Impact of the You're Hired! Program on Student Attitudes and Understanding of Engineering (RTP, Strand 4)

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Abstract

To meet the growing need for qualified employees in STEM-based careers, it is critical that middle and high school students participate in activities that increase their awareness of opportunities in these areas. With proper design, these activities can not only increase awareness of STEM-based careers, but can also help overcome current stereotypes and lead to a change in attitudes towards these careers. Researchers at North Dakota State College of Science, along with the University of North Dakota and North Dakota State University, have developed ‘You’re Hired!', a program that provides middle and high school students a hands-on, authentic experience in various engineering roles while assessing changes in student attitudes towards the engineering profession.

‘You’re Hired!’ is a series of three STEM-based activities, given over the course of a school year, that requires students to work as a ‘company’ for an entire school day to find a solution to a relevant, present-day problem. The activities are structured so that students use the engineering design process and practice 21st Century Skills, such as collaboration, critical thinking and time management, while developing, testing, and marketing a solution. At the end of each activity, the students communicate their solution to a community-led boardroom, comprised of school board members, community stakeholders and local industry representatives. The program also tracks student progress throughout the year using peer- and self-assessments.

This research project used quantitative data collection methods to measure the impact of the ‘You’re Hired!’ program on changing students’ attitudes towards engineering. The methodology includes a statistical comparison of a control group to an experimental group to clearly demonstrate the benefit of the program. The results of the statistical analysis show there is a significant difference in the change in student attitudes toward engineering when participating in the program.

Introduction

In the 21st Century workforce employers are looking for potential employees that can solve a range of intellectual and technical problems regardless of the job position.[1] Employers are looking for individuals that are willing to use an engineering mindset in which they problem solve, think critically, collaborate with others, and are able to solve elementary issues as well as more complex problems that may arise. In other terms, employers are looking for employees that have well-developed 21st Century Skills. While not always pictured this way, engineering is a very creative profession that uses 21st Century Skills on a daily basis. It is important that engineers be able to design a solution that is effective yet still meets constraints such as time, cost, manufacturability, size, etc.[2] Diversity within the profession is also important because an engineering design team with a wide range of experiences will be better at developing creative solutions to meet the needs of the diverse society we live in.

While engineering careers are in high-demand within a wide array of industries, engineering student demographics have not really shifted and the general public has only a limited perspective of what these careers really are.[3] The images or stereotypes students have about engineering frequently identify engineers as car mechanics, construction workers or train operators.[4] Other stereotypes include: engineering is boring, engineers help society, and engineers work alone or at a computer. [4,5] Research has linked K-12 students' limited knowledge and/or negative image of engineering careers to the shortage in the number of college graduates receiving degrees in engineering. [6,7]

To properly prepare for a successful future in an innovation-driven society students need two things. First, they need to be *prepared* and proficient in STEM (Science, Technology, Engineering, and Math) subjects to be ready for the future workforce. And second, they need to be *inspired* and motivated in STEM activities so that they can be encouraged to pursue a STEM career.[8] Whether students decide to pursue a STEM career or not, they should have the knowledge, conceptual understandings, and critical-thinking skills that come from studying in STEM environments.[8] STEM learning environments provide opportunities for students to focus on discovery and the ability to solidify educational concepts in their minds by understanding a concept in a variety of contexts. A true STEM environment has students engaged in all aspects of a topic, incorporating knowledge and approaches from all the core K-12 subjects, not just science and math. Unfortunately, current methods of educating K-12 students about engineering and engineering careers have shown little impact on improving the number of students pursuing an engineering related degree.[9]

Students must have a positive impression of engineering before they will consider it for their profession, as behavior will follow the attitude.[9,10,11] With the most promising approaches for changing behaviors and attitudes including a personal, authentic experience, a program that seeks to influence a positive change towards engineering should allow the student to take the role of an engineer as part of the program design.[12,13,14]

Program Description

This paper describes results from a STEM outreach program, 'You're Hired!', that addresses the need for more students to enter STEM-related careers by providing participating students with a positive, authentic experience of engineering. 'You're Hired!' is a coherent series of STEM-focused, day-long activities that require students to work as a 'company' for an entire school day to find a solution to a relevant, present-day problem and then communicate their discovery to a community-led boardroom, compromised of school administrators, school board members and local industry representatives. Typical roles include manager, advertising specialist, engineer, and technician. Each separate 'You're Hired!' activity tailors the engineering and technology-related titles to the specific careers that would actually be working on the problem. This level of explicit detail provides the practical application of role responsibility in a STEM career and draws a strong connection between their one-day experience and a possible future career.

The 'You're Hired!' program incorporates many design factors that have been proven to be effective through research done by other successful programs. Small group activities have been shown to include the key attributes of self-motivation, problem-solving, and immediate feedback, which contribute to positively influence students to pursue and complete an engineering degree.[14] Other research has identified the 'wow' factor, social responsibility, potential for world-wide impact, and personal relevance as key factors to engage in engineering.[15] These various design factors fit well into a STEM-based activity and secondary schools are currently seeking STEM experiences.

In a pilot project during the 2012-2013 school year, fifteen schools across multiple states readily signed up to participate because 'You're Hired!' is an innovative way to meet their needs of (1) implementing interdisciplinary STEM experiences for all their students and teachers without burdening existing resources and (2) providing a method to assess and hone all students' 21st Century Skills. During the 2013-2014 school year the 'You're Hired!' program expanded to impact roughly 2,800 North Dakota, South Dakota and Minnesota students in 27 schools. Ultimately, 'You're Hired!' is intended to be a proven piloted project which can be replicated, adapted to other contexts, and nationally scaled.

In this paper a research project to assess attitude changes among students participating in the 'You're Hired!' program is described. Data from pre- and post-program surveys collected during the 2013-2014 school year are used to address the following research question: Does the 'You're Hired!' program lead to a change in student attitudes towards engineering? The impact of the 'You're Hired!' program on students' self-efficacy towards engineering skills/21st Century Skills is also discussed as well as explaining the benefit to schools who choose to incorporate this program. Additional details of the research project are available in Kristin Brevik's M.S. thesis.[16]

Research Methodology

To research the effectiveness of the "You're Hired!' program at promoting positive attitudes towards engineering, pre- and post-surveys were used for summative evaluation of students' awareness and perceptions towards different aspects of engineering.

Sample Population

For this research project, the sample population consisted of one school (School A) which was selected from the 27 total participating schools. This school was chosen because it completed all of the following criteria: a letter of willingness to participate from one school administrator, an assent form from each participating student, student pre-survey, three separate 'You're Hired!' activities, and a student post-survey. School A was also selected because it was large enough to allow for a control versus experimental comparison. If a student chose not to complete the assent form, their individual data is not included within data analysis as per Institutional Review Board (IRB) requirements. Participants from School A consisted of 7th grade students only.

The students that attend School A are assigned into pods, or sub-sections of students within a grade. The pods of students stay together and have their own set of primary teachers including: math, science, geography and English. School A allowed the project to have an experimental versus control comparison by having one pod complete the surveys as well as the three separate 'You're Hired!' activities whereas another pod that served as a control group only completed the surveys. The experimental group consisted of 59 females and 78 males for a total of 137 students. The control group was made up of of 77 females and 59 males for a total of 136 students. School A is working to develop a STEM track within their middle school. The students in the experimental group were part of that STEM track consisting of both students that chose to be a part of the STEM curriculum as well as students that were chosen by teachers because they were thought to do well in a STEM-based learning environment.

Data Collection

Shortly after the start of the academic year, schools administered a letter of assent to each student to read and sign along with an electronic pre-survey adapted from the Assessing Women and Men in Engineering (AWE) Core Middle School Immediate Pre-Participation Survey.[17] This electronic survey establishes the baseline data of their initial exposure and knowledge about engineering and how this exposure and/or knowledge influences their decisions about future career paths. Both pre- and post-survey questions with the allowed categorical responses are listed in Table 1. Note, the Impact statements were only asked on the post-survey.

Table 1 – Electronic pre- and post-survey questions by category

ENGINEERS: Read the following statements about what engineers might do and indicate your agreement or disagreement with each statement: (Agree, Disagree, Don't Know)	
E1	Mainly work on machines and computers
E2	Mainly work with other people to solve problems
E3	Work on things that help the world
E4	Can choose to do many different kinds of jobs
E5	Mainly work on things that have nothing to do with me
E6	I don't know what engineers do
E7	Pursue a career in an engineering-related field?
E8	Do you think you want to be an engineer?
FUTURE WORK: How important is it to you to do: (Not Important, Somewhat Important, Very Important)	
F1	Work that makes me think
F2	Work that allows me to make lots of money
F3	Work that allows me to use math, computer, engineering, or science skills
F4	Work that allows me to tell other people what to do
F5	Work that allows me to help solve problems and create solutions
F6	Work that is fun to do
F7	Work that allows me to have time with family
F8	Work that allows me to help my community and/or society
F9	Work that makes people think highly of me
F10	Work that is satisfying to me
INTERESTS: Here is a list of statements. Tell us what you think about them. Select a response that indicates your level of agreement: (Strongly Disagree, Somewhat Disagree, Somewhat Agree, Strongly Agree)	
In1	I look forward to science class in school
In2	I look forward to math class in school
In3	I would rather solve a problem by doing an experiment than be told the answer
In4	More time should be spent on projects in science or technology activities at school

In5	I would like to (or already do) belong to a science or technology activities club
In6	I get bored when I watch programs on channels like Discovery Channel, Animal Planet, Nova, Mythbusters, etc.
In7	I like to get science books or science experiment kits as presents
In8	I like learning how things work
In9	Science is too hard when it involves math
In10	Science is a difficult subject
In11	Doing experiments in science class is frustrating
In12	I feel comfortable with using a computer to make graphs and tables
In13	I am interested in learning more about how things work
In14	I like to learn to use new technology
ATTITUDES AND SKILLS: The table lists things you can do when you are working on school activities or assignments. Check the appropriate box to tell us how often you do each of these things: (Never, Sometimes, Very Often, Always)	
A1	When I see a new math problem, I can use what I have learned to solve the problem
A2	I can use what I know to design and build something mechanical that works
A3	In lab activities, I can use what I have learned to design a solution to a problem
A4	I can effectively lead a team to design and build a hands-on project
A5	I know where I can find the information that I need to solve difficult problems
A6	I can explain math or science to my friends to help them understand
A7	I can get good grades in math
A8	I can get good grades in science
IMPACT: How much did participating in the activity impact each of the following: (Not at All, Slightly, Moderately, A Great Deal) ** these impact questions were only included in the post-survey questionnaire*	
Im1	Helped me to understand problem solving better
Im2	Led me to a better understanding of my own career goals
Im3	Increased my interests in studying engineering in college
Im4	Increased my interests in studying a technical degree in college
Im5	Made me think more about what I will do after graduating from high school
Im6	Made me decide to work harder in school
Im7	Made me decide to take different classes in school (including college) than I had planned to
Im8	Made me more confident in my ability to succeed in engineering or a technical field
Im9	Increased my confidence in my ability to participate in engineering projects or activities

After all students took the electronic pre-survey, the experimental group completed three separate ‘You’re Hired!’ activities spaced throughout the school year. Each activity provided students with a new challenge and a new engineering career to discover. At the end of the academic year after the experimental group had completed the third and final ‘You’re Hired!’ activity, all students completed the electronic post-survey. For a complete description of the ‘You’re Hired!’ program and individual activities, please refer to ‘You’re Hired! Changing Students’ Attitudes Towards Engineering.’[18]

Data Analysis

The data from the pre- and post-surveys for the 2013-2014 school year was downloaded from the online survey site Surveymonkey, formatted in Excel and analyzed using the statistical software JMP 7. For this paper, the School A data was analyzed by a comparison of pre- and post- survey data for the experimental vs. control groups.

Descriptive statistics were calculated as well as significance testing between pre- and post-survey responses and between group responses using p-values from Pearson's chi-square (χ^2) test. The χ^2 test along with its associated p-value was used to determine the significance of categorical data. Because the pre-and post-survey responses were categorical, this test is an appropriate tool for determining significance. The categorical data was also converted into numerical data using a Likert Scale. Once numerical data was available, descriptive statistics such as the mean were calculated however the mean values were not used to determine significance.

Results and Discussion

This section summarizes the statistically significant changes that were observed when completing a statistical analysis on every question that was asked of the students during the 'You're Hired!' pre- and post-surveys. The results are objectively stated, followed by a brief discussion of the results.

Analysis of Experimental and Control Group Responses

Table 2 contains questions from the pre- and post-survey in which there was a statistically significant difference between experimental and control group responses for either survey or between pre- and post-responses for either group. If a significant difference was determined for any of the comparisons, the question was included in this article. P-values less than or equal to 0.05 were considered statistically significant. For each category of question (Engineer, Future Work, Interest and Attitudes and Skills) there are two tables of data. One table is for the pre- vs. post-survey comparisons; the other table is for the experimental group vs. control group comparisons. It is possible that for the comparisons in one table, the question is not significant, but for the comparisons in the other table the question is significant. Out of the four categories of questions, three categories contained questions that showed significant differences in the survey responses as shown in Table 2. The three categories that contained significant shifts were: Engineer, Interest, and Attitude and Skills. Statistical analysis of the different questions can be found in Tables 3 – 8.

Table 2 – Statements showing statistically significant differences in responses between either experimental and control groups for either survey or between pre- and post- survey responses for either group for School A.

Engineer Questions	
E1	Mainly work on machines and computers
E2	Mainly work with other people to solve problems
E4	Can choose to do many different kinds of jobs
Interest Questions	
In1	I look forward to science class in school

In4	More time should be spent on hands-on projects in science or technology activities at school
In5	I would like to (or already do) belong to a science or technology activities club
In8	I like learning how things work
In9	Science is too hard when it involves math
Attitude and Skills Questions	
A4	I can effectively lead a team to design and build a hands-on project
A8	I can get good grades in science

Engineer Questions

The survey statement for the Engineer questions was ‘Read the following statements about what engineers might do and indicate your level of agreement or disagreement with each statement.’ Response categories were ‘Agree’, ‘Disagree’, and ‘Don’t Know’. Response choices for these statements were also converted to a Likert scale in order to calculate a numerical mean value, with ‘Agree’=3, ‘Don’t Know’=2, and ‘Disagree’=1. ‘Don’t Know’ was assigned an intermediate value on the Likert scale because it was considered a neutral response between the ‘Agree’ and ‘Disagree’ responses.

Table 3 and Table 4 provide a statistical comparison of the categorical responses to those Engineer questions which displayed statistically significant differences. The pre- and post-survey mean values are also included. Table 3 displays the analysis based on each group with p-value and χ^2 statistics representing the difference between pre- and post-survey responses, For example, when comparing control pre-survey versus control post-survey for statement E4, the statistical analysis gives a p-value of 0.05. Table 4 displays the analysis based on survey, with statistics representing the difference between control and experimental group responses for the pre- or post-survey.

Table 3 – Statistical Comparison of Pre- vs. Post-Survey Responses to Engineer Questions for Control and Experimental Groups at School A

Engineers	Group	N	P-Value	X^2	Pre-Survey Mean	Post-Survey Mean
E1 - Mainly work on machines and computers	C	270	0.74	0.60	2.20	2.29
	E	271	0.30	2.42	2.54	2.42
E2 - Mainly work with other people to solve problems	C	267	0.30	2.40	2.31	2.39
	*E	269	<0.01	17.52	2.36	2.74
E4 - Can choose to do many different kinds of jobs	*C	266	0.05	6.21	2.37	2.57
	*E	270	<0.01	13.18	2.43	2.74

*Significance: p-value less than or equal to 0.05
C: ‘Control Group’ and E: ‘Experimental Group’
Degrees of Freedom (DF) = 2

Table 4 – Statistical Comparison of Control and Experimental Responses to Engineer Questions for Pre- and Post-Surveys at School A

Engineers	Survey	N	P-Value	X^2	Control Mean	Experimental Mean
E1 - Mainly work on machines and computers	*Pre Post	269 272	<0.01 0.38	12.93 1.93	2.20 2.29	2.54 2.42
E2 - Mainly work with other people to solve problems	Pre *Post	265 271	0.89 <0.01	0.24 14.27	2.31 2.39	2.36 2.74
E4 - Can choose to do many different kinds of jobs	Pre Post	264 272	0.68 0.08	0.76 5.10	2.37 2.57	2.43 2.74

*Significance: p-value less than or equal to 0.05
DF = 2

The statement E1 - 'Engineers mainly work on machines and computers' did not have a significant shift for either group from pre- to post-survey, but there was a significant difference in how the two groups responded to the statement for the pre-survey. The experimental group responded statistically higher than the control group. The post-survey responses for the two groups resulted in less of a difference as the two groups' responses shifted slightly. There is a common misconception that while engineers do in fact spend time working on machines and computers, it is not the only type of work environment that is available to them.

The statement E2 - 'Engineers mainly work with other people to solve problems' had only the experimental group showing a statistically significant shift from pre- to post-survey responses. When looking at the statement by survey, there was no statistical difference between the experimental and control groups when looking at pre-survey responses, but there was a statistically significant difference in how the two groups responded in the post-survey. This change in understanding and attitude is thought to be a result of the 'You're Hired!' program because throughout the program students are encouraged by program designers (if present), teachers, and boardroom members to collaborate and work with their teammates. This suggests that the 'You're Hired!' program made a positive impact on the participating students' perceptions of engineers and engineering careers.

E4 - 'Engineers can choose to do many different kinds of jobs' showed a statistically significant shift for both the experimental and the control groups from pre- to post-survey responses. When comparing the surveys based on group, there was no significant difference for either survey. The results for this statement would indicate that while students did have a better understanding of the variety of possible engineering careers at the end of the program, that increase cannot be linked to the 'You're Hired!' program due to both the control and the experimental groups' levels of agreement increasing from pre- to post-survey.

<u>Interest Questions</u>

Table 5 and 6 show the statistical comparison of pre-and post-survey responses for the Interest questions. The statement for this category of questions was, 'Here is a list of statements. Tell us what you think about them. Select a response that indicates your level of agreement.' Responses for these statements were converted to a Likert scale, with 'Strongly Agree'=4, 'Somewhat Agree'=3, 'Somewhat Disagree'=2, and 'Strongly Disagree'=1.

Table 5 – Statistical Comparison of Pre- vs. Post-Survey Responses to Interest Questions for Control and Experimental Groups at School A

Interests	Group	N	P-Value	X^2	Pre-Survey Mean	Post-Survey Mean
In1 - I look forward to science class in school	C E	269 269	0.46 0.54	2.56 2.16	2.90 3.41	2.78 3.43
In4 - More time should be spent on hands-on projects in science or technology activities at school	C E	268 268	0.84 [a]	0.83 [a]	3.29 3.63	3.23 3.64
In5 - I would like to (or already do) belong to a science or technology activities club	C E	266 268	0.69 0.82	1.45 0.93	2.02 2.71	1.90 2.64
In8 - I like learning how things work	C E	267 265	0.22 0.32	4.39 3.54	3.26 3.32	3.07 3.39
In9 - Science is too hard when it involves math	C *E	264 270	0.88 0.01	0.69 11.52	2.21 1.98	2.17 2.33

*Significance: p-value less than or equal to 0.05

[a] - A reliable χ^2 and p-value could not be calculated for In4 because the answer option 'Strongly Disagree' received less than five responses.

C: 'Control Group' and E: 'Experimental Group'

DF = 3

Table 6 – Statistical Comparison of Control and Experimental Responses to Interest Questions for Pre- and Post-Surveys at School A

Interests	Survey	N	P-Value	X^2	Control Mean	Experimental Mean
In1 - I look forward to science class in school	*Pre *Post	270 268	<0.01 <0.01	30.88 44.15	2.90 2.78	3.41 3.43
In4 - More time should be spent on hands-on projects in science or technology activities at school	*Pre *Post	271 265	<0.01 <0.01	22.34 21.16	3.29 3.23	3.63 3.64
In5 - I would like to (or already do) belong to a science or technology activities club	*Pre *Post	267 267	<0.01 <0.01	30.71 35.04	2.02 1.90	2.71 2.64
In8 - I like learning how things work	Pre *Post	267 265	0.10 0.02	6.20 10.41	3.26 3.07	3.32 3.39

In9 - Science is too hard when it involves math	*Pre	268	0.03	8.66	2.21	1.98
	Post	266	0.24	4.20	2.17	2.33

*Significance: p-value less than or equal to 0.05
DF = 3

Out of the five statements that showed a statistically significant difference either between 1) the experimental and control group responses from pre- to post-survey or 2) the pre- and post-survey responses when comparing the groups, four of the five statements had pre-survey responses that were statistically different. This differentiation from the pre-survey responses was not present for all categories of questions/statements asked of the students, but for this set of Interest statements it was noted that the two groups did not have similar responses at the beginning of the study. This indicates that in terms of interests, these two groups of students were initially statistically different. It is possible that the difference in the students' responses may be due to the pod/house the students are in throughout the school year. The students in the experimental group were part of that STEM track consisting of both students that chose to be a part of the STEM curriculum as well as students that were chosen by teachers who were thought to do well in a STEM-based learning environment. While the track is still fairly new, it is possible that the type of students attracted by this particular way of learning may have caused the statistical differences between group responses.

For the statement, In8 - 'I like learning how things work', the pre-survey showed no significant difference between the two groups, however after the course of the year, the post-survey response shows a significantly lower level of agreement for the control group. If the decrease in interest shown by the control group is typical of middle school students, then the lack of a change in the experimental group may be evidence of a positive effect of the 'You're Hired!' program.

For the statement, In9 - 'Science is too hard when it involves math', there was a significant shift from pre- to post-survey for the experimental group, but not the control group, with the experimental group numerical mean increasing. This increase would suggest a negative shift in attitude towards science that involves math. This statement, as written, mentions science and math specifically, indicating that it might have been influenced by experiences in a formal science and/or math class that they had during the school year.

Attitude and Skills Questions

Table 7 and 8 show the statistical comparison of pre-and post-survey responses for the Attitude and Skills questions. The statement for this category of questions read, 'The table lists things you can do when you are working on school activities or assignments. Check the appropriate box to tell us how often you do each of these things.' Responses for these statements were converted to a Likert scale in order to further compare the responses, with 'Always'=4, 'Very Often'=3, 'Sometimes'=2, and 'Never'=1.

Table 7 – Statistical Comparison of Pre- vs. Post-Survey Responses to Attitude and Skills Questions for Control and Experimental Groups at School A

Attitude and Skills	Group	N	P-Value	X^2	Pre-Survey Mean	Post-Survey Mean
A4 - I can effectively lead a team to design and build a hands-on project	C	268	0.45	2.66	2.39	2.53
	E	267	0.15	5.35	2.85	2.85
A8 - I can get good grades in science	C	265	0.71	1.36	2.92	2.89
	E	266	0.73	1.30	3.35	3.25

*Significance: p-value less than or equal to 0.05
C: 'Control Group' and E: 'Experimental Group'
DF = 3

Table 8 – Statistical Comparison of Control and Experimental Responses to Attitude and Skills Questions for Pre- and Post-Surveys at School A

Attitude and Skills	Survey	N	P-Value	X^2	Control Mean	Experimental Mean
A4 - I can effectively lead a team to design and build a hands-on project	*Pre	269	<0.01	14.23	2.39	2.85
	*Post	266	0.03	8.71	2.53	2.85
A8 - I can get good grades in science	*Pre	267	<0.01	19.10	2.92	3.35
	*Post	264	<0.01	13.59	2.89	3.25

*Significance: p-value less than or equal to 0.05
DF = 3

When looking at the changes in responses between pre-survey and post-survey by groups, neither statement was significant. For changes in responses between groups by survey, both A4 - 'I can effectively lead a team to design and build a hands-on project' and A8 - 'I can get good grades in science' were significant for both pre- and post-survey responses. These results indicate that there was a statically significant difference between the two groups at the beginning of the program as well as at the end of the program. This analysis indicates that the 'You're Hired!' program did not have an effect on students' perceptions of their skills.

Impact of the 'You're Hired!' Program

While it is likely that outside influences (school curriculum, family and friends, extracurricular activities, etc.) also had an effect on the shifts seen in pre- vs post-survey responses to the 'Engineer' and 'Interest' questions, the 'Impact' statements attempt to identify effects that can be directly attributed to the 'You're Hired!' program. Program impact was measured on the post-survey by asking, 'How much did participating in the activity impact each of the following?' with response options of: 'A Great Deal', 'Moderately', 'Slightly' and 'Not At All'. This question, unlike the other questions asked on the pre- and post-surveys, was directly focused on the 'You're Hired!' program. Figure 1 presents responses to each of the Impact statements. The y-axis lists the Impact statements along with the percentage of students that agreed, at least on some level (i.e., ‘A Great Deal’, ‘Moderately’ or ‘Slightly’), to the statement. The x-axis represents the cumulative percentage of students’ responses.

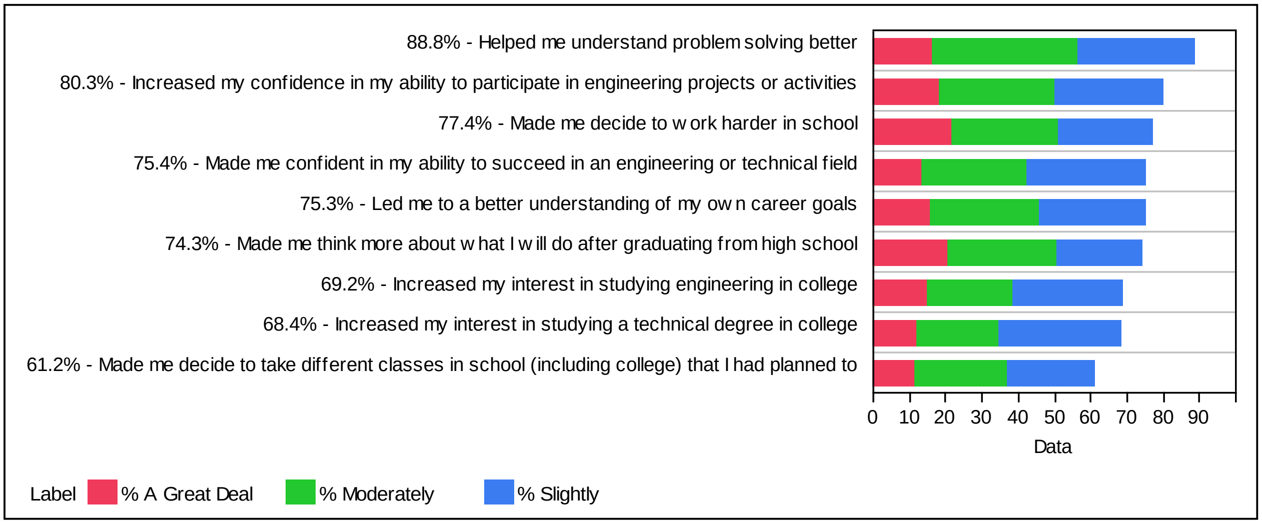

Figure 1 – Student levels of agreement to the statement, ‘How much did participating in the activity impact each of the following?’

Figure 1 indicates that the ‘You’re Hired!’ program had a positive impact on a majority of students with a very high percentage (>75%) showing levels of agreement to most statements. but one. The highest impacts were in ‘Helped me understand problem solving better’ at 94.9% and ‘Increased my confidence in my ability to participate in engineering projects of activities’ at 90.4%. These results indicate that the ‘You’re Hired!’ program is, at a minimum, improving students’ perception of their understanding and attitudes about engineering and STEM careers, and given the high levels of agreement, it seems likely that the program is in fact having a positive impact.

Finally, when students were asked, ‘Would you recommend that your friends participate in this activity?’, overall 77% of students stated, ‘Yes’. That 77% approval rating for the program includes every student across the participating pod at School A.

Conclusion

‘You’re Hired!’ appears to be a well-designed program that has increased students’ understanding and attitudes of engineering based on data collected. Overall the student responses showed a statistically significant, positive change in their understanding and attitudes towards engineering for the statement, E2 - ‘Engineers mainly work with other people to solve problems’.

Student-reported impact assessment indicates that the ‘You’re Hired!’ program had an impact on most students, with between 67% and 95% of students indicating at least some impact on their understanding, confidence, and educational and career plans, and stating the program had a moderate to large impact in these areas. The strongest area of impact was seen for statement Im1-‘Helped me understand problem solving better” with a level of agreement of 94.9%.

The program also showed success in introducing teachers to the idea of incorporating STEM and 21st Century Skills into their daily classrooms. Multiple teachers within the schools impacted by 'You're Hired!' have asked for additional suggestions to turn their current content into a more hands-on, collaborative project for their students. The 'You're Hired!' program as well as the teacher's new STEM/21st Century Skill classroom will help students to hone their engineering mindset skills.

Ongoing research will continue to assist in understanding what changes can be made to make the program more effective. Future plans for the project include changing the pre- and post-surveys from the original AWE design to one that works better for the project, professional development for teachers to extend engineering design principles from 'You're Hired!' into the daily classroom, research to identify program elements that contribute to positive student changes, expansion of its implementation across a tri-state region, and development of a model for sustainability and scalability into other regions.

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