THE DEMISE OF GUYS:

THE FLIGHT OF THE AMERICAN MALE FROM STEM

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by

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The undersigned, appointed by the dean of the Graduate School, have examined the dissertation, entitled

THE DEMISE OF GUYS:
THE FLIGHT OF THE AMERICAN MALE FROM STEM

Presented by Courtney McIntyre,

a candidate for the degree of Doctor of Education

and hereby certify that, in their opinion, it is worthy of acceptance.

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ACADEMIC ABSTRACT

This mixed methods research investigates the differences between high school males who pursue the PLTW Biomedical Science program and those males who do not. The study examines males in a rural Midwestern high school, analyzing factors such as GPA, sports, clubs, work, volunteering, and whether at least one parent attended college. It also looks at how high school male students perceive the PLTW Biomedical Science program. The focus is to understand why few males enroll in the program.

A survey constructed by the researcher is administered to gather quantitative data related to the previously mentioned factors. Pearson's Chi-square analysis further tests for statistical significance among the two groups of males. Additional qualitative data via interviews is collected from among the non-biomed males.

The study found biomed males to have a greater GPA, participation in sports, and were more likely to work than their non-biomed counterparts. The non-biomed males were more likely to have at least one parent attend college. Participation in clubs and volunteering was not statistically significant.

The perception of PLTW Biomedical Science program among non-biomed males is positive. Students feel as though their friends like the courses and talk about what a neat program it is. The non-biomed males interviewed for this study simply report not having interest in biomedicine as the main reason they did not join the program. They also reported male brains are wired differently, males are less mature than their female counterparts, and the program should be advertised as being "fun" in order to attract more males to the program.

CHAPTER 1

INTRODUCTION TO THE STUDY

In 1965, American folk singer Pete Seeger asked, “Where have all the young men gone? Long time passing. Where have all the young men gone? Long time ago. Where have all the young men gone? When will they ever learn? When will they ever learn?”. The questions that Seeger asked over five decades ago, are prescient today. When Seeger penned those lines, the lecture halls of colleges across the country were full of predominantly male students. Researchers acknowledge a significant shift in the role males and females play in society. More specifically, the educational landscape of males and females in the classroom is changing. More females than males are sitting in high school college credit courses, such as Project Lead the Way Biomedical Science, and causing educational leaders to question where all the males have gone.

Long after the 1972 Title IX court decision, yet before the breaking of glass ceilings, a group of girls at a rural high school in the Midwest United States were garnering excitement about science. “Go, girls! Go, science!” was the motto of the Girls Only Science Club and still is to this day. Led by a talented female science professor, the girls were inspired to break the stigma that females cannot do math or science. They embraced the challenges of the rigorous college coursework in Science, Technology, Engineering, and Math (STEM) and like many other girls across the country, they began changing the educational landscape and brought gender equality to the forefront. From a historical position of inferiority in society, women have long aspired to have a seat at the table and break glass ceilings. Those discriminated against, try harder to get out of that

despair, and by doing so, their stories have come to light on a national and international stage.

STEM workers are driving our nation's innovation and competitiveness (Van Overschelde, 2013). Between 2008-2018, growth in STEM-related jobs is expected to increase by 20%, twice the growth rate of non-STEM workers (Van Overschelde, 2013). This growth poses a need to educate more students in STEM fields. In general, students who attend college and obtain degrees are more likely to secure jobs. After the Great Recession, of the 11.6 million jobs created, 8.4 million were awarded to those with at least a bachelor's degree (Semuels, 2017). However, when looking at the STEM occupations, it shows a gender gap and underrepresentation of females. In 2012, 42% of males versus 36% percent of females ages 25 to 34 majored in STEM fields (National Center for Educational Statistics, 2016). There was also a slight edge of male STEM graduates, 49% versus 47%, employed in STEM occupations (NCES, 2016). However, this appears to not be the case at a high school in the Midwest. Females are not only outnumbering males in STEM classrooms, but in other high school college credit courses as well.

While it is common knowledge more males enter STEM fields than women after high school, that appears to defy the trend seen in Project Lead the Way (PLTW) Biomedical Science courses offered at a high school in the Midwest. Project Lead the Way is a STEM-focused curriculum program designed to prepare middle and high school students for the global economy (Tai, 2012). PLTW uses an APB approach which consists of activity, project, and problem based scenarios. Students are provided with real-world, hands-on activities that enables them to work independently and

collaboratively to identify problems and find solutions. PLTW (2019) believes all students, beginning at a young age, need access to real-world, applied learning experiences that will empower and provide skills to thrive in college and careers. This is why they have created numerous opportunities for schools across the United States to implement various age-appropriate STEM courses. PLTW Launch is a program geared towards Pre K through 5th grade, aimed at tapping into the student's exploratory nature, engaging them through play, and encouraging their nature to discover (PLTW, 2019). PLTW Gateway focuses on the 6th through 8th grade. This transitional course empowers students to lead their own discovery and explore what they are passionate about. Once students reach grades 9-12, they usually pick an avenue of their interest to pursue. The PLTW courses offered at the high school level are computer science, engineering, and biomedical science. In computer science, students learn computational thinking by working together to design solutions and become better thinkers and communicators (PLTW, 2019). In PLTW engineering, students are empowered to play the role of engineer and solve real-world problems. Lastly, students in the biomedical science pathway are using the same tools as professionals in the medical community to tackle big challenges to make the world a better place.

In a longitudinal, international study, roughly 5,000 students were tracked from high school through college. The students reported positive classroom experiences and the ability to relate and apply content as contributing factors to completing a college degree in STEM (Tai, 2012). "Begun in New York in 1997, PLTW has experienced consistent growth with courses now offered in over 2,700 schools in all 50 states. Enrollment in PLTW is now estimated at 500,000 students, with 53,600 students added

during the 2010-11 school year alone." (Van Overshelde, 2013, p.1). While there are reported PLTW successes, males are stepping aside as females create a new gender gap phenomena.

Statement of the Problem

If the United States is to retain its position as a global leader, the scientific and technical workforce must press on (Tai, 2012). This is even more prominent with such a large number of baby boomers ready to retire. A study by the RAND Corporation has raised concern about the U.S. maintaining its leadership position given the current educational trends (Tai, 2012). PLTW is positioned to address this national need to focus on the scientific workforce and concern over declining numbers of American youth choosing to enter STEM careers (Tai, 2012). If the United States aspires to remain an economic powerhouse in the global marketplace, we must push for more science, technology, engineering, and mathematics degrees. Although PLTW is seeing an overall increase in students enrolled in STEM courses, there is an obvious gender discrepancy in the classroom. Not only is it happening in PLTW Biomedical Science classes, but in many college credit courses offered at the high school level. While evidence shows more males are working in STEM related fields after college, no such relationship has been linked to the lack of males enrolled in Biomedical Science courses at the high school level. In fact, just the opposite seems to be occurring in the female population. More females are enrolled in STEM courses at the high school level but lack STEM jobs. If data shows more males have STEM jobs, why do we not see an abundance of males in STEM classes in high school? Why are males retreating from college level classes? What

is their motivation or lack of motivation to take rigorous courses? Why are females not seeking or receiving STEM jobs in the science workforce like their male counterparts?

A recent study of nearly 5,000 students by Raabe, Boda, and Stadtfeld (2019) found that girls increasingly prefer subjects other than STEM and would drop out of STEM career paths at a higher rate than boys. At the same time, the researchers discovered when females are surrounded by peers who like STEM subjects, they will develop a similar preference. In another study, researchers found women may avoid domains they see as requiring brilliance due to knowing STEM-oriented people are often described as geniuses while they feel they are not (Starr, 2018). Even when females perform as well or better than their male peers on STEM related tests or projects, females lose interest at a higher rate and do not pursue advanced courses, majors, and careers in STEM (Reinking & Martin, 2018).

The literature on the gender gap in STEM education is quite clear. Decades of research has shown that females lag behind their male counterparts in these areas. Despite the preponderance of evidence identifying a gender-gap detrimental to girls, an unusual phenomenon to the contrary has emerged in specific STEM courses across much of the Midwestern United States. Not only are girls gaining ground, boys are beginning to lag behind -- even in some courses that they have traditionally dominated. These new trends have manifested in various STEM courses, but are most acutely concentrated in the field of biomedicine -- and they may turn the existing literature on its head. So, where *have* all the young men gone? This question has been a long time coming. Now is the time to learn.

Purpose of the Study

The purpose of the study is to understand why there is a lack of males taking PLTW Biomedical Science courses in a Midwestern high school. Where have all the young men gone? Past studies have rightly looked at the importance of STEM education and recruitment of females, but have failed to address an emerging trend. Research shows an abundance of empowered females venturing into male territory, but the research disregards the gaping holes left behind by males fleeing academia. This case study will examine an academic void and gender trends of PLTW Biomedical Science courses offered at a high school in the Midwest and why they are in such stark contrast with the prevailing literature. Why does this disparity exist? What factors have contributed to this trend? To what extent are the issues rooted in psychology, history, or social changes in modern America? What are the effects of these trends? These questions will be examined through the role theory lens. Under the role theory umbrella, peer groups, socialization, and stereotypes will be analyzed. A mixed methods approach will be used to identify the number of males pursuing a biomedical science program in a Midwest high school, as well as quantitatively compare differences between males in the biomedical science program and those who are not. Qualitative data via interviews will be gathered to further conclude the reason(s) for the emerging trends and how the males perceive the biomedical science program for a future as a healthcare professional.

Key Terms

The key terms for this study are PLTW Biomedical Science, STEM, academic likeness, socialization, stereotype, and peer influence.

For the purpose of this study the definitions of these terms are as follows:

PLTW Biomedical Science: A high school program of study in which students explore the concepts of human medicine and are introduced to topics such as physiology, genetics, microbiology and public health (Bertram, 2014).

STEM: Science, Technology, Engineering, and Math

Academic Likeness: Students with similar grades of A's and B's, no major discipline referrals, and attendance that is greater than 90%.

Socialization: The process of learning to behave in a way this acceptable to society.

Stereotype: A widely held image or idea of a particular type of person or thing.

Peer influence: When you choose to do something you would not otherwise choose to do

Research questions

The research questions guiding this study are listed as follows:

RQ 1: What are the differences between males who pursue a biomedical science program and those who do not?

SQ 1: Is there a difference in GPA between males who pursue a biomedical science program and those who do not?

SQ 2: Is there a difference in playing sports between males who pursue a biomedical science program and those who do not?

SQ 3: Is there a difference in participation in clubs between males who pursue a biomedical science program and those who do not?

SQ 4: Is there a difference in working after school between males who pursue a biomedical science program and those who do not?

SQ 5: Is there a difference in volunteering after school between males who pursue a biomedical science program and those who do not?

SQ 6: Is there a difference in a parent attending college between males who pursue a biomedical science program and those who do not?

RQ 2: How do high school males perceive the PLTW Biomedical Science program?

Hypotheses

The researcher of this study will analyze the differences between males who choose to take PLTW Biomedical Science courses and those males who do not choose to take PLTW Biomedical Science courses. The following hypotheses will be tested to determine if there is a difference between these two groups of males.

Null hypothesis. The study will address the following null hypotheses:

1. There is no difference between males enrolled in PLTW Biomedical Science courses and males not enrolled in PLTW Biomedical Science courses.

Alternative hypothesis. The study will address the following alternative hypothesis.

1. There is a difference between males enrolled in PLTW Biomedical Science courses and males not enrolled in PLTW Biomedical Science courses.

Conceptual/Theoretical Framework

When looking at gender enrollment trends and the factors that contribute to them, the problem can be viewed through the role theory lens. The definition of role theory was shaped by social psychologists, sociologists, and anthropologists in the late 1920s and early 1930s. Role theory is defined in various ways by theorists George H. Mead, Talcott Parsons, and Ralph Linton. Mead, a social psychologist, says role taking is essential to socialization and the development of one's self (Biddle, 1979). He believes only certain people can influence our view of self and as we grow up our thoughts of what others believe is more important. The "I", our response to what society thinks, and the "me",

society views, are part of the nature of one's self (Mead and Morris, 1934). Parson's version of role theory explains the key concepts to which a society functions. Structural functionalism not only focuses on society as a whole, but how each of its structures has a role to play in a properly functioning society. The theory also states these parts work in equilibrium, without conflict, and in an orderly manner. As the society grows and becomes more complex, the evolutionary change is embraced and occurs slowly, and steadily over time. Anthropologist, Ralph Linton, sees roles as units of culture and assumes roles are constant throughout society (Biddle, 1979).

Although their definitions of role theory are varied, these theorists have one thing in common. They are all concerned at looking at humanity and the patterned behaviors we exhibit--roles. Due to various interpretations, role theory has been used in diverse ways. Role theory has been applied to many research topics such as consensus, conformity, role conflict, and role taking which can be applied to small groups, families, communities, classrooms, formal organizations, and counseling (Biddle, 1979). Using role theory, by way of STEM, one can examine the psychological and societal aspects of males in an educational setting.

Role theory involves one of the most important features of social life, characteristic behavior patterns or roles (Biddle, 1986). Socialization, stereotypes, and peer influence are means by which role theory can be viewed from a more modern perspective. Some researchers believe a gender gap exists in STEM fields due to stereotypes and socialization practices in the United States and other countries which focus on male dominance and female submissiveness (Reinking & Martin, 2018). Stereotype threat occurs when a person is at risk for living up to a negative stereotype

about their group (Steele & Aronson, 1995). Some researchers believe the gender gap in STEM is linked to the role peer groups play in the academic experiences of students (Crosnoe, Riegle-Crumb, Frank, Field, & Muller, 2008).

Design of the Study

This case study will feature the PLTW Biomedical Science program at one high school in a rural area of the Midwestern United States, Southeast High School (SEHS). The setting for this study will take place in one rural community in the Midwestern United States. The city of Southeast (pseudonym) has a population of roughly 19,000 and is comprised of 89.7% white, 6.4% black, .6% American Indian, .4% Asian, and 1.6 % Hispanic. The median household income from 2012-2016 was $41,649. The public high school, Southeast High School (SEHS) (pseudonym), has a student population of approximately 1,153. The student body closely correlates to the city population with 93.3% white (State Department of Elementary and Secondary Education, 2018). Creswell (2014) says case studies are a means of inquiry in which the researcher explores a program, event, activity, process, or individuals to collect detailed information. In addition, a sequential explanatory strategy will be used in this mixed methods design. This strategy is characterized by collecting and analyzing quantitative data first and then collecting and analyzing qualitative data second (Creswell, 2014). The quantitative approach will use a Chi-square model analyzing variables. The dependent variables will be grade point average, participation in sports, participation in clubs, whether the student has a job, whether the student volunteers, and if they have at least one parent who attended college. The independent variables will be males who participate in the PLTW Biomedical Science program and males who do not participate in the PLTW Biomedical Science

program. The Project Lead the Way Biomedical Science Male Student Survey (see Appendix A) will be distributed to males in the PLTW Biomedical Science program and males not in the PLTW Biomedical Science program. Selected male students not in the PLTW Biomedical Science program will be interviewed to gather qualitative data. The purpose of the qualitative data is to explain the results or parts of the quantitative findings in more depth (Merriam and Tisdell, 2015).

The reason for the selection of the particular school is due to its close proximity to the researcher, ease of data collection, and most importantly, to understand the gender trends of the biomedical science program in which the researcher is invested. The researcher is one of the instructors for the PLTW Biomedical Science program. The high school of interest offers PLTW Biomedical Science sequential courses which consist of Principles of Biomedical Science (PBS), Human Body Systems (HBS), Medical Interventions (MI), and Biomedical Innovation (BI). PLTW (2019) describes each course as follows:

> In the introductory course of the PLTW Biomedical Science program, students explore concepts of biology and medicine to determine factors that led to the death of a fictional person. While investigating the case, students examine autopsy reports, investigate medical history, and explore medical treatments that might have prolonged the person's life. The activities and projects introduce students to human physiology, basic biology, medicine, and research processes while allowing them to design their own experiments to solve problems (para. 2).

The second course, HBS, uses the scaffolding from PBS to build upon concepts and ideas while learning the basics of anatomy and physiology. PLTW (2019) says this about HBS:

> Students examine the interactions of human body systems as they explore identity, power, movement, protection, and homeostasis in the body. Exploring science in action, students build organs and tissues on a skeletal Maniken®; use data acquisition software to monitor body functions such as muscle movement, reflex and voluntary action, and respiration; and take on the roles of biomedical professionals to solve real-world medical cases (para. 2).

In the third course, MI, the building of knowledge to become a well versed STEM student in biomedical sciences takes students through various case studies of a family as stated below by PLTW (2019):

> Students follow the life of a fictitious family as they investigate how to prevent, diagnose, and treat disease. Students explore how to detect and fight infection; screen and evaluate the code in human DNA; evaluate cancer treatment options; and prevail when the organs of the body begin to fail. Through real-world cases, students are exposed to a range of interventions related to immunology, surgery, genetics, pharmacology, medical devices, and diagnostics (para. 2).

Lastly, the fourth course, BI, pulls information acquired from the previous courses to explore new topics often seen and experienced in the world of medicine but were not covered in PBS, HBS, and MI. PLTW (2019) describes this course as so:

> In the final course of the PLTW Biomedical Science sequence, students build on the knowledge and skills gained from previous courses to design innovative solutions for the most pressing health challenges of the 21st century. Students address topics ranging from public health and biomedical engineering to clinical medicine and physiology. They have the opportunity to work on an independent

project with a mentor or advisor from a university, medical facility, or research institution (para. 2).

The high school in this research offers all four biomedical science courses as electives, not required by the school district. The method for taking these courses may be different than other high schools offering the biomedical science program. Students may choose to apply to be in the program as 8th graders. Those students are asked to fill out an application, complete an interview with the biomedical sciences committee, and submit a letter of recommendation from a teacher. A committee usually consists of two biomedical science teachers, another member of the science department, freshman school counselor, and high school principal. The school district typically aims to accept 30-34 applicants per year, due to the expense of the equipment and consumables, rigor of the coursework, and ability to maintain low student to teacher ratio. During a typical year, the student-teacher ratio is 15:1 with only 2 classes of each course taught. As you can see in Table 1, the reported numbers of students in the Project Lead the Way Biomedical Science Program at SEHS for the past 4 years show the stark contrast between males and females.

Table 1.
Numbers of Students Enrolled in the PLTW Biomedical Science Program at SEHS from 2017-2021

	Number of Males	Number of Females
2017-2018	9	83
2018-2019	11	81
2019-2020	12	83
2020-2021	14	85

The male students identified as being in the PLTW Biomedical Science program for the year 2020-2021 will receive a survey (see Appendix A). In addition, an equal number of male students not in the PLTW Biomedical Science program will also receive the same survey. The second group of non-biomedical science males will be randomly selected based upon academic likeness. This likeness would be determined by the evidence of A and B letter grades on the student's transcript, no discipline, and attendance of 90% and above. It is a requirement of the biomedical science program for participants to meet this criteria. The expectation would be the same for the second group of males. The survey will identify differences in male students who chose to take the biomedical science courses and those who did not. The researcher will compare the following between the two groups of male students: GPA, sports, clubs, jobs, volunteering, and college attendance of parents. The survey data may help guide the questions conducted in interviews that will follow, but an interview protocol has already been established (see Appendix B). The interview questions will be used to find out the niche of the student at SEHS, what their career pathway is, why they did not do the biomed program, how they feel the program is perceived, and what can be done to draw more males into the PLTW Biomedical Science program. Those questions will further investigate the role of GPA, sports, clubs, jobs, volunteering, and college education of the parents. It is the hope of the researcher to hear stories from the perspective of the students. Stories are a means of knowing. They are where people select details of their experiences from their consciousness (Seidman, 2013). By interviewing, one can understand the lived experiences of others and make meaning of those experiences (Seidman, 2013).

Participants

During the 2020-2021 school year, data will be collected among two groups of male high school students. The first group will consist of those males who are enrolled in the PLTW Biomedical Science program and the second group are those males not enrolled in the PLTW Biomedical Science program. It is expected the study will recruit approximately 28 participants. By using nonparametric measures, the researcher will be able to test a small sample size. Field (2018) says the historical solution to reduce bias for a small sample size is a non-parametric test, one that is assumption free. One of the first steps in completing the research would be to seek and follow Institutional Review Board (IRB) protocol of working with minors in a school. Once the IRB application is filled out, sent in, and approved, consent forms (see Appendix C) would be constructed and passed out to the students outlining the purpose of the study. If students are under the age of 18, consent forms will be signed by a parent or legal guardian. If students are 18 or older, they may sign for themselves. The survey would then be sent to participating individuals.

Data Collection

Fink (2017) says a survey is valid if the information it provides accurately reflects the knowledge, attitudes, values, and behaviors of the respondents. The purpose of survey research is to generalize from a sample to a population so inferences can be made (Cresswell, 2014). There are three forms of validity to look for in research methods. Cresswell (2014) says content (measuring what is intended), predictive (correlation of criteria), and construct (scores with a useful purpose) validity should be established to draw meaningful inferences. Construct validity is established by surveying people whom experts say do and do not exhibit the behavior associated with the construct (Fink, 2017).

The purpose of this survey is to see if there is a difference between males who pursue a biomedical science program and those who do not. In addition, the survey developed for this study will run an internal test of validity using the Cronbach alpha. Lee Cronbach developed alpha, to provide a measure of the internal consistency of a test (Tavakol & Dennick, 2011).

Fourteen PLTW male biomedical science students at SEHS will be selected to receive the survey along with 14 non-biomed students. It is the hope of the researcher to administer 28 surveys. The student experimental survey will be given to all 28 male subjects in a cross-sectional manner. Fink (2017) explains that a cross-sectional survey design provides an observation of how things are at one moment in time. The researcher would like to know the reason(s) for the current status of gender enrollment numbers for the 2020-2021 school year as well as prior years. By establishing the two groups of males, this will allow for comparison between factors such as GPA, sports, clubs, jobs, volunteering, and college attendance of parents.

A survey (see Appendix A) will be created in Qualtrics and sent out via email to those students who complete and return their signed consent form. Newcomer, Hatry, and Holey (2015) suggest using the availability of the Internet to e-mail respondents. This will ensure a quick turnaround time for the researcher and ease of access to the high school students. Due to the test subjects being minors, all IRB protocol will be closely followed and monitored as well as the length of the survey kept to a minimum amount of time to allow for valid results. It is the hope of the researcher to limit the survey completion time to less than three minutes. This 10 question survey addresses the possible reasons or factors for the gender enrollment numbers in the biomed program.

Knowing this survey would be distributed to high school students in grades 9-12, it is important to keep the survey short and only allow for little to no qualitative questions. The researcher has chosen to make the questions binary and not include qualitative responses. The survey will be administered one time, to both groups of males, and include all ages in grades 9-12.

Depending on the number of IRB parent/student consent forms returned, will ultimately determine the number of surveys administered and completed. The researcher does not want to survey male students who would not even have the potential to pursue the biomedical science program. Male students of academic likeness will be randomly selected. The counselor will assist the biomedical science teacher and researcher with the appropriate students to be surveyed. The focus of this research is to not only find out why those males are taking the biomedical science courses but why those who have the potential to do so, are not choosing biomed.

Following the student survey, data between groups will be compared via Chi-square Analysis. Field (2018) says Pearson's Chi-square test is ideal for identifying relationships between two categorical variables. This quantitative statistic compares the frequencies one observes in certain categories to the frequencies one might expect to get in those categories by chance (Field, 2018). An interview protocol will be used to interview four students to further understand factors affecting enrollment numbers in the biomed program. The four students selected will be those who chose not to take biomedical science courses in order to better understand the reasons for males not taking PLTW Biomedical Science. Seidman (2013) explains that effective questions flow from the interviewer's listening, interest in what is being said, and purpose to move forward.

This qualitative approach will allow for more authentic answers from students and their thought process for choosing to pursue STEM coursework or not pursue STEM coursework.

Data Analysis

After completion of surveys, the data will be analyzed in Qualtrics. Data analysis tools in Qualtrics will be used to find glaring similarities and differences in answers. Results will be tallied for each quantitative question and percentages calculated based on responses. The researcher will then use EXCEL to run a Chi-square test to compare the males in biomedical science courses and those who are not. Statistical significance will be determined using a critical value of .05. A Chi-square analysis will help determine if there is a difference in GPA, sports, clubs, jobs, volunteering, and parental college attendance between males in biomed and those who are not.

Further qualitative research will be performed in the form of interviews. Approximately four students will be selected for an interview to gather additional qualitative information. Unlike survey research, interviews are a type of research that does not depend on the number of respondents but the potential of each person to contribute insight and understanding of the phenomenon (Merriam & Tisdell, 2015). This line of qualitative research will require a lot more time to decipher the data collected, but could prove very rewarding to the research. The interview protocol will further address RQ1 and also address RQ2: How do high school male students perceive the PLTW Biomedical Science program? The researcher will use the program, Temi, to record audio which will then transfer to text. This tool is important to ensure the information being spoken is accurately recorded and documented. The interviewer will offer to review the

transcript with the male students being interviewed to ensure what they said is accurate and they are comfortable with the answers they disclosed. The sharing of the report with participants, known as member-checking, will allow trustworthiness and credibility of the report (Seidman, 2013). The emerging themes gathered from the interview responses will be analyzed.

Significance

There are significant issues facing health-care systems that justify this research. First, we are seeing the baby boomer generation reach the age of retirement and are leaving gaping holes in STEM related jobs. If the United States is to remain a global leader in research and development, the U.S. science and technology community must keep pace (Tai, 2012). Second, very little research has been done on the gender equity of the PLTW Biomedical Science program. There appears to be a lack of males taking biomedical sciences courses in high school but this trend shows the opposite in the scientific workforce. More males are receiving STEM-related jobs. What is happening between high school, receiving an undergraduate degree, and the real world? Tai (2012) mentions several studies on PLTW students and students' experiences, but very few, if any, look at gender. Research shows studies on the principals, teachers, and parents of PLTW schools, but still no gender research.

What are males choosing to do with their time instead of being challenged in the classroom? How have the psychological roles of males and females influenced this gender gap? How have the societal roles of males and females influenced this gender gap? What role has science, technology, engineering, and math played? Although it is affecting the rural and urban Midwest, is this trend happening in other parts of the United

States? What can be done to place females in these STEM-related workforces? What can be done to increase male participation in high school biomedical sciences courses? Do we really want more males pursuing college?

It is the hope of this research to bring the educational struggles of our nation's young men to the forefront. By understanding why males are avoiding rigorous coursework like PLTW Biomedical Science, educational leaders and institutions can better equip their teachers and effectively teach the next generation.

Summary

Researchers acknowledge there has been a significant shift in the role males and females play in society. The educational landscape of males and females in the classroom is changing. More females than males are sitting in high school college credit courses, such as Project Lead the Way Biomedical Science, and causing educational leaders to question where all the males have gone. Since the 1970's, females have continued graduate college at higher rates than males, but males are producing more STEM degrees than females. This is not the case in high schools in the Midwest. The saturation of females in PLTW Biomedical Science classes has educational leaders scratching their heads. The purpose of this study is to look at the gender enrollment trends of a high school PLTW Biomedical Science program in the Midwest. Using role theory and a mixed methods explanatory sequential approach, quantitative data will be analyzed via Qualtrics surveys. Chi-square tests comparing the males in biomedical science courses and those who are not will be run on their GPA, sports, clubs, jobs, volunteering, and parental college education. Qualitative data collected via interviews will be transcribed and coded to conclude the reason for a lack of males in the biomed program. It is the

hope to not only know where all the males have gone in a Midwestern high school, but why. If the United States is going to continue to be a global force in the science workforce, we must find answers.

CHAPTER 2:

PRACTITIONER SETTING FOR THE STUDY

Southeast High School (SEHS) is a public high school located in the Midwestern United States. This high school is found in the rural community of Southeast (pseudonym). Southeast is comprised of 89.7% white, 6.4% black, .6% American Indian, .4% Asian, and 1.6 % Hispanic (US Census Bureau, 2017). The median household income from 2012-2016 was $41,649. The lone public high school in Southeast, SEHS, has a student population of approximately 1,153. The student body closely correlates to the population of the city with 93.3% being white (State Department of Elementary and Secondary Education, 2018).

History of Organization

Southeast is a high school of nearly 1,200 students. Located in the Midwestern region of the United States, it is the lone public school that serves Southeast -- a city with nearly 19,000 citizens that serves as its county's seat of government (US Census Bureau, 2018). Southeast is one of over 24,000 public secondary schools across the United States (National Center for Educational Statistics, 2018). Established in the late 1800's, Southeast High School emerged, along with thousands of other secondary schools, as a product of late 19th century progressive philosophies. One of the leading intellectuals of that period, John Dewey, wrote "to prepare him for the future life means to give him command of himself; it means so to train him that he will have the full and ready use of all his capacities" (Dewey, 1897, p. 79). Over 120 years later, the mission statement of the Southeast School District still drips of Dewey, stating that Southeast strives "to provide progressive learning environments that foster quality and excellence for all

students and assures them an opportunity to become literate, skilled, creative, confident, healthy and caring individuals prepared for life, work, citizenship and change" (Southeast School District, 2021).

Southeast, a city of tradition and progress, experienced slow growth from its founding around the turn of the 19th century. The city's population eventually grew, mirroring a national trend of the times, as cities across the United States swelled with immigrants and westward migrants. To meet the demands of their growing communities, new public and parochial schools formed. In Southeast alone, three new schools emerged: a Lutheran school, Catholic school, and Southeast Public School. Each of these institutions were forged from the same philosophical crucible that had spawned Dewey's declaration that schools should be preparing students for the future.

The future for Southeast students near the turn of the 20th century, like it was for countless students across the Midwestern manufacturing belt of the United States, was a labor intensive job. Southeast is situated among scores of towns whose very existences are owed to the rich vein of lead buried underground. While Southeast was not among the cities that lived and died as mining towns, its character as a blue collar community was shaped by proximity. The region's long history of predominantly manual labor, has likely slowed the pace of economic change in and around Southeast. As the American economy has steadily transitioned away from blue collar occupations toward white collar employment, the remnants of past professions have rusted, and traditional dreams of advancing in an industrial job have busted. The people of Southeast, the city of tradition and progress, and the citizens of towns like it across the Midwest, are mired with a

"traditional" manufacturing mindset, and have largely missed the "progress" that have reworked the American economy.

Among the biggest shifts in the American workplace over the past several decades has been the shift to white collar work, and the subsequent requirements of employers to attain increasing levels of post-secondary schooling. Occupations in STEM fields often require specialized college degrees. As of 2017, only 18.5% of residents of Southeast had a bachelor's degree or higher -- substantially less than the Missouri (28.2%) and U.S. (30.9%) averages (US Census Bureau, 2017). Because of its relative position of prestige compared to neighboring towns (the county average is 13.3%), many Southeasterners are likely not aware of their community's greater educational shortcomings. Students at SEHS are less likely to go to graduate from college than their state and national counterparts.

Organizational Analysis

Southeast High School is known to be one of the best schools for a child to receive a quality education in the area. The school district consistently updates and upgrades their facilities, offers cutting edge technology, implements beneficial programs, and lures faculty and staff with higher pay than neighboring districts. Over the past few years, the high school has seen a shift from the structural frame to that of a human resource frame. The high school was once run like a machine, delegating roles, setting goals, pushing policies, and incorporating technology. Although those concepts are still key to the success of Southeast, the high school has shifted its organization to more of a family. The high school has begun focusing on the needs, skills, and relationships of its staff and students. Within the past few years, students have been given a voice and have

been empowered to take a seat at the table. They have been placed on leadership committees and in partnerships with teachers and community members.

Looking at SEHS through the human resource frame, one can see the empowerment given to students based on the abundance of student-centered programs and organizations. SEHS offers numerous clubs, extracurricular activities, and sports opportunities. The clubs include: Air Force Junior ROTC, Art Club, Band, Black Knight TV Studios (BKTV), Card Players Club, Cheer, Chess Club, Choir, Crocheting Club, Embrace Equality, ESports Club, Family Career and Community Leaders of America (FCCLA), Fellowship of Christian Athletes (FCA), Future Business Leaders of America (FBLA), Future Farmers of America (FFA), Gateway Readers Club, Girls Only Science Club (GOSC), Guitar Club, Health Occupation Students of America (HOSA), Key Club, Knight Life (school paper), Knightline, Knights in Review (yearbook), Leadership, National Honor Society, Project Lead the Way Biomedical Science, Project Lead the Way Computer Science, Project Lead the Way Engineering, Robotics, Scholar Bowl, Speech and Debate, Standing on Scripture (SOS), Student Council, Technology Student Association (TSA),Theatre Guild, Winter guard, and World Café.

There are also a variety of sports available for students to participate in after school. The fall sports include: boys and girls cross country, boys football, girls golf, boys soccer, girls softball, boys swimming, girls tennis, and girls volleyball. Winter sports consist of boys and girls basketball, girls swimming, and boys and girls wrestling. Lastly, spring sports include: boys baseball, boys golf, girls soccer, boys tennis, and girls and boys track.

In addition to the numerous organizations and sports offered at SEHS, there are other characteristics that make SEHS standout among other high schools. SEHS offers many college credit courses for dual credit through multiple colleges and universities. Students can graduate with their 42 hour block or Associate of Arts degree while also working on their high school credit requirements. Certification in Emergency Medical Responder (EMR), Child Development Associate (CDA), Certified Nurse Assistant (CNA), as well as work experience programs are available to all students. New partnerships with local manufacturing companies are also providing students with school to work programs in jobs such as welding. The high school also facilitates a local bank inside of its walls where students learn the ins and outs of bank telling. There is a fully functioning coffee shop that is run by special needs students and their teachers. During lunch, the FBLA students open a school store and learn how to market and operate their business by selling snacks, drinks, and school spirit items. A technology help desk operates throughout the day and employs students with an interest in computers and technology. SEHS also boasts a Junior Reserve Officer's Training Corps (JROTC) program that provides leadership and training to students who have an interest in going into the military. The Future Farmers of America (FFA) program is also available for students seeking a career in agriculture. And if that were not evidence enough, SEHS is the only certified PLTW Biomedical Science School in its part of the state. Students are able to earn college credit in Biomedical Sciences while taking rigorous courses that have never been seen before by the likes of high school students. The rigorous STEM lessons and expensive equipment used are normally not encountered until college or even medical school. All of these things and more are available to students at SEHS.

With the many programs and activities available at SEHS, some students still struggle to find their niche. That is why each teacher is responsible for building relationships in their homeroom class. This class meets every day during 4th hour and gives the teacher a chance to create a family-like atmosphere. Most students find this time of day to be stress-free and a chance to relax for a moment. Teachers often check student grades, ask how they are doing, have food days, birthday celebrations, or simply give the students a chance to catch up on homework or listen to music.

Leadership Analysis

None of this would be possible without a strong relationship between the students, teachers, and staff with its leaders. The Southeast School District is led by an executive cabinet that includes a Superintendent, Associate Superintendent, Director of Business Services, Director of Operations, Director of Technology, Director of Elementary Education, Director of Special Services, and Board Secretary. SEHS falls under the authority of the Superintendent, who oversees all school operations and the Associate Superintendent, who is responsible for secondary education. Within the Southeast School District, there are eleven principals or assistant principals. There is one kindergarten building, three elementary schools for grades 1-4, an intermediate building for grades 5-6, a middle school for grades 7-8, and lastly a high school that includes grades 9-12. The kindergarten building and two of the three elementaries are led by females. The intermediate school consists of a male principal and female assistant principal while the middle school has two males at the helm. At SEHS, the newly elected principal is a female and her two assistant principals include a male and female. There is also a Juvenile Detention Center that spans all grade levels.

Ten additional personnel make up the administrative team. They include: Instructional Practices Coordinator, District Testing Coordinator, Director of Student Options and Alternative Programs, Parents as Teachers Coordinator, Athletics/Activities Director, Safety Director, Transportation Manager, Food Service Manager, Maintenance/Custodial Manager, and Innovation and Communications Director.

The current principal of SEHS is an alumnus herself. She not only attended high school at SEHS, but has worked at SEHS her entire career of 22 years. She began as an English teacher, and later took on roles such as Student Council sponsor, Scholar Bowl coach, Dean of Students, Assistant Principal, and eventually became Principal during the 2018-2019 school year. In her second year as building principal, she brings a sense of stability and connectedness to the faculty with her longevity and experience. As a hometown girl who invests all her time and energy into the school, she is largely trusted and is often lending an ear to concerns or questions. This authentic leadership can be defined in a few different ways. An authentic leader exhibits genuine leadership, is relational to others, and is developed over time (Northouse, 2015).

Implications for Research

If the United States aspires to remain an economic powerhouse in the global marketplace, there must be a push for more science, technology, engineering, and mathematics degrees. Although PLTW is seeing an overall increase in students enrolled in STEM courses, there is an obvious gender discrepancy in the classroom. With an increase in STEM related jobs, school districts must look at the gender enrollment trends in their PLTW Biomedical Science programs to figure out how to create the supply to the demand. How can schools creatively look for ways to increase enrollment numbers and

provide equitable opportunities for both males and females? This research may not only impact STEM programs at the high school level, but may create policy change at the elementary school, middle school, and collegiate level.

By identifying why male students are not taking Biomedical Science courses at the same rate as females, the administration can take action to address the discrepancies. Biomedical Science teachers and counselors may need to make adjustments in the recruitment and selection process in order to draw in more males. On the flip side, it would be ideal to understand why females, though participating more in high school programs, are receiving fewer STEM jobs after college as compared to their male counterparts.

Summary

SEHS is a public high school located in the Midwestern United States offering a PLTW Biomedical Science program. SEHS, a school of approximately 1200 students and led by an authentic leader, is the lone high school in Southeast. Southeast is a city of tradition and progress, and the citizens of towns like it across the Midwest, are mired with a “traditional” manufacturing mindset, and have largely missed the “progress” that have reworked the American economy. Though one of the best schools in its area, offering numerous clubs, organizations, and extracurricular activities to its students, SEHS has become the site of a female dominated biomedical science program. It is the hope to figure out what the gender enrollment trends in biomedical sciences courses are and what factors are contributing to the trends.

CHAPTER 3:

SCHOLARLY REVIEW FOR THE STUDY

Introduction

The literature on the gender gap in Science, Technology, Engineering, and Mathematics (STEM) education is quite clear. Decades of research has shown that females lag behind their male counterparts in these areas. Despite the preponderance of evidence identifying a gender-gap detrimental to girls, an unusual phenomenon to the contrary has emerged in specific STEM courses across much of the Midwestern United States. Not only are girls gaining ground, boys are beginning to lag behind, even in some courses that they have traditionally dominated. These brand new trends have manifested in various STEM courses, but are most acutely concentrated in the field of Biomedicine--and they may turn the existing literature on its head.

The American academic Charles W. Eliot (1869) wrote, “What can I do with my boy? I can afford, and am glad, to give him the best training to be had. I should be proud to have him turn out...a learned man; but I don’t think he has the making of that in him. I want to give him a practical education; one that will prepare him, better than I was prepared, to follow...any...active calling. The classical schools and the colleges do not offer what I want. Where can I put him?” (p.1). Eliot’s questioning certainly captured the zeitgeist of education in America; the article helped catapult him to the presidency of Harvard University.

In the same essay, which he wrote for the Atlantic Monthly, Eliot was contemplating the role of males in American academia. He wrote, “A system of education which attracts no great number of boys, which unites its disciples in no strong

bonds of common associations and good-fellowship, and which, after years of trial, is not highly organized … has no strong hold upon the community in which it exists" (p.3). In these two quotes, Elliot identified something timeless but elusive: that in order to influence students and their communities, an educational system must attract pupils by being practical, preparing them for an uncertain future.

One hundred fifty years later, Eliot's point appears permanently prescient. Boys are confused, and as a result are lagging further and further behind their female counterparts in U.S. public schools. Girls have made methodical advances for generations in academia, and so it comes as no surprise that by many metrics, female students outperform their male peers (National Center for Educational Statistics, 2016). In a study by the American Psychological Association that spans nearly 100 years (1914-2011), researchers determined that girls make higher grades than boys in all school subjects -- a trend goes back decades. Daniel Voyer and Susan Voyer (2014) assert that this historical trend debunks the current claims of a "boy crisis" in education. That assertion is naive. To ignore this issue is irresponsible, as poor male performance in secondary schools has metastasized beyond the halls of the high school.

The National Center for Education Statistics (NCES), a branch of the U.S. Department of Education, has been collecting data on the high school dropout rate in the United States since 1972. Not surprisingly, the data from this five-decade longitudinal study revealed a general decline in the overall dropout rate. Surprisingly though, dropout rates have spiked in the years since 2010, and male dropout rates have risen more sharply than female. Between 2010 and 2017, the female dropout rate rose 1.0%, while the male dropout rate rose 2.4% (NCES, 2017). At those rates, about 75,000 girls, and 180,000

boys dropout of high school each year. Dropping out has ramifications that go well beyond a diploma; Dianda (2008) revealed that over 40% of state and federal inmates are high school dropouts, and according to the Federal Bureau of Prisons, nearly 93% of the inmate population in the United States is male. While dropping out and locking up, is certainly not the norm, many more male students have demonstrated academic apathy toward post-secondary education.

Female dominance is now well established at the university level. Marcus (2017) writes that men once went to college in proportions far higher than women--58% to 42% as recently as the 1970s. That ratio has now reversed. According to the U.S. Department of Education, women comprised more than 56% of students on campuses nationwide. Some universities are actually adding androcentric activities to recruit more men to their campuses (Marcus, 2017). For over a half-century now, the American male has been fleeing academia.

Researchers acknowledge there has been a significant and sustained shift in the roles that males and females play in society. More specifically, the educational landscape of males and females in the classroom is changing along with societal expectations. Across the United States, almost 2.10 million female students from the Class of 2013 took at least one AP test, while only 1.75 million male students did the same, meaning just 46% of test takers were male (Kennedy, 2018). These trends are also present in the enrollment data in STEM programs like Project Lead the Way (PLTW) Biomedical Science. A University of Texas study using data from 2006-2011 found PLTW female participation in the state increased, rising at a clip 201% faster than male participation

(Van Overshelde, 2013). Educational leaders have yet to fully identify this trend, much less address it.

Past studies have rightly looked at the importance of STEM education and recruitment of females, but have failed to address an emerging trend. Research shows an abundance of empowered females venturing into male territory, but disregards the gaping holes left behind by males fleeing academia. The purpose of this study is to look into that academic void; it will examine the gender trends of Project Lead the Way biomedical science courses offered at high schools in the Midwest, and why they are in such stark contrast with the prevailing literature. In particular, this study will focus on differences between males who choose to seek rigorous coursework and those who do not. Why does this disparity exist? What factors have contributed to this trend? To what extent are the issues rooted in psychology, history, or social changes in modern America? What are the effects of these trends? These questions will be examined through role theory: socialization, stereotype, and peer influence.

A Primer on STEM Education and Occupations

Science, technology, engineering, and mathematics (STEM) workers are driving our nation's innovation and global competitiveness (Van Overschelde, 2013). Between 2008-2018, growth in STEM-related jobs was expected to increase by 20%, twice the growth rate of non-STEM workers (Van Overschelde, 2013). This suggests an obvious need to educate more students in STEM fields. In general, students who attend college and obtain degrees are more likely to secure jobs. In the years following the Great Recession of 2008, 11.6 million jobs have been created, of which 8.4 million were awarded to those with at least a bachelor's degree (Semuels, 2017). The significance of

that statistic is staggering; during the 2017 academic year, some 2.2 million fewer men than women were enrolled in college (Marcus, 2017).

However, when looking at STEM occupations, it shows a long-standing gender gap in the opposite direction -- the underrepresentation of females. In 2012, 42% of males vs. 36% of females ages 25 to 34 majored in STEM fields (NCES, 2016). Beede (2011) reported that in 2011, less than 25 percent of STEM jobs were held by women. Just five years later, the NCES reported that 47% of female STEM graduates were employed in STEM occupations (NCES, 2016). Clearly, female's working in the field is on the rise. However, despite decades of effort to level the male-dominated STEM playing field, a gender gap remains.

Surprisingly, this does not appear to be the case in high schools in the Midwest. Females are outnumbering males not only in STEM classrooms, but in other high school college credit courses. If the United States is to remain a leader in the global economy, we must produce more STEM graduates. To be well-rounded, this requires the gender makeup of both males and females in the workforce. How can females appear to be dominating STEM classrooms at the high school level and overall college graduation rates, yet still fall behind in STEM college degrees? In contrast, how can males appear to be lagging behind in STEM majors in high school but dominate the STEM workforce post college? What is it about the modern educational system in which the young male population is struggling?

Biomedical Science and Healthcare Occupations

STEM can encompass a broad range of college degrees and occupations. The Bureau of Labor Statistics (2020) classifies STEM occupations as computer,

mathematical, architectural, engineering, life science, physical science, and managerial or post-secondary teaching occupations related to these areas. The median annual wage for STEM occupations in 2019 was $86,980 while non-STEM jobs was $38,160 (Bureau of Labor Statistics, 2020). The total employment in the U.S. is projected to grow to 161 million over the 2012-2022 decade. Of the 818 occupations as published by the Bureau of Labor Statistics, 667 are projected to add jobs. Some of the fastest projected growth will occur in healthcare, healthcare support…and personal care fields (Bureau of Labor Statistics, 2013). This is good news for PLTW Biomedical Science students.

Women hold 76% of all health care jobs and have driven 80% of the overall growth in the booming health care field since the turn of the century (Cheeseman-Day & Christnacht, 2019). The number of full-time, year-round healthcare occupations has nearly doubled since 2000, increasing from 5 million to 9 million workers. (Cheeseman-Day & Christnacht, 2019). Women account for three-quarters of these workers. Some of these occupations, once dominated by men, have seen a surge of women step into the role. Women have increased their participation in record numbers in health care occupations that require higher education, including dentists, optometrists, pharmacists, physicians/surgeons, and veterinarians (Cheeseman-Day & Christnacht, 2019). Of the approximately 763,000 full-time physicians/surgeons in the U.S., a third are female. Women now make up the majority of veterinarians and pharmacists. Strong gains have also been made in occupations such as dentistry and optometry, although men still account for more than half of dentists, optometrists, EMT/paramedics, and physicians/surgeons (Cheeseman-Day & Christnacht, 2019). It is commonly known midwives, speech pathologists, dental assistants, and medical assistants are favored by

females. Women account for 90% of these healthcare occupations (Cheeseman-Day & Christnact, 2019). Another obvious gender gap includes registered nurses. Women make up more than 85% of workers as nurses and home health aides.

An abundance of healthcare jobs are available that allow for a variety of biomedical science skill sets. The U.S. News and World Report (2021) ranked the best health care jobs in the United States. The occupations were rated based on median salary, unemployment rate, growth volume, growth percentage, future job prospects, stress level, and work-life balance. The top ten are listed as follows: 1. Physician Assistant, 2. Nurse Practitioner, 3. Physician, 4. Speech-Language Pathologist, 5. Dentist, 6. Veterinarian, 7. Orthodontist, 8. Anesthesiologist, 9. Oral and Maxillofacial Surgeon, and 10. Occupational Therapist

Even more newsworthy, in January of 2021 with Covid cases on the decline, the U.S. News and World Report unveiled the overall best jobs for the new year. At a time when health care is more critical than ever, 42 of the 100 best jobs were in health care or health care support roles (U.S. News & World Report, 2021). Once again, the list was created based on criteria such as growth potential, work-life balance, and salary. The top ten to make the list included: 1. Physician Assistant, 2. Software Developer, 3. Nurse Practitioner, 4. Medical and Health Services Manager, 5. Physician. 6. Statistician, 7. Speech Language Pathologist, 8. Data Scientist, 9. Dentist, and 10. Veterinarian. One thing the global pandemic has reinforced is the need for health care professionals (U.S. News & World Report, 2021).

Most of the same occupations topped the U.S. News and World Report top STEM jobs as well. They included: 1. Physician Assistant, 2. Software Developer, 3.Nurse

Practitioner, 4. Medical and Health Services Manager, 5. Statistician, 6. Data Scientist, 7. Dentist, 8. Orthodontist, 9. IT Manager, and 10. Information Security Analyst. For students competent in STEM fields, these trends forecast an optimistic future. Those ill-equipped in these growth fields face an less certain occupational future. If these STEM jobs (especially medicine) continue to be gendered, boys face an uphill climb in the fastest growing job market. Part of this increasing disparity can be attributed to shifting gender norms and roles in American society.

An Overview of Role Theory

The definition of role theory was shaped by social psychologists, sociologists, and anthropologists in the late 1920s and early 1930s. Role theory is defined in various ways by theorists George Mead, Talcott Parsons, and Ralph Linton. Mead, an eminent social psychologist, says the development of roles is essential to socialization and the development of one's self (Biddle, 1979). Mead believes only certain people can influence our view of self and as we grow up our thoughts of what others believe is more important. The "I", our response to what society thinks, and the "me" society views, are part of the nature of one's self (Mead and Morris, 1934).

Parson's version of role theory explains the key concepts to which a society functions. His idea of structural functionalism not only focuses on society as a whole, but that each part of society positively contributes. The theory also states these parts work in equilibrium, without conflict, and in an orderly manner. As the society grows and becomes more complex, the evolutionary change is embraced and occurs slowly, and steadily over time.

Rostow (1953) reviews Parson's work, saying men act in relation to their environment to maximize their gratification or minimize their deprivation. He also states there are primitive drives which man seeks to satisfy. He believes seeking gratification and avoiding deprivation involves a choice that is largely man-made, "a product of the prior action of men crystallized into their culture and social system, and built early into the mind, heart, and soul, of the individual, or if you like, the nervous system." (Rostow, 1953, p.533).

Anthropologist, Ralph Linton, sees roles as units of culture and assumes roles are constant throughout society (Biddle, 1979). Linton believes status is merely a position in society and roles are behaviors associated with the status. These three theorists, Mead, Parsons, and Linton; although they contribute differently to role theory, have one thing in common. They are all concerned at looking at humanity and the patterned behaviors we exhibit -- the roles we play. Due to various interpretations, role theory has been used in diverse ways. Role theory has been applied to many research topics such as consensus, conformity, role conflict, and empathy. Role theory can be applied to small groups, families, communities, classrooms, formal organizations, and counseling (Biddle, 1979). In one study, role theory was used to assess over sixty teachers in twelve different schools in Arizona. The research looked at actual teacher behavior while performing the role of teacher (Beezer, 1974). Role theory can also be used to frame the roles males and females play in high school STEM classrooms.

Additionally, role theorist Bruce Biddle, contributed for his work in psychology and sociology. Biddle (1986) says most versions of role theory presume that expectations are the major generators of roles, are learned through experience, and that people are

aware of the expectations they hold. He also explains human beings behave in ways that are different and predictable depending on their social identities and situations. When one visualizes the roles played by boys and girls in the United States, it is nearly impossible not to identify boys as being masculine and girls as feminine. Boys play outside in the dirt, race bicycles, and compete in sports such as baseball, basketball, and football. Girls are seen wearing dresses, playing school, house, or having tea parties with an abundance of dolls and stuffed animals (Eliot, 2010). Bredemeier (1955) says social systems evolve some mechanism for sorting their members into the functional roles for which they are comparatively best fitted. Are women best-fitted for their roles as nurturers and caretakers of the children and the home? Are men the strong leaders of the family, showing their worth by financially supporting a family with a job that demands strength and grit? As a society, it is obvious to see the evolution of gender roles in the United States.

Factors Contributing to a Gender Gap in Biomedical Classrooms

Why should educators care about gender discrepancies in the classroom? While there are numerous studies on the gender gap in education and the ways in which males and females learn differently, there is still much more to investigate and research. There is a plethora of literature on the psychological and sociological influence of how and who American schools educate. Specific political events and general historical trends have shaped gender and education policy that still matter today. How does this disparate literature help explain the dearth of males in medicine?

Biddle (1986) says the concept of role is one of the most popular ideas in the social sciences. He says perceived expectations generate the roles that people play.

Expectations have altered drastically, which has befuddled both sexes to some degree. There is a level of confusion of what is expected out of a man and a woman. Men are confused because our society has not established new roles for them. What it means to be a man is in flux. What is means to be a woman is in flux.

The effect of psychology. Claudia Buchmann and Thomas Diprete, authors of "In The Rise of Women: The Growing Gender Gap in Education and What It Means for American Schools" (2013) have been leading researchers in examining the societal changes and gender trends that have created educational advantages for women. By 2010, women in their mid-twenties surpassed their male counterparts in earning college degrees by more than eight percentage points (Buchmann & Diprete, 2013). They found girls show higher levels of persistence and self-control as early as kindergarten and derive more intrinsic gratification on a daily basis. Girls enter kindergarten more prepared, aim to please parents and teachers, and have more social and behavioral skills for success compared to boys at an early age (Semuels, 2017). Buchmann and Diprete (2013) feel boys may be more susceptible to instant gratification and have a hard time tackling and paying for a college degree when they know there are decent jobs readily available.

A recent study by the Organization for Economic Cooperation and Development (OECD) found countries that empower women are less likely to choose math and science professions (Khazan, 2018). Also, nations like Jordan, Qatar, and the United Arab Emirates that traditionally are less gender equal have more women in science and technology than their gender progressive counterparts (Khazan, 2018). The more gender-equal the country, as measured by the World Economic Forum's Global Gender Gap Index, the larger the gap between boys and girls love of science (Khazan, 2018).

Countries that produced the most female college graduates in fields such as STEM, were some of the least gender-equal countries (Khazan, 2018). The implications of this study are interesting when applied to the United States. The OECD data suggest that an increase in female STEM participation is actually an indicator of societal inequality.

The effect of society. For most of the 20th century, American education served a clear and obvious function---to prepare most young people to be laborers. It prepared them with the skills necessary to succeed in the industrial workforce: promptness, discipline, respect, obedience. School served an obvious, manifest function of preparing students for work. That preparation produced a populace perfectly suited for the economy of the 1900s, but not 2021. The American Industrial economy has rusted-out, but the chassis of the American educational structure remains largely the same. Many students have a hard time seeing the connection between their coursework and their desired work. The economy has changed so much that there is a dysfunction between what school offers and what is expected by employers.

Boys struggle with their masculine identity and an attachment to school (Buchmann & Diprete, 2013). They are pressured to be "masculine" -- especially in lower-income or working class families (Semuels, 2017). They see doing well in school as something only girls do. If a boy has a male role model in his family that works a physically demanding or blue-collar job, he is more likely to not want any part of doing well in school (Semuels, 2017). However, if boys have role models that are educated, they are taught a different concept of masculinity and therefore do better in school (Semuels, 2017).

In society as a whole, males and females have historically defined, deep-seated roles. Marcus (2017) discovered that Carlow University, among other institutions, is struggling to attract more men to its campus. They are adding sports teams, marketing more men in promotional photos, and providing new degree programs such as business majors to appeal to men. Some researchers believe the problem to attract and keep men in college is problematic as early as primary school and fueled by forces that discourage the belief that a degree is worthy of time and money (Marcus, 2017). Some argue that boys are slower to learn than girls and may lose interest early on in their education. Others feel boys in America do not see successful male role models who attended college (Marcus, 2017). And yet others believe males have more choices and would rather make just as much money by completing an 18 month vocational program (Marcus, 2017).

Gender Gaps Around the Globe

A study by Boda, Raabe, and Stadtfeld (2019) on nearly 5,000 students from Sweden, observed the widening gender gap of preferences to STEM subjects over the course of a year. They found strong evidence that students adjust their preference to those of friends (peer influence) and will like STEM subjects more if other females develop a similar preference (peer exposure). Boda, Raabe, and Stadtfeld (2019) say early-life socialization happens mostly within the family, but as the child grows older, the role of peers becomes more important. With more boys than girls interested in STEM, gender differences continuously grow during adolescence and adulthood (Boda, Raabe, & Stadtfeld, 2019). Adolescence is an important time of life, not only because of peer socialization, which implies long lasting attitudes, norms, and values, but because it is the time when life choices are made regarding their career (Boda et al., 2019).

Martin and Reinking (2018) found that there are three theories that have contributed to a gender gap in STEM: socialization, stereotypes, and peer influence. Some researchers believe a gender gap is present in the United States and other countries in response to stereotypes and socialization practices that focus on male dominance and female submission. Others believe it is due to the stereotypical characteristics of STEM professionals. They may be viewed as being nerdy, awkward, or introverted. In one study, researchers found that the students' stereotypes of the culture of the STEM field steered them away. Professionals appeared to be more male-oriented and the profession seemed to involve characteristics of social isolation (Martin & Reinking, 2018). Girls are social butterflies and do not value social isolation. And lastly, the strength of a peer group during adolescence can greatly influence or deter female individuals to take STEM courses (Martin & Reinking, 2018).

The Significance of STEM

Why should educators care about STEM coursework? There has been a push for science education reform in the United States. Project Lead the Way is a STEM-focused curriculum program designed to prepare middle and high school students for the global economy (Tai, 2012). This nationwide nonprofit program headquartered in Indianapolis, is offering courses from kindergarten through high school. "Begun in New York in 1997, PLTW has experienced consistent growth with courses now offered in over 2,700 schools in all 50 states. Enrollment in PLTW is now estimated at 500,000 students, with 53,600 students added during the 2010-11 school year alone." (Van Overshelde, 2013, p.1). PLTW uses an APB approach which consists of activity, project, and problem based scenarios. Students are provided with real-world, hands-on activities that enables them to

work independently and collaboratively to identify problems and find solutions. PLTW (2019) believes all students, beginning at a young age, need access to real-world, applied learning experiences that will empower and provide skills to thrive in college and careers. In a longitudinal, international study, roughly 5,000 students were tracked from high school through college. The students reported positive classroom experiences and the ability to relate and apply content as contributing factors to completing a college degree in STEM (Tai, 2012). Although there have been a number of studies on project-based learning, including several on PLTW, very few have addressed the gender trends of PLTW courses.

In 2009, state leaders came together to establish the Common Core State Standards (CCSS) for kindergarten through twelfth (K-12) grade students (Common Core State Standards Initiative, 2012). This initiative was aimed at providing robust and relevant real world problems to prepare students for college and their careers. Then in 2013, the Next Generation Science Standards (NGSS) were developed to improve specific K-12 science content and set expectations for what students should know and do (Next Generation Science Standards, 2013). These initiatives, although different, have the same goal of establishing educational standards for students. The Next Generation Science Standards (2013) believes that with a high quality science education, students will develop an in-depth understanding of content and key skills that will serve them throughout their lives. Godfrey and Kaliski (2014) say the more advanced courses a student takes in high school, the more likely he or she is to graduate college.

Summary

There has been a shift in the roles males and females play in society. This study acknowledges once predominantly male heavy classrooms are now flooded with females. The noticeable presence of females in PLTW Biomedical Science programs in the Midwest and the glaring lack of male counterparts in the same programs has researchers questioning where all the males have gone. By looking at the gender trends, factors affecting the trends, and the effect of these trends, educators can have a better understanding of how to deal with the changing landscape. With studies showing those students with college degrees are more likely to land a job in today's economy, especially in STEM, more research needs to be conducted to figure out what males are doing in place of taking these courses and why?

CHAPTER 4:

CONTRIBUTION TO PRACTICE

Introduction

Southeast, a city of tradition and progress, has continued to grow and thrive from the time of its inception until now. The community has wrapped its loving arms around Southeast School District and has provided an abundance of support to the administration, staff, and students that walk through its doors. Southeast High School is known to be one of the best schools in the area to receive a quality education. Other school districts often look at Southeast and model their ideas, decisions, and programs to meet their own needs. In 2013, Southeast High School started the first PLTW Biomedical Science program in the region. Word spread quickly into the community about the new biomed courses being offered at the high school. The largest hospital in the county began to take notice and was interested in how to bring these future health care professionals back to the area to work in the rural community after they graduate from college. This program evaluation helps to identify potential reasons for the lack of males in the biomedical science classroom. The analysis of the program can offer insight to help the administrators, counselors, and biomedical science teachers to better recruit and train males for a future in healthcare. Not only would the school benefit from the gender diversity and increase in male participation, but the community that raised these young people as well.

In addition, understanding the gender gaps in the biomed program can be shared with thousands of schools in all 50 states, tens of thousands of teachers, and millions of students who are also invested in the PLTW community. The researcher could potentially

network by presenting the research with other PLTW teachers at the state and national PLTW Conferences. Identifying reasons that affect male participation in the biomed program helps school districts decide best practices to recruit incoming students. This information could provide valuable, equitable changes to the admittance process. This self-reflection allows the stakeholders to find ways to improve upon not only its recruitment and current performance of its program, but its relevance to getting a job in the real world. This could potentially change the life course of its young people in rural areas such as Southeast, but urban cities across the United States as well.

Statement of the Problem

When looking at the ratio of females to males sitting in a high school biomedical science classes, it is somewhat mind boggling. The females outnumber the males roughly 8:1 depending on the class. “Where have all the males gone?”. As a high school biomed teacher, I did not think too much of the gender enrollment during the first year or two. Then after a few years, I started to take note. There were very few males taking the rigorous PLTW Biomedical Science Program. I can recall attending a Health Occupations Students of American (HOSA) state conference and chatting with other PLTW Biomedical Science teachers. The stories kept coming and kept coming. Each teacher told the same story. There were very few males in their biomed program. We talked with each other about the location of our schools, demographic data, how we recruit, and the process to get into the program. Regardless of the minor differences, we all had the same problem and no one had an answer. There were several other moments I can remember where others were taking notice of the males in my classroom. During our annual 8th grade tours where I would proudly pitch my biomed program to future high school

students. A few of the teachers would ask, “Where are all the guys?”. In addition, when the school administrators would perform their walk through or would show other school district administrators around to view our program. They asked the exact same questions. “Do any boys take these classes?”. I knew in those instances I needed to figure out why, we as educators, were struggling to fill our classes with an equal number of male students and how we were going to remedy the situation.

The gap in knowledge that exists in this research may contribute to better understanding the gender imbalance of males taking rigorous courses such as PLTW Biomedical Science. Valuable insight into the problem may be provided by further research of male participation in rigorous high school courses.

Evaluation Approach and Methods

The setting for the study was Southeast High School (SEHS), a school in the Midwestern region of the United States in the city of Southeast. SEHS is comprised of approximately 1,153 students who are predominantly white/Caucasian. The research was conducted with a mixed methods approach using a sequential explanatory strategy. More specifically, the strategy of inquiry was a bounded case study of SEHS and its PLTW Biomedical Science program. The quantitative part of the study uses a survey and Chi-square analysis to compare the males in the biomedical science program with those males who are not the biomedical science program. The dependent variables are whether the males were enrolled in the biomed program or not enrolled in the biomed program. The independent variables are GPA, sports, clubs, jobs, volunteering, and parental college attendance. Twenty-five students were surveyed, 14 biomed males and 11 non biomed males. Following the surveys, 4 non biomed males were selected from the group of 11 to

complete an interview. Each of the males selected represented each of the grade levels at the high school. During the interview, they were asked 5 questions to further understand why males do not take the PLTW Biomedical Science program at SEHS. Four major themes emerged from this study: 1. Future orientation, 2) Peer influence for choosing a biomedical pathway, 3) Family influence for choosing a biomedical pathway, 4) Biomedical program should be "fun".

Field (2018) says Pearson's Chi-square test is ideal for identifying relationships between two categorical variables. This statistic is based on comparing frequencies one observes in certain categories to the frequencies one might expect to get in those categories (Field, 2018). For example, is there a difference in GPA for males that take biomed and those who do not? Is there a difference in the number of sports they participate in? Is there a difference in the number of clubs they participate in? Is there a difference in whether they have a job or not? Is there a difference in whether they volunteer or not? Is there a difference in whether one of their parents attended college? A Chi-square test can be used to determine if there is a significant level difference in these categories between biomed males and non-biomed males. The level of statistical significance is determined by the degrees of freedom (n-1) via a Chi-square table. This study uses one degree of freedom due to having two groups (n), biomed males and non-biomed males. Each category was tested for the null hypothesis (there is no difference between males enrolled in PLTW Biomedical Science courses and males not enrolled in PLTW Biomedical Science courses.) Using a Chi-square statistic compared the distribution in the categories with the distribution of the group as a whole.

Survey

Fink (2017) says surveys are means to collect information to describe, compare, or explain individual and societal knowledge, feelings, values, preferences, and behavior. There are at least three good reasons for conducting surveys: a policy needs to be set or a program planned, the effectiveness of a program evaluated, or to get information about how to guide a study or program (Fink, 2017). In this case, surveys were constructed to evaluate the PLTW Biomedical Science program and its ineffectiveness to recruit male students. Is there a difference between males who pursue a biomedical science program and those who do not?

The Project Lead the Way Biomedical Science Male Student Survey (see Appendix A) was created via Qualtrics to be effective, yet efficient. The survey consisted of 10 questions that could be completed quickly. After IRB approval and due to Covid-19 concerns, an electronic copy of the parental consent forms were sent out via email to the parents of 28 males students (14 PLTW biomed males and 14 non PLTW biomed males). Of the 28 forms sent, 25 electronic signatures were collected giving permission (14 biomed and 11 non biomed). Of the participants, 12 were in 9th grade, five were in 10th grade, six were in 11th grade, and two were in 12th grade. The Qualtrics survey was sent via school email to the students. The first question asked for the grade level of the student. This would help in data analysis to understand the possible maturity of the students in their educational journey. The second question asked about GPA. This was to ensure that the researcher had chosen students of academic likeness. The third question was used to differentiate between the two groups of male students. It asked if the student had ever been enrolled in a PLTW Biomedical Science course. The fourth question reiterated the academic likeness of the student by asking if they always did well in

science class. The remaining questions in the survey, addressed each of the additional factors that were to be tested in the research. They included questions on sports, clubs, work, volunteering, plans after high school, and parental college degrees. Data was tabulated using Qualtrics and further analyzed with Excel to complete a Chi Square Analysis.

Findings

This study set out to determine why there are a lack of males taking PLTW Biomedical Science courses in high school. For the purpose of this study, males were put into two categories: those enrolled in a PLTW Biomedical Science program and those not enrolled in a PLTW Biomedical Science program. Of the 25 males who participated in the survey, 14 were biomed students and 11 were not. Multiple chi square tests were run, begging to answer the research question, "What are the differences between males who pursue a biomedical science program and those who do not?". Each sub question consisting of GPA, sports, clubs, working, volunteering, and whether at least one parent attended college was analyzed. The following findings surfaced.

The first variable analyzed was GPA. Sub question one asked if there is a difference in GPA between males who pursue a biomedical science program and those who do not. Students were to select between four choices: above 4.0, 3.0-3.9, 2.0-2.9, or 1.9 or below. Of the twenty-five males, seven had GPAs above 4.0 and 18 had GPAs in the 3.0-3.9 range. The biomed males represented five of the seven above 4.0 while the non-biomed males represented only two of the seven. Although the biomed students appeared to have higher GPAs, every male (regardless of whether they were biomed or not) had a GPA of 3.0 or higher. The data from this question demonstrates the academic

likeness and ability for each male to be a part of the biomed program. Chi-square analysis showed the biomed males as not statistically significant and the non-biomed males as negatively skewed.

The second variable analyzed was sports. Sub question two asked if there is a difference in playing sports between males who pursue a biomedical science program and those who do not. When asked how many sports they were involved in, six did not compete in any sport, seven chose one sport, nine chose two sports, and three chose three sports. Biomed students were mostly involved in sports, while non-biomed students were less involved. Eighty six percent of biomed students played one or more sports while only 64% of non-biomed students played one or more sports. Chi-square analysis showed biomed males as being skewed positively and non-biomed kids being skewed negatively. Both groups were statistically significant.

The third variable analyzed was clubs. Sub question three asked if there is a difference in participation in clubs between males who pursue a biomedical science program and those who do not. The students were asked how many clubs they were involved in at school. They had the option of choosing zero, one to two, three to four, or five or more. Ninety two percent of the entire group chose two or less. The percentages of the two groups in each category were very similar. The data showed biomed males joining clubs at school compared to non-biomed males joining clubs at school to not be significant. Therefore, participation in clubs has no impact on participation of males in a PLTW Biomedical Science program.

The fourth variable analyzed was work. Sub question four asked if there is a difference in working after school between males who pursue a biomedical science program and those who do not. When asked if the students worked after school, seven said yes and 18 said no. Forty three percent of the biomed males said they worked as compared to only nine percent of non-biomed students. Chi-square analysis showed statistical significance with the biomed males to be positively skewed and the non-biomed males negatively skewed. This data shows biomed males are more likely to work after school compared to non-biomed males.

The fifth variable analyzed was volunteering. Sub question five asked if there is a difference in volunteering after school between males who pursue a biomedical science program and those who do not. When asked if the students volunteer after school, nine said yes they did volunteer and 15 said not they did not volunteer. Thirty-six percent of biomed males said they volunteer as compared to 40% of non-biomed males. The Chi-square showed the data was not statistically significant for either group. Therefore, volunteering has no impact on the participation in the PLTW Biomedical Science program.

The sixth variable analyzed was whether at least one parent attended college. Sub question six asked if there is a difference in a parent attending college between males who pursue a biomedical science program and those who do not. When asked if they have at least one parent or guardian with a college degree, all 11 of the non-biomed males said yes. Three of the 14 biomed males reported they did not have at least one parent who attended college. All of the non-biomed males reported having at least one parent attend college. Chi-square analysis showed the biomed group to be positively skewed and

statistically significant while the non-biomed group was not statistically significant. Biomed males were less likely to have at least one parent attend college.

The second research question asked how males perceive the PLTW Biomedical Science program. The qualitative data stemmed from interviews conducted with 4 non-biomed males at Southeast High School. Each male represented a different grade level in the 9-12 high school. The senior male is recognized at participant A, the junior male is participant B, the sophomore male is participant C, and the freshman male is participant D. The 5 question from the interview included: 1. How would you describe yourself as a student at SEHS? 2. What influenced your decision to choose your career pathway? 3. How do you feel the PLTW Biomedical Science program is perceived among students at your high school? 4. Explain why or why not you chose to participate in the PLTW Biomedical Science program. 5. What do you feel might draw more males into the PLTW Biomedical Science program?

How would you describe yourself as a student at SEHS? Each student admitted they were good students who make good grades. Participant D considered himself quiet, gets along with most people, plays basketball, and participates in Student Council. Participant C is a former private school student who felt he is a good student, gets his work done, is kind of quiet, and feels he doesn't really fit in with the cool kids. Two of the students considered themselves quiet while the other two talked about being involved in athletics and working hard to keep their grades up. Participant B described himself as always trying his best, stays caught up with his grades, is very big into sports, and plays football and wrestles. Participant A said he is fairly engaged, keeps his grades up, makes mostly As, is into track and cross country, robotics club, and tries to find a balance

between school and sports. Overall, each student admitted to being a good student who cares about school and strives to make good grades.

What influenced your decision to choose your career pathway? Participant D said he had an interest in zoology. He has loved animals since a young age. If he could not be a Zoologist, he thought he may want to be a basketball coach and teacher. He acknowledged his mom as being an influence in that decision due to her love of teaching. He further added that his mom now has her doctorate and is a school administrator while his dad does not have a college education. He is a self-employed handyman. Participant C spoke of both of his parents being an influence on his life. He is interested in being a lawyer, seeing how he can help everything going on in the world. He added that his mom is a retired special education teacher and his dad works for a natural gas company. At one point in time, he thought about doing something medical or going into law enforcement, but he had recently swayed away from that. Participant B said he was currently leaning towards dentistry. He said he knows a lot of dentists and really finds what they do interesting. No one in his family is a dentist, but he recognized that dentists have good office hours to raise a family. He is a big family guy. This is a big reason why he wants to be a dentist. Participant A knew early on he wanted to be some sort of engineer. He has always been interested in mechanical things and how they work. His mother is a chemical engineer and his dad is a financial planner. He said his mom has influenced his career choice because she took him to the plant she worked at several times when he was younger and he thought it was really neat to see. Overall, the males interviewed in this study were influenced mostly by their parents. The freshman and senior in particular were both influenced by the mother figure in their homes. The sophomore acknowledged the

influence of both of his parents and the junior found the importance of family to ultimately decide his career choice.

How is the PLTW Biomedical Science program perceived among students at SEHS? Participant D admitted he had a lot of friends in the program and that they liked it a lot. He said both males and females enjoyed the program. Participant C thought it sounded interesting in 8th grade, but did not think it would be a good fit for him. He knows of a few people in the program and he says they like biomed. He feels like the program has a good vibe. Participant B did not have a lot of information to add to this question. He said he was never really informed of the program and did not remember visiting during the 8th grade tours. He has no friends in the program. Lastly, Participant A acknowledged he does not know much about the program itself, but said it seems like it is pretty cool. He feels like it is equal to the engineering program he is a part of at SEHS. It seems like a lot of people enjoy it. When asked about the engineering program he said they mainly have males in the program---even the males they have is a fairly low number. His PLTW engineering class has only 4 males. The number of students tends to drop off as classes become more rigorous and have more prerequisites. Overall, the three of the four males agreed that the program has a positive perception among students. The junior male did not have information to add positively or negatively.

Explain why or why not you chose to participate in the PLTW Biomedical Science program. Participant D did not really have a reason other than he just did not want to do the program. He felt like it was only for people going into the medical field. Participant C also felt like it was not part of what he wanted to do in the future. He further mentioned the fact he was coming from the private school with a handful of

others and they were not going to pursue the program. Participant B admitted he did not really know what he wanted to do before he came to the high school. He mentioned not having any friends going into the program so he ultimately decided the program would not be for him. Participant A reiterated he thinks the biomed stuff is pretty cool, but he is more into the mechanical side of things. Engineering is his thing. Overall, three of the four males did not know what they wanted to do or be as an 8th grader coming into the high school, so they did not choose to take the program. The senior was the only one who knew what he wanted to do, which was pursue PLTW engineering. Peer pressure also seemed to play a role in deciding whether or not to do the biomed program. The junior admitted to not doing it because he had no friends doing it.

What do you feel might draw more males into the PLTW Biomedical Science program? Participant D thought wording things differently when introducing the program would help. He feels not very many guys want to be doctors and do something medical, however, if words like fun and experiments are used, more males would join. When further questioned about the application process to get into the program, he felt like some may not apply because they do not meet the criteria. He says a lot of guys get in trouble. He feels it is a stereotype. Participant C struggled to come up with a solution. He thought the school could have a fun event to make the program sound interesting. He mentioned remembering the 8th grade tours and the discussion of a dead body. Those are the kind of things that would draw males in. Participant B said if more guys were doing it, then more guys would join in. He felt males are more immature in middle school and may find it difficult to meet the criteria of the application process. He says males are more worried about other things. When asked what they were more worried about, he said they just

want to have fun. Participant A thought the male brains are just wired differently than female brains. He thinks females find the topic more interesting than males. Overall, the theme of making the course sound more "fun" was mentioned in three of the four interviews. Males appear to be more immature during the age of the application process and do not know what they want to do for their career.

Conclusions and Implications

The study results found statistical significance in sports and work for both biomed and non-biomed males. Statistical significance was also found among non-biomed males in GPA as well as biomed males in parental college attendance. Biomed males have a slightly higher GPA, play more sports, and are more likely to work after school. These males appear to be more involved at school and after school than non-biomed students. This may be attributed to the level of commitment needed to play sports or work a job. The biomed program is rigorous and requires commitment, work ethic, and perseverance. Those attributes could be said of a high school athlete or employee as well. Although not statistically significant, the data showed non-biomed males were more likely to have at least one parent attend college. This could indicate the drive and will power on behalf of the biomed students to want to succeed and excel even though their parents were not able to attend college. Participation in clubs and volunteering did not have any significance in this study. These activities may be something sporadic and does not require a high level of commitment, therefore does not have much of an impact.

Furthermore, males are perceived to be immature at the middle school level. They do not know what they want to do as 8th graders for the rest of their lives. School work is probably not on the top of their priority list as compared to sports, playing video games,

snapping on a cell phone, being outdoors, and just having fun with friends. They follow their peers and have to live up to a stereotype. Male brains are indeed wired differently than females. Girls at that age would be more likely to join the biomed program due to being more mature and wanting to pursue something more rigorous.

A further study might look at a school that has a higher enrollment of male biomed students to see how they have bridged the gender gap. In addition, other schools that offer PLTW could be surveyed to collect more data on the subject matter. A new study could be proposed to see why the male students who are in the biomed program chose the program. Another study could analyze the female population of biomed students to see what enticed such a vast number of them to join the program as opposed to their male counterparts. The process to get into the program could be altered or changed to make the program more equitable for males. Is the application process a deterrent? Do males struggle to fill out an application and interview? The presentation of the program could be introduced differently as to appear to be more "fun" for males. The thought of using PLTW Biomedical Science male role models to help speak about and encourage others to join the program may be helpful. Additional funding could be pursued to help aid additional costs to allow more students into the program.

Action Plan

The number of students that participated in this study was a limiting factor. The biomed program at SEHS encompasses such a small number of males, there was not an abundance of test subjects to work with. Due to Covid 19 and the United States being in the middle of a pandemic, this also made it difficult to secure parental consent forms, administer surveys to students, and conduct interviews. In order to test a larger sample

size, other schools that offer PLTW could administer the same survey. This study would provide more data to analyze to see if the male students at SEHS are like other high school male students. Stakeholders may also consider surveying the entire male population at SEHS to better understand their thoughts on the PLTW Biomedical Science program, careers they are interested in, and what they feel would help encourage more males to attempt the program.

The next steps would entail having a discussion with the stakeholders at SEHS. The committee responsible for selecting the students during their 8th grade year should revisit their protocol to best address the concerns from the research data. Additionally, further cooperation between middle and high school science teachers about how to promote the program would be fruitful. Administrative teams at both middle and high school should further emphasize male participation in the program. The research data should also be shared with other PLTW Biomedical Science teachers, who if willing could further expand on these findings by administering the same survey.

CHAPTER 5:

CONTRIBUTION TO SCHOLARSHIP

In 1965, American folk singer Pete Seeger asked, “Where have all the young men gone? Long time passing. Where have all the young men gone? Long time ago. Where have all the young men gone? When will they ever learn? When will they ever learn?”. The questions that Seeger asked over five decades ago, are prescient today. When Seeger penned those lines, the lecture halls of colleges across the country were full of predominantly male students. It is common knowledge a significant shift has occurred in the role males and females play in society. More specifically, the educational landscape of males and females in the classroom is changing. More females than males are sitting in high school college credit courses, such as Project Lead the Way Biomedical Science, and causing educational leaders to question where all the males have gone.

Women have long aspired to have a seat at the table. Since the 1970’s, academic researchers ignored issues related to gender and leadership (Northouse, 2016). Dramatic changes in American society and increased numbers of women in leadership and academia have fueled the now robust scholarly interest (Northouse, 2016). Since the passing of Title IX, women have been breaking glass ceilings. Over the past few decades, many women have risen to positions of prominence including United Kingdom’s Margaret Thatcher, Germany’s Angela Merkel, and the United States’ Hillary Clinton. They have provided an example for young women such as the former first lady, Michelle Obama, and current Vice President, Kamala Harris, to grasp what was once unreachable. Similarly, the advances by women are also visible in the business world. In 2020, Fortune 500 reported a new high for the number of women running America’s

largest corporations with 37, a new record (Henchliffe, 2020). Unfortunately, even with that record, women only run 7.4% of the 500 businesses in the rankings. Some of these companies include General Motors, Anthem, United Parcel Service, Best Buy, among others. Many of these companies are geared around Science, Technology, Engineering, and Math (STEM). Take the Wojcicki sisters for example. Anne Wojcicki is the co-founder and CEO of 23 and Me, Susan Wojcicki is the CEO of YouTube, and Janet Wojcicki is an anthropologist and epidemiologist with a PhD. From a historical position of inferiority in society, those discriminated against try harder to get out of that despair. Young women across the world, and especially the United States, have taken note. Gender equality has been brought to the forefront, changing the educational landscape.

Science, Technology, Engineering, and Mathematics (STEM) workers are driving our nation's innovation and competitiveness (Van Overchelde, 2013). Between 2008-2018, growth in STEM-related jobs is expected to increase by 20%, twice the growth rate of non-STEM workers (Van Overschelde, 2013). This growth poses a need to educate more students in STEM fields. In general, students who attend college and obtain degrees are more likely to secure jobs. After the Great Recession, of the 11.6 million jobs created, 8.4 million were awarded to those with at least a bachelor's degree (Semuels, 2017). However, when looking at the STEM occupations, it shows a gender gap and underrepresentation of females. In 2012, 42% of males versus 36% percent of females ages 25 to 34 majored in STEM fields (National Center for Educational Statistics, 2016). There was also a slight edge of male STEM graduates, 49% versus 47%, employed in STEM occupations (NCES, 2016). However, this appears to not be the case at a high

school in the Midwest. Females are not only outnumbering males in STEM classrooms, but in other high school college credit courses as well.

While it is common knowledge more males enter STEM fields than women after high school, which appears to defy the trend seen in Project Lead the Way (PLTW) Biomedical Science courses offered at a high school in the Midwest. Project Lead the Way is a STEM-focused curriculum program designed to prepare middle and high school students for the global economy (Tai, 2012). Dr. Vince Bertram, president and CEO of PLTW since 2011, runs the nation's leading provider of STEM programs in K-12 education (Bertram, 2014). As a former school superintendent, principal, and teacher, he has advocated for STEM curriculum before the U.S. House of Representatives and was appointed by the U.S. Department of State as its speaker on STEM education. His goal to solve America's skills gap by using an APB approach which consists of activity, project, and problem based scenarios. Students are provided with real-world, hands-on activities that enables them to work independently and collaboratively to identify problems and find solutions. PLTW (2019) believes all students, beginning at a young age, need access to real-world, applied learning experiences that will empower and provide skills to thrive in college and careers. The PLTW courses offered at the high school level not only include biomedical science, but computer science and engineering as well. Students in the biomedical science pathway are using the same tools as professionals in health-care to tackle big challenges to make the world a better place.

Women hold 76% of all health care jobs and have driven 80% of the overall growth in the booming health care field since the turn of the century (Cheeseman-Day & Christnacht, 2019). The number of full-time, year-round healthcare occupations has

nearly doubled since 2000, increasing from 5 million to 9 million workers. (Cheeseman-Day & Christnacht, 2019). Women account for three-quarters of these workers. PLTW Biomedical Science students will become our future healthcare professionals.

The purpose of the study is to understand why there is a lack of males taking PLTW Biomedical Science courses in a Midwestern high school. Where have all the young men gone? Past studies have rightly looked at the importance of STEM education and recruitment of females, but have failed to address an emerging trend. Research shows an abundance of empowered females venturing into male territory, but the research disregards the gaping holes left behind by males fleeing academia. This case study will examine an academic void and gender trends of PLTW Biomedical Science courses offered at a high school in the Midwest and why they are in such stark contrast with the prevailing literature. Why does this disparity exist? What factors have contributed to this trend? To what extent are the issues rooted in psychology, history, or social changes in modern America? What are the effects of these trends? These questions will be examined through the role theory lens. Under the role theory umbrella, peer groups, socialization, and stereotype threat will be analyzed. A mixed methods approach will be used to identify the number of males pursuing a biomedical science program in a Midwest high school, as well as quantitatively compare differences between males in the biomedical science program and those who are not. Qualitative data via interviews will be gathered to further conclude the reason(s) for the trends and how the males perceive the biomedical science program for a future as a healthcare professional.

The research questions guiding this study are:

RQ 1: What are the differences between males who pursue a biomedical science program and those who do not?

SQ 1: Is there a difference in GPA between males who pursue a biomedical science program and those who do not?

SQ 2: Is there a difference in playing sports between males who pursue a biomedical science program and those who do not?

SQ 3: Is there a difference in participation in clubs between males who pursue a biomedical science program and those who do not?

SQ 4: Is there a difference in working after school between males who pursue a biomedical science program and those who do not?

SQ 5: Is there a difference in volunteering after school between males who pursue a biomedical science program and those who do not?

SQ 6: Is there a difference in a parent attending college between males who pursue a biomedical science program and those who do not?

RQ 2: How do high school males perceive the PLTW Biomedical Science program?

Hypotheses

The researcher of this study will analyze the differences between males who choose to take PLTW Biomedical Science courses and those males who do not choose to take PLTW Biomedical Science courses. The null hypothesis states there is no difference between males enrolled in PLTW Biomedical Science courses and males not enrolled in PLTW Biomedical courses. The alternative hypothesis states there is a difference between males enrolled in PLTW Biomedical Science courses and those not enrolled in PLTW Biomedical Science courses.

Conceptual/ Theoretical Framework

When looking at gender enrollment trends and the factors that contribute to them, the problem can be viewed through the role theory lens. The definition of role theory was shaped by social psychologists, sociologists, and anthropologists in the late 1920s and early 1930s. Role theory is defined in various ways by theorists George H. Mead, Talcott Parsons, and Ralph Linton. Mead, a social psychologist, says role taking is essential to socialization and the development of one's self (Biddle, 1979). He believes only certain people can influence our view of self and as we grow up our thoughts of what others believe is more important. The "I", our response to what society thinks, and the "me", society views, are part of the nature of one's self (Mead and Morris, 1934). Parson's version of role theory explains the key concepts to which a society functions. Structural functionalism not only focuses on society as a whole, but how each of its structures has a role to play in a properly functioning society. The theory also states these parts work in equilibrium, without conflict, and in an orderly manner. As the society grows and becomes more complex, the evolutionary change is embraced and occurs slowly, and steadily over time. Anthropologist, Ralph Linton, sees roles as units of culture and assumes roles are constant throughout society (Biddle, 1979).

Although their definitions of role theory are varied, these theorists have one thing in common. They are all concerned at looking at humanity and the patterned behaviors we exhibit--roles. Due to various interpretations, role theory has been used in diverse ways. Role theory has been applied to many research topics such as consensus, conformity, role conflict, and role taking which can be applied to small groups, families, communities, classrooms, formal organizations, and counseling (Biddle, 1979). Using

role theory, by way of STEM, one can examine the psychological and societal aspects of males in an educational setting.

Role theory involves one of the most important features of social life, characteristic behavior patterns or roles (Biddle, 1986). Socialization, stereotypes, and peer influence are means by which role theory can be viewed from a more modern perspective. Some researchers believe a gender gap exists in STEM fields due to stereotypes and socialization practices in the United States and other countries which focus on male dominance and female submissiveness (Reinking & Martin, 2018). Stereotype threat occurs when a person is at risk for living up to a negative stereotype about their group (Steele & Aronson, 1995). Some researchers believe the gender gap in STEM is linked to the role peer groups play in the academic experiences of students (Crosnoe, Riegle-Crumb, Frank, Field, & Muller, 2008).

Review of Literature

Science, Technology, Engineering, and Mathematics (STEM) capable students are increasing important in the modern world. The existing literature on the gender gap in STEM education is quite clear. Decades of research has shown that females lag behind their male counterparts in these specialized areas. Despite the preponderance of evidence identifying a gender-gap detrimental to girls, an unusual phenomenon to the contrary has emerged in specific STEM courses across much of the Midwestern United States. Not only are girls gaining ground, boys are beginning to lag behind, even in some courses that they have traditionally dominated. These new trends have manifested in various STEM courses, but are most acutely concentrated in the field of Biomedicine.

The Significance of Biomedical Science and Healthcare Occupations

STEM encompasses a broad range of college degrees and occupations. The Bureau of Labor Statistics (2020) classifies STEM occupations as computer, mathematical, architectural, engineering, life science, physical science, and managerial or post-secondary teaching occupations related to these areas. The median annual wage for STEM occupations in 2019 was $86,980 while non-STEM jobs was $38,160 (Bureau of Labor Statistics, 2020). The total employment in the U.S. is projected to grow to 161 million over the 2012-2022 decade. Of the 818 occupations as published by the Bureau of Labor Statistics, 667 are projected to add jobs. Some of the fastest projected growth will occur in healthcare, healthcare support…and personal care fields (Bureau of Labor Statistics, 2013).

Women dominate the medical field. They hold 76% of all health care jobs and have driven 80% of the overall growth in the booming health care field since the turn of the century (Cheeseman-Day & Christnacht, 2019). The number of full-time, year-round healthcare occupations has nearly doubled since 2000, increasing from 5 million to 9 million workers. (Cheeseman-Day & Christnacht, 2019). Women account for three-quarters of these workers. Some of these occupations, once dominated by men, have seen a surge of women step into the role. Women have increased their participation in record numbers in health care occupations that require higher education, including dentists, optometrists, pharmacists, physicians/surgeons, and veterinarians (Cheeseman-Day & Christnacht, 2019).

Healthcare jobs abound for graduates with biomedical science skill sets. The U.S. News and World Report (2021) ranked the best health care jobs in the United States. The

occupations were rated based on median salary, unemployment rate, growth volume, growth percentage, future job prospects, stress level, and work-life balance. The top ten are listed as follows: 1. Physician Assistant, 2. Nurse Practitioner, 3. Physician, 4. Speech-Language Pathologist, 5. Dentist, 6. Veterinarian, 7. Orthodontist, 8. Anesthesiologist, 9. Oral and Maxillofacial Surgeon, and 10. Occupational Therapist. All are branches in the medical field.

Even more newsworthy, in January of 2021 with Covid cases on the decline, the U.S. News and World Report unveiled the overall best jobs for the new year. At a time when health care is more critical than ever, 42 of the 100 best jobs were in health care or health care support roles (U.S. News & World Report, 2021). Once again, the list was created based on criteria such as growth potential, work-life balance, and salary. One thing the global pandemic has reinforced is the need for health care professionals (U.S. News & World Report, 2021).

For students competent in STEM fields, these trends forecast an optimistic future. Those ill-equipped in these growth fields face an less certain occupational future. If these STEM jobs (especially medicine) continue to be gendered, boys face an uphill climb in the fastest growing job market in the United States. Part of this increasing disparity can be attributed to shifting gender norms and roles in American society.

Project Lead the Way courses emphasize a practical, problem-based pedagogy long sought by many in academia. American intellectual Charles W. Eliot wrote, “What can I do with my boy? I can afford, and am glad, to give him the best training to be had. I should be proud to have him turn out...a learned man; but I don’t think he has the making of that in him. I want to give him a practical education; one that will prepare him, better

than I was prepared, to follow...any...active calling. The classical schools and the colleges do not offer what I want. Where can I put him?" (1869, p.1). Eliot's questioning certainly captured the zeitgeist of education in America; the article helped catapult him to the presidency of Harvard University. He wrote that lament on education in 1869. One can imagine that article being written today.

Elaborating further in the same essay, which he wrote for the Atlantic Monthly, Eliot, an architect of the American public school system was, it seems, contemplating the role of males in American academia. He wrote, "A system of education which attracts no great number of boys, which unites its disciples in no strong bonds of common associations and good-fellowship, and which, after years of trial, is not highly organized … has no strong hold upon the community in which it exists" (p.3). In these two quotes, Elliot identified something timeless but elusive: that in order to influence students and their communities, an educational system must attract pupils by being practical, preparing them for an uncertain future.

A century and a half later, Eliot's point appears permanently prescient. Boys are confused about their role in society, and as a result are lagging further and further behind their female counterparts in U.S. public schools. Girls have made methodical advances for generations in academia, and so it comes as no surprise that by many metrics, female students outperform their male peers (National Center for Educational Statistics, 2016). In a study by the American Psychological Association that spans nearly 100 years (1914-2011), researchers determined that girls make higher grades than boys in all school subjects -- a trend goes back decades. Daniel Voyer and Susan Voyer (2014) assert that this historical trend debunks the current claims of a "boy crisis" in education. That

assertion is naive. To ignore this issue is irresponsible, as poor male performance in secondary schools has metastasized beyond the halls of the high school.

Building an educated populace is one of the bedrocks of a democracy; and the public school system has been the primary vehicle by which the United States has sought that goal. However, some concerning trends have emerged. The National Center for Education Statistics (NCES), a branch of the U.S. Department of Education, has been collecting data on the high school dropout rate in the United States since 1972. Not surprisingly, the data from this five-decade longitudinal study revealed a general decline in the overall dropout rate. Surprisingly though, dropout rates have spiked in the years since 2010, and male dropout rates have risen more sharply than female. Between 2010 and 2017, the female dropout rate rose 1.0%, while the male dropout rate rose 2.4% (NCES, 2017). At those rates, about 75,000 girls, and 180,000 boys dropout of high school each year. Dropping out has ramifications that go well beyond a diploma; Dianda (2008) revealed that over 40% of state and federal inmates are high school dropouts, and according to the Federal Bureau of Prisons, nearly 93% of the inmate population in the United States is male. While dropping out and locking up, is certainly not the norm, many more male students have demonstrated academic apathy toward post-secondary education. On the contrary, female participation and performance in public schools and beyond continues to increase.

Beyond local high schools, female dominance is now well established at the university level. Marcus (2017) writes that men once went to college in proportions far higher than women--58% to 42% as recently as the 1970s. That ratio has now reversed. According to the U.S. Department of Education, women comprised more than 56% of

students on campuses nationwide. Some universities are actually adding androcentric activities to recruit more men to their campuses (Marcus, 2017). For over a half-century now, the American male has been fleeing academia.

There is general consensus of a significant and sustained shift in the roles that males and females play in society. For most of American history, men dominated the public sphere (education and employment) and women, the private sphere (home and kids) in American culture. For decades now, those traditional expectations have been blurred. More specifically, the educational landscape of males and females in the classroom is changing along with societal expectations. Across the United States, almost 2.10 million female students from the Class of 2013 took at least one AP test, while only 1.75 million male students did the same, meaning just 46% of test takers were male (Kennedy, 2018). These trends are also present in the enrollment data in STEM programs like Project Lead the Way (PLTW) Biomedical Science. A University of Texas study using data from 2006-2011 found PLTW female participation in the state increased, rising at a clip 201% faster than male participation (Van Overshelde, 2013). Educational leaders have yet to fully identify this trend, much less address it. The repercussions of these tectonic shifts in the academic world are yet to be known, but are certainly worth exploring.

Past studies have rightly looked at the importance of STEM education and recruitment of females, but have failed to address an emerging trend. Research shows an abundance of empowered females venturing into male territory, but disregards the gaping holes left behind by males fleeing academia. The purpose of this study is to look into that academic void; it will examine the gender trends of Project Lead the Way biomedical

science courses offered at high schools in the Midwest, and why they are in such stark contrast with the prevailing literature. Why does this disparity exist? What factors have contributed to this trend? To what extent are the issues rooted in psychology, history, or social changes in modern America? What are the effects of these trends? These questions will be examined through the lens of role theory: socialization, stereotype, and peer influence.

A Primer on STEM Education & Occupations

Science, technology, engineering, and mathematics (STEM) workers are driving our nation's innovation and global competitiveness (Van Overschelde, 2013). Between 2008-2018, growth in STEM-related jobs was expected to increase by 20%, twice the growth rate of non-STEM workers (Van Overschelde, 2013). This suggests an obvious need to educate more students in STEM fields. In general, students who attend college and obtain degrees are more likely to secure jobs. In the years following the Great Recession of 2008, 11.6 million jobs have been created, of which 8.4 million were awarded to those with at least a bachelor's degree (Semuels, 2017). The significance of that statistic is staggering; during the 2017 academic year, some 2.2 million fewer men than women were enrolled in college (Marcus, 2017).

Interestingly, when looking at STEM occupations, it shows a long-standing gender gap in the opposite direction -- the underrepresentation of females. In 2012, 42% of males vs. 36% of females ages 25 to 34 majored in STEM fields (NCES, 2016). Beede (2011) reported that in 2011, less than 25 percent of STEM jobs were held by women. Just five years later, the NCES reported that 47% of female STEM graduates were employed in STEM occupations (NCES, 2016). Clearly, female's working in the field is

on the rise. However, despite decades of effort to level the male-dominated STEM playing field, a gender gap remains.

Here in lies the crux of this study. Surprisingly, this gender gap appears not to be the case in high schools in the Midwest. Females are outnumbering males not only in STEM classrooms, but in other high school college credit courses. If the United States is to remain a leader in the global economy, we must produce more STEM graduates. How can females appear to be dominating STEM classrooms at the high school level and overall college graduation rates, yet still fall behind in STEM college degrees? In contrast, how can males appear to be lagging behind in STEM majors in high school but dominate the STEM workforce post college? What is it about the modern educational system in which the young male population is struggling?

The Gender Gap in Biomedical Classrooms

Why should educators care about gender discrepancies in the classroom? While there are numerous studies on the gender gap in education and the ways in which males and females learn differently, there is still much more to investigate and research. There is a plethora of literature on the psychological and sociological influence of how and who American schools educate. Specific political events and general historical trends have shaped gender and education policy that still matter today. How does this disparate literature help explain the dearth of males in medicine?

The University of Missouri's Bruce Biddle (1986) says the concept of role is one of the most popular ideas in the social sciences. He says perceived expectations generate the roles that people play. Expectations have altered drastically, which has befuddled both sexes to some degree. There is a level of confusion of what is expected out of a man

and a woman. Men are confused because our society has not established new roles for them. What it means to be a man is in flux. What it means to be a woman is in flux. What jobs are socially suitable for men and women are in flux. Thus, what classes that students take must also be in flux. These transitions no doubt affect the psyche of malleable, young minds.

Psychological Influences. Some of the reasons for the shifting achievement gap in academia may in fact be psychological. Claudia Buchmann and Thomas Diprete, authors of "In The Rise of Women: The Growing Gender Gap in Education and What It Means for American Schools" (2013) have been leading researchers in examining the societal changes and gender trends that have created educational advantages for women. By 2010, women in their mid-twenties surpassed their male counterparts in earning college degrees by more than eight percentage points (Buchmann & Diprete, 2013). They found girls show higher levels of persistence and self-control as early as kindergarten and derive more intrinsic gratification on a daily basis. Girls enter kindergarten more prepared, aim to please parents and teachers, and have more social and behavioral skills for success compared to boys at an early age (Semuels, 2017). Buchmann and Diprete (2013) feel boys may be more susceptible to instant gratification and have a hard time tackling and paying for a college degree when they know there are decent jobs readily available. Psychological hardwiring when combined with social circuitry may also contribute to difference in interests.

A recent study by the Organization for Economic Cooperation and Development (OECD) found countries that empower women are less likely to choose math and science professions (Khazan, 2018). Also, nations like Jordan, Qatar, and the United Arab

Emirates that traditionally are less gender equal have more women in science and technology than their gender progressive counterparts (Khazan, 2018). The more gender-equal the country, as measured by the World Economic Forum's Global Gender Gap Index, the larger the gap between boys and girls love of science (Khazan, 2018). Countries that produced the most female college graduates in fields such as STEM, were some of the least gender-equal countries (Khazan, 2018). The implications of this study are interesting when applied to the United States. The OECD data suggest that an increase in female STEM participation is actually an indicator of societal inequality.

Societal Influences. From its inception in the 19th century, American public education served a clear and obvious function---to prepare young people to be laborers. It prepared them with the skills necessary to succeed in the industrial workforce: promptness, discipline, respect, obedience. School served an obvious, manifest function of preparing students for work. That preparation produced a populace perfectly suited for the economy of the 1900s, but not 2021. The American Industrial economy has rusted-out, but the chassis of the American educational structure remains largely the same. Many students have a hard time seeing the connection between their coursework and their desired work. The economy has changed so much that there is a dysfunction between what school offers and what is expected by employers.

Adolescent boys often struggle forming meaningful attachments to school (Buchmann & Diprete, 2013). They are pressured to be "masculine" -- especially in lower-income or working-class families (Semuels, 2017). Academic success is often considered effeminate -- something only girls do. If a boy has a male role model in his family that works a physically demanding or blue-collar job, he is more likely to not want

any part of doing well in school (Semuels, 2017). However, if boys have role models that are educated, they are taught a different concept of masculinity and therefore do better in school (Semuels, 2017). While gender roles are fluid and have been shifting nationally, rural and conservative communities like Southeast are often slow to shift. Some schools have taken drastic measures to combat this dearth of dudes.

Fully aware of the historically defined, deep-seated gender roles, Marcus (2017) discovered Carlow University, among others, is struggling to attract more men to its campus. They are adding sports teams, marketing more men in promotional photos, and providing new degree programs such as business majors to appeal to men. Some researchers believe the problem to attract and keep men in college is problematic as early as primary school and fueled by forces that discourage the belief that a degree is worthy of time and money (Marcus, 2017). Some argue that boys are slower to learn than girls and may lose interest early on in their education. Others feel boys in America do not see successful male role models who attended college (Marcus, 2017). And yet others believe males have more choices and would rather make just as much money by completing an 18 month vocational program (Marcus, 2017). While certainly of interest locally, these disparities can be examined globally as well.

Gender Gaps Around the Globe

Even Sweden, a global bastion of equality and opportunity has a growing gender gap in STEM. A study by Boda, Raabe, and Stadtfeld (2019) on nearly 5,000 students from Sweden, observed the widening gender gap of preferences to STEM subjects over the course of a year. They found strong evidence that students adjust their preference to those of friends (peer influence) and will like STEM subjects more if other females

develop a similar preferences via peer exposure. This Swedish phenomenon is likely at play in Southeast as well. From its inception, the biomed program has been predominantly female, and has no doubt developed a self-perpetuating reputation as such.

In the same study, Boda, Raabe, and Stadtfeld (2019) say early-life socialization happens mostly within the family, but as the child grows older, the role of peers becomes more important. Gender differences continuously grow during adolescence and adulthood which instills long lasting attitudes, norms, and values. (Boda, Raabe, & Stadtfeld, 2019). The pressure from peers to adhere to perceived gender norms in high school and college is especially noteworthy because it is the time when life choices are made regarding their career (Boda et al., 2019).

Martin and Reinking (2018) found that there are three theories that have contributed to a gender gap in STEM: socialization, stereotypes, and peer influence. Some researchers believe a gender gap is present in the United States and other countries in response to stereotypes and socialization practices that focus on male dominance and female submission. Others believe it is due to the stereotypical characteristics of STEM professionals. They may be viewed as being nerdy, awkward, or introverted. In one study, researchers found that the students' stereotypes of the culture of the STEM field steered them away. Professionals appeared to be more male-oriented and the profession seemed to involve characteristics of social isolation (Martin & Reinking, 2018). Girls are social butterflies and do not value social isolation. And lastly, the strength of a peer group during adolescence can greatly influence or deter female individuals to take STEM courses (Martin & Reinking, 2018).

The Significance of STEM

Our nation is at risk. Since the mid-1960s, American students have been slipping in what they actually learn in school, especially STEM fields (Bertram, 2014). In 2010, only 26% of American high school seniors scored at or above the proficiency level in math according to the National Assessment of Education Progress (Bertram, 2014). Possibly more alarming was a staggering 36% had failing scores. Why do so few U.S. educated high school students go on to pursue STEM courses in college? Why does Silicon Valley have to recruit thousands of foreign-educated graduates to fill their jobs? Why don't our schools do a better job? In 1983, the Department of Education released a report titled, "A Nation at Risk." It stated, "Our Nation is at risk. Our once unchallenged preeminence in commerce, industry, science, and technological innovation is being overtaken by competitors throughout the world."

For decades there has been a push for science education reform in the United States. Project Lead the Way is a STEM-focused curriculum program designed to prepare middle and high school students for the global economy (Tai, 2012). This nationwide nonprofit program headquartered in Indianapolis, is offering courses from kindergarten through high school. "Begun in New York in 1997, PLTW has experienced consistent growth with courses now offered in over 2,700 schools in all 50 states. Enrollment in PLTW is now estimated at 500,000 students, with 53,600 students added during the 2010-11 school year alone." (Van Overshelde, 2013, p.1). PLTW uses an APB approach which consists of activity, project, and problem based scenarios. Students are provided with real-world, hands-on activities that enables them to work independently and collaboratively to identify problems and find solutions. PLTW (2019) believes all

students, beginning at a young age, need access to real-world, applied learning experiences that will empower and provide skills to thrive in college and careers. In a longitudinal, international study, roughly 5,000 students were tracked from high school through college. The students reported positive classroom experiences and the ability to relate and apply content as contributing factors to completing a college degree in STEM (Tai, 2012). Although there have been a number of studies on project-based learning, including several on PLTW, very few have addressed the gender trends of PLTW courses.

In 2009, state leaders came together to establish the Common Core State Standards (CCSS) for kindergarten through twelfth (K-12) grade students (Common Core State Standards Initiative, 2012). This initiative was aimed at providing robust and relevant real world problems to prepare students for college and their careers. Then in 2013, the Next Generation Science Standards (NGSS) were developed to improve specific K-12 science content and set expectations for what students should know and do (Next Generation Science Standards, 2013). These initiatives, although different, have the same goal of establishing educational standards for students. The Next Generation Science Standards (2013) believes that with a high quality science education, students will develop an in-depth understanding of content and key skills that will serve them throughout their lives. Godfrey and Kaliski (2014) say the more advanced courses a student takes in high school, the more likely he or she is to graduate college.

Summary

There has been a shift in the roles males and females play in society. This study acknowledges once predominantly male heavy classrooms are now flooded with females.

The noticeable presence of females in PLTW Biomedical Science programs in the Midwest and the glaring lack of male counterparts in the same programs has researchers questioning where all the males have gone. By looking at the gender trends, factors affecting the trends, and the effect of these trends, educators can have a better understanding of how to deal with the changing landscape. With studies showing those students with college degrees are more likely to land a job in today's economy, especially in STEM, more research needs to be conducted to figure out what males are doing in place of taking these courses and why.

Methods

The setting for the study was Southeast High School (SEHS). The school has an enrollment of 1,153 students in the Midwestern town of Southeast. The rural town has a population of approximately 19,000 people. The student population is predominantly white Caucasian. The research was conducted with a sequential explanatory mixed methods approach.

A Chi-square method was chosen to analyze variables. The dependent variables are grade point average, participation in sports, participation in clubs, whether the student has a job, whether the student volunteers, and if they have at least one parent who attended college. The independent variables are males who participate in the PLTW Biomedical Science program and males who do not participate in the PLTW Biomedical Science program. Surveys were given to 25 male students. Fourteen of the males were enrolled in the PLTW Biomedical Science program and 11 were males not in biomed. Four follow up interviews were performed with a non-biomed male in each grade, 9-12. This case study examined the school in which the researcher is invested. The smaller

sample size was due to the low number of male students enrolled in the PLTW Biomedical Science program.

Field (2018) says Pearson's Chi-square test is ideal for identifying relationships between two categorical variables. This quantitative statistic compares the frequencies one observes in certain categories to the frequencies one might expect to get in those categories by chance (Field, 2018). For example, is there a difference in GPA for males that take biomed and those who do not? Is there a difference in the number of sports they participate in? Is there a difference in the number of clubs they participate in? Is there a difference in whether they have a job or not? Is there a difference in whether they volunteer or not? Is there a difference in whether one of their parents attended college? A Chi-square test can be used to determine if there is a significant level difference in these categories between biomed males and non-biomed males. The level of statistical significance is determined by the degrees of freedom (n-1) via a Chi-square table. This study uses one degree of freedom due to having two groups (n), biomed males and non-biomed males. Each category was tested for the null hypothesis (there is no difference between males enrolled in PLTW Biomedical Science courses and males not enrolled in PLTW Biomedical Science courses.) A Chi-square statistic compared the distribution in the categories with the distribution of the group as a whole. A p value level was set at .05. The reason this value was chosen was due to a small population for the study. The researcher wanted to lower the risk of a Type II error, thus the decision to accept a 5% chance that rejecting the null hypothesis is correct (there is a difference between the groups).

Data Collection Tools

The Project Lead the Way Biomedical Science Male Student Survey was created via Qualtrics to be effective, yet efficient. The survey consisted of 10 questions that could be completed quickly. After IRB approval and due to Covid-19 concerns, an electronic copy of the parental consent forms were sent out via email to the parents of 28 males students (14 PLTW Biomed males and 14 non PLTW Biomed males). Of the 28 forms sent, 25 electronic signatures were collected giving permission (14 biomed and 11 non-biomed). Of the participants, 12 were in 9th grade, 5 were in 10th grade, 6 were in 11th grade, and 2 were in 12th grade.

The interview protocol was developed by the researcher to further investigate why males were not taking PLTW Biomedical Science courses. It also sought to find out how non-biomed males perceived the PLTW Biomedical Science program. Four non-biomed males of academic likeness to the biomed males were selected. One male from each grade level 9-12 was chosen. The audio recording app, Temi, was used by the researcher to record the qualitative data. Due to Covid 19, the interviews were conducted more than 6 feet apart, allowing for social distancing. Only one male was interviewed at a time. The interview consisted of five questions. The students were asked to describe themselves as a student at SEHS, what influenced their decision to choose their career pathway, how the PLTW Biomedical Science program is perceived among students, why they did not choose to participate in the PLTW Biomedical Science program, and what might draw more males into the program.

Findings

This study set out to determine why there are a lack of males taking PLTW Biomedical Science courses in high school. For the purpose of this study, males were put

into two categories: those enrolled in a PLTW Biomedical Science program and those not enrolled in a PLTW Biomedical Science program. Of the 25 males who participated in the survey, 14 were biomed students and 11 were not. Multiple Chi-square tests were run, begging to answer the research question, “What are the differences between males who pursue a biomedical science program and those who do not?”. Each sub question on GPA, sports, clubs, working, volunteering, and whether at least one parent attended college was analyzed. The following findings surfaced.

Is there a difference in GPA between males who pursue a biomedical science program and those who do not? All males surveyed in both groups had GPAs of 3.0 or higher. Approximately 36% of Biomed students had GPAs of 4.0 or higher, while non-biomed students consisted of only 18% of its students with a 4.0 or higher. This indicates the two groups are of academic likeness, with the biomed males having a slightly better GPA than their male classmates. The Chi-square analysis showed no statistical significance for the biomed males while showing statistical significance for the non-biomed males. These results are shown in Table 2a and Table 2b.

Table 2a.
Summary of Biomed GPA (DF=1)

Response	Expected (%)	Observed (%)	Chi-square p value
4.0	**28**	**35.714**	**.086**
3.0-3.9	**72**	**64.286**	
2.0-2.9			
1.9 or below			

P< .05

Table 2b.
Summary of Non-biomed GPA (DF=1)

Response	Expected (%)	Observed (%)	Chi-square p value
4.0	**28**	**18.182**	**.029**
3.0-3.9	**72**	**81.818**	
2.0-2.9			
1.9 or below			

P< .05

A Chi-square test of independence was performed to examine the difference between biomed males and non-biomed males in the category of GPA. Biomed males were found to not be statistically significant (p = .086) while non-biomed males were found to be statistically significant (p = .029).

Is there a difference in playing sports between males who pursue a biomedical science program and those who do not? Eighty-six percent of the biomed males play at least one sport as compared to 64% of the non-biomed males. The data also showed only 14% of biomed males do not play any sport as compared to 36% of non-biomed males. As a whole, biomed males are more likely to play sports when compared to non-biomed males. Both groups of males were shown to be statistically significant. These results are show in table 3a and 3b.

Table 3a.
Summary of Biomed Sports (DF=1)

Response	Expected (%)	Observed (%)	Chi-square p value
0 Sports	**24**	**14.286**	**.025**
1 Sport	**28**	**35.714**	
2 Sports	**36**	**42.857**	
3 Sports	**12**	**7.143**	
4 Sports	**-**		

P< .05

Table 3b.
Summary of Non-biomed Sports (DF=1)

Response	Expected (%)	Observed (%)	Chi-square p value
0 Sports	**24**	**36.364**	**.0017**
1 Sport	**28**	**18.182**	
2 Sports	**36**	**27.273**	
3 Sports	**12**	**18.182**	
4 Sports	**-**		

P< .05

A Chi-square test of independence was performed to examine the difference between biomed males and non-biomed males in the category of Sports. Biomed males were found to be positively skewed (p = .03) while non-biomed males were found to be negatively skewed (p = .00).

Is there a difference in participation in clubs between males who pursue a biomedical science program and those who do not? There was no statistical significance of males in biomed versus those not in biomed for participation in clubs. Both groups of males showed approximately 36% participate in zero clubs, over 50% participate in one to two clubs, and less than 10% participate in three to four clubs. Clubs do not seem to be a factor distinguishing the two groups of males. These results are shown in table 4a and 4b.

Table 4a.
Summary of Biomed Clubs (DF=1)

Response	Expected (%)	Observed (%)	Chi-square p value
0 Clubs	**36**	**35.714**	**.9897**
1-2 Clubs	**56**	**57.143**	
3-4 Clubs	**8**	**7.143**	
5 or more Clubs			

P< .05

Table 4b.
Summary of Non-biomed Clubs (DF=1)

Response	Expected (%)	Observed (%)	Chi-square p value
0 Clubs	**36**	**36.364**	**.9792**
1-2 Clubs	**56**	**54.545**	
3-4 Clubs	**8**	**9.091**	
5 or more Clubs	**-**	**-**	

P< .05

A Chi-square test of independence was performed to examine the difference between biomed males and non-biomed males in the category of clubs. Biomed males were found to have a normal distribution of participation in clubs (p = .99) wile non-biomed males were also found to have a normal distribution of participation in clubs (p = .98).

Is there a difference in working after school between males who pursue a biomedical science program and those who do not? Approximately 43% of biomed students said they worked after school while only nine percent of non-biomed students worked. In other words, 91% of the non-biomed group do not have a job. This shows that biomed students are more likely to work while in high school. These results are shown in table 5a and 5b.

Table 5a.
Summary of Biomed Work (DF=1)

Response	Expected (%)	Observed (%)	Chi-square p value
Yes	**28**	**42.857**	**.00094**
No	**72**	**57.143**	

P< .05

Table 5b.
Summary of Non-biomed Work (DF=1)

Response	Expected (%)	Observed (%)	Chi-square p value
Yes	**28**	**9.091**	**.000025**
No	**72**	**90.909**	

P< .05

A Chi-square test of independence was performed to examine the difference between biomed males and non-biomed males in the category of work. Biomed males were found to be positively skewed (p = .00) while non-biomed males were found to be negatively skewed (p = .00).

Is there a difference in volunteering after school between males who pursue a biomedical science program and those who do not? When asked if they volunteer after school, both groups of males had roughly 35-40% say yes, they do volunteer. This left 60-65% to say they did not volunteer. The willingness to volunteer is not a factor when comparing biomed and non-biomed males. There was no statistical significance between biomed males or non-biomed males compared to the group as a whole. These results are shown in table 6a and 6b.

Table 6a.
Summary of Biomed Volunteer (DF=1)

Response	Expected (%)	Observed (%)	Chi-square p value
Yes	**37.5**	**35.714**	**.712**
No	**62.5**	**64.286**	

P< .05

Table 6b.
Summary of Non-biomed Volunteer (DF=1)

Response	Expected (%)	Observed (%)	Chi-square p value
Yes	**37.5**	**40**	**.606**
No	**62.5**	**60**	

P< .05

A chi square test of independence was performed to examine the difference between biomed males and non-biomed males in the category of volunteering. There is no statistical significance between the two groups compared to the whole

Is there a difference in a parent attending college between males who pursue a biomedical science program and those who do not? Seventy-eight percent of the biomed group said yes, they do have at least one parent who attended college. The non-biomed group had 100% of its males respond yes to having at least one parent attend college. This means 21% of the biomed respondents, claimed to not have either parent attend

college. The biomed males show statistical significance while the non-biomed males do not. These results are shown in table 7a and 7b.

Table 7a.
Summary of Biomed Parental College Attendance (DF=1)

Response	Expected (%)	Observed (%)	Chi-square p value
Yes	**88**	**78.571**	**.0037**
No	**12**	**21.423**	

P< .05

Table 7b.
Summary of Non-biomed Parental College Attendance (DF=1)

Response	Expected (%)	Observed (%)	Chi-square p value
Yes	**88**	**100**	**.2008**
No	**12**	**0**	

P< .05

A Chi-square test of independence was performed to examine the difference between biomed males and non-biomed males in the category of a parent college attendance. The results for this test were statistically significant for the biomed males (p=.00) but not for the non-biomed males (p=.20).

Quantitative and qualitative data was collected during the Fall of the 2020-2021 school year. Twenty-five male students who attended Southeast High School were administered a ten question quantitative survey. Of those 25 males, 14 were part of the Biomed program and 11 were not part of the Biomed program. Qualtrics data showed, of

the twenty-five male students who took the survey, 12 were in 9th grade, five were in 10th grade, six were in 11th grade, and two were in 12th grade. Those that were not in the program had the academic likeness and ability to be in the program had they chosen to do so. Survey data showed 24 out of 24 male students responded they always do well in science class. The 25th male failed to respond to the question. The quantitative data consisted of analysis of survey questions using Qualtrics and Pearson's Chi-square test using EXCEL.

RQ 2: How do high school males perceive the PLTW Biomedical Science program?

The qualitative portion of this mixed methods approach examines interview data from a phenomenological perspective. This analysis investigates the phenomena of low male involvement in a PLTW Biomedical Science program at a mid-sized, Midwestern high school. The qualitative data collected for this study supported the Chi-square results discussed earlier (Creswell, 2014). Four male students, one freshman, one sophomore, one junior, and one senior, were interviewed for the study. Participants were young men not participating in the biomed program. Study members were randomly selected based on their academic likeness with the assistance of the guidance counselor. They were all aware of the scope and purpose of the study and willingly agreed to participate. Parents or legal guardians were contacted for consent and knowledge that their student was taking part in the interviews. Each interview was corroborated by member-checking. All interviewees agreed these were their responses. The five question interview consisted of the following questions: 1. How would you describe yourself as a student as SEHS? 2. What influenced your decision to choose your career pathway? 3. How do you feel the PLTW Biomedical Science program is perceived among students at your high school?

4. Explain why or why not you chose to participate in the PLTW Biomedical Science program. 5. What do you feel might draw more males into the PLTW Biomedical Science program?

Axial coding discovered four major themes emerging from this study: 1. Future orientation, 2) Peer influence for choosing a biomedical pathway, 3) Family influence for choosing a biomedical pathway, 4) Biomedical program should be "fun".

Future Orientation

Many of the student participants were focused on their career future. They had a vision of what their career lives would look like. While the biomedical field did not define their future, they did have other professional options to consider. Participant A, a senior, expressed a strong interest in engineering as a career choice. "Pretty early I knew that I wanted to be some sort of engineer. I've always been interested in mechanical stuff…". Another student, Participant B, a junior male who saw himself as "big into sports", believed his career future would be in dentistry. From an early age, he described himself as someone drawn to dentistry and the work dentists do. "I know a lot of dentists. A dentist's office has been kind of interesting to me. I've enjoyed seeing what they do and I've taken time and interest in it." Participant C, a sophomore male, saw himself going into "the law field…like a lawyer of some sort…seeing the world and everything and how it is. I'd like to do what I can to help that." While freshman male, Participant D, has a love for animals and basketball. He would like to do something in zoology or "probably coaching basketball." All participants saw themselves in careers that are primarily male dominated. The implication is that these career stereotypes fit a

socialization pattern familiar to them a space where they would be comfortable (Martin and Reinking, 2018).

Peer Influence

High school students typically know what interests them, although they may not have a clear idea of what career pathway they want to pursue. However, sometimes peer influence causes the student to do something they would not otherwise choose to do. Alternatively, peer influence can inhibit a student from doing something that could be rewarding. Participant B stated, “Before I came to high school, I didn’t really know if I wanted to do anything in the medical field. So I decided I probably wouldn’t do that (the PLTW biomedical science program)…I didn’t really have any of my friends coming in to do it. I feel maybe a big part of what would draw other males into biomed would be just more guys doing it.” Participant D, said “I have a lot of friends in it and they like it a lot. All of my friends have like good grades and stuff. They don’t really get in trouble, but a lot of guys do. It’s kind of a stereotype.” When Participant A, an engineering student, was asked if there were a lot of males or females in the engineering program he said they have mostly males. He went on to say that even with the males they have, the program has fairly low numbers. His class only has four students in it. He further elaborated on the reasoning behind the enrollment numbers. “They have the first class...introduction to engineering. There’s usually 40 kids or so that go out for that. And then the next year that opens up into another two or three classes you can take, but the beginning classes are prerequisites. So there’s less people that year. And then the following year, you have to have more prerequisites…less people as the years go on. The trend for peer influence not only shows how males tend to stay true to their stereotype and be surrounded by their

peers, but there is indication of struggles with rigor and being educationally challenged in the classroom. Students adjust their preference to those of their friends (Boda, Raabe, & Stadtfeld, 2019).

Family Influence

Most of the participants indicated the role family members played in their decision to choose their career pathway. Participant A spoke very highly of his parents, in particular his mom. “My mom is a chemical engineer…I would say my mom has influenced my career…because she’s taken me out to her chemical plant that she works at a few different times and it was a really neat thing to see.” Participant B admitted to being “a pretty big family guy.” He said his interest in dentistry revolved around the ability for “spending time with my family” and the job “tends to have pretty good hours. That’s a big, major reason why I want to be a dentist.” When participant D was asked about his reason for choosing zoology or coaching basketball, he referred back to his family. “I thought about it because my mom really loved teaching and so that kind of makes me want to teach.” The success of males in the classroom is deeply rooted in their families. If boys have role models that are educated, they are taught a different concept of masculinity and therefore do better in school (Semuels, 2017).

Biomedical Program Should Be “Fun”

A few of the participants mentioned how males are simply different and they just like to have “fun”. Participant A said, “I think it’s possible that it’s just the way maybe male brains are wired could just be different than a female. More females find this interesting than males.” When asked if the application process during the 8th grade year

for the biomed program was a factor for the lack of male applicants, participant B said, "Males definitely tend to be more immature than females in middle school. So I think a lot of males aren't really worried…cause they don't really feel like they want to...that's not something that interests them. They're more worried about other things." When asked what they are more worried about, he responded with, "Just having fun." When participant C was asked what he feels might draw more males into the PLTW Biomedical Science program he said, "...like a fun event or something. Cause I know you guys do something with like a dead body or something the first like day or something. And I feel like that'd be kind of interesting to learn about that kind of thing just before you come into it." Participant D said, "I would probably like change it where like, they didn't say the medical part, cause I don't think a lot of, well, guys probably want to be doctors but like make it sound fun, like experiments." Adolescent boys often struggle forming meaningful attachments to school (Buchmann & Diprete, 2013). Some researchers believe the problem lies in the discouragement of a degree, boys are slower to learn than girls, boys lose interest early on in education, and some boys do not see successful role models (Marcus, 2017). Boys simply just want to have fun.

Discussion

The study results indicate that biomed males as compared to the whole were more likely to play sports and work while in high school. GPA calculations showed biomed males to have higher GPAs, but Chi-square results did not prove to be significant. Results also indicate non-biomed males were more likely to have one parent who attended college, but the Chi-square data also proved not significant. Whether the males participate in clubs or volunteer were not found to be statistically significant.

Some of the findings from the research corroborate with the existing literature. Studies have shown that high school athletes receive better grades, have higher educational and occupational aspirations, spend more time working on homework, and have a more positive attitude towards school (Rees & Sabia, 2010). Those males choosing to take the more rigorous PLTW Biomedical Science courses, maintain higher GPAs, play more sports, and work more jobs. The biomed males are perceived to be more motivated and achievement-seeking. The results of club and volunteering may indicate that participation in those activities require less time and commitment to be a factor. The research provides new insight into the relationship between males and parental college attendance. The researcher would have assumed biomed males, having chosen to pursue the rigorous PLTW program, while making higher grades, participating in sports, and working while in high school, would be more likely to have parents that attended college. Based on general percentage calculations, this was not the case. The fact that biomed males were less likely to come from those families may indicate a need to succeed and create a better life than the one their parents were given. Participating in the accessible high school biomed program might be the ticket to get a higher paying job and out of that despair.

There were several items that posed interesting thoughts and questions from the non-biomed male interviews. Participant A spoke of his mother's influence to pursue engineering. Being an engineer, the mother created opportunities for her son to see and explore the career, providing an influential foundation for his future. In addition, participant B acknowledged choosing the dentistry pathway because he values his family so much that he wants to have a career that allots time and energy to dedicate to his own

family. He gives credit to a family friend who is a dentist for influencing him. Participant C said his parents and society influenced him to be a lawyer. How interesting to hear a sophomore speak of societal and worldly influences.

Participant D spoke of his love for animals from his upbringing and possibly pursuing zoology. He also mentioned wanting to be a teacher, like his mom, and coaching basketball. To what extent do parents or loved ones play a role in the career selection of a child? To what extent does society play a role? Boda, Raabe, and Stadtfeld (2019) say early-life socialization happens mostly within the family, but as the child grows older, the role of peers becomes more important.

Participant A made an interesting note about the PLTW Engineering program and its diminishing number of males that make it through to senior year. He reported only having four males in his current engineering class. Is this a sign of males retreating from the rigor of the classroom? Could the lack of males in engineering courses be connected to the lack of males in biomedical science courses? Some researchers believe the problem to attract and keep men in college is problematic as early as primary school and fueled by forces that discourage the belief that a degree is worthy of time and money (Marcus, 2017).

Participant B admitted to not really knowing about the PLTW Biomed program as an 8th grader or having any friends in the program. This identifies a possible need to do a better job of promoting the program at the middle school level. It also shows a glimpse of peer influence. If the junior were to have a friend or two join the program, would he have joined also? Buchmann and Diprete (2013) say boys struggle with their masculine identity and an attachment to school. Participant B also said the way to get more guys to

join the program is to have more guys in the program. Participant A, C, and D all thought the program sounded interesting, felt a lot of students liked it, and was perceived as being good. They were just not interested in doing something in the medical field. Participant C thought a way to get more males to join biomed was to have an event to talk about the program and continue to discuss things such as dead bodies and how fun it is. Participant D agreed and thought if the program sounded more like fun experiments and less medical talk, males would want to join. He added that guys have a stereotype—they get in trouble. Participant A felt male brains are simply wired differently. He did not have an answer on how to recruit more males. What factors have attributed to the recruitment of the current males in the biomed program? Why has the program attracted so many females?

Existing literature begs for answers as to why some STEM fields are more gender-balanced than others. The only problem is, no one is talking about the gap left behind when males retreat from biomedical sciences. The buzz revolves around the lack of females taking engineering and computer science classes. Researchers are continually seeking guidance on how to motivate and encourage females in these STEM classrooms. Previous research tried to write the gender gap off as individual preference and abilities (Galvin, 2016). These factors were found to be insignificant. The opposite is happening in biomedical science classrooms. Where have all the males gone?

This study challenges the existing literature in that it focuses entirely on the biomedical science arm of STEM. While much research has been done on the whole of STEM education, and the lack of female participation, much less ink has been spilled on the demographic data of PLTW. Of course no data existed on male involvement in

biomedical science at SEHS. The demographic oddity that prompted this study – while a small sample size – may act as a harbinger of things to come. These trends matter. If male participation continues to decline in one of the nation's most prolific job markets, many of America's best and brightest minds will miss an opportunity to make a difference in improving people's health and ultimately their lives. Educators thus have a duty to identify troubling trends and seek to improve equity in their programs.

Limitations

The most notable limitation of this study was the number of research participants. Due to the research design using a case study strategy, SEHS had a small sample of male biomed students to work with. In order to keep the sample populations consistent for comparison, a small number of non-biomed males were also chosen. Of the approximately 1,200 students at SEHS about 100 students are in the program during any given year. Still yet, each year SEHS has approximately 80+ female students while only 9-14 male students. The numbers are simply not available to run a larger study. In addition, since the focus of this case study was in a rural Midwestern high school, the demographics did not allow for diversity.

The sample population at SEHS is generally homogenous demographically, as is the broader community of Southeast. Those who were surveyed and interviewed were predominantly white and would be characterized by most observers as middle class. As such, it would be difficult to apply the findings of this very specific case study to other communities whose demographics were markedly different.

Another limitation was performing research on young people. In order to survey participants and conduct interviews, parental permission was required due to most of the

male students being under the age of 18. Although 96% (27/28) of the parents responded with electronic signatures for permission, a handful of the non-biomed males did not respond when the survey was pushed out. The researcher had to send out a few reminders to take the survey as well as rely on male students to check their emails. During the time of this research, SEHS, was living through the Covid 19 pandemic. This required more virtual interactions during the quantitative stages and social distancing during the qualitative component of the research.

Implications

Quantitative study results found a statistical significance between biomed males and sports, work, and whether one parent attended college. The study also found statistical significance between non-biomed males and GPA, sports, and work. Males who take PLTW Biomedical Science courses participate in more sports and are more likely to work a job while in high school than non-biomed male students. This may be attributed to a greater maturity, worth ethic, and yearning for rigor. A male who chooses to pursue biomedical science may not fit the mold of the typical male stereotype. They may be less likely to follow their peers by accepting the challenge to compete in a classroom full of girls. They may practice socialization and are willing to go against the norms of the blue-collar community or practices of their parents. Although the data initially showed a greater number of non-biomed males having a parent attend college, it was proven to not be significant. Biomed males did show significance for coming from a family with one parent attending college. This finding is in line with the idea that biomed males would come from homes where college attendance is modeled and encouraged. There were a few biomed males when surveyed had said their parents did not attend

college. Their enrollment in the biomed program may indicate a need to break the cycle. If their parents did not attend college they may be highly motivated to receive a better education in order to find a better job.

Qualitative study results indicate signs of socialization, stereotype, and peer influence. The non-biomed males interviewed for the study indicated immaturity among males their age as compared to females. It is no surprise males in middle school typically do not know what they want to do for the rest of their life and therefore may not attempt to apply to a program such as PLTW Biomedical Science. They also indicated their brains are wired differently than females and demand less rigor and structure. More than once, it was mentioned that boys just want to have fun. Males stereotypically recognize being smart and studious a negative characteristic. Choosing a program such as PLTW Biomedical Science may also limit their friends. Their choices in life, as with most teenagers, if affected by peer pressure. If their friends are not doing it, they will not do it either. However, the non-biomed males indicated a strong influence by their parents in selecting a career pathway.

A further study might look at a larger sample size of biomed males and non-biomed males from other school districts that offer PLTW Biomedical Science. This would allow for comparisons of urban and rural programs, diversity in demographics, and simply more data to chew on. Another study could look at the males currently in the PLTW Biomedical Science program to see why they chose to do the program. By knowing what positively influenced their decision to apply for the program could allow for policy change and better recruitment practices. Another study could analyze the motivation behind all of the females that choose to take the biomed program.

Conclusion

This research aimed to identify why there are a lack of males taking PLTW Biomedical Science courses at a rural Midwestern high school. The study used a survey to see if there was a difference in males who pursue a biomedical science program and those who do not. GPA, sports, clubs, work, volunteering, and whether at least one parent attended college were the factors analyzed via Chi-square analysis between the two groups. Using a sequential explanatory mixed methods approach, the survey was followed up with interviews of a sample of non-biomed males.

Among the entire group of males, there was statistical significance in playing sports and working while in high school as well as statistical significance in GPA for non-biomed males and parental college attendance for biomed males. The first variable analyzed was GPA. Thirty-six percent of males in biomed attained a 4.0 GPA or higher as compared to only18% of non-biomed males. However, all males surveyed had a 3.0 GPA or higher. The second variable analyzed was sports. Eighty-six percent of biomed students play at least one sport while only 64% of non-biomed males played sports. In contrast, thirty-six percent of non-biomed males did not play sports at all. The third variable analyzed was clubs. There was no statistical significance in club participation between biomed males and non-biomed males. The fourth variable was work. Forty-three percent of biomed males work while in high school while only nine percent of non-biomed students work. In other words, 91% of non-biomed high school males do not work. The fifth variable was volunteering. There was no statistical significance in volunteering between biomed males and non-biomed males. The sixth variable was whether at least one parent attended college. Although one hundred percent of non-

biomed males had a parent attend college to only 79% of biomed males, the data for non-biomed males was not statistically significant. Overall, biomed males are more likely to play sports and work while in high school as compared to those males who did not participate in the biomed program. Biomed males also had a higher GPA, although not statistically significant using Chi-square. Non-biomed males were more likely to have at least one parent attend college, although also not statistically significant. Among the entire group, biomed males versus non-biomed males, there was no significance in whether males participate in clubs or complete volunteer hours.

The second research question asked how males perceive the PLTW Biomedical Science program. Qualitative interviews of non-biomed males showed the biomed program is viewed as being a positive program. The program was identified as being neat, cool, and interesting. A couple of the students reported they did not know much about the program, but felt it was positive. Most of the students had friends in the program who found the program interesting and liked it a lot. However, not having an interest in the medical field swayed them to not pursue the biomed program. Additional interview data acknowledged the role peer groups, socialization, and stereotypes play. Males want to have fun and be around their friends. If their friends were to do the program, they would be more likely to do it as well. Family seemed to be a major influence in the student choosing a career pathway. Socially, males can be viewed as being less mature. Their brains are wired differently than females. Males must live up to a stereotype.

So, where have all the young men gone? When Pete Seeger asked that simple question nearly sixty years ago, it was a follow up to a very similar question asked a

verse earlier: “Where have all the young girls gone?” His answer was simple; they had “Gone to young men, every one.” Seeger concluded with the lament, “When will they ever learn? Oh when will they ever learn?” And learn they have. Young girls no longer have to go to young men for validation. In fact, they have flown right by their male counterparts, bumping many young men right out of the educational equation. So the question asked by Charles Eliot 152 years ago again comes to the forefront: “Where can I put him?” Eliot knew the answer before he asked the question. He wrote, “I want to give him a practical education; one that will prepare him…to follow…any…active calling” (p.1). The most active “calling” in America today is in health care, and we should heed Eliot’s timeless warning, “a system of education which attracts no great number of boys…has no strong hold upon the community in which it exists” (p.3).

CHAPTER 6:

SCHOLARLY PRACTITIONER REFLECTION

Life is a journey. My journey is an improbable one. Born the third child in a family of three to a realtor mother and electrician father, I became an educational oddity. Neither of my parents received college degrees, much less, a doctoral one. My grandfathers were both veterans, turned blue collar workers. As for my grandmothers, they initially took on the role of homemakers, but found life beyond the comfort of their homes, working in the secretarial and nursing lines of work. However, without their life choices, I would not be where I am today.

It is a bittersweet moment reflecting on the growth I have experienced these past four years flying through the coursework of the Educational Leadership and Policy Analysis (ELPA) doctoral program at the University of Missouri. Working towards completing my 19th year of teaching high school students, my role as leader has included teaching various science courses, coaching high school volleyball and basketball, creating a PLTW Biomedical Science program for my district, and implementing a state and national award winning HOSA program. I have held a Master in Educational Administration degree since 2009, but have yet to follow a calling down that path. During the summer of 2017, as I walked into a room full of higher education instructors, K-12 principals, and superintendents, in a way, I felt an outcast. There I was, a high school biomedical science teacher with no official administrative experience under my belt, surrounded by a diverse and acclaimed group of educators. Engaging with these people and the Mizzou instructors, although initially intimidating, allowed me to view

education through various lenses and develop a deeper understanding of educational ethics and diversity. Within a short period of time, I quickly realized I was more like this cohort than I originally thought. Lei, Gorelick, Short, Smallwood, and Wright-Porter (2011) say cohort programs create positive peer relationships, collaboration, and higher retention, graduation, and success rates of students. Being a part of the Southeast Missouri State University (SEMO) cohort, has contributed to this sense of belonging. We have become a family of sorts. Over the last two years, I have learned that being a leader is not about a title. This program took a group of people from various backgrounds and experiences, and forced each person to be vulnerable to work cohesively together to achieve common goals. I was able to use the strengths I had to assist others in my group while seeking guidance in areas I was weak. As I dove into the numerous assigned readings of scholarly journals and books, and completed numerous research projects, I saw the world of education in a whole new light. I was becoming a scholarly practitioner. Throughout this process, I honed in on my science background, learned how to read and synthesize scholarly works, asked questions, employed research techniques, conducted ethical research, and attempted to solve the wicked problems. I have nothing but respect for my time on this journey with ELPA Cohort 11. I am thankful for my family, school, and colleagues, which provided the foundational experiences to get me to this point. May the journey continue…

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Appendix A

Project Lead the Way Biomedical Science Male Student Survey

1. What grade are you in?

    a. 9th

    b. 10th

    c. 11th

    d. 12th

2. What is your grade point average (GPA)?

    a. 4.0

    b. 3.0-3.9

    c. 2.0-2.9

    d. 1.9 or below

3. Have you ever been enrolled in any PLTW Biomedical Science course (Principles of Biomedical Sciences, Human Body Systems, Medical Interventions, or Biomedical Innovations)?

    a. Yes

    b. No

4. Do you always do well in science classes?

    a. Yes

    b. No

5. How many sports are you involved in at school?

a. 0

b. 1

c. 2

d. 3

e. 4

6. How many clubs are you involved in at school?

a. 0

b. 1-2

c. 3-4

d. 5 or more

7. Do you work after school?

a. Yes

b. No

8. Do you volunteer after school?

a. Yes

b. No

9. After high school, where do you plan to go?

a. Two year/Junior College

b. Trade or technical school

c. Four year college or university

d. Work

e. I do not know

10. Do you have at least one parent/guardian with a college degree?

    a. Yes

    b. No

Appendix B

Male Student Interview Protocol

1. How would you describe yourself as a student at SEHS?
2. What influenced your decision to choose your career pathway?
3. How do you feel the PLTW Biomedical Science program is perceived among students at your high school?
4. Explain why or why not you chose to participate in the PLTW Biomedical Science program.
5. What do you feel might draw more males into the PLTW Biomedical Science program?

Appendix C

Parental Consent Form to Participate in Research
University of Missouri-Columbia

INVESTIGATOR'S NAME: Courtney McIntyre **PROJECT #2023949**

TITLE OF RESEARCH STUDY: The Demise of Guys: The Flight of the American Male from STEM

INTRODUCTION

Your child is being asked to participate in a research study. The purpose of this study is to understand why there is a lack of males taking PLTW Biomedical Science courses at a FHS. You have the right to be informed about the study procedures so that you can decide whether you want to consent for your child to participate in this research study.

You have the right to know what your child will be asked to do so that you can decide whether or not to include your child in the study. Your child's participation is voluntary. They do not have to be in the study if they do not want to. You may refuse to be in the study and nothing will happen. If your child does not want to continue to be in the study, they may stop at any time without penalty or loss of benefits to which they are otherwise entitled.

This form provides you with information about the study. Please read the information below and ask any questions you may have before allowing your child to participate in this study.

WHAT IS THE PURPOSE OF THIS STUDY?

The purpose of this study is to understand why there is a lack of males taking Project Lead the Way Biomedical Science courses at FHS. Your child has been invited to be in this study because he is a male currently in the PLTW Biomedical Science program or is a male who is not in the PLTW Biomedical Science program, but would have the potential to be in the program.

WHAT ARE THE PROCEDURES OF THE STUDY?

Your child will be asked to take a brief survey, and may be asked to participate in an interview. The survey should take less than 3 minutes. If asked to do an interview, it will be scheduled at a later date and take approximately 10-15 minutes.

HOW LONG WILL MY CHILD BE IN THE STUDY?
This survey will take approximately 3 minutes for your child to complete. Your child can stop participating at any time without penalty.

WHAT ARE THE BENEFITS OF THE RESEARCH?
The research will give PLTW high school teachers, counselors, and administrators insight to the factors that affect gender enrollment trends and the perceptions of the PLTW Biomedical Science program. School districts may then create policy changes to make the program more equitable.

WHAT ARE THE RISKS OF THE RESEARCH?
The risks involved in this study are minimal. Student names are not used and demographic data gathered is information the researcher is already privy to. If a student feels there is a risk or is uncomfortable in any way, they can opt out of the study.

WHAT ABOUT CONFIDENTIALITY?
We will do our best to make sure that your child's answers to survey and interview questions are kept private. Information produced by this study will be stored in the investigator's file and identified by a code number only. The code key connecting the child's name to specific information about them will be kept in a separate, secure location. Information contained in the child's records may not be given to anyone unaffiliated with the study in a form that could identify the subject without written consent, except required by law.

WHAT ARE MY RIGHTS AS A PARTICIPANT?
Your participation in this study is entirely voluntary. You may refuse to allow your child to participate or withdraw your child from the study at any time. Your child may also refuse to participate or withdraw themselves at any time. Your child will not be penalized in any way if you decide not to allow your child to participate or to withdraw your child from this study.

WHO CAN I CONTACT IF I HAVE QUESTIONS ABOUT THE RESEARCH?
If you have any questions about the study or if you would like additional information, please call Courtney McIntyre at (573) 701-1310 (ext. 2158) or cmcintyre@farmington.k12.mo.us. You may also contact my advisor, Dr. Bret Cormier Ed.D. at bcormier@semo.edu. If you want to talk privately about your rights or any issues related to your participation in this study, you can contact University of Missouri Research Participant Advocacy by calling 1-888-280-5002 (a free call), or emailing MUResearchRPA@missouri.edu.

A copy of this consent form will be given to you to keep for your records.

CONSENT

I have read this parental consent form and have been given the opportunity to ask questions. I give my permission for my child to participate in this study. I understand that, in order for my child to participate, they will need to be able to give their consent also. I understand that participation is voluntary and I can withdraw my child at any time without penalty or loss of benefits. You will be informed of any significant new findings discovered during the course of this study that might influence your child's health, welfare, or willingness to continue participation in this study.

_____

Parent/Guardian Signature Date

_____

Child's Name Date

VITA

Courtney McIntyre was born July 20, 1979 in Farmington, Missouri. After attending public school in the neighboring communities of Desloge and Bonne Terre, Missouri, she received the following degrees: Associate of Arts from Mineral Area College (1999) with Honors; Bachelor of Science in Education-Biology from Southwest Missouri State University (2002); Masters in Educational Administration from Missouri Baptist University (2009); Educational Doctorate from University of Missouri-Columbia (2021). She is married to Brandon McIntyre, has 3 daughters, Cayman, Capri, and Catalina, and currently teaches Project Lead the Way-Biomedical Science at Farmington R-7 High School in Missouri.

Awards and recognitions include: Distinguished Academic All-American-Women's Basketball (1999), All-Conference/All Region 1st Team-Women's Basketball (1999), Athlete of the Year Award (1999), and graduation with Honors from Mineral Area College (1999); Teaching certificate for Project Lead the Way-Principles of Biomedical Sciences from Missouri University of Science and Technology (2013); Implemented the first certified high school PLTW Biomedical Science program in Southeast Missouri (2013); Teaching certificate for Project Lead the Way-Human Body Systems from Indiana University-Purdue University Indianapolis (2014); Began the state and nationally recognized HOSA program at FHS (2014); FHS Feature Teacher/Teacher of the Year (2015); Teaching certificate for Project Lead the Way-Biomedical Innovation from Missouri University of Science and Technology (2016).