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The Relationship Between Gender, Academic Performance, and Confidence Within Science, Technology, Engineering, and Mathematics (STEM) Classes

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Abstract

This research investigated the relationship between student confidence, academic performance, and gender within sixth, seventh, and eighth grade STEM classes. After comparing student self-esteem survey scores to student math and science grades, two types of statistical tests were run (linear regression tests and a comparison of two means). The result of these tests suggests that there is not a statistical relationship between student confidence, academic performance, and gender within the sample population of 122 junior high students. It appears that the gender gap within STEM has closed, at least for this student sample population.

Introduction

Through this research, the effect that student confidence has on student performance will be examined, as well as the influence of gender on student confidence and student performance. I believe it is important to investigate whether confidence is a significant factor in a student's performance. As educators, it is important to research and understand the factors that play a role in academic success. Another important aspect of this paper is to determine if there is an existent gender gap between male and female students in math and science classes. Due to the fact that this research has a limited sample size, the results of the research will only be generalizable for specific population of students studied. The concepts of gender, confidence, and academic performance will first be explored to better understand the aspects that will be observed in the data collection. Next, prior literature regarding confidence, academic performance, and gender will be reviewed and annotated. Lastly, the methodological process is explained.

Gender

In this research, the role of gender will be investigated regarding academic confidence and performance within public education. Gender biases and stereotypes will also be considered during the discussion of what 'gender' is. A technical definition and related commentary for the term gender is that it refers to "the characteristics of women, men, girls and boys that are socially constructed. This includes norms, behaviors, and roles associated with being a woman, man, girl, or boy, as well as relationships with each other. As a social construct, gender varies from society to society and can change over time" (World Health Organization, N.D., p.1). Through the sociological perspective, gender is viewed as the role and identity in which people categorize themselves. Gender is an identity that each person has to discover individually, but also an

identity that carries patterns and trends from groups of people over time. The dominant culture of the United States has established several norms and expectations of individuals based on gender. From these common norms and expectations, individuals are then expected to take on the roles and norms of their said gender. Biases and stereotypes have been formed as a result of the continual pressure on gender throughout generations. Specifically, looking at the 1950s, there was a stereotype of men working, making money, and providing for their families financially, while women were commonly known as "housewives"; cooking, cleaning, and taking care of children. Gender has since become a more fluid term, where there is room for discovery and non-conformity to typical gender roles. Observing through a sociological lens, an insightful view of gender from Lindsey (202) *Gender: Sociological Perspectives* is that it involves understanding its influence "in shaping our lives, our attitudes, and our behavior." This understanding is enhanced "by investigating not only the links between sociology and other disciplines, but by integrating key concepts such as race, social class, and sexuality to clarify gender relations. With this integration in mind, sociology advanced one of the most important thrusts shaping research, theory, and activism in gender since the mid-twentieth century" (p. 4). This quote supports the formative impact that sociology has had and will continue to have on the development and investigation of 'gender'. Gender is relevant in all aspects of life, but through this research, the concept of gender will remain as a social construct, investigating its effect, influence, and (possible) inequality within public education.

Grades as performance measure

A study was conducted in Nigeria investigated the validity of grading in student achievement given certain conditions (specifically, teacher gender and teacher residency). In

2015, stratified random sampling was used to question 300 educators who taught secondary school in the area of Delta State, Nigeria. The two essential questions in this study were: “Is there any difference between male and female teachers' grading of students in secondary schools in Delta State?” and “Does the assignment of grades by urban and rural teachers accurately reflect how students work in secondary schools in Delta State?” (Chiekem, 2015, p. 25). The validity of grading was evaluated by providing the participating teachers with a questionnaire. The findings of this study were calculated by statistical measures. The author concluded that there was not a significant difference between the grading of male and female teachers, but there was a significant correlation between the differences in urban and rural educators in their assignment of grades to students. Considering this study took place in Nigeria, rural communities may be under-resourced and more impoverished than urban community schools. Due to the lack of equity between rural and urban areas, educators were found to have assigned their students’ grades differently. While grades are given to depict an accurate reflection of students’ academic achievement, this study reflects the finding that grading systems used by teachers “vary widely and unpredictably and often have low levels of validity due to the inclusion of nonacademic criteria used in the calculation of grade” (Chiekem, 2015, p. 25).

In a study conducted in 2013, the effects of student reflection on academic performance and motivation were evaluated. This research took place at a small high school in Orlando, Florida. There were 242 students who participated in this research, all of whom were in eleventh or twelfth-grade English classes. These students were racially diverse, but the majority of the students were part of a lower socio-economic class. This study was conducted because Mr. Cavilla, the English teacher at this school, wanted to gain an understanding of student motivation and student self-reflection, and how that may result in higher academic achievement. Mr. Cavilla

allowed students to form a written reflection regarding the work they were completing in class. Cavilla writes, “To strengthen and add potential credence to the qualitative data collected from the students’ reflection instruments, data were also collected from a quantitative standpoint to assist with determining if a correlation existed between student self-reflection and academic performance, student motivation to complete assignments, or both” (Cavilla, 2017, p. 8). From his research and data collection, he concluded that the results of the quantitative research “indicated that there was a statistically insignificant correlation between student self-reflection and academic performance and motivation to complete assignments for underserved students in 11th- and 12th-grade English; however, analysis of the qualitative data indicated that students’ levels of metacognition and reaction to the intervention were largely positive” (Cavilla, 2017, p. 8). Although the quantitative data was statistically insignificant, the qualitative data found that students’ understanding of their own learning was positively impacted by the interventions that were conducted.

James D. Allen, an educational psychology professor at the College of Saint Rose in Albany in New York began investigating the validity of grades in a research study in 2005. Allen discussed some of the invalidity that occurs when teachers grade their students. One of these factors is stated as being that teachers attempt to incorporate other aspects of a student, such as attendance, attitude, or effort, into a single letter grade. Allen believes that an overall report of a student should not be compiled into an actual grade of their performance but rather considered separately. Another component of the grading process involves evaluating and awarding effort shown by a student. Educators are oftentimes likely to consider the genuine attempts of a student when giving them a summative grade, rather than strictly the academic performance of the student. To close his argument, Allen writes; “Two major thrusts need to occur in reforming

grading practices. First, if factors such as effort, attitude, compliance, and behavior are to be noted about a student on a report card, then they should be reported with a separate mark and not figured in as part of a grade for academic achievement of content knowledge. However, as in most situations, if a teacher must summarize and communicate a student's classroom progress in an academic subject through a single report card grade, then there must be a consensus that the grade represents the most accurate statement of the student's academic achievement, and only academic achievement. This is the essence of valid assessment" (Allen, 2005, pp. 221-222).

From the gathered sources, many differences are present, such as the types of classrooms the research took place in, the number of students being observed, or even the wording of the research questions themselves. Together, these sources have a commonality that grading systems, educators, and students are all imperfect. Grades should be a reflection of academic achievement, and attendance and effort should be taken into account with a separate measure. The validity of grading often lies within the educators and their beliefs of what a grade should be made of. Grades may be an accurate performance reflection, but oftentimes can be skewed by a range of variable factors in the education system (Allen, 2005, Cavilla, 2017, & Chiekem 2015).

Student Participation as Performance Measure

In 2006, a group of middle school mathematics teachers at a large school in New York City conducted a study regarding student participation and its relationship with student achievement. For this study, 120 students were surveyed. Quantitative and qualitative data were so gathered to assess the students' willingness to participate in their math classrooms and the reasoning behind their answers. The staff that was conducting the research created a raffle system to motivate students to participate, and they also implemented math problems that applied

to the students. Students were given one raffle for every five tally marks of class participation. The educators that conducted this research did not find a direct correlation of student participation to student achievement, but rather a link to classroom motivation. The authors of the article stated, “Overall, the implications of our study offered great insight into improving student achievement. It would appear that the combination of pedagogical practices, reward systems, and student support created a child-centered learning environment in our classrooms” (Tang, Reddington, & Cañada, 2006, para. 17). “Child-centered learning” refers to a classroom structure where student learning and inquiry is the top priority, as opposed to teacher-centered learning, where the educator makes the class centered on notes, textbooks, and lectures. In the teacher-centered class, motivation, and confidence lack from the students because they are not actively engaged, participating, and invested in the content material. Tang, Reddington, and Cañada conclude that student achievement is supported by student participation and motivation, which are the foundational blocks to child-centered learning.

In a study conducted in 2020, Tedd Ward and Ernst Bekkering evaluated the relationship between class participation and student performance in technology classrooms. This investigation took place at Northeastern State University in Tahlequah, Oklahoma. The two educators measured students’ attendance and attentiveness by using recording tools. The students’ participation was then measured by a combination of their class attendance and their attentiveness in technology class. The two classes they observed differed in the way of instruction. Class One is a concepts-type class, which is formatted by lectures, while Class Two is a skills-type class, which is formatted by hands-on learning. The authors write; “In the one class, we found a positive relationship between participation and scores on the final examination. This class is a concepts-type class, focusing on theoretical information presented in lecture

format. In the other class, we did not find a relationship. This class is a skills-type class, focusing on practical skills and involving more hands-on work. The relationship may have been masked by the associated lab and relatively late dropping of the class by multiple students" (Bekkering & Ward, 2020, p.86). Due to the findings of this study, it can be observed that the concept class, which was taught by lecture, did have a significant relationship between student participation and final exam grades, while the skills class did not show this relationship. The authors mention that the lab of the skills class may have affected the data of this study, as well as the significant loss of students from the class. This study may have resulted in this way because the students in the concepts class were used to recalling information theoretically and that is a skill that is required for the final exam, as opposed to the skills class, which practiced these theories rather than simply learning about the theories. It is logical to think that the final exam was not formatted to represent the ability of the skills class students.

A research study was conducted during the 2011-2012 school year in a health science collegiate course at Canadian Memorial Chiropractic College, investigating the potential relationship between student participation and academic success. The 185 students enrolled in this course acted as the participants and were evaluated using their participation percentage and test scores. In this case, participation "marks" were measured by students' attendance to class and completion of assignments regarding the lecture. Two groups were formed from the participants, one group of students who earned 100% of their participation points, and the other group of students who earned less than 100% of their participation points. The researchers of this study calculated significance using t-tests. They concluded that higher levels of student participation in the course, "regardless of whether learners were in class or outside of class,

related positively to exam performance and the achievement of higher levels of learning" (Starmer, Duquette, & Howard, 2015, p. 137).

Many observations can be made from the above three articles regarding the relationship between participation and academic success. Each study was conducted with different methods, participants, and factors. Overall, the studies varied in whether the quantitative data collected resulted in a statistical significance between participation and performance. In these studies, several different methods were used as motivation to encourage students to participate, such as tracking tally marks of participation and grades for participation and completion. Through this research, it can be stated that the qualitative data that was collected showed a relationship between participation and performance. Motivating students to participate will lead to a more engaging class, where some students will be benefitted. It should nevertheless be noted that competent students, who are very successful academically do not participate for a variety of reasons. Although participation is often helpful to student learning, there must not be a negative outlook on students who are more introverted or just do not feel comfortable with active classroom participation.

Teacher Biases

There has been a long-standing stereotype that male students perform better in math classrooms than female students. In some cases, this has been observed, but it has also been evident that some teachers have biases that support boys performing better than girls. In 2019, a study was published that focused on the investigation of teacher bias towards gender and race. The study was funded by the Mathematics and Science Partnership programs, which is publicly provided by the United States government, and is given based on need and poverty rates. The

researchers recognize the academic gap between white students and non-white students, as well as the lack of representation of women and students of color within math and science careers. The goal of this study was to investigate the racial and gender biases of teachers, and this was done by creating a very specific system. Researchers asked 390 teachers across southern states, who taught kindergarten students through twelfth-grade students, to participate in grading students' work. In addition, the educators were asked to rate the mathematical ability of the students. Teachers were given a variety of false names on the papers that they were grading, which led the teachers to believe what gender the student was, as well as an idea of what race the student was. These false names and how the teacher graded their work and ability were the sole factors in observing racial and gender biases. The educators that participated in this study were told that their answers were anonymous, but researchers noted the teachers' gender, race, and educational background to compare with their answers. An important factor in this study is that the student work was all the same, and only that the names were changed to match a specific demographic. The researchers found that the teachers graded the correctness of the assignment without bias being present, but the mathematical ability of the student had the opposite result. The researchers found that "For partially correct responses, teachers' ratings of papers by authors with White-sounding names were rated significantly higher than those of Black- and Hispanic-sounding names…" (Copur-Gencturk, Cimpian, Lubienski, & Thacker, 2020, p. 36). It was also noted that there was no bias found in the evaluations conducted by white educators, but rather non-white educators rated white students, particularly white male students, higher than all other students. Copur-Gencturk, Cimpian, Lubienski, and Thacker mention that the bias from non-white teachers could have potentially stemmed from their past educational experience, with a bias that white students performed better or were smarter.

Confidence Theories

The concept of student confidence will be referred to frequently throughout this research study. The concept of confidence will be seen through the lens of Bandura's theory regarding self-efficacy, wherein the concept is defined as the belief that you are "capable of carrying out a specific task or of reaching a specific goal." As Bandura writes, "In self-efficacy theory, the beliefs become a primary, explicit explanation for motivation" (Bandura, 1997, p. 1). Self-efficacy acts as a significant factor in academic success. When students have belief in their intelligence, they are provided with the confidence to participate and to engage in a classroom setting. In this study, student self-efficacy will be investigated, as well as the effects that it has on students' academic success. In an article regarding academic self-efficacy, Artino (2012) writes, "Self-efficacy theory postulates that people acquire information to evaluate efficacy beliefs from four primary sources: enactive mastery experiences (actual performances); observation of others (vicarious experiences); forms of persuasion, both verbal and otherwise; and 'physiological and affective states from which people partly judge their capableness, strength, and vulnerability to dysfunction" (p. 78). For students to experience one of these four sources of efficacy requires them to have most of their other needs met. Confidence and achievement are both at the highest level of Maslow's (year) Hierarchy of needs. Students are not able to reach a level of self-efficacy unless they have achieved other needs such as psychological needs, safety and security, and love and belonging.

Confidence & Academic Performance

Booth and Gerard (2011) conducted a cross-cultural stud in the 2004-2005 school year in the Cleveland Municipal School District in Ohio, and the Greater Manchester Schools in England to evaluate the relationship between self-esteem and academic achievement. This research focused on 258 participants who were in sixth grade. Manchester and Cleveland are both urban, working-class areas with students who varied in culture. The majority of the students who were part of these school districts were also from lower-income families. To collect data, the researchers required participants to complete the Rosenberg Self-Esteem Scale, rating several prompts from one to four. A sample of 45 students was interviewed, and the content discussed was based on the Simmons and Rosenberg Self-Image Scale. These two forms of data collection regarding self-esteem were then compared to students' scores on standardized tests. The method to compute the data collected is described as follows; "Preliminary tests include t-tests to determine whether self-esteem scores differ by cultural setting (i.e., country of student) as well as by gender. Correlations also were employed to examine the strength of relationships between self-esteem and academic achievement indicators" (Booth & Gerard, 2011, pp. 6-7). Through statistical tests, Booth and Gerard concluded that "First, the young adolescents from both the United States and England begin school at age 11 with similar strengths in the relationship between self-esteem and academic achievement; however, this relationship largely disappears by the end of that academic year for North American students. Second, patterns were consistently found between the level of self-esteem and math achievement in both of these samples of students. Finally, cultural expectations regarding gender-appropriate skills may influence self-esteem, especially for students from the United States" (Booth & Gerard, 2011, p. 11).

A study was conducted in Hebei, China, where 480 adolescents completed a self-efficacy survey. The students ranged from seventh grade to eleventh grade, and were from two schools in

Hebei. Students were asked to take a questionnaire for this survey, which assessed students' self-efficacy by using Rosenberg's Self-Esteem Scale. Another portion of the survey was dedicated to questions that used the Perceived Social Support Scale, allowing students to answer prompts regarding the students' perception of social support. Still another scale was used on the test to consider the students' academic self-efficacy, this scale was known as the Academic Self-Efficacy Scale. The students' surveys were calculated using statistical tests, and then the researchers were able to conclude the following; "... self-esteem was positively correlated with academic engagement ($r = 0.23$, $p < 0.01$) and academic self-efficacy ($r = 0.36$, $p < 0.01$), and academic engagement was positively correlated with academic self-efficacy ($r = 0.52$, $p < 0.01$)" (Zhao, Zheng, Pan, & Zhou, 2001, para. 19). This research study thus showed a significant correlation between self-efficacy and student engagement and academic self-efficacy amongst the students studied. Finally, the authors found several influential parts of a student's academic success; "Our findings suggest that adolescent self-esteem, academic self-efficacy, and perceived social support are key factors that should be considered together to improve adolescent academic engagement" (Zhao, Zheng, Pan, & Zhou, 2001, para. 1).

Chilca conducted research at the Technical University of Peru in 2016 to investigate possible correlation between self-esteem, study habits, and academic performance. There were 196 participants in this research collection. All were students in a basic math class within the school of engineering. From the participants, a sample size of 86 students' survey results was used for this research. Several methods were used for this study and collected from students, including the Coopersmith Self-Esteem Inventory and the Luis Vicuña Peri's Study Habits Inventory, as well as each students' grades. To compare these inventories with students' grades, the researcher ran several statistical tests, such as the Pearson Correlation Coefficient, linear

regression analysis, and analysis of variance. After the results were calculated, the researcher evaluated the data and concluded that "... self-esteem does not significantly impact academic performance, but study habits do influence academic performance ($p = .000 < \alpha = .05$). Hence students are expected to enhance academic performance as they refine study technique" (Chilca, 2017, p. 102). Chilca conducted this research because of his interest in investigating the factors that affect students' performance positively or negatively. From his findings, the author noted, "…university authorities may now draw on these results to take immediate action to improve students' study habits in math classes, implement information lectures, either face-to-face or online, in light of the profile of students they serve, to increase student counseling and tutoring hours while focusing on study techniques, and last but not least, to train teachers so as to enhance their teaching skills by covering all the cognitive aspects of a student, especially in math classes" (Chilca, 2017, p. 119).

The three articles regarding confidence and academic performance within the classroom present many similarities. Observers can gather that two of the articles provided statistical significance between confidence and performance, while the other research article did not. These studies took place all over the world, at a variety of age levels. From the combination of these research studies, it is evident that student confidence will likely lead to their greater engagement within a class, as well as academic success. Through the case studies, it can be noted that promoting student confidence may well create a chain reaction for students to become more engaged in class, allowing them to participate in a motivating atmosphere, which finally leads students to retain information and perform well. Although student confidence and self-efficacy have the potential to help students succeed academically, this is not the case for every student. Some students may perform just as well, without having self-belief or confidence.

Confidence and Academic Performance within STEM

In 2016, Tony McClary, Germain Degardin, John Kulpa, Patricia Sullivan, and Karen Trujillo investigated the relationship between self-efficacy and academic performance within the STEM (Science, Technology, Math, and Engineering) areas. There were 49 students from the New Mexico PREP Middle School Academy, ranging from sixth to eighth grade, where 19 students were female and 30 were male. There was a diverse ethnic range of students who participated in this survey. The majority of students attended public school, and the minority attended a private school, charter school, or homeschool. Most students were from urban areas, while a few were from a rural setting. Students' math and science grades, PARCC (Partnership for Assessment of Readiness for College and Careers) test scores, and essay answers regarding students' intelligence were used when selecting these specific 49 students. After students were selected, they took a self-efficacy survey, as well as a STEM exam. After a two-week STEM intervention with these students, the students took the survey and the exam for a second time. The researchers investigated four questions: 1) "Did the confidence and/or content knowledge of the students change during the PREP program?", 2) "Was there a relation between active learning and gains in student knowledge and/or confidence?", 3) "Did the PREP program impact a students' inclination to participate in additional STEM activities and/or pursue engineering as a career?", and 4) "Was there a relation between changes in student confidence and knowledge?" (McClary, Degardin, Kulpa, Sullivan, & Trujillo, 2017, p. 2). After the researchers compared and calculated the students' surveys and exam scores, they wrote that "in addition to exploring the influence of the camp on knowledge and confidence separately, we were interested in a possible relation between knowledge and confidence. However, we did not find a significant

correlation between overall knowledge and confidence in the pretest scores ($r = -0.16$, $t(43) = 1.06$, $p = .852$, ns) or the posttest scores ($r = -0.02$, $t(43) = -0.16$, $p = .562$). Nor did we find a significant correlation between overall changes in knowledge and confidence ($r = 0.06$, $t(43) = 0.42$, $p = .338$, ns)" (McClary, Degardin, Kulpa, Sullivan, & Trujillo, 2017, p. 6). Through the testing before and after STEM intervention, there was not a correlation between confidence and performance within STEM education among the students studied.

Han, Kelley, and Knowles (2021) investigated student STEM learning, self-efficacy and learning outcome. The study was part of a STEM project, known as TRAILS (Teachers and Researchers Advancing Integrated Lessons). This research study took place during three school years, 2016-2019. Students that participated in this survey were enrolled in high school science or engineering classes in Indiana and were taught by TRAILS educators. Essentially, teachers participated in a STEM professional development training during one summer, and the researchers asked the following two questions: "Are teacher self-efficacy and outcome expectancy, student STEM attitudes, 21st century skills, and STEM career awareness positively associated with student STEM knowledge achievement?" and "Are there any direct and indirect effects of teacher self-efficacy and outcome expectancy on students' STEM attitudes, 21st century skills, and STEM career awareness?" (Han, Kelley, & Knowles, 2021, p. 121). After calculating the key number, the researcher's examination showed that a correlation existed between teacher self-efficacy and students' STEM knowledge achievement. The most relevant takeaway from this study was that teacher and student confidence and teacher and student expectations play critical roles in both teaching and learning in STEM classes (Han, Kelley, & Knowles, 2021).

Heaverlo (2011) conducted a study in Ames, Iowa in 2009, surveying 1,283 female students from sixth through twelfth grade. The goal of this study was to evaluate girls' interest and confidence in STEM subjects. Participants were from rural, urban, and suburban communities in Iowa. The majority of the surveyed students were white, and racial diversity was thus lacking in this study. Students were given a survey which consisted of components regarding the classes the students were taking, students' extracurricular activities, as well as student confidence. The student surveys were then calculated statistically, revealing two high correlations. The two most significant findings in this study are captured here: "Analysis indicated a high positive correlation relationship between math interest and math confidence ($r=.59$, $p<.0011$). This suggests that participants who reported higher scores in math interest also reported higher scores in math confidence. A similar high correlation relationship existed between science interest and science confidence ($r=.60$, $p<.0011$). This also reveals that participants who reported higher scores in science interest also reported higher scores in science confidence" (Heaverlo, 2011, p. 66). This takeaway is relatively significant because it established that student confidence in STEM subjects and student interest in STEM subjects were directly correlated among study participants.

The three articles regarding confidence and academic performance within STEM concern correlation between confidence and performance within the STEM content curriculum. These articles support the idea that confidence and interest often relate when compared within STEM subjects. Within the studies, it is also evident that while self-efficacy has the potential to benefit students in their academic success, it is not essential, nor statistically significant. These three studies were performed using a variety of surveys and test assessments for the participants. Another relevant note is that one of the studies mentions teacher self-efficacy, and it did seem to

positively impact student engagement and interest for the specific STEM content that was being taught. Through these research articles, it is important to take away that self-efficacy from teachers and students is a positive contribution to students' academic success, even though it is not always necessary for students to succeed.

Gender, Confidence, and Academic Performance

In 2009, Naderi, Abdullah, Tengku Aizan, Sharir, and Kumar (2009) conducted a study including students attending Malaysian Universities in Iran regarding the relationship between self-esteem, gender, and academic performance. There were 153 Iranian undergraduate college students who acted as the participants in this study. Slightly more men participated in the survey than women, and all participants ranged from 18 to 27 years in age. First, student self-esteem was measured, utilizing a similar test to the Rosenberg Self-Esteem Scale. The researchers hypothesized that confidence would have an impact on academic performance, and that self-esteem would be found similarly in male and female students. After statistical scores were calculated, the researchers were able to conclude the following: "The main finding of the current study is that although self-esteem and gender (the combination of independent variables) predicts cumulative grade point average (CGPA), there was no significant relationship between self-esteem and academic achievement. According to multinomial logistic regression of the results, we found a statistically significant overall relationship between the combination of independent variables (self-esteem & gender) and the dependent variable (CGPA). However, the individual relationship between total self-esteem and academic achievement was not statistically significant" (Naderi, Abdullah, Tengku Aizan, Sharir, & Kumar, 2009, pp. 33-34).

Arshad, Zaidi, and Mahmood (2015) conducted a study in Faisalabad, Pakistan, evaluating the potential relationship between self-efficacy, gender, and academic achievement. The participants included 80 university students, evenly split between males and females. These students were all in attendance at University Faisalabad and were between the ages of 18 and 25. The students' self-esteem was measured by the Rosenberg Self-Esteem Scale, while their academic performance was surveyed by the Academic Performance Rating Scale. Male and female results were calculated and compared, using Pearson's Product Moment and the t-test. The researchers hypothesized the following; "there would be a positive relationship between self-esteem and academic performance among university students, there would be a significant difference in scores on self-esteem scale among male and female university students, and there would be a significant difference in scores on academic performance scale among male and female university students" (Arshad, Zaidi, & Mahmood, 2015, p. 159). After comparing the results between self-efficacy and academic success from both male and female students, several relationships were found. "Keeping in view the findings of the current study it is concluded that there exists a strong positive correlation between self-esteem and academic achievement in university students. Furthermore, it can be said that a high level of self-esteem leads to good academic performance. It has been found that female students had a higher academic performance as compared to male students. It has also been found that male students had higher self-esteem as compared to female students" (Arshad, Zaidi, & Mahmood, 2015, p. 161).

Sander and De la Fuente (2020) investigated the relationship between gender, personality, and academic self-efficacy through a study in Spain. There were 1,523 Spanish students who participated in this study, enrolled in Psychology, Primary Education, or Educational Psychology degree programs within two universities. A questionnaire was sent to all

of the participants to complete. The questionnaire evaluated student personality or student academic confidence. Researchers observed five different personality traits: extraversion, conscientiousness, neuroticism, agreeableness, and openness. After the surveys were submitted, the researchers used t-tests to calculate statistical correlations between academic confidence, personality traits, and gender. After the calculations and graphs were observed, it was found that "the female students were more confident in their grades, studying and attendance components of academic confidence and had higher scores for conscientiousness, agreeableness and neuroticism personality measures" (Sander & De la Fuente, 2020, p. 1). After the comparison between male and female students was complete, it was evident that female students had higher confidence levels, as well as higher scores for several of the personality trait options. The authors noted the following; "This research further confirms the validity of the Academic [Behavioural] Confidence scale and suggests that measures of personality and, especially, academic confidence could be usefully used in student support situations to help students acquire the strategies and skills that lead to successful university study" (Sander & De la Fuente, 2020, p.1).

All three of the articles regarding gender, confidence, and academic performance provide useful similarities, although the studies vary by student ages, backgrounds, and research methods. In the majority of research studies that contain self-efficacy or confidence, the Rosenberg Self-Esteem Scale, or another type of survey scale is used to evaluate students regarding a reflective response to their academic confidence or self-efficacy. These articles are commonly supportive of utilizing motivation and student self-efficacy as positive strategies to improve academic achievement. The three articles above however do not have statistical significance demonstrating a major difference between gender confidence and how that affects performance in the classroom.

Gender, Confidence & Academic Performance Within STEM

Hand, Rice, and Greenlee (2017) investigated gender biases among teachers and students, as well as student confidence in the STEM field. There were 44 teachers and 121 eleventh-grade students from the Academic Magnet High School in Charleston, South Carolina who participated in this survey. Men and women almost equally divided the number of participants in this study. Two surveys were created; one for teachers to submit, and the other for students to submit. These surveys were created to evaluate the gender biases of the teachers and the students. Students' surveys also had a section dedicated to self-efficacy. The participants indicated their gender biases by answering questions based on assigning masculine and feminine characteristics, as well as categorizing people who worked in certain fields as either "masculine" or "feminine." Statistical tests were used to calculate and compare the evaluations of the teachers and the students. The researchers concluded the following: "Consistent with the hypotheses, results indicated that both teachers and students reported the perception that boys perform better in STEM disciplines, while girls perform better in humanities disciplines. In addition, also consistent with our hypotheses, the data showed that both teachers and students attributed more masculine characteristics to someone working in the sciences and more feminine characteristics to someone working in the humanities" (Hand, Rice, & Greenlee, 2017, p. 941). The authors further concluded that there was a gender gap within the confidence category of the evaluation between male students and female students.

Litzler, Samuelson, and Lorah (2014) explored the relationship between gender confidence and academic achievement in a U.S. context. There were 10,366 undergraduate engineering students who participated in this research study. These students all attended

universities that were part of the PACE program, which represented minority groups, and was sponsored by the Alfred P. Sloan Foundation. This study well-represented women, people of color, and other underrepresented groups earning engineering degrees. Students were given a PACE survey to complete, evaluating their confidence and academic achievement, while also taking gender and ethnic background into consideration. After using statistical calculations to evaluate the collected data, researchers found that "...all race/gender groups have either lower STEM confidence or confidence not significantly different from White men" (Litzler, Samuelson, & Lorah, 2014, p. 823). The researchers also made an important note; "… little is known about how academic confidence, and particularly, STEM confidence varies across the intersection of gender and race/ethnicity. Given the underrepresentation of women and minorities in engineering, and continued concerns about these students' retention, this research study is unique in that it examines how outcomes such as STEM confidence vary by specific student demographic group (Litzler, Samuelson, & Lorah, 2014, p. 825).

From the research articles pertaining to gender, confidence, and academic performance within the STEM fields, it is evident that there is a strong relationship among these variables. While the first article addresses gender biases, the second article addresses self-confidence. These articles demonstrate two different ways of conducting research although both use surveys and statistical calculations to evaluate the collected data. Within the studies, it is evident that women, as well as people of color, are underrepresented within STEM classes or the STEM field. The stereotype that math and science are deemed "masculine" and that humanities and arts are deemed "feminine" is still relevant and statistically established today. This research also reveals the lack of confidence that comes from female students and / or students of color in comparison to white male students.

Methodology

The goal of this research was to investigate the relationship between confidence, academic performance, and gender in a mid-western U.S. middle school in mid-sized city. The participants in this study were all young adolescents, ranging from sixth grade to eighth grade (eleven to fourteen years old). There were one-hundred and twelve participants in this study. Below are visual representations of the sample population in comparison to the total number of students.

Chart 1

Sixth Grade Participant Data

Class Period	Number of Participants	Class Total
Period 4/5	19	20
Period 6/7	19	26
Total	38	46

Chart 2

Seventh Grade Participant Data

Class Period	Number of Participants	Class Total
Period 2	14	19
Period 3	17	20
Total	31	39

Chart 3

Eighth Grade Participant Data

Class Period	Number of Participants	Class Total
Period 1	6	17
Period 2	8	22
Period 4	14	24
Period 5	7	15
Period 6	8	24
Total	43	102

Chart 4

Overall Participant Data

Grade	Number of Participants	School Total
6	38	174
7	31	171
8	43	199
Total	112	544

The research process took approximately two weeks. One week was designated for the parent consent forms to be distributed and returned. It took one day to administer the Rosenberg Self-Esteem Survey to all of the math students, and another day to administer the survey to all of the science students. The study went through full Institutional Review Board approval at the author's university. Each participant received parental consent and gave assent before taking the survey. Two days were designated to the data collection portion of this project. The data collection required each survey to be graded (confidence score to be calculated), and a

spreadsheet to be made that included each participants' confidence score, math grade, science grade, and gender. Below is the Rosenberg Self-Esteem Survey, that all participating students were given.

Image 1

Rosenberg Self-Esteem Survey

Name:_____

I identify as… (circle one)

Male Female Other

Rosenberg Self-Esteem Scale

I feel that I am a person of worth, at least on an equal plane with others.

Strongly Disagree Disagree Agree Strongly Agree

I feel that I have a number of good qualities.

Strongly Disagree Disagree Agree Strongly Agree

All in all, I am inclined to feel that I am a failure.

Strongly Disagree Disagree Agree Strongly Agree

I am able to do things as well as most other people.

Strongly Disagree Disagree Agree Strongly Agree

I feel I do not have much to be proud of.

Strongly Disagree Disagree Agree Strongly Agree

I take a positive attitude toward myself.

Strongly Disagree Disagree Agree Strongly Agree

On the whole, I am satisfied with myself.

Strongly Disagree Disagree Agree Strongly Agree

I wish I could have more respect for myself.

Strongly Disagree Disagree Agree Strongly Agree

I certainly feel useless at times.

Strongly Disagree Disagree Agree Strongly Agree

At times I think I am no good at all.

Strongly Disagree Disagree Agree Strongly Agree

There were ten prompts on the Rosenberg Survey; students had to rate each prompt as strongly agree, agree, disagree, or strongly disagree. The ranking given to each prompt determined a score for that specific prompt, with those scores added together, the confidence score of each student was calculated. The score process was different for various questions, due to the fact that some of the prompts were worded positively, and others had a negative connotation. The scoring rubric is presented below.

Image 2

Rosenberg Self-Esteem Survey Rubric

Scores are calculated as follows:

- *For items 1, 2, 4, 6,* and *7:*
  Strongly agree = 3
  Agree = 2
  Disagree = 1
  Strongly disagree = 0
- *For items 3, 5, 8, 9,* and *10* (which are reversed in valence):
  Strongly agree = 0
  Agree = 1
  Disagree = 2
  Strongly disagree = 3

The scale ranges from 0-30. Scores between 15 and 25 are within normal range; scores below 15 suggest low self-esteem.

This rubric explains that the scoring system for items 1, 2, 4, 6, and 7 is different from the scoring system for items 3, 5, 8, 9, and 10. Items 1, 2, 4, 6, and 7 are worded in a positive connotation, and the scoring ascends from strongly disagree (0) to strongly agree (3). Items 3, 5, 8, 9, and 10 are worded in a negative connotation, and the scoring is the opposite, strongly agree being 0 and strongly disagree being 3. The scale for this survey ranges from 0 to 30. Scores between 15 and 25 are considered normal, while scores below 15 suggest that the participant has low self-esteem.

A spreadsheet was then created to organize the data of each students' confidence score, math grade, science grade, as well as their gender. Through this process, the self-esteem trends of the participants were compared with the trend of the students' grades. After comparing the data on the spreadsheet, the observation was made of the likelihood of a common trend within the categories of students' grades, students' self-efficacy, and students' gender. After collecting

survey results, grades, and gender data, the quantitative and quantitative trends were determined by using statistical tests. A t-test was used to compare the two means of male and female confidence levels. Six linear regression tests were run, investigating the relationships between confidence (x) and grade (y). When the relationships were calculated, it was evident that there was not a significant correlation between self-esteem and grades, or the relationship between the confidence level of males and females.

Data & Analysis

Below is a statistical test that reveals the result of the comparison between the confidence mean of the male population and the confidence mean of the female population. In Diagram 1, the first listed mean under Sample 1, 19.9666 is the female population mean. Under Sample 2, the mean for the male population is listed, 20.7059. The significance level, where P= 0.1094, demonstrates that there is not a statistical significance between the confidence means of male and female students. To be statistically significant, the P-value would need to be less than .05.

Diagram 1

Comparison of Confidence Means

Sample 1

Mean:	19.9666
Standard deviation:	3.535533906
Sample size:	60

Sample 2

Mean:	20.7959
Standard deviation:	0.7071067812
Sample size:	49

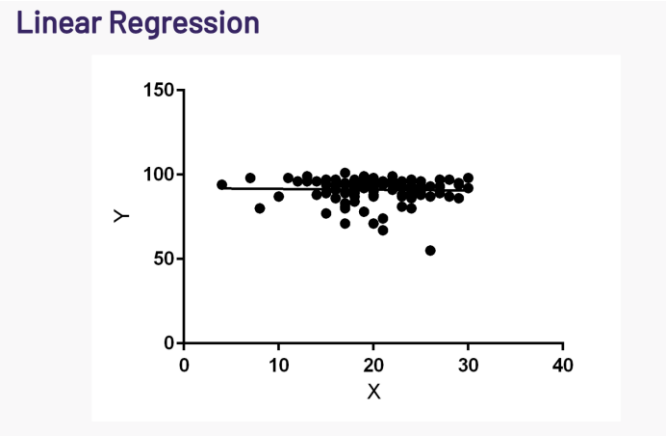
Test

Results

Difference	0.829
Standard error	0.514
95% CI	-0.1890 to 1.8476
t-statistic	1.614
DF	107
Significance level	P = 0.1094

Diagram 2

These visuals display a representation of the linear regression, where x is male and female confidence and y is science grade percentage.



Best-fit values

Slope	-0.04688 ± 0.1463
Y-intercept	91.99 ± 3.012
X-intercept	1962
1/Slope	-21.33

95% Confidence Intervals

Slope	-0.3370 to 0.2432
Y-intercept	86.02 to 97.97
X-intercept	290.2 to +infinity

Goodness of Fit

R square	0.0009331
Sy.x	7.405

Is slope significantly non-zero?

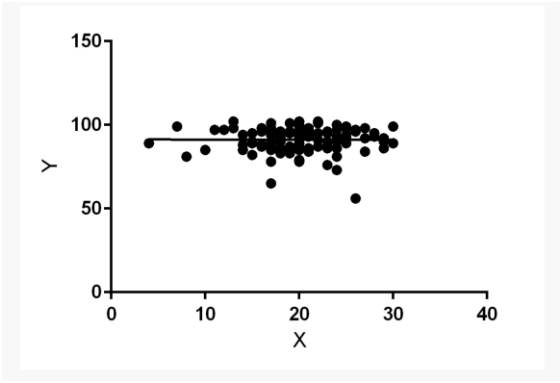
F	0.1027
DFn,DFd	1,110
P Value	0.7492
Deviation from horizontal?	Not Significant

Data

Number of XY pairs	112
Equation	Y = -0.04688*X + 91.99

Diagram 3

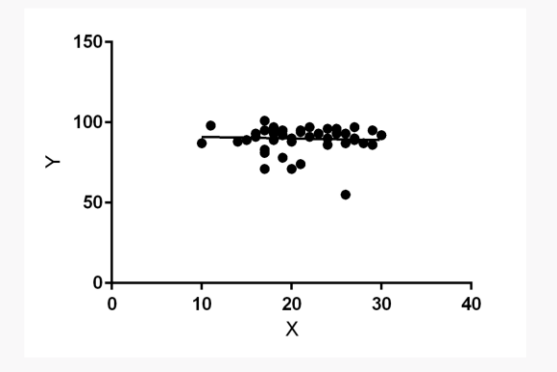
These visuals display a representation of the linear regression, where x is male and female confidence and y is math grade percentage.



Best-fit values	
Slope	-0.007201 ± 0.1469
Y-intercept	91.30 ± 3.025
X-intercept	12678
1/Slope	-138.9
95% Confidence Intervals	
Slope	-0.2986 to 0.2842
Y-intercept	85.30 to 97.30
X-intercept	325.2 to +infinity
Goodness of Fit	
R square	2.183e-005
Sy.x	7.438
Is slope significantly non-zero?	
F	0.002402
DFn,DFd	1,110
P Value	0.9610
Deviation from horizontal?	Not Significant
Data	
Number of XY pairs	112
Equation	Y = -0.007201*X + 91.30

Diagram 4

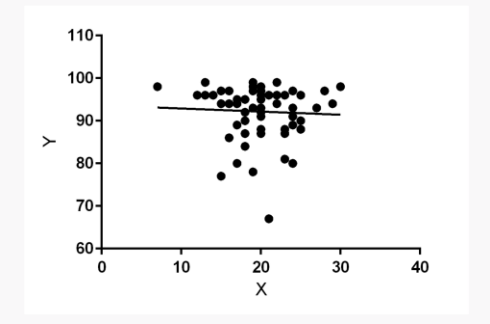
These visuals display a representation of the linear regression, where x is male confidence and y is science grade percentage.



Best-fit values	
Slope	-0.09635 ± 0.2614
Y-intercept	91.92 ± 5.567
X-intercept	954.0
1/Slope	-10.38
95% Confidence Intervals	
Slope	-0.6226 to 0.4299
Y-intercept	80.71 to 103.1
X-intercept	165.1 to +infinity
Goodness of Fit	
R square	0.002883
Sy.x	8.412
Is slope significantly non-zero?	
F	0.1359
DFn,DFd	1,47
P Value	0.7140
Deviation from horizontal?	Not Significant
Data	
Number of XY pairs	49
Equation	Y = -0.09635*X + 91.92

Diagram 5

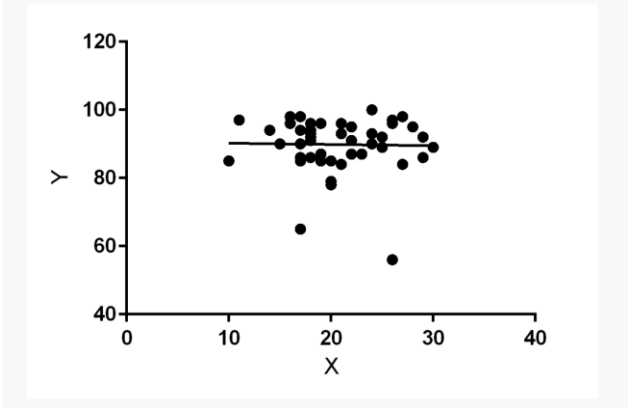
These visuals display a representation of the linear regression, where x is female confidence and y is science grade percentage.



Best-fit values	
Slope	-0.07328 ± 0.1984
Y-intercept	93.63 ± 4.047
X-intercept	1278
1/Slope	-13.65
95% Confidence Intervals	
Slope	-0.4704 to 0.3238
Y-intercept	85.53 to 101.7
X-intercept	215.9 to +infinity
Goodness of Fit	
R square	0.002347
Sy.x	6.458
Is slope significantly non-zero?	
F	0.1365
DFn,DFd	1,58
P Value	0.7132
Deviation from horizontal?	Not Significant
Data	
Number of XY pairs	60
Equation	Y = -0.07328*X + 93.63

Diagram 6

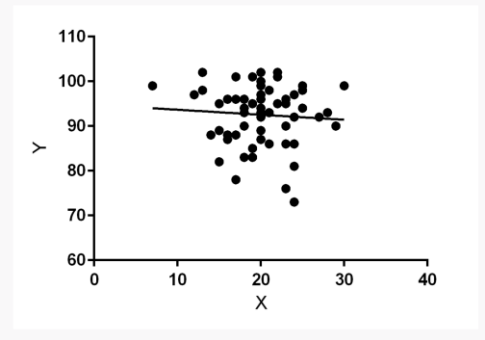
These visuals display a representation of the linear regression, where x is male confidence and y is math grade percentage.



Best-fit values	
Slope	-0.03652 ± 0.2520
Y-intercept	90.58 ± 5.367
X-intercept	2480
1/Slope	-27.38
95% Confidence Intervals	
Slope	-0.5440 to 0.4709
Y-intercept	79.77 to 101.4
X-intercept	185.9 to +infinity
Goodness of Fit	
R square	0.0004467
Sy.x	8.111
Is slope significantly non-zero?	
F	0.02101
DFn,DFd	1,47
P Value	0.8854
Deviation from horizontal?	Not Significant
Data	
Number of XY pairs	49
Equation	Y = -0.03652*X + 90.58

Diagram 7

These visuals display a representation of the linear regression, where x is female confidence and y is math grade percentage.



Best-fit values	
Slope	-0.1122 ± 0.2068
Y-intercept	94.79 ± 4.220
X-intercept	845.0
1/Slope	-8.914
95% Confidence Intervals	
Slope	-0.5262 to 0.3019
Y-intercept	86.34 to 103.2
X-intercept	195.8 to +infinity
Goodness of Fit	
R square	0.005047
Sy.x	6.733
Is slope significantly non-zero?	
F	0.2942
DFn,DFd	1,58
P Value	0.5896
Deviation from horizontal?	Not Significant
Data	
Number of XY pairs	60
Equation	Y = -0.1122*X + 94.79

The data above displays a t-test and six linear regression tests. As observed in the statistical results, the confidence levels among male and female students is not statistically significant. It can be observed that the confidence level mean for females was 19.9666 and the confidence level mean for males was 20.7959. The p-value is calculated to be 0.1094. To have statistical significance that p-value had to have been less than 0.05. Each of the linear regression tests do not display any significance between students' confidence level and their math and/or science grade.

Explanations and Limitations

After conducting this research project, there were many limitations present that could have affected the data and analysis. The first limitation was that the participants' ages ranged

from eleven to fourteen years old, which could have affected their comprehension of the prompts on the Rosenberg Self-Esteem Survey. In the survey, half of the questions were worded in a positive connotation, whereas the other half were worded in a negative connotation. If the students did not read the prompts carefully, they easily could have circled a rating (strongly agree, agree, disagree, or strongly disagree) that was not accurate to their beliefs about themselves. If students did not thoroughly understand the prompt, and selected an inaccurate rating, their confidence score would have been affected as well, thus skewing the data. Another possible limitation in this research might have been that students answered the survey in a way that was not accurate to their self-esteem. Inaccurate survey results could have also led to inaccurate overall results. The sample size of this research was one-hundred and twelve students total, ranging from students in sixth grade to students in eighth grade. The participation of the students was limited to those who had consenting parents and those students also had to give their assent to participate. If the sample population would have been larger, there is a possibility that the data collected (survey results and statistical tests) might have been more accurate. The student participants in this survey attend a suburban school, comprised mostly of Caucasian students. The majority of the families of the students at this school have socio-economic statuses that range from middle-class to upper-middle class. Many of the students in these classes play travel sports, are involved in various clubs, teams, as well as other extracurricular activities. The opportunities given to these students and the environment in which they are growing up, provide them with an equal chance to participate and thrive within their community. This advantaged community and school may have had an effect on the self-esteem levels of the participating students. This research is not generalizing the patterns of the relationships between confidence, academic performance, and gender of all junior high students, rather it is solely concerned with

the participants in this study. If this study were to be conducted again, there are many alterations that could be made. Due to the fact that the students in the sample population are very similar, it would be beneficial for there to be greater diversity among the students (socio-economic status, race, gender). If a different confidence survey was given to the sample population, that related to education, specifically confidence in math and science courses, the confidence results would then be directly linked to confidence within education, rather than general student confidence.

Conclusion

In conclusion, the data from this research reveals that there was not a statistical significance within the relationship between student confidence and academic performance, or the relationship between male and female confidence within the sample population. The graphs that display the relationship between male confidence to their math grades, male confidence to their science grades, female confidence to their math grades, female confidence to their science grades, and even total student confidence to math grades, and total student confidence to science grades do not here demonstrate a statistical significance. The results of this study differed greatly from the majority of the research studies present in the literature review. Several of the studies in the literature review demonstrated results of a significant relationship between student confidence and academic performance (Zhao, Zheng, Pan, & Zhou, 2001, Booth & Gerard, 2011). Separate studies observed that there was a significance between the relationship of the confidence of males and females, stating that males commonly did report to have higher confidence levels (Litzler, Samuelson, & Lorah, 2014, Hand, Rice, & Greenlee, 2017) Contrary to the literature review, the statistical relationship between male and female confidence scores is not significant within this particular population of students. While reviewing the data, there were

several students who were outstanding in their grades but scored very low in their self-esteem. Specifically, there were ten students who scored below twenty, but had A's or B's in their math and science classes. There were also several students who had lower math and science scores (compared to their peers), but reported to have very high self-esteem. Specifically, there were eight students who had confidence levels over fifteen, while having performance levels for math and science at seventy percent or less. Another important aspect of this research is that students who selected "other" for their gender, had extremely low self-esteem scores. The four students who selected "other", had confidence scores ranging from four to fourteen, any score under fifteen is considered low self-esteem. There were only three other students who had confidence scores under fifteen. Overall, this research study provides evidence that confidence does not necessarily affect academic performance in STEM classes in all situations, and there is not a significant statistical relationship between male and female confidence within this particular population. Regardless of the results within this research, it is important that students in the classroom are accepted, empowered, and supported. When students are in a safe classroom environment and are unafraid to fail, they are more willing to participate. Greater participation and engagement then leads to higher student achievement within the classroom.

Annotated Bibliography

Allen, J. D. (2005). *Grades as Valid Measures of Academic Achievement of Classroom Learning*. Retrieved February 19, 2022, from https://facultysenate.tcnj.edu/wp-content/uploads/sites/306/2012/10/GradesasValidMeasures.pdf

This article refers to the research on grades and the several factors that make a grade valid or not. The author believes that factors such as attendance and effort should be taken into consideration, but noted separately from the actual grade the student receives.

Arshad, M. A., Zaidi, S. M. I. H., & Mahmood, K. (2015). *Self-esteem & academic performance among university students*. Journal of Education and Practice. Retrieved February 23, 2022, from https://files.eric.ed.gov/fulltext/EJ1083788.pdf

This research investigated the relationship between gender, self-efficacy, and academic performance. The researchers found that there was a positive correlation between higher self-efficacy, leading to higher grades.

Artino A. R., Jr (2012). Academic self-efficacy: from educational theory to instructional practice. *Perspectives on medical education, 1*(2), 76–85. https://doi.org/10.1007/s40037-012-0012-5

This author contributed to the understanding of confidence theories and self-efficacy. He supports the idea that basic needs must be met before students can experience efficacy.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* W H Freeman/Times Books/ Henry Holt & Co.

Bandura contributed the self-efficacy theory, which served as a foundation for the explanation of confidence. Self-efficacy is one's belief in carrying out a certain task.

Bekkering, E., & Ward, T. (2020, December). *Class participation and student performance: A tale of two courses*. Information Systems Education Journal. Retrieved February 20, 2022, from https://files.eric.ed.gov/fulltext/EJ1258148.pdf

This research investigated the relationships between participation and performance in technology classes. The results from the two classes differed because of circumstantial classroom practices.

Booth, M. Z., & Gerard, J. M. (2011, September). *Self-esteem and academic achievement: A comparative study of adolescent students in England and the United States*. Compare. Retrieved January 27, 2022, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3779915/

This article regarded a cross-cultural study in Cleveland and England. There was a relationship between student confidence and student performance in both county contexts.

Cavilla, D. (2017, September 25). *The effects of student reflection on academic performance and motivation*. SAGE Journals. Retrieved February 19, 2022, from https://journals.sagepub.com/doi/full/10.1177/2158244017733790

Student reflection on academic performance and motivation were evaluated in this study. The statistics showed that the relationships between student self-reflection and academic performance and motivation were quantitatively insignificant.

Chiekem, E. (2015). *Grading practice as valid measures of academic achievement of secondary*

schools students for national development . Journal of Education and Practice. Retrieved February 19, 2022, from https://files.eric.ed.gov/fulltext/EJ1077389.pdf

This study investigated the differences of educators' grading biases. A significant difference between the grading of male and female teachers did not exist; however ,there was a significant correlation between the biases of urban and rural educators.

Chilca, L. (2017). Self-Esteem, Study Habits and Academic Performance Among University Students. *Propósitos y Representaciones,* Retrieved February 19, 2022, from https://files.eric.ed.gov/fulltext/EJ1139345.pdf

This research refers to a study done to investigate self-esteem, study habits, and academic performance among college engineering students. According to the researchers, student confidence does not significantly impact academic performance, but study habits and patterns do influence academic performance.

Copur-Gencturk, Y., Cimpian, J. R., Lubienski, S. T., & Thacker, I. (2020). Teachers' Bias Against the Mathematical Ability of Female, Black, and Hispanic Students. Educational Researcher, 49(1), 30–43. https://doi.org/10.3102/0013189X19890577

This study investigates the biases of teacher grading towards students. Teachers were given the same written math work, with various male, female, and ethnic names. The general finding was that teachers scored students with white-sounding names higher than any other ethnicity.

Han, J., Kelley, T. & Knowles, J.G. (2021) Factors Influencing Student STEM Learning: Self-Efficacy and Outcome Expectancy, 21st Century Skills, and Career Awareness. *Journal for STEM Educ Res* 4, 117–137. https://doi.org/10.1007/s41979-021-00053-3

This study was conducted to evaluate TRAILS educators and their students. The researchers found that there is a statistical correlation between teacher self-efficacy and student academic improvement in STEM.

Hand, S., Rice, L. & Greenlee, E. (2017).*Exploring teachers' and students' gender role bias and students' confidence in STEM fields*. *Soc Psychol Educ* 20, 929–945 https://doi.org/10.1007/s11218-017-9408-8

These researchers investigated gender biases among teachers and students. They also took note of student confidence in STEM. Their findings supported their hypothesis that students and teacher reported that males perform better in STEM subjects, while females perform better in humanity and art subjects.

Heaverlo, C. A. (2011). *STEM development: A study of 60RW1S34RfeSDcfkexd09rT3th1RW1S34RfeSDcfkexd09rT3–120RW1S34RfeSDcfkexd09rT3th1RW1S34RfeSDcfkexd09rT3 grade girls' interest and confidence in mathematics and science* (Order No. 3473025). Available from ProQuest Dissertations & Theses A&I; ProQuest Dissertations & Theses Global. (894337556). https://www.proquest.com/dissertations-theses/stem-development-study-6-sup-th-12-grade-girls/docview/894337556/se-2?accountid=26417

This study was conducted to evaluate female students' interest and confidence in STEM subjects. Researchers found that there was a strong relationship between students' confidence and interest in STEM subjects.

Lindsey, L. L. (2020, December 18). *Gender: Sociological perspectives: Linda L. Lindsey: Taylor & franc*. Taylor & Francis. Retrieved February 16, 2022, from https://www.taylorfrancis.com/books/mono/10.4324/9781315102023/gender-linda-lindsey

This literature gives an insight of the sociological lens of gender. Gender acts as a sociological construct that is represented by common norms and expectations.

McClary, T., & Degardin, G., & Kulpa, J., & Sullivan, P., & Trujillo, K. (2020, March), *Self-efficacy and STEM knowledge as observed during a short-term middle school intervention program* Paper presented at 2017 Gulf Southwest Section Conference, Richardson, TX. https://peer.asee.org/33823

This article regards a study that was done to evaluate student confidence and academic performance within STEM education. Researchers found that there was not a significant correlation between student self-efficacy and student performance.

Naderi, H., Abdullah, R., Tengku Aizan, H., Sharir, J., & Kumar, V. (2009, January). *Self esteem, gender and academic achievement of ...* Retrieved January 27, 2022, from https://www.researchgate.net/profile/Habibollah-Naderi/publication/254896618_Self_Esteem_Gender_and_Academic_Achievement_of_Undergraduate_Students/links/0c96053b78e7c29fbc000000/Self-Esteem-Gender-and-Academic-Achievement-of-Undergraduate-Students.pdf

Researchers conducted a study to investigate the relationship between gender, self-efficacy, and academic performance. There was a statistical significance when evaluating self-esteem and

gender, but there was not a significance found when evaluating self-esteem and student achievement.

Sander, P., & De la Fuente, J. D. la F. (2020, August). *Undergraduate student gender, personality, and academic confidence* Research Gate. Retrieved February 23, 2022, from https://www.researchgate.net/publication/343365915_Undergraduate_Student_Gender_Personality_and_Academic_Confidence

This study evaluated the relationship between gender, personality, and academic self-efficacy among students. The research showed that females had higher levels of confidence and displayed higher numbers for the personality trait portion of the study.

Starmer, D. J., Duquette, S., & Howard, L. (2015, October). *Participation strategies and student performance: An Undergraduate Health Science Retrospective Study*. The Journal of chiropractic education. Retrieved February 21, 2022, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4582611/

This research demonstrates an investigation of the relationship between student participation and student academic success. The authors found that there was a statistical significance between student participation and student academic achievement.

Tang, Reddington, & Cañada. (2019, October 7). *How does student participation influence student achievement?* NYU Steinhardt. Retrieved February 20, 2022, from https://steinhardt.nyu.edu/departments/teaching-and-learning/research/practitioner-action-research/how-does-student

This study evaluates the relationship between student participation and student achievement. The researchers found that academic achievement is support by student participation and motivation.

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This study was based on a survey given to students that collected information about student self-efficacy and their perceived support. The authors found that there was a significant statistical correlation between self-efficacy, student engagement, and academic self-efficacy.