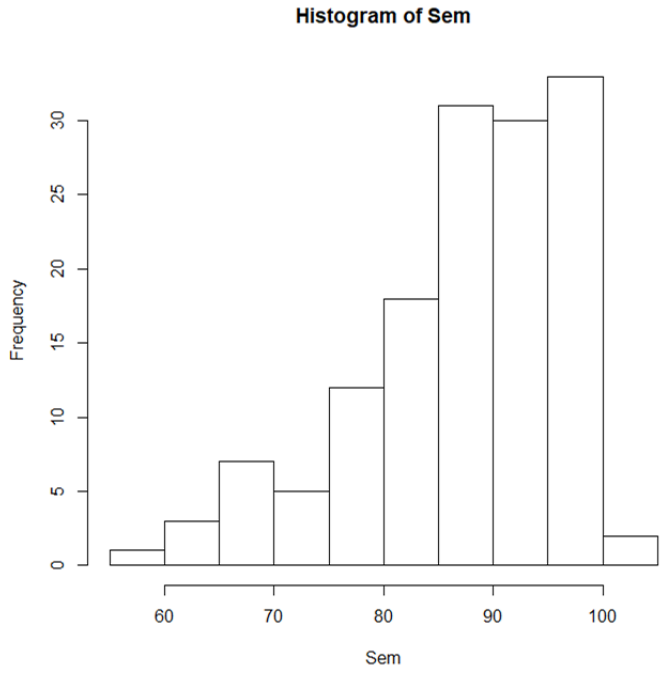
2012). Other researchers have used multiple regression in nested designs in fields such as biology and psychology (Barnett & Stohlgren, 2003; Wampold & Serlin, 2000). Since researchers did use multiple regression techniques where multilevel modeling would have been appropriate, this is a serious limitation and a threat to the generalizability of the study.

Data Analysis - Primary Research Question

The primary research question for the study was “Is athletic motivation in high school sponsored athletics predictive of academic success in mathematics?” Researchers used ANOVA techniques to compare mean semester course grades in mathematics across the highest type of motivation for the student-athlete. The independent variable was the type of motivation to which the student aligned the most. This was a categorical variable with each participant falling into intrinsic motivation, extrinsic motivation, or amotivation. The dependent variable for this research question was mean semester grade in the student’s current mathematics course. This variable was continuous and quantitative.

The assumptions for ANOVA techniques include normality and homogeneity of variances. Researchers used the Shapiro-Wilk’s method to test for normality of the semester 1 grades in mathematics. The Shapiro-Wilk’s method resulted in statistically significant evidence to reject the null hypothesis that the data was normally distributed ($W = 0.92$, $p < .001$). As shown in Figure 2 below, a histogram of semester mathematics grades also supports that the data is not normally distributed.

Figure 2. Histogram of Semester Mathematics Grades



Additionally, researchers used Levene's Test to check the assumption of homogeneity of variances. Results from Levene's Test do not provide enough evidence to reject the null hypothesis that the variances in semester mathematics grades are equal across types of motivation ($F(2,139) = 0.14$, $p = .87$).

Despite the violation of the normality assumption for semester mathematics grades, researchers proceeded with one-way ANOVA techniques since the assumption of homogeneity of variances was not violated. A one-way ANOVA showed that there was not a statistically significant difference in semester mathematics course grade across type of motivation ($F(2,139) = 1.12$, $p = .329$). A post-hoc Tukey HSD showed that there was not a statistically significant difference in mean semester mathematics grades between pairs of motivation types. Table 3 shows the results of the Tukey HSD.

Table 3. Post-hoc Tukey HSD of Mean Semester Mathematics Grade across Motivation Type

	Adjusted p-value
Intrinsic Motivation and Amotivation	$p = 0.37$
Extrinsic Motivation and Amotivation	$p = 0.80$
Intrinsic Motivation and Extrinsic Motivation	$p = 0.42$

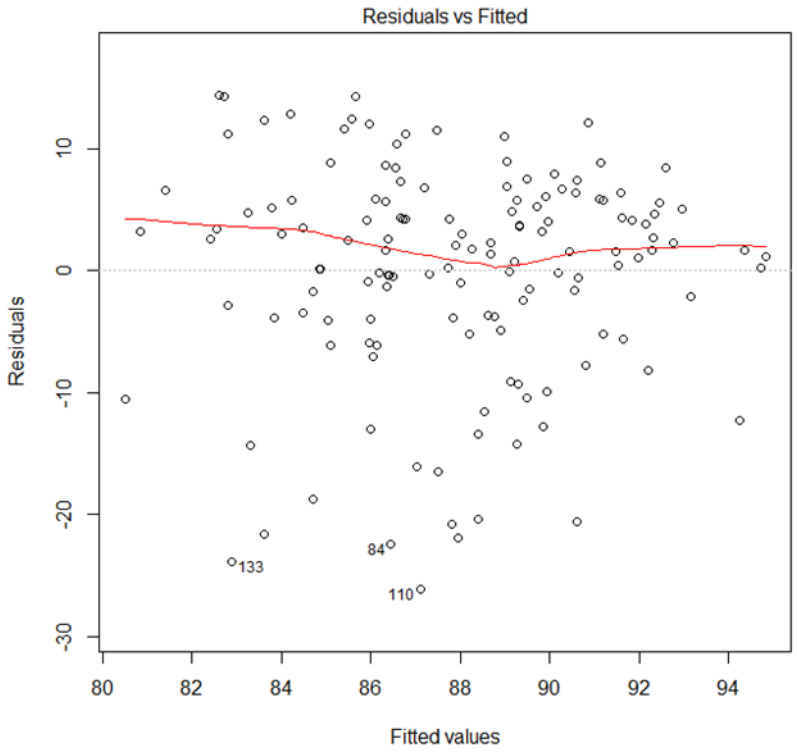
Additionally, researchers considered the student athletes' cumulative grade point average across the three categories of motivation (intrinsic, extrinsic, amotivation). Researchers found that there was not a statistically significant difference in mean grade point average across these three types of motivation ($F(2,139) = .911$, $p = .404$).

In order to analyze the more specific seven categories of motivation (intrinsic motivation - to know, intrinsic motivation - to accomplish, intrinsic motivation - to experience stimulation, extrinsic motivation - external regulation, extrinsic motivation - introjection, extrinsic motivation - identification, amotivation), researchers used multiple regression techniques. Researchers used multiple regression techniques with the scores in each type of athletic motivation to predict mathematics semester course grade. The assumptions for multiple regression techniques are linearity, independence, homogeneity of variances, and normality. Homogeneity of variances and normality were reported in the ANOVA test above. For semester mathematics course grade, the normality assumption was violated, but the homogeneity of variances assumption was not violated.

Figure 3 below shows a plot of standardized residuals vs. standardized predicted values for the model predicting semester mathematics course grade from the scores in the seven categories of athletic motivation type. The trendline is relatively horizontal with

data spread both above and below the line, suggesting that the linearity assumption may not have been violated. Additionally, three outliers can be seen in the data representing subjects 84, 110, and 133.

Figure 3. Residuals vs. Fitted for the model predicting semester mathematic grade from average scores in seven categories of motivation



In order to test multicollinearity of predictors, researchers used variance inflation factors. These variance inflation factors ranged in value from 1.3106 (amotivation) to 2.7662 (intrinsic motivation - to accomplish). The guideline is that variance inflation factors above 10 are cause to assume multicollinearity is an issue (Myers, 1990). These values are not high enough to suggest that the predictors are highly correlated.

Table 4 below shows the results of an ANOVA analysis on the multiple regression model using the scores for the seven types of motivation to predict semester mathematics course grade. This model reached statistical significance at the .05 level in

predicting semester course grade from motivation scores in the seven categories of motivation ($F(7,134) = 2.336$, $p = .02787$). The model explained 10.88% of the variance in semester mathematic course grades ($R = .3298$, $R^2 = .1088$, adjusted $R^2 = .0622$).

Table 4. Results of ANOVA for Regression

Model	**Sum of Squares**	**df**	**Mean Square**	**F**	**p-value**
Regression	1342	7	191.7	2.336	.02787
Residual	10997.2	134	82.07		
Total	12339.2	141			

Table 5 below shows the coefficients for the model predicting semester mathematics course grade from the scores in the seven athletic motivation categories. Table 6 below shows the 95% confidence intervals for the coefficients of each factor. Extrinsic Motivation - Regulation was the only factor that represented statistical significance in predicting semester course grade at the .05 level ($\beta = -1.8161$, $p < .05$). For every point increase in average extrinsic motivation - regulation, semester mathematics course grade decreased by 1.8161 percent.

Table 5. Regression Coefficients

Model	**Coefficients**	**Standard Error**	**t-value**	**p-value**
Intercept	95.5323	5.0114	19.063	< .001
Amotivation	0.0135	0.6037	0.022	0.9822
Intrinsic Motivation - To Know	-1.0012	0.8277	-1.210	0.2286

Intrinsic Motivation - To Accomplish	-0.3208	1.0855	-0.296	0.7680
Intrinsic Motivation - To Experience Stimulation	0.9364	0.0523	0.983	0.3272
Extrinsic Motivation - Identified	0.3978	0.8024	0.496	0.6209
Extrinsic Motivation - Introjected	-0.2540	0.6657	-0.381	0.7034
Extrinsic Motivation - Regulation	-1.8161	0.7559	-2.403	0.0177

Table 6. 95% Confidence Intervals for Coefficients of Model

	2.5%	**97.5%**
Intercept	85.6207	105.4439
Amotivation	-1.1805	1.2075
Intrinsic Motivation - To Know	-2.6384	0.6359
Intrinsic Motivation - To Accomplish	-2.4678	1.8261
Intrinsic Motivation - To Experience Stimulation	-0.9471	2.8200
Extrinsic Motivation - Identified	-1.1892	1.9849
Extrinsic Motivation - Introjected	-3.3112	-0.3211

Data Analysis - Additional Research Questions - Question 1

The next research question considered was “Are athletic motivation, gender, type of sport in which the student athlete competes, and race predictive of course success in mathematics?” To analyze this research question, researchers will use multiple

regression techniques. The assumptions for multiple regression techniques are linearity, independence, homogeneity of variances, and normality. Homogeneity of variances and normality for semester mathematics course grade were reported in the primary research question. For semester mathematics course grade, the normality assumption was violated ($W = 0.92$, $p < .001$), but the homogeneity of variances assumption was not violated ($F(2,139) = 0.14$, $p = .87$).

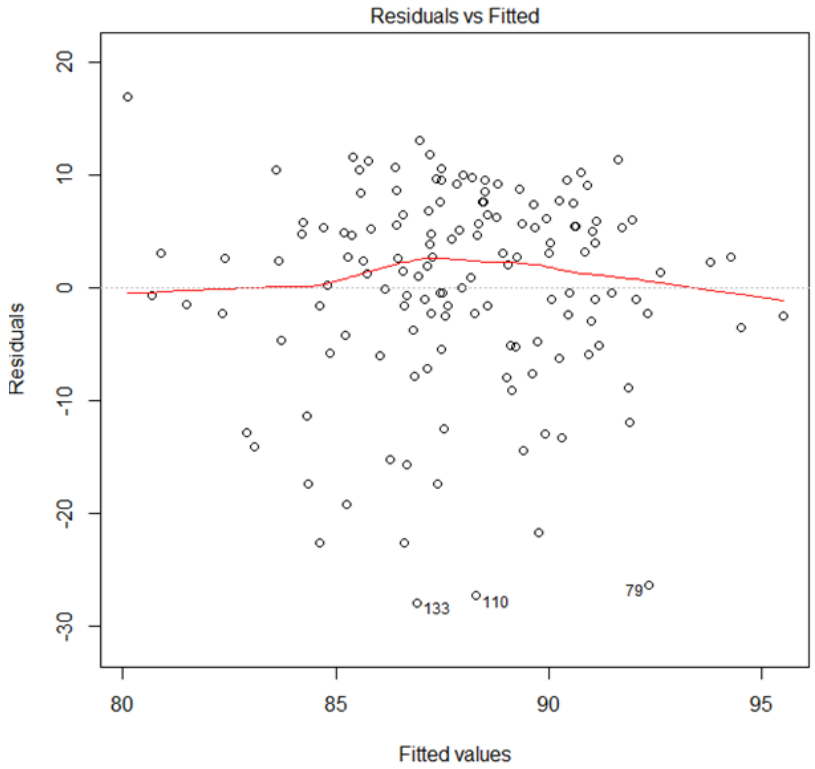
Of the 142 participants in the study, 135 (95.1%) identified as White when asked about their race. Due to the small portion of the population that identified as a race other than white, researchers eliminated race as an independent variable from this research question. A common guideline for the minimum number of cases of data in order to use a predictor is 10 or 15 (Field, et al., 2012). Since the number of participants that did not identify their race as white was only 7, it is appropriate to eliminate this as a predictor.

In order to consider type of motivation for this research question, researchers used the average scores for questions on the Sport Motivation Scale (Pelletier, et al., 1995) that aligned to the three broad categories of motivation (intrinsic, extrinsic, amotivation). Researchers used athletic motivation averages for three categories of motivation (intrinsic, extrinsic, amotivation), type of sport in which the athlete competes (team, individual, both), and gender (participants all identified as either male or female) as the independent variables in the multiple regression techniques and semester mathematics course grade as the dependent variable.

The other assumptions for multiple regression are linearity and independence. Figure 4 below shows a plot of the standardized residuals versus standardized predicted values for the model predicting semester course grade from the three motivation type averages, type of sport, and gender. The trendline is relatively horizontal with data spread both above and below the line, suggesting that the linearity assumption may not

have been violated. Additionally, this graph shows that there are three outliers in this data representing subjects 79, 110, and 133.

Figure 4. Residuals vs. Fitted for the model predicting semester mathematics grade from average scores in three categories of motivation, type of sport, and gender



In order to test independence, researchers used variance inflation factors. The values for each of the independent variables fell between 1 and 2 suggesting that the assumption of independence of variables was not violated. The guideline is that variance inflation factors higher than 10 suggest violation of the assumption of independence (Myers, 1990).

Table 7 below shows the results of an ANOVA analysis on the multiple regression model using the three athletic motivation scores, type of sport, and gender to predict

semester mathematics course grade. This model reached statistical significance at the .05 level for predicting semester course grade from the three athletic motivation scores, type of sport, and gender ($F(6,135) = 2.28$, $p < .05$). The model explained 9.201% of the variance in semester mathematics course grade ($R = .3033$, $R^2 = .09201$, adjusted $R^2 = .05165$).

Table 7. Results of ANOVA for Regression

Model	**Sum of Squares**	**df**	**Mean Square**	**F**	**p-value**
Regression	1135.4	6	189.2	2.28	.03966
Residual	11304.0	135	82.99		
Total	2255.4	141			

Table 8 below shows the coefficients for the model predicting semester mathematics course grade from the average scores in three types of athletic motivation, type of sport, and gender. Table 9 below shows the 95% confidence intervals for the coefficients of each factor. Extrinsic motivation was the only factor that represented statistical significance in predicting semester course grade at the .05 level (β = -1.8978, t = -2.118, p = .036). For every point increase in average extrinsic motivation score, semester mathematics grade decreased by 1.8978 percent.

Table 8. Regression Coefficients

Model	**Coefficients**	**Standard Error**	**t-value**	**p-value**
Intercept	103.4274	5.5559	18.616	<.001
Intrinsic Motivation	-0.6830	0.9743	-0.701	.484

Extrinsic Motivation	-1.8978	0.8960	-2.118	.036
Amotivation	-.4815	.6024	-0.799	.426
Type of Sport - Individual	-2.9003	2.6250	-1.105	.271
Type of Sport - Team	-1.0735	2.4081	-0.446	.656
Gender (Male)	-2.3402	1.587-	-1.475	.143

Table 9. 95% Confidence Intervals for Coefficients of Model

	2.5%	**97.5%**
Intercept	92.4396	114.4152
Intrinsic Motivation	-2.6098	1.2438
Extrinsic Motivation	-3.6698	-0.1258
Amotivation	-1.6728	0.7098
Type of Sport - Individual	-8.0918	2.2912
Type of Sport - Team	-5.8359	3.6889
Gender	-5.4788	0.7983

Researchers used ANOVA methods to further examine the relationship between the type of sport in which the athlete participates (individual, team, both) and academic performance. Researchers found that there was not a statistically significant difference in mean semester mathematics grades across types of sport ($F(2,139) = .147$, $p = .864$). Furthermore, there was not a statistically significant difference in mean grade point average across the three types of sports ($F(2,139) = .161$, $p = .851$).

Researchers also used ANOVA methods to examine the relationship between gender and academic performance. There was not a statistically significant difference in semester mathematics grades across gender ($F(1,140) = 2.179$, $p = .142$). There was also not a statistically significant difference in grade point average across gender for these student athletes ($F(1,140) = 2$, $p = .159$).

Data Analysis - Additional Research Questions - Question 2

The final research question studied was “Is there a statistically significant difference in mean summative grades across types of athletic motivation when controlling for formative grades?” In order to test this question, researchers will use an Analysis of Covariance (ANCOVA) with the covariate being students' formative grades. Formative grades refer to how well students do on homework, participation, etc. in their mathematics courses. The dependent variable is each student’s mean summative assessment grade and the factor is the type of athletic motivation the student-athlete has (Amotivation, Extrinsic, Intrinsic.) Descriptive statistics in Table 10 show that students who were primarily amotivated had the highest mean for both summative and formative assessment grades. In contrast, there were only 11 students of the 142 surveyed who identified as being amotivated in their sport. Students who were primarily extrinsically motivated had the lowest mean summative and formative assessment grades. Similar to their small group of amotivated peers, there were only 21 student-athletes that were considered to be extrinsically motivated.

Table 10. Descriptive Information of Mean Summative and Formative Assessment Grades.

(Mean ± Standard Deviation)

Primary Athletic Motivation Type	Mean Summative Assessment Grade	Mean Formative Assessment Grade
Intrinsic	84.18 ± 12.80	91.94 ± 12.43
Extrinsic	81.57 ± 14.01	87.24 ± 20.94
Amotivation	85.91 ± 15.35	94.27 ± 4.96

The assumptions for an ANCOVA are the same as for an ANOVA, including: independence of covariate and treatment and the homogeneity of regression slopes. Assumptions for the ANOVA should be tested prior to running an ANCOVA. Using histograms of student's mean summative assessment grades and formative assessment grades to test for a normal distribution, researchers noticed the graphs were skewed. It is visible in Figure 5 and Figure 6 that the data is not normally distributed. Further testing the normal distribution of variables, researchers again used the Shapiro-Wilk's method. The Shapiro-Wilk's method resulted in statistically significant evidence to reject the null hypothesis that the data was normally distributed for both formative assessment grades ($W = 0.66$, $p < .001$) and summative assessment grades ($W = 0.87$, $p < .001$.) Researchers then ran a Mardia's Test for Multivariate Normality in order to further analyze the distribution of the data. The result of the Mardia's Test showed that the dataset rejected the null hypothesis stating the data portrayed a normal distribution ($\hat{\gamma}_{1,p} = 219.12$,p < .001). This outcome solidifies that the data does not come from a normal distribution.

Figure 5. Histogram of Mean Summative Assessment Grades

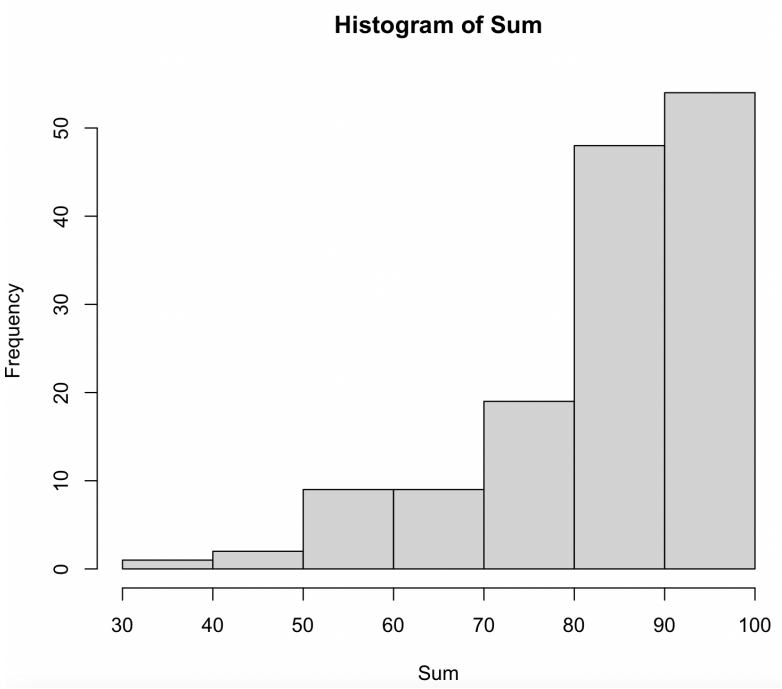
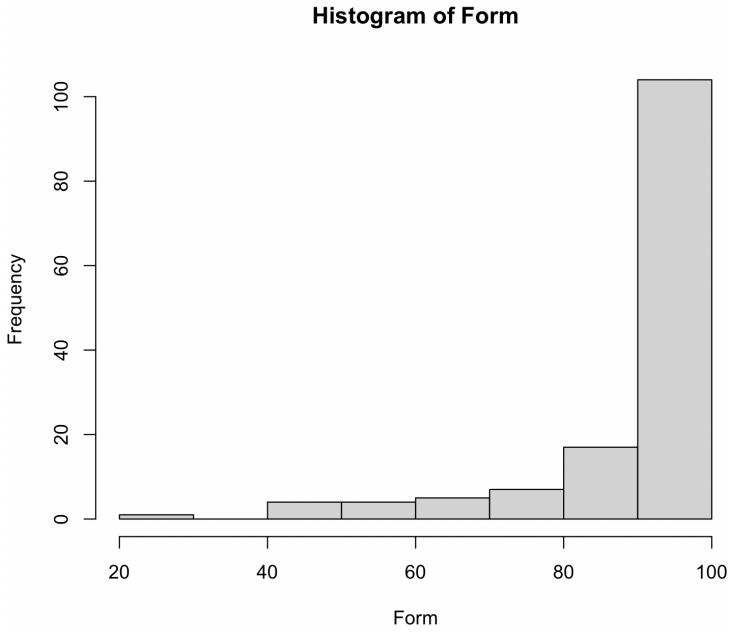


Figure 6. Histogram of Mean Formative Assessment Grade



Since ANCOVA methods have been shown to be effective even when normality is violated, researchers moved forward despite the violation of the normality assumption (Olejnik & Algina, 1984). Researchers moved on to test for the homogeneity of variances. The Levene's Test for Homogeneity of Variance did not show statistically significant evidence to reject the null hypothesis that the variances for mean summative assessment grade are equal across types of motivation ($F(2, 139) = 0.20$, $p = 0.82$). However, results from Levene's Test showed statistically significant results pertaining to the mean formative assessment grades being equal across types of motivation ($F(2, 139) = 5.628$, $p < 0.05$). Researchers moved on from the ANOVA assumptions to the ANCOVA assumptions.

The ANCOVA assumptions that must be met in order to successfully test the current dataset are independence of the covariate (Mean Formative Assessment Grades) and the factor (Motivation Type), as well as, homogeneity of regression slopes. Researchers will run an ANOVA including the covariate over the factor. The results of the ANOVA show that there is no statistical significance to support the claim that means for the formative assessment grades differ over type of motivation ($F(2, 139) = 1.306$, $p = 0.274$). Therefore, mean formative assessment grades are independent of type of motivation. Next, researchers tested for the homogeneity of regression slopes using another ANOVA where the dependent variable, mean summative assessment grades, over the covariate, mean formative assessment grades, interacting with the factor, motivation type. Examining the interaction, researchers found that there was no statistical significance meaning the homogeneity of regression slopes is not violated ($F(2, 139) = 2.169$, $p = 0.118$). For further analysis of the regression slopes, researchers looked at scatter plots with lines of best fit for each type of motivation. The scatterplots show similar regression lines and therefore solidify the notion that the data has

homogeneity of regression slopes. Researchers continued their data analysis using ANCOVA methods.

Since both assumptions for the ANCOVA were met, researchers moved forward with their data analysis. Researchers used a Type III sum of squares calculation where the sum of squares is independent of any other factors in the model. The results of the Type III ANCOVA show that when the effect of the mean formative assessments is removed, the effect of motivation type is not statistically significant ($F(2, 139) = 0.04$, $p = 0.96$). However, the covariate, or the mean formative assessment grades, has an extremely small p-value showing that researchers fail to reject the null hypothesis ($F(1, 140) = 36.25$, $p < .001$). The interpretation of this is that the mean formative assessment grades significantly predict the mean summative assessment grades. Therefore, a student-athletes' mean summative assessment grade is highly influenced by their mean formative assessment grade.

Table 11. Results of ANCOVA with factor Motivation Type and covariate Formative Assessment Grades (Form)

Model	**Sum of Squares**	**df**	**F**	**p-value**
Intercept	4530.3	1	32.69	6.407e-08
factor	11.2	2	0.04	0.9604
Form	5023.6	1	36.25	1.484e-08

Researchers analyzed the ANCOVA results further using post hoc analysis. A multiple comparisons of means Tukey Contrasts test was run in order to look at the differences of the data in terms of p-values. This test gives comparisons of

student-athletes that are amotivated, extrinsically motivated or intrinsically motivated controlling for adjusting the variation in summative assessment grades when including mean formative assessment grades as the covariate. However, there was no statistical significance when comparing extrinsically motivated to amotivated ($p = 0.96$), intrinsically motivated to amotived ($p = 0.98$), and extrinsically motivated to intrinsically motivated ($p = 0.98$).

Results of the ANCOVA showed statistical significance when predicting summative assessment grades from mean formative assessment grades. The factor of motivation type was not necessarily a predictor of summative assessment grades when controlling for formative assessment grades.

Summary

In this chapter, researchers explained their materials, methods, and data analysis for each question asked in the current study. Using an ANOVA analysis for the primary research question, there was statistically significant evidence in predicting semester course grade from motivation scores in the seven categories of motivation. More specifically, extrinsic motivation - regulation was the only factor providing statistically significant evidence in predicting semester course grade. As for additional research question 1, ANOVA analysis as well as multiple regression techniques were used to study if athletic motivation, gender, type of sport in which student-athletes competes, and race are predictive of course success in mathematics. The results of the ANOVA for Regression showed statistical significance for the factor extrinsic motivation in predicting semester course grade. Lastly, researchers used an ANCOVA in order to analyze whether types of athletic motivation when controlling for formative grades affects a student's mean summative grades. Results of the ANCOVA showed no statistical

significance when using the type of motivation as the covariate. However, researchers found statistical significance that mean formative assessment grades significantly predict the mean summative assessment grades. Although not every statistical test showed significant results, researchers were intrigued with their results.

In Chapter 4, methods and analysis for the current study were portrayed. Previous chapters discussed the appropriate steps in order to successfully begin analyzing the dataset. Researchers will give a summary of their research in Chapter 5 as well as discuss any limitations in their research and provide ideas for future research in the field of mathematics education.

CHAPTER V: SUMMARY

Introduction

Chapter 5 will summarize the techniques and methods that went into the current study, as well as the results researchers discovered. Recall, the purpose of the current study is to examine the relationship between athletic motivation in school-sponsored athletics and mathematics performance. Researchers used a few ways to measure mathematics performance such as specific math course' semester grade, and second quarter formative and summative grades. In order to measure athletic motivation, researchers had varsity student-athletes complete the Sports Motivation Survey published by Pelletier in 1995. It is important to recall these details as they will come up frequently in Chapter 5.

In this chapter, researchers will discuss the statement of the problem, all research questions, any significant findings, and real-world applications of their findings. Also, researchers will explain any limitations they had when conducting their study. In Chapter 5, the connection to the literature will be explained and recommendations for any further research in this field will be discussed. A summary of the entire study will be given in this chapter.

Summary of Findings

Given the large amounts of research surrounding the concept of school-sponsored athletics benefiting students (Selgo, 2016; Bowen & Greene, 2012; White, 2005), researchers decided to concentrate specifically on their academic success. Researchers thought to take data from one of the more challenging high school subjects: mathematics. The idea being, if students are motivated to do well in their sport, then that motivation might transfer over to doing well even in a tough subject

like math. The problem researchers came across is the lack of research that studies the correlation between motivation in sports and motivation in mathematics.

Researchers developed three questions to help guide their study. The main research question being: Is the level of athletic motivation in school-sponsored athletics for high school students predictive of academic success in mathematics? Student athletes completed the Sports Motivation Survey and teachers filled out their Cumulative GPA, first semester mathematics course grade, overall quarter two grade, summative math grade, and formative math grade on the back in order to help researchers get sufficient data. Between Coventry High School and Lake Middle High School, 142 varsity student athletes completed this survey. Two additional research questions were analyzed using the data from student surveys. The first additional question being “Are athletic motivation, gender, type of sport in which the student athlete competes, and race predictive or course success in mathematics?” and the second one asking “Is there a statistically significant difference in mean summative grades across types of athletic motivation when controlling for formative grades?” Researchers entered all of the data from student surveys into an Excel sheet and analyzed each of these questions using statistical tests in R.

ANOVA techniques were used to compare mean semester course grades in mathematics across the highest type of motivation (Intrinsic, Extrinsic, Amotivation) for the student-athlete which guided researchers to answer the primary research question. The one-way ANOVA showed no statistical significance in mathematics course grade across types of motivation. Researchers then broke down the three broad types of motivation into their specific seven categories (intrinsic motivation - to know, intrinsic motivation - to accomplish, intrinsic motivation - to experience stimulation, extrinsic motivation - external regulation, extrinsic motivation - introjection, extrinsic motivation -

identification, amotivation) and used multiple regression techniques. The ANOVA analysis on the multiple regression model provided statistical significant results in predicting semester course grade from motivation scores in the seven categories of motivation. More specifically, Extrinsic Motivation - Regulation was the only one factor of the seven which provided statistical significance in predicting semester course grade. Researchers found that student-athletes who identified with extrinsic motivation - regulation have a lower semester mathematics course grade. In analyzing the additional research questions, researchers discovered more significant findings.

The additional research questions provided interesting findings for the current study. When using an ANOVA analysis on the multiple regression model to analyze if athletic motivation, gender, type of sport in which the student athlete competes, and race is predictive of course success in mathematics, researchers found significant results. Meaning, student-athlete success in their mathematics course can be predicted from their athletic motivation scores, type of sport and gender. Researchers then used a model to predict semester mathematics course grades from the average scores in three types of athletic motivation, type of sport, and gender. In this model, extrinsic motivation was the only factor that portrayed statistical significance in predicting semester course grade. As for the second additional research question, researchers used ANCOVA techniques. The outcome of the ANCOVA provided statistical significance when predicting mean summative assessment grades from mean formative assessment grades. However, the purpose of the question was to determine if there is a statistically significant difference in mean summative grades across types of athletic motivation when controlling for formative grades. In this case, researchers did not find significant results pertaining to the factor of motivation type being a predictor or summative

assessment grades when controlling for formative assessment grades. All things considered, each research question analyzed gave researchers information to dwell on.

Interpretation of Findings

Although researchers did not get the exact results they were expecting, there are still ways educators can use this study to guide their lessons in the classroom. Also, researchers are aware of the limitations that took place when collecting their data. One dominant limitation researchers found was a threat to generalizability because the means of independent variables between school districts were considerably different. Had there not been significant limitations, results would have been more valid. With that in mind, teachers can use the results of the current study as they please to enhance lessons being used in their classroom.

The results of the current study could be useful for teachers of student athletes. Specifically, researchers found that increased levels of extrinsic motivation in student athletes correlated to lower performance in the mathematics classroom. This means that teachers could focus on motivating students, and particularly student athletes, through non-extrinsic methods. This fits with educational research which has shown that removing extrinsic motivators from the classroom can improve student learning (Gillard, et al., 2015). Explicitly, when these extrinsic motivators are removed, this leaves the opportunity to cultivate students' intrinsic motivation and improves long term learning. However, researchers are attentive to the fact that limitations of their research could have skewed their data.

A major limitation to the current study was that the dataset came from two different high schools in Northeast Ohio. Due to this factor, researchers had to test the independence of semester mathematics course grade, cumulative grade-point average,

and motivation type between the two school districts. Once t-tests were run, researchers found red flags in their study because they received multiple statistically significant results. Researchers discovered that there was a statistically significant difference in mean semester mathematics course grade ($t(140) = -3.8307, p < .05$), mean cumulative grade-point average ($t(140) = -4.504, p < .001$), mean amotivation scores between the two school districts ($t(140) = -2.1453, p = .03366$). Not only that, but once researchers ran a baseline model with a single intercept for semester mathematics course grade and compared it to a random intercept model for semester mathematics course grade an ANOVA comparing these two models resulted in statistically significant evidence to reject the null hypothesis that the difference in the fixed intercept model varies from the random intercept model ($p < .05$). This unfortunately revealed to researchers that the current study resulted in a nested design. Other limitations were discovered aside from this extensive flaw.

One limitation of the study was that only willing participants were included in the study. Furthermore, many of these willing participants had to complete the survey on their own time in addition to other obligations related to their personal lives, school, or athletics. This means that there were likely eligible participants that chose not to take the time to complete the survey properly or at all. This impacted the relatively small sample size in the study (142). Given the appropriate resources, a future researcher could attempt to make the survey more accessible to the participants in order to increase participation and potentially make the results more accurate. For example, student athletes could be given a designated amount of time in their class to complete the survey and be given an incentive for completing the survey. This would result in a larger sample size and possibly give the opportunity to analyze the data in more ways. Researchers initially planned to consider race when predicting semester mathematics course grade

and were unable to use this variable in multiple regression techniques due to the large portion of participants that identified as White (135 participants, 95.1%). This also may have allowed more student athletes to fall into different categories of motivation. A large majority of the participants in the study identified most strongly with intrinsic motivation (110 participants, 77.5%), followed by extrinsic motivation (21 participants, 14.8%), then amotivation (11 participants, 7.7%).

Another limitation of the study was that researchers conducted the study in 2021 during the Covid-19 pandemic. During this time there were students in both school districts that were absent for pandemic-related reasons such as choosing to take courses remotely, being quarantined due to exposure to the disease, or being currently ill and unable to attend school. Due to the surveys being distributed in person and on paper, there may have been student athletes in these districts that were unable to complete the study due to not being in attendance at school during the survey time period. As more students return to school in person, a future study could be conducted in a similar manner that would not leave out this category of student.

The researchers realize that most studies have biased results and that many have limitations. In particular the current study has a relatively small sample size which could have caused issues with the study. In summary, the 142 surveys produced adequate power, so sample size is not a concern for this study.

Connection to Literature

Researchers in this study were motivated by two key theories in the field of motivation, self-determination theory and social cognitive theory (Deci & Ryan, 1990; Bandura, 2005). An individual is defined to be self-determined when they can integrate experiences in their environment with their view of self and cognition, particularly in decision making (Deci & Ryan, 1990). When an individual is intrinsically motivated, the

person behaves in a certain way due to the internal rewards they feel. Intrinsically motivated behaviors are self-determined. Extrinsic motivation is when an individual performs behaviors due to external rewards and consequences from the individual's environment. Extrinsically motivated behaviors may or may not be self-determined depending on the individual's cognition associated with the behavior. Amotivation is when an individual participates in a behavior without considering why they are doing so. Amotivation is not self-determined (Deci & Ryan, 1990). Social cognitive theory describes the behavior of individuals as being a compilation of the way the individual relates their view of self with their environment (Bandura, 2005). According to Bandura, behaviors by individuals are a result of their dynamic interaction between the behavior, the environment the individual is in, and the person's own cognition (2005).

Prior research in the area of motivation, namely self-determination theory, has shown that individuals who are intrinsically motivated in a given area are more likely to be able to adjust corresponding behaviors in order to achieve their goals (Deci & Ryan, 1990). Additionally, social cognitive theory posits that people who are able to self-regulate their behaviors can make adjustments to those behaviors in order to be more successful in that area (Bandura, 2005). Specifically, people who are intrinsically motivated in an area are considered to be self-regulated and some forms of extrinsic motivation can also be self regulated (Deci & Ryan, 1990). The current study used the Sports Motivation Scale which includes questions aligning to seven factors of motivation (intrinsic motivation - to know, intrinsic motivation - to accomplish, intrinsic motivation - to experience stimulation, extrinsic motivation - external regulation, extrinsic motivation - introjection, extrinsic motivation - identification, amotivation) (Pelletier, et al., 1995). All three types of intrinsic motivation along with extrinsic motivation - identification represent forms of motivation that are self-regulated (Pelletier, et al., 1995).

Applied to this study, researchers anticipated that student athletes who were intrinsically motivated in their sport would be more likely to achieve higher academically due to their ability to regulate their behaviors. The initial ANOVA techniques used to test whether mean semester mathematics grades varied significantly across the three broad categories of motivation (intrinsic, extrinsic, and amotivation) did not result in statistical significance. This suggests that for this sample, the broad type of motivation did not have a significant impact on the student athletes' mathematics performance. Furthermore, researchers found that there was not a statistically significant difference in grade point average for this population across the three broad categories of motivation when they used ANOVA techniques. This suggests that for this population of student athletes, the category of motivation did not have a significant impact on overall academic performance. Researchers used two additional models to consider the relationship between motivation type and mathematics performance.

The model using the seven more specific categories of motivation (intrinsic motivation - to know, intrinsic motivation - to accomplish, intrinsic motivation - to experience stimulation, extrinsic motivation - external regulation, extrinsic motivation - introjection, extrinsic motivation - identification, amotivation) to predict mathematics semester course grade reached statistical significance. This suggests that specific motivation type scores are effective in predicting mathematics semester course grade. This aligns with other studies that show a correlation between motivation type and academic performance (Mata, et al., 2012; Suraya & Ali, 2009). For the model in the current study using motivation type to predict mathematics semester course grade, the only factor that reached statistical significance for this model was *extrinsic motivation - external regulation.* For every point increase in average extrinsic motivation - external regulation from the Sport Motivation Scale (Pelletier, et al., 1995), semester mathematics

course grade decreased by 1.8161 percent. This type of extrinsic motivation is the most traditional form of extrinsic motivation in which an individual is motivated by external consequences (Pelletier et al., 1995). Since this is a form of extrinsic motivation that is not self-regulated, it fits with researchers' anticipation that semester mathematics course grade decreases with increasing scores in this motivation category.

A third model predicting mathematics semester course grade from broad motivation type (intrinsic motivation, extrinsic motivation, amotivation), type of sport (individual, team, both), and gender also reached statistical significance. In this model, extrinsic motivation was the only factor that reached statistical significance. This suggests that for every point increase in average extrinsic motivation score, semester mathematics grade decreased by 1.8978 percent. Once again, since increases in extrinsic motivation scores resulted in lower mathematics performance, this fits with the theory that extrinsically motivated individuals may not be able to regulate and change behaviors as easily (Deci & Ryan, 1990; Bandura, 2005).

Researchers were motivated by prior studies relating athletic or exercise participation and academic performance. A number of studies have shown that when students exercise throughout the day they tend to perform at a higher level academically (Dwyer, et al., 1983; Linder, 2002; Shepherd 1997). Additionally, implementation of exercise programs into the school day have also been shown to have positive effects on the academic performance of students (Calik, et al., 2018). A study from Marietta College showed that participation in athletics had a positive impact on academic performance defined both qualitatively by teacher opinions and quantitatively by grade point average (White, 2005). Additional studies have also shown that athletes tend to perform higher academically than non-athletes both in mathematics and in the overall academic setting (Bowen & Greene, 2012; Lumpkin & Favor, 2012).

Prior studies in the area of motivation and academics have shown that higher levels of motivation in students correlates to higher academic performance (Burgess, 2016; Suraya & Ali, 2009). A study from Kent State University found that higher levels of intrinsic motivation correlated to higher grade-point averages in collegiate students (Burgess, 2016). A study in Malaysia found that higher levels of motivation defined in the categories of self-efficacy, , and worry also correlated to higher grade-point averages in collegiate students (Suraya & Ali, 2009). Although the current study did not see statistical significance in predicting mathematics course grade from intrinsic motivation levels, extrinsic motivation did reach statistical significance in predicting mathematics course grade. Specifically, increases in extrinsic motivation levels correlated to decreases in semester mathematics course grade.

Additionally, research relating attitudes and effort in mathematics and mathematics performance was a motivator for this study. Prior studies have shown that more positive attitudes towards mathematics correlate to a higher performance level in the mathematics classroom (Mata, et al., 2012; Georgiou, et al., 2007). As students get older, attitudes towards mathematics tend to decline, particularly for females (Mata, et al., 2012; Nicolaidou & Philippou, 2003). Another study from Virginia Polytechnic University showed that motivation and attitude scores from a survey correlated to mathematics achievement scores (Singh, et al., 2002).

Although this study did not evaluate attitude towards mathematics directly, researchers investigated mean summative mathematics course grades across types of motivation when controlling for formative grades in their mathematics course. Formative grades were reflective of the students' effort in mathematics since these grades come from assignments such as homework and classwork. Summative grades were reflective of the student's overall performance in the mathematics classroom since they come from

assignments such as tests, quizzes, and cumulative projects. Researchers found that mean summative mathematics grades did not vary significantly across the three main motivation types (intrinsic, extrinsic, amotivation). Of note, researchers did find that formative mathematics grades reached statistical significance in predicting mathematics summative grades. This suggests that the level of effort the student athletes in this study put forth in their mathematics course was predictive of their overall mathematical success. Since effort and attitude are closely related (Li, 2012), this suggests that the attitude of the student athletes in the study may also have been predictive of their performance in the mathematics classroom.

Recommendations

This study could be a motivator for future research opportunities. Specifically, the current study examined only students at two suburban high schools in northeast Ohio. Future researchers interested in the field of motivation for student athletes and mathematical performance could broaden a study to include a wider range of participants. The Sport Motivation Scale (Pelletier, et al., 1995) seemed to be an effective way of determining the type of motivation an athlete had related to the sport they participated in. This scale could be used for a larger population throughout a variety of school districts in order to get a more diverse sample. This would also allow future researchers to consider whether the type of district the student athlete attends is indicative of their motivation type athletically.

A similar type of study using the Sport Motivation Scale (Pelleteier, et al., 1995) to examine athletic motivation types could also be conducted over a variety of age groups including elementary, middle, secondary, and collegiate student athletes. This would allow future researchers to consider how motivation of student athletes affects

academics throughout the developmental stages. It could be intriguing to see if the ways athletes are motivated to participate in sports varies with age.

A future area of research related to this study could consider more about the motivation types of student athletes. A prior study relating motivation and academics used the Academic Intrinsic Motivation Inventory which included 81 questions fitting under six subscales of motivation (Burgess, 2016). Future researchers interested in student athletes and motivation could compare the motivation levels of student athletes academically using the Academic Intrinsic Motivation Inventory with the motivation levels of student athletes athletically using the Sport Motivation Scale. It could be interesting to see whether the ways in which a student athlete is motivated in the academic setting correlates to the motivation types in the athletic setting.

Another opportunity for research related to motivation and student athletes could consider how the motivation for students compares when considering non-athletes and athletes. Prior studies have shown that students who participate in athletics tend to perform at higher levels academically (Bowen & Greene, 2012; Lumkin & Favor, 2012). These studies have not examined how the motivation levels for those athletes compare to those of non-athletes. A study could be conducted evaluating the motivation levels for a population of students and comparing those of athletes to non-athletes in order to determine if there is a relationship between motivation type and these two groups.

Lastly, future studies could focus on school districts with similar academic performance standards. This would assist in further validity of the statistical tests run in current study. If a future study does use multiple school districts, it is pertinent that researchers run independent sample t-tests in order to compare the means of values relative to their study. Otherwise, researchers can implement a category called “School District” and add it to any regression models used, which could be used to control for

the variation across school district and address issues with the nested design. Since the current study resulted in a nested design, this would allow further research to be done on an extremely similar layout. (Aarts, et al., 2014).

Conclusion

In Chapter 5, researchers concluded the current study by summarizing the entirety of their work. To recap, the current study resulted in a nested design, posing a threat to generalizability of their results. Cognitive of this, researchers found that whether a student-athlete was intrinsically motivated, extrinsically motivated, or amotivated, did not have a powerful influence on the student athletes' mathematics performance. However, when broken down using multiple regression techniques, researchers found that extrinsically motivated students are more likely to have lower mathematics performance scores. The results of this study, given the nested design, can assist in further investigation of mathematics education and how it correlates with the top notch athletes at other school districts. Researchers are hopeful to be motivators for future studies done in the field of mathematics education, school-sponsored athletics and/or types of motivation.

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Appendix A

The document below is the Internal Review Board application submitted by researchers and approved by the Shawnee State University Internal Review Board.

Shawnee State University Exempt Review Application

Title of Research Project: The Correlation Between Level of Athletic Motivation in High School Students and their Academic Success in Mathematics.

Name(s) of Principal Investigators:	Email address:	Faculty	Student	Other	
___*Grace Franjesevic_____	gfranesevic@gmail.com	☐	☐	☐	
___*Dr. Doug Darbro_____	ddarbro@shawnee.edu	☐	☐	☐	
___*Courtney Nestoff_____	nestoffc@mymail.shawnee.edu	☐	☐	☐	
_____	_____	☐	☐	☐	
_____	_____	☐	☐	☐	
_____	_____	☐	☐	☐	

*Please place an asterisk by the investigator name(s) whose NIH certificate(s) is/are already on file with the IRB, if the certificate is less than 3 years old.

Contact Name: Grace Franjesevic Contact Phone Number:___(330)312-4031_____

Department(s)/Division/Agency: __Mathematic - Graduate Program_____

Please place a check mark next to the category that best describes your research. You may check more than one category.

□ Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (a) research on regular and special education instructional strategies, or (b) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

□ Research involving the use of educational tests (e.g., cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (a) data obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (b) any disclosure of the human subjects' responses outside the research could reasonably place the participants at risk of criminal or civil liability or be damaging to

the participants' financial standing, employability, or reputation. No videotaping or photography is allowed for data collection. You may not collect data from appointed public officials or candida for public office.

✓ Research involving the collection or study of existing information, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

□ Research and demonstration projects that are conducted by or subject to the approval of supporting agencies, and which are designed to study, evaluate, or otherwise examine: (a) public benefit or service programs; (b) procedures for obtaining benefits or services under those programs; (c) possible changes in or alternatives to those programs or procedures; or (d) possible changes in methods or levels of payment for benefits or services under those programs.

□ Taste and food quality evaluation and consumer acceptance studies, (a) if wholesome foods without additives are consumed or (b) if a food is consumed that contains a food ingredient at or below the level, and for a use, found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the Food and Drug Administration and approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture.

If at least one of these categories does NOT describe your research, then you should complete the "Expedited and Full Review Application" instead of this one.

1. Describe the key demographics (age, SES, ethnicity, geographic locations, gender, etc) of the sample that you wish to obtain. (see Research Summary)

1a. What is the greatest number of participants that will be recruited? 100 participants

1b. How will participants be recruited? Participants will be recruited based on if they play a Varsity sport at either Coventry High School or Lake High School.

2. Will participants be remunerated for their participation? Yes No

2a. If so, how will participants be remunerated? Please indicate the type of remuneration and the amount. For instance, the participants will be given a $10 Amazon Gift Card for participation or the participants will receive 3% of their final grade in extra credit in their Introduction course.

_____

2b. If participants do not complete the study, will partial or full remuneration be given? Please describe how that will be determined. _____

3. What direct benefits (other than remuneration) exist for the participants who participate?

_There are no benefits for the participants, however there are also no risks. _____

_____

4. What direct risks could the participants potentially face? Check all that apply.

_____ Risk of breach of confidentiality or privacy

_____ Risk of coercion by researcher(s)

_____ Risk of psychological harm

_____ Risk of physical harm

_____ Other potential risk: _____

If you checked any direct risks in Item 4, then you should complete the "Expedited and Full Review Application."

5. Will the participants be informed of the risks and benefits of the study? Yes No

5a. If so, how will the participants be informed?

There are no risks or benefits of the study to which participants would need to be informed.

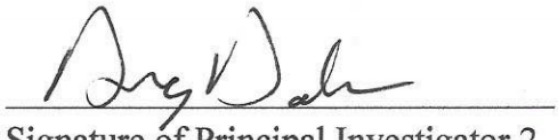
5b. Please check each box if the following criteria match your research.

✓ The research involves no greater than minimal risk.
✓ It is not practicable to conduct the research without a waiver of informed consent or alteration to informed consent.
✓ Waiving or altering the informed consent will not adversely affect the subjects' rights and welfare.
✓ The consent document would be the only record linking the subject and the research, and the principal risk would come from a breach of confidentiality.

5c. Do you wish to waive the signed informed consent? Yes No

In submitting this form and the corresponding documents, I acknowledge that I have completed Human Research Participants training and that I understand and will uphold the rights of human participants. I also verify that all information contained in this form and any other corresponding documentation is correct based on my knowledge. I understand that I may not have contact with any research participants until the Shawnee State University IRB has given me their approval.

Signature of Principal Investigator 1



Signature of Principal Investigator 2

Signature of Principal Investigator 3

Date of Submission: 10/25/2020

Appendix B

The survey below which includes demographic information, academic information, and the Sports Motivation Scale (Pelletier et al., 1995) was distributed to participants through their mathematics teachers.

Student-Athlete: If you are willing, please complete the demographic information below and the following Sport Motivation Scale survey. Please note that participation is optional and all information will be kept anonymous.

Sport(s) in which you are at the Varsity level: _____
Grade Level: _____ Current Math Course Level: _____
Race: _____ Gender: _____

THE SPORT MOTIVATION SCALE (SMS-28)

Using the scale below, please indicate to what extent each of the following items corresponds to one of the reasons for which you are presently practicing your sport.

Does not correspond at all		Corresponds a little		Corresponds moderately		Corresponds a lot		Corresponds exactly
1		2	3	4	5		6	7

WHY DO YOU PRACTICE YOUR SPORT ?

1. For the pleasure I feel in living exciting experiences.	1	2	3	4	5	6	7
2. For the pleasure it gives me to know more about the sport that I practice.	1	2	3	4	5	6	7
3. I used to have good reasons for doing sport, but now I am asking myself if I should continue doing it.	1	2	3	4	5	6	7
4. For the pleasure of discovering new training techniques.	1	2	3	4	5	6	7
5. I don't know anymore; I have the impression of being incapable of succeeding in this sport.	1	2	3	4	5	6	7
6. Because it allows me to be well regarded by people that I know.	1	2	3	4	5	6	7

7. Because, in my opinion, it is one of the best ways to meet people. 1 2 3 4 5 6 7

8. Because I feel a lot of personal satisfaction while mastering certain difficult training techniques. 1 2 3 4 5 6 7

9. Because it is absolutely necessary to do sports if one wants to be in shape. 1 2 3 4 5 6 7

10. For the prestige of being an athlete. 1 2 3 4 5 6 7

11. Because it is one of the best ways I have chosen to develop other aspects of myself. 1 2 3 4 5 6 7

12. For the pleasure I feel while improving some of my weak points. 1 2 3 4 5 6 7

13. For the excitement I feel when I am really involved in the activity. 1 2 3 4 5 6 7

14. Because I must do sports to feel good about myself. 1 2 3 4 5 6 7

15. For the satisfaction I experience while I am perfecting my abilities. 1 2 3 4 5 6 7

16. Because people around me think it is important to be in shape. 1 2 3 4 5 6 7

17. Because it is a good way to learn lots of things which could be useful to me in other areas of my life. 1 2 3 4 5 6 7

18. For the intense emotions I feel doing a sport that I like. 1 2 3 4 5 6 7

19. It is not clear to me anymore; I don't really think my place is in sport. 1 2 3 4 5 6 7

20. For the pleasure that I feel while executing certain difficult movements. 1 2 3 4 5 6 7

21. Because I would feel bad if I was not taking time to do it. 1 2 3 4 5 6 7

22. To show others how good I am good at my sport. 1 2 3 4 5 6 7

23. For the pleasure that I feel while learning training techniques that I have never tried before. 1 2 3 4 5 6 7

24. Because it is one of the best ways to maintain good relationships with my friends. 1 2 3 4 5 6 7

25. Because I like the feeling of being totally immersed in the activity. 1 2 3 4 5 6 7

26. Because I must do sports regularly. 1 2 3 4 5 6 7

27. For the pleasure of discovering new performance strategies. 1 2 3 4 5 6 7

28. I often ask myself; I can't seem to achieve the goals that I set for myself. 1 2 3 4 5 6 7

_____

To be completed by the teacher about the student submitting the form:

Mathematics Semester Grade: _____

Mathematics Quarter 2 Formative Grade: _____

Mathematics Quarter 2 Summative Grade: _____

Mathematics Quarter 2 Overall Grade: _____

Cumulative GPA: _____

BIBLIOGRAPHY[1]

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