Breaking the Wired Ceiling: Investigating the Development of Leadership Skills Within Female Secondary Students

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ABSTRACT

The gender gap in the STEM workforce is a prevalent issue in society today. With barriers facing women when pursuing postsecondary STEM education, attaining their first job in the workforce and when looking to earn senior management positions, it is important to recognize what can be done to support these women. This recognition led to the goal of this research: to determine to what extent leadership characteristics are being developed in female high school students in secondary technology and engineering classes, preparing them for a future in the STEM industry.

A questionnaire was sent to female high school students at [redacted] High School where they were asked to answer a series of Likert scale questions and open-ended questions.

It was concluded that secondary technology and engineering classes largely do not foster skills of communication, creativity, proactivity, and teamwork amongst female high school students.

INTRODUCTION

Gender inequality is still prevalent in the 21st century and is evident in the professional sector. This inequality is largely represented by numbers since “women are vastly underrepresented in STEM jobs and among STEM degree holders despite making up nearly half of the U.S. workforce and half of the college-educated workforce” (Beede et al.). STEM is a widely used acronym that stands for science, technology, engineering, and math. Additionally, low numbers of women in STEM also equate to a lower percentage of women holding higher professional positions, such as CEO, in the STEM field.

Women who look to earn higher positions in a professional capacity and bridge this gender gap often face a phenomenon named the glass ceiling. This phrase was first coined by Hymowitz and Schellhardt in a Wall Street Journal report in 1986 and has increasingly been used to describe the gender gap in the workforce. It should be acknowledged, however, that there are varying opinions about the existence of the glass ceiling phenomenon. Rather than barriers from the outside, some claim that using the phrase “glass cage” would be more accurate because the negative attitude of women themselves has been researched to be a large inhibitor to women's success (Lahti). For this study, the phrase glass ceiling will be used to refer to the barriers women face when attempting to earn senior management positions (Wilson).

Today, women need to “break the glass ceiling” to get over barriers and progress to top-level positions. To do so, they need to face adversity and show leadership. In the context of technology and engineering fields, “leadership was one of the key attributes mentioned that would be necessary ‘“to support the success and relevance of the engineering profession in 2020 and beyond,” (Paul and Falls). Technical education alone is no longer an indicator of professional success in the technology and engineering field. To earn managerial positions, leadership skills need to be present as well. Therefore, to bridge the gap between men and women in this field, women must be given adequate resources to overcome this adversity through the development of leadership skills. Specifically, “Given the barriers, advancing and retaining women in traditionally male-dominated professions requires organizations to implement strategies for professional development tailored to address the fendered context of women’s careers and lives,” (Van Oosteen et al.). One way that organizations can implement strategies is through education at an early age (Lahti).

Therefore, providing female students the opportunity to be successful in the professional sector enables the possibility that more women will be able to climb the rungs of the labor ladder to shatter the glass ceiling and be an inspiration to girls all over the world.

GAP

There is extensive research on the gender gap in STEM and it is established that education is a way to bridge this gap. Education could be referring to technical education earned in postsecondary programs, and in the context of the 21st century, leadership skills earned in postsecondary education. Additionally, there is much research on leadership development at a post-secondary level within the technology and engineering sector. However, many female students are interested in the engineering and technology sector from a young age, which can start in high school. There is little to no research on the perceived leadership qualities that develop within females from enrolling in technology and engineering classes at the high school level. By discovering the skills that female students develop through enrollment in such classes and finding a correlation between these skills, this gap in the research will be filled while increasing female students’ ability to become successful leaders. In other words, this research aims to find the link between secondary technology and engineering classes and how they can provide women with the capabilities to break the glass ceiling at a young age.

RESEARCH QUESTION

With the gap in this field of study in mind, the research focused on the question, to what extent do participation in secondary technology and engineering classes foster leadership skills vital for the technology and engineering workforce amongst female high school students? The realm of technology and engineering is a specific sector within the STEM industry. The answer to this question will be found by measuring leadership traits that were discovered in previous research papers to be of the highest importance in the technology and engineering fields. These baseline characteristics will then be used to ask students who enrolled in technology and engineering classes in high school if they felt that they learned these skills and were developed as part of enrollment in their technology and engineering class. Through additional research, a consensus was reached that the specific leadership traits that will be measured are communication, creativity, proactivity, and teamwork. These leadership characteristics were most frequently seen in papers evaluating the importance of certain leadership characteristics in the technology and engineering industry such as *Engineering Leadership Education: A Review of Best Practices*.

LITERATURE REVIEW

Search Strategies

Sources were all found on reputed databases that employed peer-reviewing techniques to ensure the validity of the research. Some keywords used were: engineering, leadership, glass ceiling, computer science, Post-Secondary, and programs.

History

To understand the gender disparity in the field of STEM, the history of this phenomenon must be understood. This phenomenon can be viewed through the lens of computer science, and the change in demographics in computer science can be applied to all engineering and technology fields.

It was common to work in computer science from the 1880s until decades after World War II (Jensen). Then in the late 1980s, the internet started to make its way through society, and the emergence of video games in the 1990s added to the craze over technology (Iskander). During this time, toy stores were segregated by gender and most, if not all, video and computer games were put into the boy’s section (Lavorata). Businesses enabled and followed gender stereotypes to appease their target audience, and slowly started to alienate women from the technology conversation. Such insinuation and implications led to women often being in ads posing as homemakers and the stereotype of male computer geniuses or nerds prevailed. These gender normative stereotypes, ideologies that certain characteristics and roles are for females and others are for males, had a detrimental effect and were successful in pushing women out of the conversation. Looking forward to the present day, the media continues to perpetuate these gender normative stereotypes by typically placing “male characters in dominant roles when using technology”. However, many claim that these stereotype-driven images are decreasing with the rise of Internet “chat rooms, websites and videogames” which aim to interest women (Banerjee and Ramona).

Currently, more women than men attend college and pursue bachelor’s degrees, however, the percentage of women attaining computer science degrees is declining. “In 1995, the proportion of women obtaining a bachelor’s degree in computer science was 28%, 25% in 2004, and 18% in 2014” (Jensen). Moreover, women are even less likely to pursue a career in engineering as opposed to software development and computer science. When looking at the general picture, this trend and historical reasoning which explains why women are not prominent in computer science can be utilized in all technology and engineering concepts.

Importance

The gender disparity in STEM is significant because the STEM market is rapidly growing, but the demand for such jobs exceeds the supply of experienced candidates (Sadler et.al). From 2010 to 2020, the Bureau of Labor Statistics reported that 1.2 million computer science jobs were predicted to be added, but there was only half that number of graduates who could fill these positions (Bottia et. al.) Specifically, women in the United States only make up 30% of the STEM workforce, pointing to a large untapped potential in the labor market. (Riegle-Crumb et. al.). Researchers Banerjee and Ramona assert that interest in STEM among female students wanes from eighth grade onward and further deteriorates with the presence of unsupportive attitudes (Banerjee and Ramona). Therefore, it is important to support female high school students showing an interest in STEM in order to maintain that interest. It is important to find a correlation between high school classes, the interests of female high school students, and the gender gap in STEM because research has shown that many students decide to pursue a STEM degree in high school (Bottia et. al.).

However, earning a STEM education is only the first step for women looking to earn high-level leadership positions in such industries. Along with narrowing the gender gap in STEM education and the workforce, more women must break the glass ceiling and hold positions of power (Jensen). The importance of more female leaders can be broken down into four categories which “include equality, women’s contributions as leaders, the importance of women being able to seek out and meritocracy,” (Lahti). Women in power have greatly impacted companies as “...the higher proportion of women in senior management has been proven to positively influence the growth of the stock market, returns on invested capital, return on equity and sales.. “ (Lahti). Additionally, an increase of women in certain professions increases diversity and creates opportunities that can lead to increased quality of life for marginalized populations. Researcher Elsi Lahti states, “The positive effects of gender diversity can be seen most prominently in the work environment, values and vision,” (Lahti). If women were to join the STEM field, they have a chance to help increase representation from inside the institution. However, adversity in the technology and engineering field, such as the wage gap, can lead to women leaving the industry due to their skills being underestimated and underappreciated (Jensen). By finding ways in which female students can develop strategies and characteristics that may make them more successful in breaking the glass ceiling, more women will be able to shatter it. This opens up opportunities for future generations and ends the perpetuating cycle of the glass ceiling, enabling women to be represented in the highest positions in the professional field.

Finding the correlation between secondary technology and engineering education and the development of communication, creativity, proactivity, and teamwork is important because if a correlation exists between these two ideas, educational institutions will be able to better support their female populations. With proper support and guidance, female students will be better able to pursue their interests in STEM without fear of discrimination and loneliness.

RESEARCH DESIGN AND METHODOLOGY

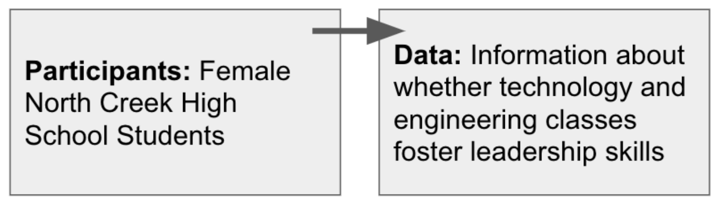
Study Design and Subjects

Female students at [redacted] High School who had participated in technology and engineering classes were asked to fill out a questionnaire to find this correlation. These students had experienced secondary education firsthand, making them the best indicators of what leadership characteristics are developed at the secondary level. They were asked questions about their experiences in these classes and the leadership skills they may have obtained.

Procedure and Research Instruments

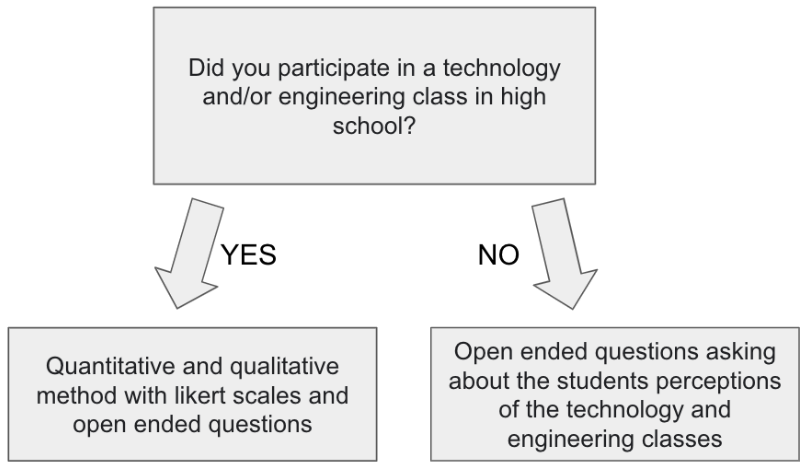
The first step in the research process was identifying the baseline leadership characteristics that would be later measured in female high school students. This was done through a meta-analysis of relevant research papers that examined essential leadership skills needed for employees in the technology and engineering workforce and examined key themes in post-secondary technology and engineering leadership education. Two sources, in particular, *Engineering Leadership Education: A Review of Best Practices*, and *Competencies Required by Industry from Early Career Engineering Graduates – Developing Management & Leadership Skills in Engineering Education*, played a large role in the final decision of measuring communication, creativity, productivity, and leadership as the baseline leadership traits. Both of these studies had similar traits highlighted as crucial for technology and engineering graduates to have and were prevalent in post-secondary technology and engineering leadership development programs. This similarity bolstered the validity of using the four leadership characteristics of communication, creativity, proactivity, and teamwork as baseline characteristics. Then, the survey was made using these baseline traits through the platform Google Forms due to its easy accessibility and recognizability.

With the baseline data, this survey was sent to female students in classes across [redacted] High School and was distributed amongst female sports teams. Female-identifying students at [redacted] High School were asked to find correlations between the baseline data and their experiences in technology and engineering classes. In the first section of the survey, students were asked to read the Informed Consent Form and sign their names to confirm that they understand the risks of the study (Appendix A). Then, students were taken to the second part of the survey where they were asked to fill out their gender orientation, grade, school name, and whether or not they had enrolled in technology or engineering class (Appendix B). A list of technology and engineering classes at [redacted] High School, found from the high school class catalog, was provided for the participant's convenience (Appendix C). This section sorted the data so it would be easy to analyze the data of the participants that identified as female and had enrolled in at least one semester of a technology and engineering class. If the participant had not participated in a technology or engineering class, they were directed to a section with two long response questions asking them why they chose not to enroll in technology and engineering classes and what stereotypes they associate with students who do choose to enroll in such classes (Appendix D). These questions helped preliminary determine barriers to female enrollment in secondary technology and engineering classes. The answers to this question were not used in this research, but provide some context to the qualitative data that was gathered and used for this research.



Finally, the last question asked whether the participant would consider enrolling in a technology and engineering class in the future.

However, if the participant had enrolled in at least one semester of a technology and engineering class, they were led to a part of the survey which gathered both quantitative and qualitative data (Appendix E). Quantitative data was attained through the usage of a Likert scale from 1 to 5 with 1 being “the skill developed a lot as part of enrollment in the class” and 5 being “this skill was extremely developed through enrollment in the class.” Additionally, qualitative data was further attained by asking open-ended questions where students were able to explain why a leadership skill was facilitated or not facilitated as part of enrollment in the pre-specified class.



Ethical Concerns

No compensation was offered for participation to ensure the validity of the data. Additionally, all participants signed an informed consent form and were made aware that their participation is voluntary and that no identifying information will be collected to maintain anonymity and privacy. To ensure data privacy, email addresses, not names, were collected for organizational purposes. After the analysis of data, all identifying information was deleted.

Purpose and Alignment

To increase women’s participation in technology and engineering fields, more women need to be in leadership roles. Therefore, finding a correlation between secondary education and soft skills or traits provides avenues to empower and encourage young women to break barriers in male-dominated fields. By focusing on some of the most important traits for technology and engineering graduates to have when entering the workforce- communication, creativity, proactivity, and teamwork- this method demonstrates how secondary education supports or does not support female students, thus, accomplishing the goal of the research. Additionally, the information gathered from this study will inform students and educators about the inherent value of secondary computer science and engineering programs.

Gathering data through a questionnaire was the ideal way to obtain qualitative and quantitative results while providing convenience to participants. Participants were able to take the survey on their own time, which provided quality results and a greater sample size. Additionally, questionnaires gather both qualitative and quantitative data with no difficulty and provide a functional format to view results. Gathering mixed quantitative and qualitative data through the survey enabled the research to clarify to what extent the 4 leadership characteristics were developed within students, rather than just answering a yes or no question. Using a Likert scale allowed a wide variety of opinions and perspectives to be accepted into the dataset, further solidifying the complexity of the question and conclusion. Finally, this survey format was similar to the method used by researchers Banerjee and Ramonda in the study *A Study of Student's Perception of Computer Education: Lack of Interest in STEM Fields for Female Students,* which had a similar goal to this research paper.

RESULTS

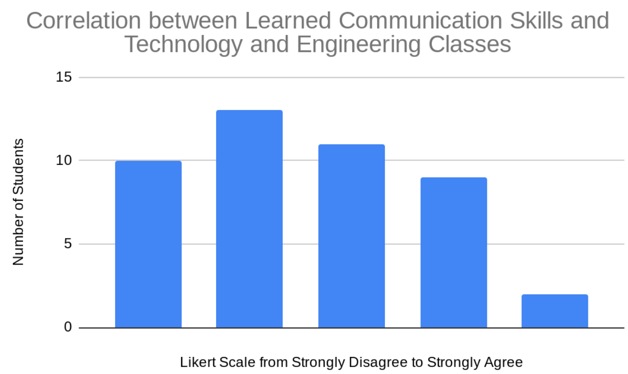
Sample Size

The questionnaire was distributed around [redacted] High School and was completed by 70 students. 45 of those 70 students were students who identified as female and had enrolled in at least one technology or engineering course during their high school career. This is an adequate sample size of participants because it is estimated that around 300-400 female students are enrolled in technology and engineering at [redacted] High School, making this group of research participants 10% of the estimated population.

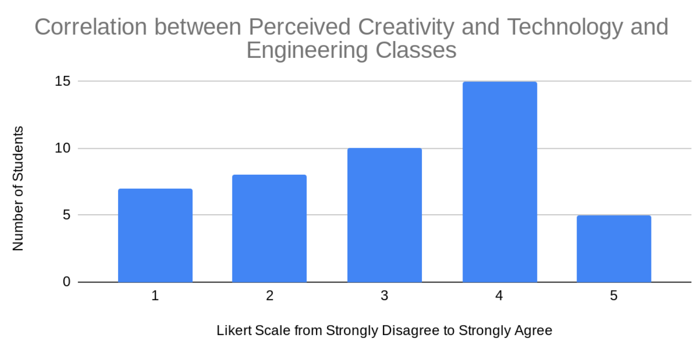
Quantitative Results

The answers of the 45 female-identifying students who had enrolled in at least one semester of technology and engineering classes were analyzed. In regards to the Likert scale data, the median, mode, and percentages of answers of 1 and 2 versus the percentages of answers of 4 and 5 were analyzed. The mean was not used because of its insignificance, since no mean can be taken on the opinions of others.

Starting with the first spotlighted soft skill of communication, students were asked to answer the question, “To what extent did you learn/improve on your communication skills?” The median answer was 2 and the mode of the data set was 2. This shows that the data was skewed towards the “skill not developed as a result of enrollment in the class” and largely, many students did not see development or improvement in their communication skills as a result of participation in secondary technology and engineering courses. 51% of the participants claimed that communication was not developed in these classes compared to 24% that claimed that their communication skills did improve. 24% of participants were neutral and answered “3” in response to this question. Largely, it can be concluded that communication was not developed or improved among female high school students as a result of enrollment in technology and engineering classes.

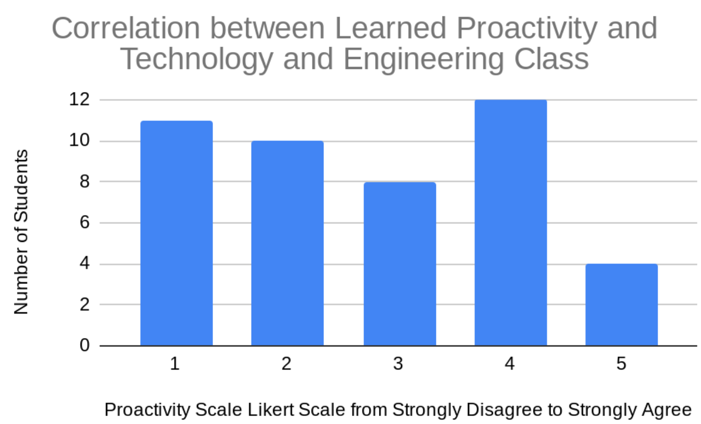


Participants then moved on to the second question, “To what extent did you learn/improve on your creativity?”, with a focus on a new soft skill, being creativity. The median answer to this question was a “2”, and the mode was

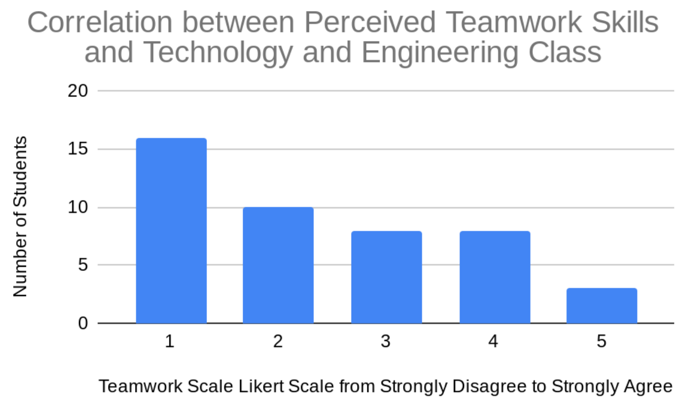


“4”. The data was skewed to the right, indicating a correlation between development or improvement of creativity as a result of enrollment in technology and engineering classes. 33% of participants claimed that creativity was not facilitated as a result of enrollment compared to 44% who claimed that their creativity was positively impacted. 22% of participants remained neutral to this question with an answer on the Likert scale of “3”. From this data set, it can be concluded that creativity was developed and improved amongst female high school students as a result of enrollment in technology and engineering classes.

The third question that participants answered with a Likert scale was “To what extent did you learn/improve on your proactivity? (Proactivity is defined as self-initiated behavior that endeavors to solve a problem before it has occurred)”. A baseline definition of proactivity was provided to reduce discrepancies about the meaning of the focused soft skill of proactiveness. The median answer amongst the participants was a 3 and most participants answered the Likert scale with a 4. This makes it seem as though most students believed that their proactivity was positively benefited as a result of enrolment. However, when comparing percentages, 47% of students claimed that proactivity was not facilitated in these classes as opposed to 36% claiming that proactivity was facilitated. 18% remained neutral. With the data being so close, it cannot be said definitely whether the current technology and engineering curriculum does positively impact the proactivity of female students.



Finally, the last Likert scale question was “To what extent did you learn/improve on your teamwork?” This question resulted in the clearest results. The median answer was “2” with the mode being “1”. This clearly shows that the majority did not believe that their teamwork was positively developed as a result of enrollment in technology and engineering classes. When looking at percentages, 58% of participants claimed that teamwork was not developed as a result of enrollment compared to 18% claiming that teamwork was developed. 24% of participants remained neutral to the question by selecting an answer of “3”. From this, it is clear that teamwork was not developed as a result of enrollment in technology and engineering classes.



Qualitative Results

Qualitative answers were also garnered from the survey and iterative coding techniques were used to find prevalent themes and evidence of soft skill development. The coding process for each of the soft skills happened in four iterations, finally resulting in two major themes that students identified regarding the identified soft skill.

With regard to communication, students identified that enrollment in these classes, if affected their communication skills, affected it in these ways. Students specifically stated that “Explaining my code to other people when they asked for help required concise and clear language. Because of this, I have improved my ability to articulate my words more clearly”. Another student expressed that “I was able to ask for help from teachers and peers when needed which definitely helped me improve without knowing.” Mainly, the delivery of their ideas and vulnerability with respect to communication increased. The coding map below lists the main themes and their specific nuances.

Figure 1: Students' Perceptions on how Communication was Developed as a Result of Enrollment, Final Qualitative Coding Map

1.) Delivery
    a.) Methods of Communication
    b.) Concise and Clear Communication
    c.) Communicate Ideas to Different Audiences of Varying Levels of Knowledgeability
2.) Vulnerability
    a.) Asking Questions
    b.) Relying on Classmates; Collaboration

Concerning creativity, students specifically stated that “It makes you appreciate different solutions and approaches to the same problem” and another student expressed that “I learned to think outside the box to solve problems efficiently. The creative freedom that I got when designing programs was incredibly helpful.” Students identified that enrollment in such classes improved creative problem-solving skills and also improved their capacity to be creative as they gathered more technical skills in technical knowledge. The coding map below lists these themes.

Figure 2: Students' Perceptions on how Creativity was Developed as a Result of Enrollment, Final Qualitative Coding Map

1.) Creative Problem Solving
    a.) Out of the Box Thinking
2.) Increased Technical Knowledge
    a.) Technical Knowledge Provided more Opportunities to Build Tangible Ideas
    b.) Increased Open-mindedness to New Ideas and Solutions

With regard to proactivity, a student stated that “..proactivity was improved through this class because we were taught to predict certain errors in our program before they occurred” with another student expressing that “I learned to think outside the box to solve problems efficiently. I was more proactive in getting my work done. It’s impossible to start a coding project last minute and get it to work, so I would always start early to avoid the last-minute stress.” In conclusion, when the topic of proactivity came to light, students' problem-solving skills improved and they took more charge of their education. The coding map further goes over these themes.

Figure 3: Students' Perceptions on how Proactivity was Developed as a Result of Enrollment, Final Qualitative Coding Map

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1.) Enhanced Problem Solving
    a.) Anticipated Errors in Advance
2.) Take Charge of their Education
    a.) Limited Procrastination
    b.) Utilized and Reached out to Outside Resources to Understand the Curriculum

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Finally, with regard to teamwork, students claimed “I was able to work well with my partners and I learned that there is a huge benefit to working with partners as you can ask each other questions and work together towards a common goal and achieve it successfully”, and another student expressed that “Engineering was a group project class and I learned how to identify someone’s strengths and weaknesses to assign who does which part of the project.” As a result, students' problem-solving skills improved and they took more charge of their education. The coding map below lists the main themes and their specific nuances.

Figure 4: Students' Perceptions on how Teamwork was Developed as a Result of Enrollment, Final Qualitative Coding Map

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1.) Improved Collaboration
    a.) Learned about Relying on Individual Strengths
    b.) Learned how to Work With Individuals with Differing Viewpoints
    c.) Increased Team Problem Solving Skills

These specific themes emerged as a result of the research and show that some leadership characteristics are built upon in technology and engineering classes amongst high school students, while not on a quantifiably large level. While these skills are not experienced by the majority of students, they are still present.

CONCLUSION

In conclusion, this research shows that there is no large correlation between the development of communication, proactivity, and teamwork for female students after enrollment in secondary technology and engineering classes at [redacted] High School. However, creativity is being developed on a larger scale through enrollment, although it is not very prominent. These conclusions were made by looking at the quantitative data and recognizing that the majority of students claimed that their specific leadership skills were not facilitated through enrollment in the classes. Using this information, school administrators are better able to interpret the amount of support and encouragement that women are receiving at a young age to pursue technology and engineering fields. Therefore, further measures can be taken to analyze what more can be done. No pre-existing research compares the secondary education that females receive to the gender gap in STEM, making this research fill a necessary gap in the realm of research. This correlation is extremely important as female students use their experiences in secondary education to influence their decision in postsecondary education. Without a beneficial and positive association with technology and engineering-related concepts, it is less likely for women to look to pursue careers in these fields. This paper adds new data to the body of knowledge and paves a way for further, extensive research to take place for more data to be acquired.

Implications

Since the primary goal of technology and engineering classes is to build technical skills, this conclusion makes sense. But since the gender gap in STEM is too large to ignore and women should have extra support to get over the wired ceiling, more must be done. School curriculums should look to enhance the spread of the themes mentioned before and should take frequent feedback from women to see how these classes have impacted them. Specifically, curriculum designers could consider finding a way to make technology and engineering classes more collaborative to mitigate the gap in a perceived improvement in teamwork skills. Enhanced teamwork would also lead to better communication and proactivity, both of which are skills that could be taught more in the context of leadership education in these classes. Additionally, companies looking to bridge the gender gap within their ranks and improve their brand image should look for ways they can invest in secondary education. The outside investment will enhance the number of opportunities available for women and will lead to additional resources being implemented in the mainstream technology and engineering curriculum. With additional resources, it will be easier for school districts to enhance curriculum, therefore including more leadership curriculum in technology and engineering classrooms. With all of these changes, it is anticipated that more women will join the technology and engineering fields.

Limitations

However, in regards to the results of the survey, some limitations must be kept in mind. This research was conducted in 2022 regarding the education of high school students at [redacted] High School, in [redacted]. Due to the beginning and progression of the coronavirus pandemic, students had participated in online school for 18 months or one and a half school years. As a student wrote in response to a survey question, “ There was barely any improvement. I did csa [AP Computer Science A] online”. This greatly impacted the quality and retention of education and students admitted this to be a factor or possible non-development in certain soft skills. Perhaps if the sample population of high school students was composed of students who had only participated in school in-person the results could have been more skewed towards the “soft skill developed” side.

Additionally, there are a lot of technology and engineering classes at [redacted] High School and all of them have different curricula. Therefore certain classes could have facilitated leadership skills better than others, but further research into specific classes will need to be had to make that distinction.

Finally, since the sample group only consisted of students at [redacted] High School, the results can only be generalized to the [redacted] School District with confidence because it is a reasonable assumption that the curriculum of similar classes across the different high schools in the district would be comparable. However, when talking about schools outside the [redacted] School District, there is no guarantee that their technology and engineering classes had the same curriculum. Therefore, this research needs to be conducted in different schools across the nation to validate the results of the study.

Areas for Future Research

Researchers looking to build on this research should look to measure the opinions of students in different areas and different socioeconomic backgrounds to see how much these external factors impact leadership development among female students in technology and engineering classes. This would diversify the overall sample population and would lead to more accurate results. Additionally, researchers should measure the percentage of females in secondary technology and engineering classes that decided to pursue a career in STEM and see in enrollment influences their career decisions. This would paint a better picture of how better to support female students at a young age.

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APPENDICES

Appendix A: *Informed Consent Form that was in the questionnaire for participants*

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Thank you for your participation in this study. This questionnaire should take no more than 15 minutes. All answers will be kept confidential so please answer honestly, thoroughly and to the best of your ability.

[redacted]

* Required

Please read the following consent form

Breaking the Wired Ceiling

INTRODUCTION

The Department of Education at North Creek High School in Bothell, Washington supports the practice of protection for human subjects participating in research. The following information is provided for you to decide whether you wish to participate in the present study. You may refuse to sign this form and not participate in this study. You should be aware that even if you agree to participate, you are free to withdraw at any time. If you do withdraw from this study, it will not affect your relationship with this unit, the services it may provide to you, or North Creek High School.

PURPOSE OF THE STUDY

Gender inequality is a prevalent problem in the workforce today. Whether it be the wage gap, sexual misconduct, or biases, women have to face a variety of problems when entering the workforce. This is even more pronounced in male-dominated industries such as computer science and engineering. These barriers have led to a large gender gap in these two fields, perpetuating a cycle that limits female participation.

It is important to find ways to mitigate the gender gap in order to solve this problem. I look to answer the question: to what extent do technology and engineering classes foster specific and relevant leadership qualities within female students, which will help them attain managerial positions in the STEM industry? In order to increase women's participation in technology and engineering fields, more women need to be in leadership roles. Therefore, finding a correlation between secondary education and leadership characteristics provides avenues to empower and encourage young women to break barriers in male-dominated fields.

PROCEDURES

You will be asked to participate in a questionnaire that should no longer than 30 minutes. All answers will remain confidential and no identifiable information will be saved or shared. Only the primary researcher will have access to these records and they will be promptly destroyed upon the completion of the research project.
Please respond as honestly and tthoroughly as possible and to the best of your ability.

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RISKS

There are no major risks to participants as a course of this study. Data for this research will be accumulated by participants conducting self-reflection. If self-reflection is psychologically stressful, individuals will have the opportunity to opt out of the research.

BENEFITS

There are no anticipated benefits to the research subjects.

PAYMENT TO PARTICIPANTS

Payments will not be made to participants.

PARTICIPANT CONFIDENTIALITY

Your name will not be associated in any publication or presentation with the information collected about you or with the research findings from this study. Instead, the researcher will use a study number or a pseudonym rather than your name. Your identifiable information will not be shared unless you give written permission.

Permission granted on this date to use and disclose your information remains in effect indefinitely. By signing this form you give permission for the use and disclosure of your information for purposes of this study until June 2022.

REFUSAL TO SIGN CONSENT AND AUTHORIZATION

You are not required to sign this Consent and Authorization form and you may refuse to do so without affecting your right to any services you are receiving or may receive from North Creek High School or to participate in any programs or events of North Creek High School. However, if you refuse to sign, you cannot participate in this study.

CANCELLING THIS CONSENT AND AUTHORIZATION

You may withdraw your consent to participate in this study at any time. You also have the right to cancel your permission to use and disclose further information collected about you, in writing, at any time, by sending your written request to Sthiti Patnaik at 3613 191st Pl SE, Bothell, WA 98012.

If you cancel permission to use your information, the researchers will stop collecting additional information about you. However, the research team may use and disclose information that was gathered before they received your cancellation, as described above.

QUESTIONS ABOUT PARTICIPATION should be directed to:

I have read this Consent and Authorization form. I have had the opportunity to ask, and I have reviewed answers to, any questions I had regarding the study and the use and disclosure of information about me for the study. I agree to take part in this study as a research participant. By my signature, I agree to participate in this study as a research participant. *

Your answer

Appendix B: *First Section of Questionnaire Which was Sent to Participants*

Gender Orientation *

- ◯ Female
- ◯ Male
- ◯ Non-Binary
- ◯ Prefer not to answer

Grade *

- ◯ 9
- ◯ 10
- ◯ 11
- ◯ 12

School Name *

Your answer

Did you participate in a technology and/or engineering class in high school? *
(Click this link for examples of technology and engineering classes https://docs.google.com/document/d/1S6K8uMMDP13ulLQa59_Sjxb6ChnONK3k9JfO7x4jkiM/edit?usp=sharing)

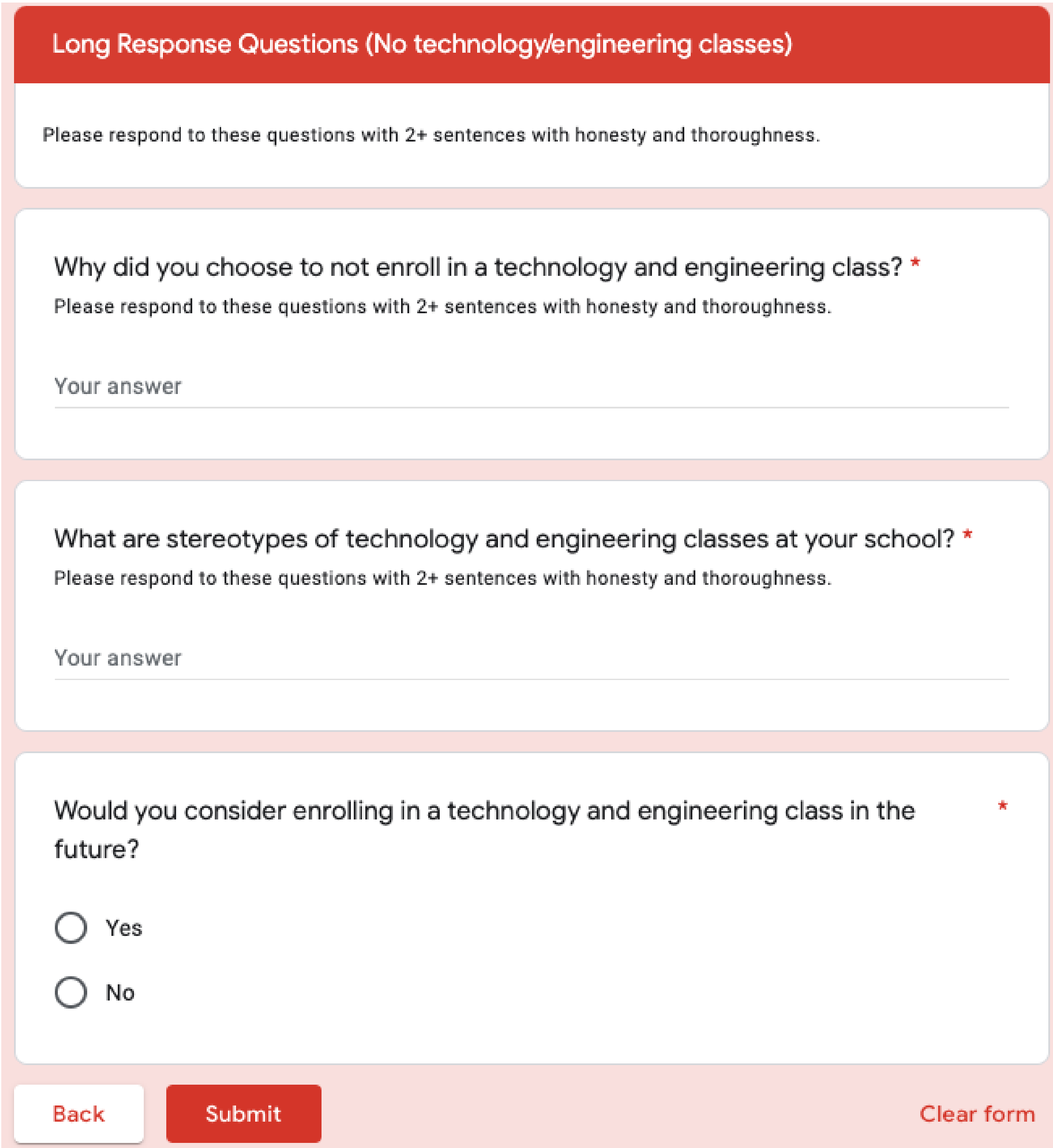
- ◯ Yes
- ◯ No

Appendix C: *List of Technology and engineering Classes that Was Provided to Participants*

Examples of Technology and Engineering Classes
(this list does not include all technology and engineering classes that may be offered)

- AP Computer Science Principles
- AP Computer Science A
- Advanced Topics
- Intermediate Data Programming
- Web Design
- Introduction to Computer Science Principles
- Microsoft Office Certification
- Introduction to Robotics
- Advanced Robotics
- Introduction to Engineering Design
- Aviation: Introduction to Flight
- Metal Fabrication
- CAD Lab

Appendix D: *Section of the Survey where participants were Directed if Answered "No" the Question Before*


Long Response Questions (No technology/engineering classes)

Please respond to these questions with 2+ sentences with honesty and thoroughness.

Why did you choose to not enroll in a technology and engineering class? *

Please respond to these questions with 2+ sentences with honesty and thoroughness.

Your answer

What are stereotypes of technology and engineering classes at your school? *

Please respond to these questions with 2+ sentences with honesty and thoroughness.

Your answer

Would you consider enrolling in a technology and engineering class in the future? *

- Yes
- No

Back

Submit

Clear form

Appendix E: *Section of the Survey where participants were Directed if Answered "Yes" the Question Before*

Long Response Questions

Please respond to these questions with 2+ sentences with honesty and thoroughness.

Technology and Engineering Classes Taken at High School (select all that apply) *

- [ ] AP Computer Science A
- [ ] AP Computer Science Principles
- [ ] Advanced Topics
- [ ] Intermediate Data Programming
- [ ] Web Design
- [ ] Introduction to Computer Science Principles
- [ ] Microsoft Office Certification
- [ ] Introduction to Robotics
- [ ] Advanced Robotics
- [ ] Introduction to Engineering Design
- [ ] Aviation: Introduction to Flight
- [ ] Metal Fabrication
- [ ] CAD Lab
- [ ] Other
- [ ] I did not take any technology or engineering courses

If you selected "Other" what other technology or engineering class did you enroll in?

Your answer

How many semesters were you enrolled in a technology or engineering class? *

- ◯ 0
- ◯ 1-2
- ◯ 3-4
- ◯ 5-6
- ◯ 7-8
- ◯ 8+

To what extent did you learn/improve on your communication skills? *

	1	2	3	4	5	
Was not developed in my technology or engineering class	◯	◯	◯	◯	◯	Built upon this skill exponentially as part of this technology an engineering class

Can you provide one example as to how your communication skills developed or improved? Please write in 2 or more sentences. (If this skill was not developed or improved, type "N/A"). *

Your answer

To what extent did you learn/improve on your creativity? *

	1	2	3	4	5	
Was not developed in my technology or engineering class	◯	◯	◯	◯	◯	Built upon this skill exponentially as part of this technology an engineering class

Can you provide one example as to how your creativity developed or improved? Please write in 2 or more sentences. (If this skill was not developed or improved, type "N/A"). *

Your answer

To what extent did you learn/improve on your proactivity? (Proactivity is defined as self-initiated behavior that endeavors to solve a problem before it has occurred) *

	1	2	3	4	5	
Was not developed in my technology or engineering class	○	○	○	○	○	Built upon this skill exponentially as part of this technology an engineering class

Can you provide one example as to how your proactivity developed or improved? Please write in 2 or more sentences. (If this skill was not developed or improved, type "N/A"). *

Your answer

To what extent did you learn/improve on your teamwork? *

	1	2	3	4	5	
Was not developed in my technology or engineering class	○	○	○	○	○	Built upon this skill exponentially as part of this technology an engineering class

Can you provide one example as to how your teamwork developed or improved? Please write in 2 or more sentences. (If this skill was not developed or improved, type "N/A"). *

Your answer

Back

Submit

Clear form