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Gender Dynamics and Divisions in Youth Robotics through *FIRST*® Programs

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Abstract

FIRST® (For Inspiration and Recognition of Science and Technology), an international organization operating youth robotics teams for elementary through high school aged students affects female and male students in different ways and to different degrees. This research studies the possible causes for this by collecting survey responses from male and female FIRST students. The results of this study indicate that female students are more likely to be involved in Business/Marketing and Build/Mechanical, while male students are more likely to be involved in Programming/Electronics and Strategy. Female students also reported enjoying the social aspects of a FIRST team slightly more than male students, who reported enjoying the technical aspects slightly more. Female students also reported much higher ratings of feelings of judgement/discrimination at FIRST events and on their FIRST teams. This suggests that male and female students are not equally engaged in both "technical" and "social" roles on FIRST teams.

Keywords: Gender, robotics, education, STEM, technology, science, engineering

1. Introduction

FIRST (For Inspiration and Recognition of Science and Technology) is an international organization which operates youth robotics teams for elementary through high school students. As of 2019, there are over 570,000 students registered with *FIRST* through 67,000 teams globally ("At a Glance," 2019). There are four levels of *FIRST* robotics programs divided by age group and corresponding program intensity: FLL Jr. (*FIRST* LEGO League Junior) for grades K-5, FLL (*FIRST* LEGO League) for grades 4-8, FTC (*FIRST* Technology Challenge) for grades 7-12, and FRC (*FIRST* Robotics Competition) for grades 9-12. The mission of *FIRST* is to "inspire young people to be science and technology leaders, by engaging them in exciting mentor-based programs that build science, engineering and technology skills, that inspire innovation, and that foster well-rounded life capabilities including self-confidence, communication, and leadership" ("Vision and Mission," 2019). The purpose of this project is to study whether or not there is a significant difference between male and female students in the areas of a *FIRST* team they participate in, and in their experiences with discrimination in *FIRST*. A survey was used to measure factors in female students' experiences in *FIRST* programs and their involvement in specific areas of *FIRST* teams.

On a *FIRST* team, students design and robots, which are used in competitions. Many *FIRST* robotics teams, especially FRC teams, have a similar structure of leadership and project organization. *FIRST* teams tend to be divided into distinct areas of activity. One such area is "Build", or "Mechanical", typically concerned with the design, manufacturing, and assembly of the team's robots using machines and tools. "Programming" and "Electronics" involves the wiring and programming of robots, using control systems that allow the robot to move and sense things.

Sponsoring information: Research assisted by "#*FIRST*LikeAGirl," an initiative of 4-H Exploding Bacon Robotics, Team 1902.

"Business" raises money to pay for the team's expenses including materials and registration fees and travel expenses, and "Marketing" encapsulates team media and branding. Many teams also include a "Strategy" department, which handles formulating the match strategies at competitions as well as "scouting," which is collecting match play data on other teams for selecting and competing against them. Departments may be defined or organized differently across teams, but the general activities typically remain distinct from one another.

Aside from this study, it is often observed in many *FIRST* Robotics Competition teams that non-technical departments (business, marketing, and strategy) will have more female student members than areas more directly related to the technical aspects of building robots (build, design, and programming) ("FRC Female Involvement," 2017). When being faced with less encouragement and past experiences that negatively affect girls' perceptions of their abilities to fill technical roles, female students may be more inclined to leave STEM programs such as FRC teams before being able to fully experience them. However, there have been initiatives to promote young women's participation in STEM through *FIRST* robotics, such as the formation of all-girl teams, as well as the spread of the social media campaign from FRC Team 1902, "#*FIRST*LikeAGirl" (FIRSTLikeAGirl, 2019). However, there remains a disparity between the number of female and male participants in *FIRST*, as well as their areas of involvement (Center for Youth and Communities, Brandeis University, 2011, p.6).

The factors that influence who joins and who stays on robotics teams in elementary, middle school, and high school are evaluated on a more specific level in this report. Variables that were surveyed include the level of interest in STEM subjects demonstrated by students, the impact of female involvement in *FIRST* teams, the decision of students to remain involved in STEM fields and *FIRST* programs, and the level of enjoyment and engagement in *FIRST* and STEM programs. The levels of involvement among different areas of a *FIRST* team (including build/mechanical, programming/electronics, business/marketing, and strategy) for male and female students were also measured.

2. Literature Review

Although there is a growing number of women in STEM fields, the majority of jobs and degrees related to engineering remain held by men. As of 2017, 9.2% of mechanical engineers, 12.3% of electrical and electronics engineers, and 21.2% of computer programmers were women. By comparison, 47.4% of those in life, physical, and social science occupations and 54% of those working in business and financial operations occupations were women (U.S. Bureau of Labor Statistics, 2018). There are a number of possible explanations for this, including cultural expectations and preconceptions of activities in which females are interested and at which they will succeed. When these stereotypes are believed and enforced either directly or indirectly, women may be less involved with certain activities. This is shown in stereotype threat, in which one's performance on a task or activity will conform to a stereotype about him or herself. Spencer et al. (1998) found that women who were shown gender differences on a math test before taking it, enforcing the stereotype that women are weaker at math than men, performed significantly worse than their male counterparts. By comparison, when told before taking the test that there were no gender differences associated with the test, men and women performed similarly (Spence, Steele, & Quinn, 1999). When risking being judged based on the common stereotype that women are less capable at performing STEM related activities or less likely to succeed in STEM subjects than men, girls in robotics programs may feel less encouraged from pursuing more technical areas and view them as more challenging.

Data supports the positive impact of participating in *FIRST* on students' (both male and female) interest in STEM and increased skills (Burack, Melchior, & Hoover, 2018). In a multi-year study that tracked 1,273 students over the course of over five years that measured characteristics related to attitudes towards STEM, it was found that both male and female *FIRST* participants scored significantly higher than comparison students on overall interest in STEM and STEM careers and a sense of STEM identity (the extent to which a person considers themself a science, math or technology person). Among *FIRST* year college students, "*FIRST* alumni reported statistically significant higher interest in majoring in Computer Science, Engineering, and Robotics" than comparison students (Burack et al., 2018). However, a much higher percentage of male *FIRST* participants than female *FIRST* participants reported being highly interested in Computer Science, Engineering, as well as Robotics. This indicates that although participating in *FIRST* has a great positive impact on female students in getting them involved in STEM, it remains that even after participating in *FIRST*, there are disparities between how male and female students pursue STEM in their futures. A major factor that may contribute to this is uneven distribution of activities between male and female students.

Such differences are demonstrated in a 2011 study in which online surveys developed by *FIRST* staff were sent to a sample of FTC and FRC team leaders and team members in the U.S., found that in general, male team members were more likely to report being involved in activities related to designing, building, and operations of the robot than female teammates, while female team members were more likely to be involved in activities related to marketing and fundraising, community service projects, and making presentations (Center for Youth and Communities, Brandeis University, 2011, p.6). Additionally, female team members were more likely than male ones to report that their participation in robotics resulted in impacts on "attitudes related to teamwork or communication skills" while male team members were more likely than females to report increased interest "in science and technology and STEM-related careers and the skills related to designing and building their robot" (Center for Youth and Communities, Brandeis University, 2011, p.6). Furthermore, a 2016 survey sent out by an FRC student to FRC teams in the Pacific Northwest, data collected from 56 teams showed that an average of 25% of students who reported to be involved in "Build" and 20% of those in "Programming" were female, lower than the overall percentage of female membership across all departments of the teams (30%) ("FRC Female Involvement," 2017), demonstrating that female students are less represented in technical departments. A 2016 study which gathered survey responses elementary, middle, and high school robotics competition participants evaluated the gender differences between programming involvement with relation to age. In the youngest age groups and in entry-level competitions, girls were more heavily involved in programming, but girls were generally less involved in programming in more advanced competitions for middle and high school. This demonstrates that "while robotics competition experiences may motivate students to learn more programming, gender gaps in programming involvement persist in these learning environments and appear to widen as students grow older and enter more advanced competition" (Witherspoon, Schunn, Higashi, & Baehr, 2016).

3. Methodology

An anonymous online survey was constructed for individual *FIRST* students to report their answers to a series of questions about themselves and their team. The social media campaign "#*FIRST*LikeAGirl," ran by *FIRST* Robotics Competition Team 1902 to encourage girls to pursue STEM through *FIRST* programs, was the primary method of survey distribution. #*FIRST*LikeAGirl posted about the survey on social media platforms including Instagram, Twitter, and Facebook, by asking *FIRST* students to "provide [their] feedback and experience on gender diversity and representation in *FIRST*" by filling out the survey. Additionally, the survey was spread through other channels through which *FIRST* participants communicate both by individual *FIRST* students and anyone who may have received it, including *FIRST* Discord servers and team-wide e-mails.

The first part of the survey asked a series of general questions about the student and their team, including their gender, grade level, and the most recent *FIRST* program in which they have participated. Several following questions asked the students to rate their level of involvement in the different departments of a robotics team, including "Build/Mechanical," "Programming/Electronics," "Business/Marketing," and "Strategy" on a scale of 1 ("Not at all") to 10 ("Very much"). On the same scale, students were also asked to rate how much they enjoy participating in the technical aspects and social aspects of a *FIRST* team, as well as how much they enjoy participating in *FIRST* overall. The survey also asked if they had ever experienced harassment or judged or discriminated against due to gender at a *FIRST* event or on their own *FIRST* team on a scale from 1 ("No, not at all") to 10 ("Yes, very much").

4. Results

4.1 Distribution of Respondents' *FIRST* Program Participation

A total of 165 responses were recorded. Of these, 141 identified as female and 22 identified male, and 1 identified as "Non-binary" (Figure 6.1) Due to the low sample size of responses who did not identify as male or female, no statistical tests could be run for genders beyond male and female. For all statistical tests used, the significance level α is 0.05.

The primary basis of data analysis for this research was comparing the survey responses between male and female respondents. To confirm that any difference between the two gender groups being compared were not due to confounding from the level of *FIRST* program in which they were participating (FLL Jr., FLL, FTC, FRC), the distribution of the levels of *FIRST* programs being participated in between male and female students were compared using a chi-square test for homogeneity (Figures 6.1, 6.2, and 6.3). With a p-value of 0.806, a chi square test for homogeneity on the most recent FIRST programs among male and female respondents reveals no significant difference in the distribution of program type between male and female students.

4.2 Differences in Department Involvement by Gender

To compare if there was a significant difference between the male and female ratings of their personal involvement in each activity on their *FIRST* team, a t-test was performed. However, with less than 30 male responses, the sample size was not large enough to perform statistical tests. To compensate for this, a bootstrap was run for both male and female sets of data. 1000 simulated samples of the same size as the original were created by randomly selecting values from the original sample. The averages of each sample were then taken as a new sample (for a sample size of n = 1000) on which a paired two sample t-test for the difference in means could be run. All responses reporting levels of involvement in different departments ("Build/Mechanical," "Programming/Electronics," "Business/Marketing," and "Strategy") were based on a scale on a scale from 1 ("Not at all") to 10 ("Very much").

The bootstrapped average rating for involvement from 1 to 10 in Build/Mechanical was 6.71 for females and 6.32 for males (Figure 6.5). Both distributions for raw data for male and female ratings in response to "How involved are you in Build/Mechanical" had "10" as the most common rating (Figure 6.4). The distribution for female responses had less variance, and a lower overall percentage who rated their involvement in Build/Mechanical as "10" than that of male responses (Figure 6.4). 36.4% of male respondents rated their involvement in Build/Mechanical as "10", while only 29.1% of female respondents did the same.

The bootstrapped average rating for involvement in Programming/Electronics was 2.77 points higher in male respondents than female respondents (4.88 for females and 6.65 for males) (Figure 6.8). Looking closer at the distributions in ratings for involvement in Programming/Electronics, female responses were bimodal, and the most common response being "1", at 19.9% of female responses. The second most common response was "10" (Very much so), at 18.4% of female responses (Figure 6.7). By contrast, the most common male response was 10, at 40.9% of male responses, and the second most common male response was 7, at 22.7% (Figure 6.7).

The bootstrapped average rating for involvement in Business/Marketing was 2.02 higher in female respondents than male respondents (7.08 for females, 5.07 for males) (Figure 6.11). More female respondents rated their involvement in Business/Marketing as "10" than any other rating at a frequency of 36.9%, while the most common rating for male respondents was a "3", at 22.7% (Figure 6.10).

The bootstrapped average rating for Strategy involvement in males (Figure 6.88) was 0.48 points higher than that for females at 6.40 (Figure 6.14). There was a higher percentage of male respondents who rated their involvement as 10 (36.4%) than the percentage of female respondents who did the same (24.8%). Additionally, 13.6% of male respondents rated their involvement in Strategy as 9, while only 4.3% of female respondents did so (Figure 6.13).

4.3 Student Enjoyment in Aspects of *FIRST*

A bootstrap was run for ratings in response to the questions "How much do you enjoy participating in the technical aspects of a *FIRST* team?" and "How much do you enjoy participating in the social aspects of a *FIRST* team?" in the same manner as that for ratings of department involvement. To compare if there was a significant difference between the male and female ratings of their enjoyment in participation in technical aspects or social aspects, a t-test on the bootstrapped averages of ratings was performed in the same way as that on ratings of department involvement. All responses reporting levels of enjoyment in participating in aspects of a *FIRST* team ("Technical" or "Social") were based on a scale from 1 ("Not at all") to 10 ("Very much").

The bootstrapped average rating for levels of enjoyment in the technical aspects of a *FIRST* team was 0.95 points higher in male respondents than in female respondents (9.45 for males and 8.50 for females) (Figures 6.17 and 6.18) Both distributions for raw data for male and female ratings in response to "How much do you enjoy participating in the technical aspects of a *FIRST* team" were skewed left and had "10" as the most common rating. 86.5% of female respondents reported a rating of 7 or higher, while 100% of male respondents did the same (Figure 6.16).

The bootstrapped average rating for levels of enjoyment in the social aspects of a *FIRST* team was 0.67 points higher in female respondents than in male respondents (7.91 for males and 8.58 for females) (Figures 6.19 and 6.20). The distribution of responses in female and male distributions were both skewed left but differed in that the most common female response was a "10", at 54.6% of responses (Figure 6.18). By contrast, only 31.8% of male respondents rated their enjoyment in social aspects as a "10", with the second most common response was an "8", also at 31.8% (Figure 6.18).

Both male and female students rated high overall enjoyment in participating in *FIRST*, with a very small difference in bootstrapped average ratings of 0.03. The average female rating in response to "How much do you enjoy participating in *FIRST* overall?" was 9.48, while it was 9.45 in male students (Figures 6.22 and 6.23).

4.4 Judgement/Discrimination in *FIRST*

A bootstrap was run for ratings in response to the questions: "Have you ever felt judged or discriminated against due to gender at a *FIRST* event?" and "Have you ever felt judged or discriminated against due to gender on your own *FIRST* team?" in the same manner as that for ratings of department involvement. To compare if there was a significant difference between the male and female ratings of their feelings of judgement or discrimination at a *FIRST* event or on one's own *FIRST* team, a t-test on the bootstrapped averages of ratings was performed in the same way as that on ratings of department involvement. All responses reporting levels of feelings of judgement or discrimination at a *FIRST* event and on one's own *FIRST* team were based on a scale from 1 ("Not at all") to 10 ("Very much").

The average bootstrapped rating in response to "Have you ever felt judged or discriminated against due to gender at a *FIRST* event?" was 2.54 points lower in male respondents, at 1.69, than that for female respondents, at 4.23. 82.6% of male respondents reported a rating of 1, "No, not at all," while only 33.6% of female respondents did the same (Figures 6.26 and 6.27). 42.2% of female students rated a 6 or higher, compared to 8.6% of male students (Figure 6.25). A similar pattern was present in ratings in response to "Have you ever felt judged or discriminated against on your own *FIRST* team?". The average bootstrapped rating for male respondents was 1.45, 2.65 points lower than that for female respondents at 4.10 (Figures 6.29 and 6.30). Additionally, 87.0% of male students reported a 1, "No, not at all," compared to 43% of female students who did the same. 40.5% of female students rated a 6 or higher, compared to only 4.3% of male students (Figure 6.28).

5. Analysis

5.1 Distribution of Respondents' *FIRST* Program Participation

A chi square test on the response ratings to "What *FIRST* program have you most recently participated in as a student?" reveals that there is no significant difference in the distribution of program type between male and female students. Thus, any differences observed between male and female responses can't be attributed to differences among the level of *FIRST* program in which they participated. This is significant as previous studies have found differences in boys' and girls' involvement in programing in older age groups, but not in younger ones. This minimizes the effects of confounding based on differences in the level of *FIRST* programs, and any further differences observed are more likely to be accounted for by gender.

5.2 Differences in Department Involvement by Gender

All matched pairs T test comparing male and female ratings of involvement in each department from the bootstrapped had a p-value equal to about 0.00, indicating statistical significance.

The bootstrapped average rating for involvement from 1 (Not at all) to 10 (Very much so) in Build/Mechanical was 0.40 points higher in female respondents than in male respondents. As a lower percentage of female students rated their involvement in Build/Mechanical as 10 than male students, this indicates that there are more female students who will be moderately involved in mechanical (rating their involvement as 7-10), but male students are more likely to identify themselves as extremely involved (rating their involvement as 10), but overall, female students are slightly more likely to be involved in Build/Mechanical. This may mean that female students tend to partake in smaller roles involved in Build/Mechanical, such as machining or assembly (resulting in more ratings <10), but more often than their male counterparts (resulting in a higher overall average rating), while male students may be more involved in major roles such as robot design (resulting in more ratings of 10), but less frequently than female students who participate in smaller roles. This is indicative that there may be more male student leadership in Build/Mechanical on *FIRST* teams.

On average, male *FIRST* students on average reported being significantly more involved in Programming/Electronics than female *FIRST* students. Furthermore, the distributions reveal that male students are more likely to be somewhat or extremely involved in Programming/Electronics, while female students are either extremely involved or not involved at all or involved very little in Programming/Electronics. When they do partake in Programming/Electronics, it is commonly in lower ratings of involvement (2, 3, or 4), possibly indicating smaller roles being fulfilled. This is indicative that there may be more male student leadership in Programming/Electronics on *FIRST* teams.

While male students were much more likely to participate in Programming/Electronics, the opposite was observed in Business/Marketing. It is much more common for male students to be only a little bit involved (ratings 2-5) than it is for female students. There is also more variance in the distribution for male responses than that for female responses, indicating that it is consistently common for female *FIRST* students to be extremely involved in Business/Marketing, while the levels of involvement for male *FIRST* students in Business/Marketing does not have much of an apparent trend. This is indicative that there may be more female student leadership in Business/Marketing on *FIRST* teams.

There was a much smaller difference in the average ratings for Strategy between male and female respondents, although the average rating for males was greater than that for females. A possible explanation for the higher percentage of male respondents reporting high ratings is that female students may fulfill different, smaller roles in strategy than males, such as scouting, while male students may be lead scouts or be involved with interactions with other teams in planning match strategies at competitions.

This is evidence of a gap between male and female *FIRST* students in their self-reported involvement in major technical aspect of robotics, and as a result, their contributions to and experience gained from this area. Although there appear to be only slight differences in the average ratings in involvement for Build/Mechanical and Strategy between male and female respondents, an examination of the distributions reveals that there is still a notable difference in the levels of involvement between male and female students for each department.

5.3 Student Enjoyment in Aspects of *FIRST*

Both genders overall reported enjoying the technical aspects of *FIRST*, but male students tended to report higher ratings. By contrast, female students tended to report higher ratings of enjoyment in participating in social areas more than their male counterparts. Both male and female students rated high overall enjoyment in participating in *FIRST*. This is evidence that despite any differences between levels of enjoyment in technical areas as opposed to social aspects, the overall enjoyment that students get out of being a part of a *FIRST* team is consistently high.

5.4 Judgement/Discrimination in *FIRST*

For both at a *FIRST* event and on one's own *FIRST* team, female respondents reported higher ratings of feelings of discrimination and judgement due to gender. This is evidence that female *FIRST* students are much more likely to feel judged or discriminated against both within a *FIRST* team as well as at *FIRST* events. Thus, this contributes to a more negative atmosphere in robotics for female students than for male students, and female students have a much higher chance of facing social barriers in participating in STEM activities such as robotics, and not being as welcomed to participate in these activities as their male peers.

6. Conclusion

A possible explanation for these differences in involvement and enjoyment in each department and the technical and social aspects of *FIRST* teams between male and female students can be found in students' preconceptions of how gender relates to interest and ability in STEM, which may affect how they treat their peers also involved in *FIRST* based on gender. This may result in further differences in students' own perception of how their gender relates to their STEM identity and how much they enjoy participating in certain areas of a *FIRST* team. By enjoying a certain aspect of an activity, students are much more likely to engage with it and therefore learn from and possibly want to pursue it in the future. However, despite still reporting that overall they still enjoy participating in the technical aspects of *FIRST*, most female students reported low ratings of involvement in Programming/Electronics. By contrast, female students reported higher ratings in enjoyment in the social aspects of being on a *FIRST* team than male students, and also reported significantly higher ratings of involvement in Business/Marketing. This indicates that it is much more likely for male *FIRST* students to enjoy the technical aspects of *FIRST*, possibly because it is easier for them to contribute to them and they are less likely to be judged or discriminated against for participating in them, thus making it more likely for them to be more highly involved with them. A possible reason that female students reported lower levels of enjoyment in technical aspects of *FIRST* is the presence of social barriers within the technical departments that may exist on *FIRST* teams that may result from expectations of other students and mentors that female students are less likely to enjoy and contribute to these areas. For example, a female student may be less likely to participate in the technical departments if she is the only one to do so, or if students already in the technical departments are not as likely to introduce her to the topics.

Being judged and discriminated against in these environments may cause her to not interact with those involved in the technical departments as much, and thus not learn about these technical areas, leading her to reach the understanding that she does not enjoy the technical aspects of being on a *FIRST* team. This perpetuates a cycle, because if there are not many female students in technical departments to begin with, it is less likely that others will join. This would also perpetuate the idea on a *FIRST* team, in both members involved with technical and social/communications aspects of the team, that female students are not interested in joining technical areas, which in itself makes it less likely that they will engage in such topics. This data shows that female students still have the desire to participate in technical aspects of *FIRST*, but due to other factors that may make it less enjoyable to do so, they reported lower ratings than male *FIRST* students.

A possible explanation as to why male students did not report enjoying the social aspects of being on a *FIRST* team as much as female students could be due to a similar explanation as to why female students did not report enjoying the technical aspects as much as male students. If there are fewer male students to begin with in a non-technical area, it may be less likely that other male students will engage in these areas. By contrast, female students may feel more comfortable in these areas if they are surrounded by other female students. However, as male students rarely reported experiencing any judgement or discrimination at *FIRST* events or on their *FIRST* team, this discrepancy between male and female students is more likely explained by female students being pushed out of technical areas and into non-technical areas due to barriers, rather than male students being pushed out of non-technical areas and into technical ones. As students develop their interests in a team environment that does not equally engage male and female students in both "technical" and "social" roles, gender stereotypes may have a greater impact on the skills that they acquire on robotics teams and what they choose to pursue in the future. As *FIRST* programs do have such a positive long term impact on students' attitudes about STEM and what they decide to pursue in college and thus their careers, this demonstrates their potential to bridge the gap between male and females in STEM if gender inequalities are further corrected at the age levels of students in *FIRST*.

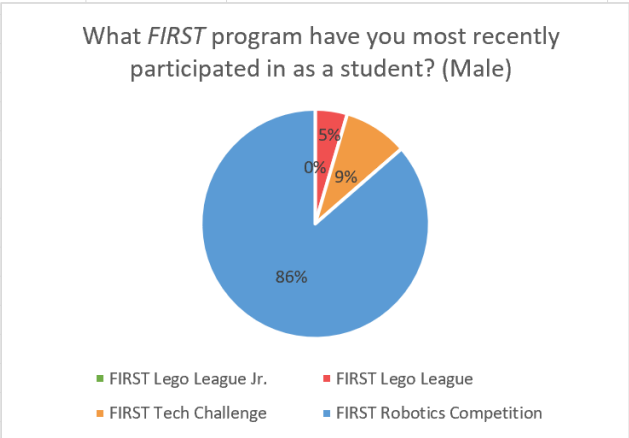
These observations can be compared with the pattern of women being underrepresented in STEM fields and being more likely to be involved with communications or marketing activities in the workplace. The gender gap in STEM present in the professional world is reflected even in youth robotics teams. While youth STEM programs such as *FIRST* encourage young people of all genders to become more involved in STEM in the future, the gender dynamics and representation that exist on this level could create a gender divide among robotics students. By reaching gender equality in younger groups of people interested in STEM, it is more likely that there will be less of a gender gap in STEM fields as the students get older and move on to higher education and the workforce.

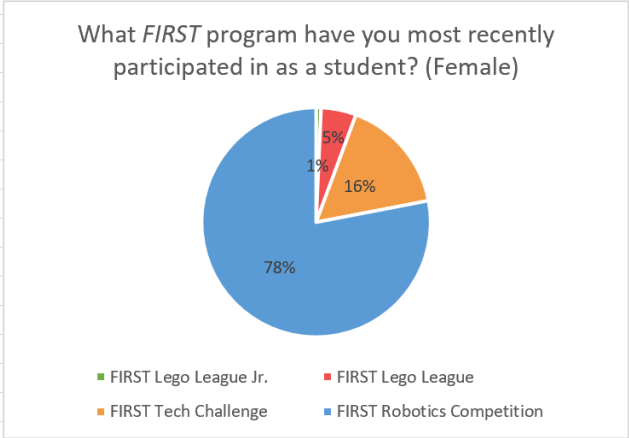
6. Tables and Figures

6.1 Distribution of survey respondents by gender and the most recent *FIRST* program in which they participated

		Most recent *FIRST* program				
		FLL Jr.	FLL	FTC	FRC	Total
Gender	Male	0	1	2	19	22
	Female	1	7	23	110	141
	Non-binary	0	0	0	1	1
	Total	1	8	25	130	165

6.2 Distribution of the most recent *FIRST* program participated in among male and female respondents.

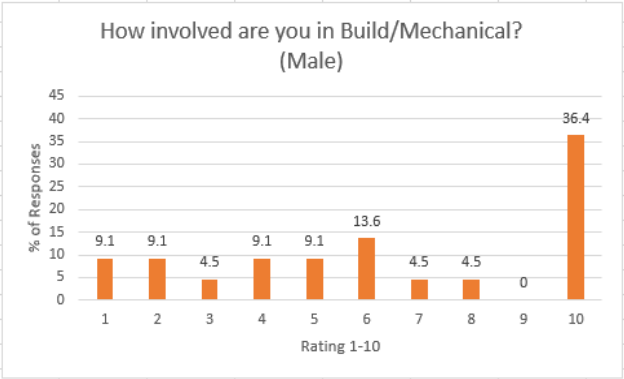


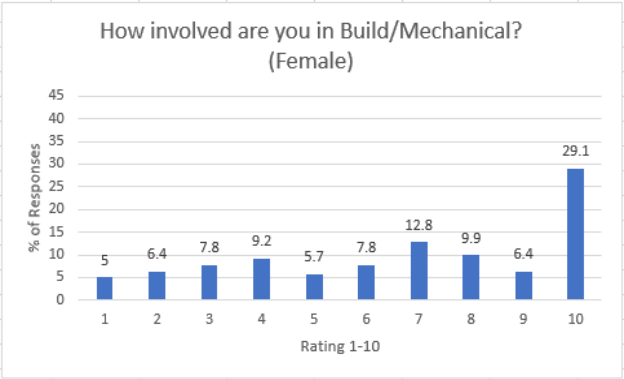


6.3 Chi Square test for Homogeneity for Most Recent *FIRST* Programs

χ^2	0.9775
p-value	0.8067

6.4 Distributions of raw responses for involvement ratings in Build/Mechanical.





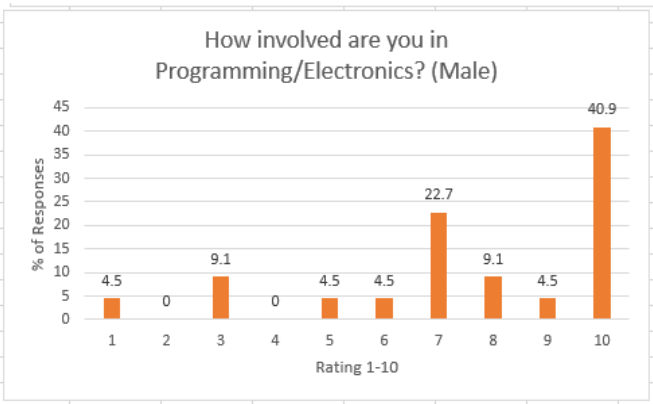
6.5 Build/Mechanical Involvement Rating Bootstrap Averages

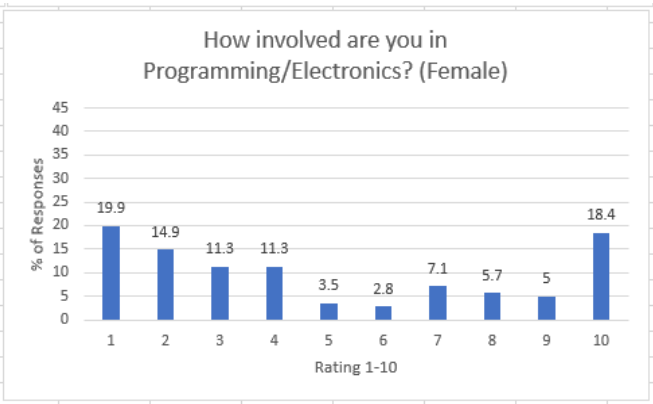
	Male	Female	Difference (Male - Female)
Mean	6.32	6.71	-0.40
Variance	0.548	0.067	

6.6 Build/Mechanical Involvement Rating Bootstrap T-Test

Hypothesized mean difference	0
Degrees of freedom	999
t Statistic	-16.10
T critical value for α = 0.05 (two tailed)	1.96
p value (two tailed)	0.00

6.7 Distributions of raw responses for involvement ratings in Programming/Electronics





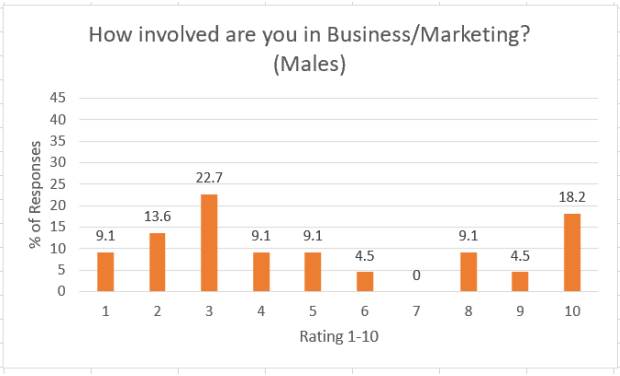
6.8 Programming/Electronics Involvement Rating Bootstrap Averages

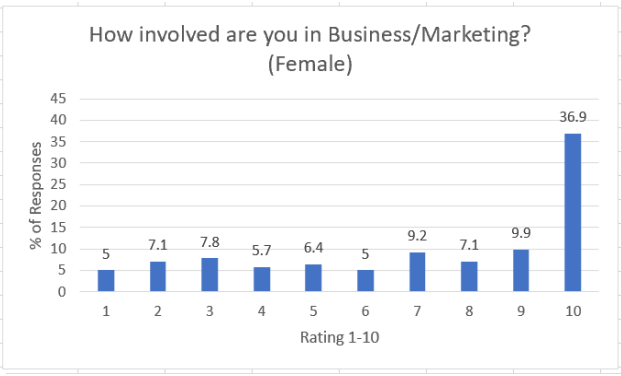
	Male	Female	Difference (Male - Female)
Mean	6.65	4.88	2.77
Variance	0.320	0.073	

6.9 Programming/Electronics Involvement Rating Bootstrap T-Test

Hypothesized mean difference	0
Degrees of freedom	999
t Statistic	137.99
T critical value for α = 0.05 (two tailed)	1.96
p value (two tailed)	0.00

6.10 Distributions of raw responses for involvement ratings in Business/Marketing





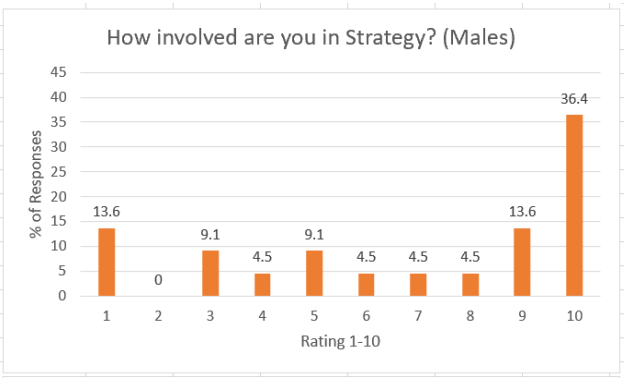
6.11 Business/Marketing Involvement Rating Bootstrap Averages

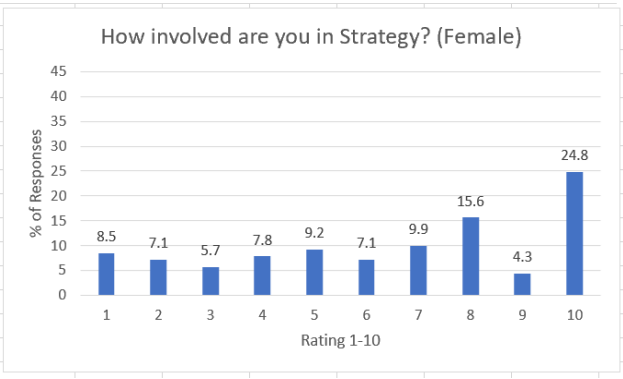
	Male	Female	Difference (Male - Female)
Mean	5.07	7.08	-2.02
Variance	0.437	0.064	

6.12 Business/Marketing Involvement Rating Bootstrap T-Test

Hypothesized mean difference	0
Degrees of freedom	999
t Statistic	-91.141
T critical value for α = 0.05 (two tailed)	1.96
p value (two tailed)	0.00

6.13 Distributions of raw responses for involvement ratings in Strategy





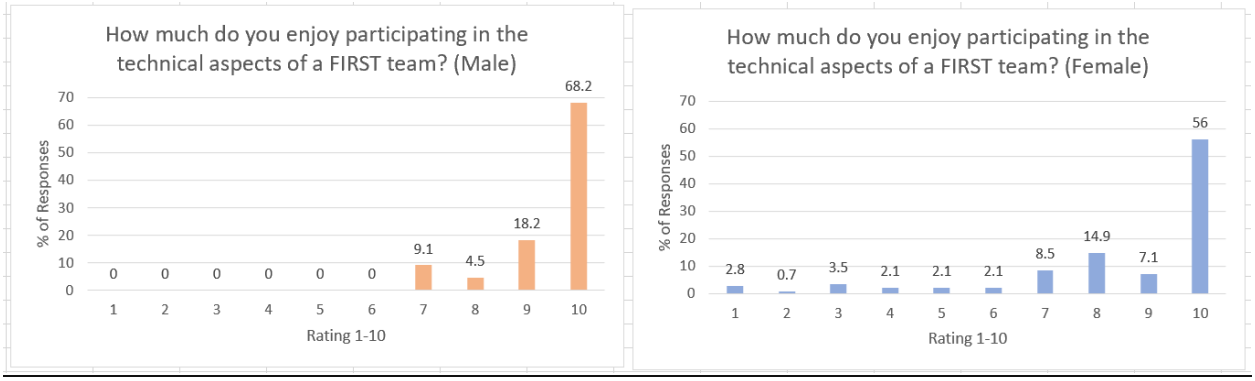
6.14 Strategy Involvement Rating Bootstrap Averages

	Male	Female	Difference (Male - Female)
Mean	6.88	6.40	0.48
Variance	0.504	0.063	

6.15 Strategy Involvement Rating Bootstrap T-Test

Hypothesized mean difference	0
Degrees of freedom	999
t Statistic	20.046
T critical value for α = 0.05 (two tailed)	1.96
p value (two tailed)	0.00

6.16 Distributions of raw responses for ratings of enjoyment in participating in technical aspects of *FIRST*



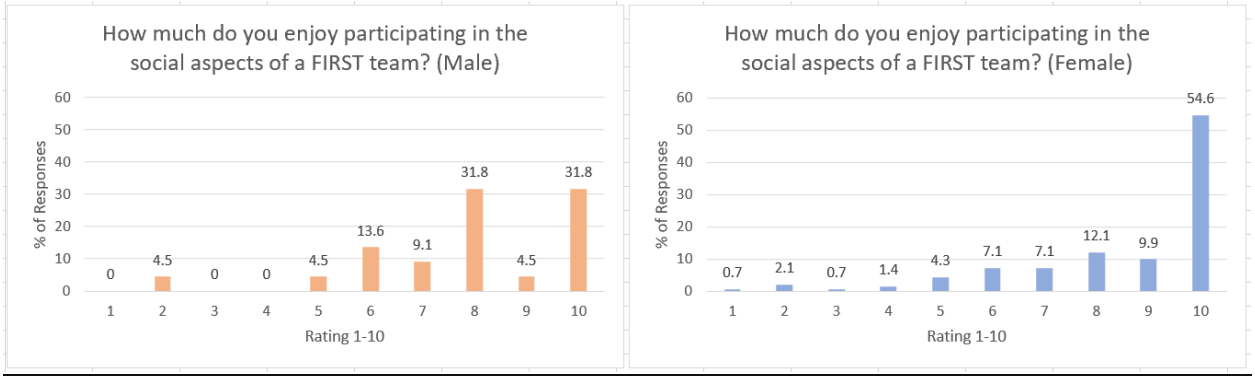
6.17 Enjoyment in Technical Aspects Rating Bootstrap Averages

	Male	Female	Difference (Male - Female)
Mean	9.45	8.50	0.95
Variance	0.039	0.036	

6.18 Enjoyment in Technical Aspects Rating Bootstrap T-Test

Hypothesized mean difference	0
Degrees of freedom	999
t Statistic	109.35
T critical value for α = 0.05 (two tailed)	1.96
p value (two tailed)	0.00

6.19 Distributions of raw responses for ratings of enjoyment in participating in social aspects of *FIRST*



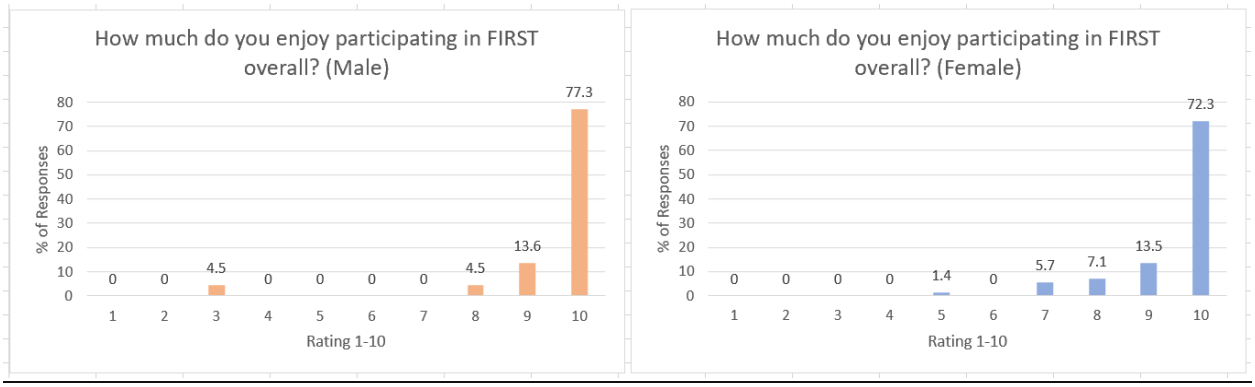
6.20 Enjoyment in Social Aspects Rating Bootstrap Averages

	Male	Female	Difference (Male - Female)
Mean	7.91	8.58	-0.67
Variance	0.19	0.031	

6.21 Enjoyment in Social Aspects Rating Bootstrap T-Test

Hypothesized mean difference	0
Degrees of freedom	999
t Statistic	-45.36
T critical value for α = 0.05 (two tailed)	1.96
p value (two tailed)	0.00

6.22 Distributions of raw responses for ratings of enjoyment in participating in *FIRST* overall



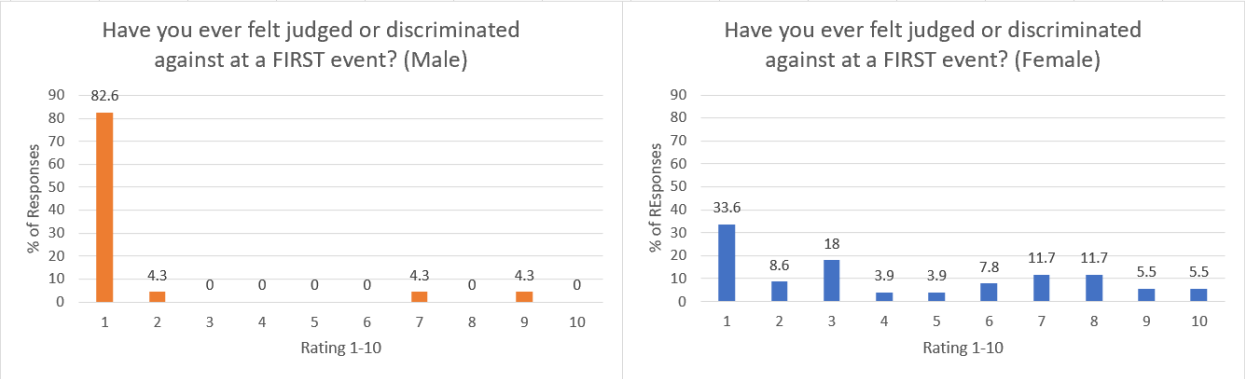
6.23 Enjoyment in *FIRST* Overall Rating Bootstrap Averages

	Male	Female	Difference (Male - Female)
Mean	9.45	9.48	-0.03
Variance	0.110	0.007	

6.24 Enjoyment in *FIRST* Overall Rating Bootstrap T-Test

Hypothesized mean difference	0
Degrees of freedom	999
t Statistic	-2.38
T critical value for α = 0.05 (two tailed)	1.96
p value (two tailed)	0.00

6.25 Distributions of raw responses for ratings of feelings of judgement or discrimination at a *FIRST* event



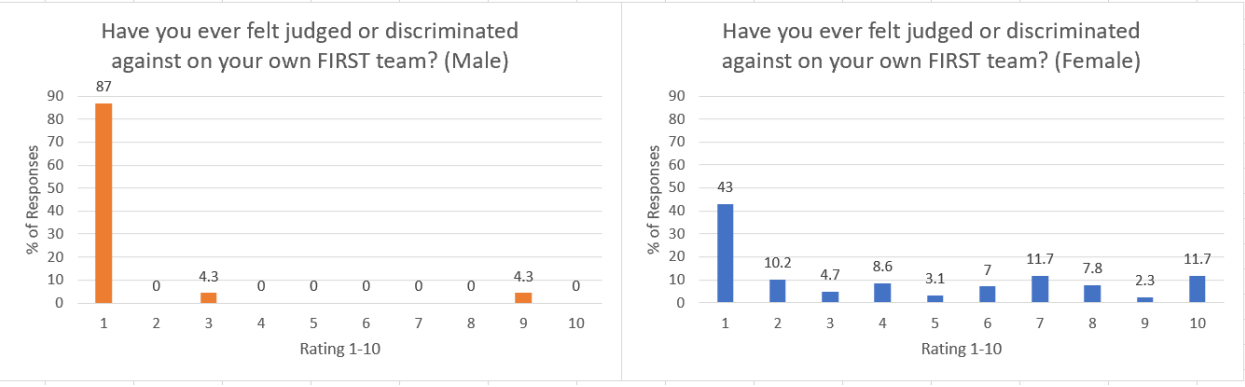
6.26 Feelings of Judgement and Discrimination at a *FIRST* Event Rating Bootstrap Averages

	Male	Female	Difference (Male - Female)
Mean	1.69	4.23	-2.54
Variance	0.192	0.068	

6.27 Feelings of Judgement and Discrimination at a *FIRST* Event Rating Bootstrap T-Test

Hypothesized mean difference	0
Degrees of freedom	999
t Statistic	-158.10
T critical value for α = 0.05 (two tailed)	1.96
p value (two tailed)	0.00

6.28 Distributions of raw responses for ratings of feelings of judgement or discrimination on one's own *FIRST* team



6.29 Feelings of Judgement and Discrimination on *FIRST* Team Rating Bootstrap Averages

	Male	Female	Difference (Male - Female)
Mean	1.45	4.10	-2.65
Variance	0.122	0.074	

6.30 Feelings of Judgement and Discrimination on *FIRST* Team Rating Bootstrap T-Test

Hypothesized mean difference	0
Degrees of freedom	999
t Statistic	-188.61
T critical value for α = 0.05 (two tailed)	1.96
p value (two tailed)	0.00

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