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Paper ID #15046

# Design, Implementation, and Assessment of an After-School Engineering Program for Deaf Students

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# DESIGN, IMPLEMENTATION, AND ASSESSMENT OF AN AFTER-SCHOOL ENGINEERING PROGRAM FOR DEAF STUDENTS


## Abstract

The Engineering Exploration program for deaf and hard-of-hearing students at the Metro Deaf School exposes middle school after-school program participants to engineering disciplines and concepts while integrating the Next Generation Science Standards into the program's curriculum. This project began in the spring of 2014 with a short pilot of four two-hour long sessions, all focused on Creative Circuitry and sewable/wearable circuits. This paper will focus on the Engineering Exploration program of 2015, which consisted of six weekly two-hour sessions, featuring a new engineering challenge every week. We present the results of our surveys and observations regarding the effectiveness of the program in teaching the engineering design process, different engineering disciplines, and attitudes toward the field of Engineering.


## Instructors, Communication, and Motivation

The research team consisted of four undergraduate instructors: three Mechanical Engineering majors and one Engineering Education major, all attending the University of St. Thomas in Saint Paul, Minnesota. The student lead on the project was a senior mechanical engineering major with a minor in American Sign Language (ASL) and has been exposed to and integrated into Deaf culture throughout her life and is fluent in ASL. One other engineering major is ASL-proficient and familiar with Deaf culture. The remaining two instructors have very little ASL skills but were able to communicate with the deaf students through an ASL interpreter and by using other non-verbal communication techniques.

President Barack Obama's 2009 Educate To Innovate STEM Initiative caught the research team's attention regarding the growing need for engineering-based science lessons [1]. In September 2010, the President's Council of Advisors on Science and Technology published a report titled Prepare and Inspire: K-12 Education in Science, Technology, Engineering, and Math (STEM) For America's Future [2]. The report was intended to provide a way to improve K-12 STEM education in the United States - a necessity to move Americans ahead in the math and science disciplines. Recognizing the importance of this initiative as a result of their engineering and education backgrounds, the research team decided it was a topic worth pursuing. Despite growing engineering standards, such as the Next Generation Science Standards and Integrated STEM focuses linking engineering with various Minnesota K-12 Academic Standards, resources at publicly funded schools can be tight, possibly leading to limited engineering lessons during the school day [3]. Because of both the reality of this and the Educate to Innovate STEM Initiative, along with the research team's background in ASL, it was decided to bring a technical program to the Metro Deaf School in an attempt to not only fill the holes regarding the topic of engineering that the students might experience, but to also discover the most effective way to teach this growing subject area to a different community of students than typically considered.

## A Note on Deafness and Language Facilitation

This program is unique as we tailored each activity to the abilities, skills and interests we assumed might be present for the group of deaf students we worked with. Keeping in mind the little importance and relevance sound-related activities would hold with our students, we modified existing activities to include as much visual interest as possible. Each module began by introducing the engineering discipline of focus and related applications of that discipline with the help of posters. Each poster gave a broad definition of the profession (i.e. for software engineering: designs computer software), gave specific examples of what a professional in that field might work with (i.e. works to improve software for the computer industry by making it better or faster) and depicted a character doing an activity related to the engineering field (i.e. a female cartoon character behind a computer). In addition to the written English and simple pictures provided by the posters, ASL was used to elaborate on the definition and answer questions that the students had.

Weeks where written instructions were required, we developed worksheets with pictures and diagrams along with ASL instruction to encourage student understanding and benefit. Applications like MaKey MaKey © and the Kodu Game Lab © were modified to ignore sound applications and focus on tactile and visual applications respectively. This provided an inclusive environment for the deaf students to experience these technologies and learn through playful interaction, increasing the likelihood they would enjoy and appreciate the activity. The fall 2015 program had an 8:3 student to ASL-fluent instructor ratio. The complications of this will be discussed in the Observations and Discussions portion of this paper.

As we looked to make our program culturally sensitive, we needed a definition of "deaf" with which we could respectfully talk about the students. Within the Deaf community, there are several ways to identify as someone with hearing loss and refer to someone with a hearing loss. These different forms of deafness are deaf, Deaf, and hard of hearing. Capital-D Deaf is defined as an individual that has been exposed to Sign Language for the entire duration of their life, has used Sign Language as their main form of communication, and has accepted a role within the Deaf community. Lowercase deaf is used to refer to an individual that is not fully submersed in the Deaf community but is deaf due to age, illness, or trauma and has not accepted Sign Language as their main form of communication. Instead, a person who identifies as deaf may use other ways of communicating such as speech, with the help of hearing-aids or cochlear implants, or lip reading. These individuals may not have access to the knowledge, beliefs and practices of Deaf culture. An individual that identifies as hard of hearing might be someone that has mild to moderate hearing loss and has no affiliation to Deaf culture. Hard of hearing individuals may or may not be involved in the Deaf community as that decision is up to them [4]. In this paper, we will refer to all of the Metro Deaf School students who participated in our program as lowercase deaf, in order to include all of the students that might identify as Deaf, deaf, or hard of hearing.

**Previous Programs Conducted by The University of St. Thomas at Metro Deaf School**

The spring 2014 program concentrated on electronics and circuitry. This pilot program named Creative Circuity integrated into the Metro Deaf School science club made use of Squishy Circuits ©, MaKey MaKey ©, and incorporated other electronic design challenges such as an e-textiles workshop. The team was able to reflect on the initial Creative Circuitry program and its reception with the middle school students in order to build more engaging programs in the future.

A fall 2014 program was also run and involved a concentration on individual engineering disciplines with each week focusing on a different discipline. This curriculum was built to introduce and expose the deaf students to six different disciplines in enjoyable ways. During the development of this after-school program, several goals were built into each module of the engineering curriculum. The main goal was to expose an underrepresented group of deaf students to engineering disciplines in fun and creative ways. The team also decided to incorporate the Next Generation Science Standards for Engineering into this educational community as often schools like this otherwise rarely have the resources to focus on these standards.

**Fall 2015 Engineering Exploration Program**

As many of the same students that attended the fall and spring 2014 versions of this program were slotted to attend the most recent program, the instruction team decided a different approach would be necessary to continue to engage repeat attendees. The 2015 Engineering Exploration program consisted of six weekly two-hour sessions in which various engineering challenges were presented to the group of deaf and hard of hearing middle school students. The program was instructed through American Sign Language (ASL) with assisting documents and surveys presented in written English, as with the previous programs. The activities chosen were concerned with understanding, designing and building parachutes; creating, building, refining and competing with art bots (or bristle bots); and a water filtration lab. This set of the program also involved a visit to the University of St. Thomas where the middle school students got to tour the labs, drive undergraduate student-made robots and use a laser cutter.

The research team identified several goals in which they incorporated into the program structure and chose to focus the program evaluations around. These goals include:

- Create challenging yet entertaining activities appropriate for the demographic,
- Develop the students' understanding of what engineers do,
- Change negative attitudes about engineering careers and grow positive attitudes about the profession,
- Build student self-confidence and critical thinking skills as they relate to engineering
- AND; help students draw connections between their interests, passions and engineering professions [5].

To achieve these goals, the team provided exposure to new ways of thinking about engineering and design challenges. These after-school modules were designed to engage the students and motivate them to learn more about science, technology, engineering and math (STEM) subjects. Through these playful challenges, the team hoped to break down any preconceived notions that the engineering field is boring or unwelcoming to deaf and hard-of-hearing students.

Unique to the Fall 2015 Engineering Exploration program, the research team made necessary steps in order to survey and collect feedback from students at the beginning of the program, after each activity, and the conclusion of the program. The aim of these surveys was to collect data on how the students felt regarding the program in general, feelings towards engineering, whether they learned, whether they felt capable of being engineers, and what it means to be an engineer. These surveys led to concrete data and help with the research team's scope to determine effective

ways to include engineering education and the next generation science standards in a deaf school setting.

**Data Collection**

As stated above, the research team made necessary steps in order to survey and collect feedback from students participating in the Fall 2015 Engineering Exploration. Surveys were distributed at the beginning of the program, after each engineering challenge activity, and at the conclusion of the program.

The pre-survey covered topics to inquire about the students' pre-existing ideas about their abilities related to engineering and design. Some of these questions are listed in Table 1.

*Table 1: Questions sampled from the pre-survey.*

| **Pre-Survey Questions** |
|---|
| What do you think it means to be an engineer? What things do you think an engineer is good at? |
| Can you imagine yourself as an engineer? Why or why not? |
| Engineering is a good career choice for Deaf students (strongly agree – strongly disagree). |
| I would consider myself as a good candidate for engineering (strongly agree – strongly disagree). |

The following surveys were given at the end of each activity. These surveys were intended to collect data on how the students felt regarding each workshop topic and their resulting feelings towards engineering and are shown in Figures 1 & 2.

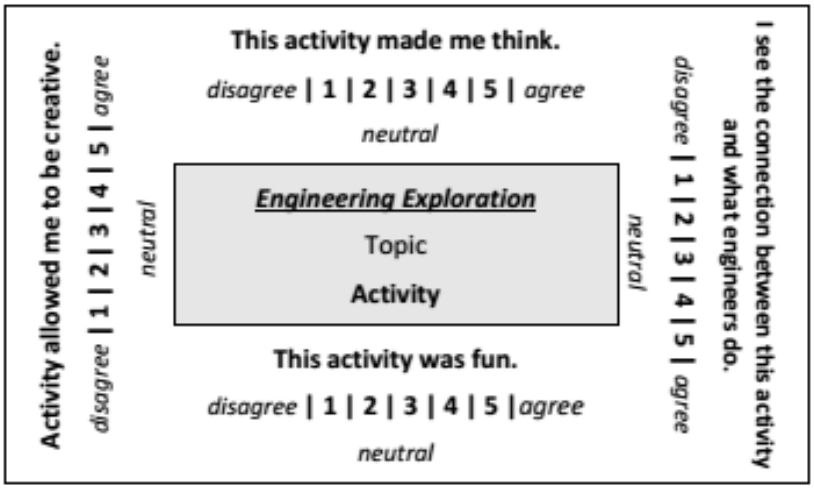


*Figure 1: Example of Daily Activity Survey, front*

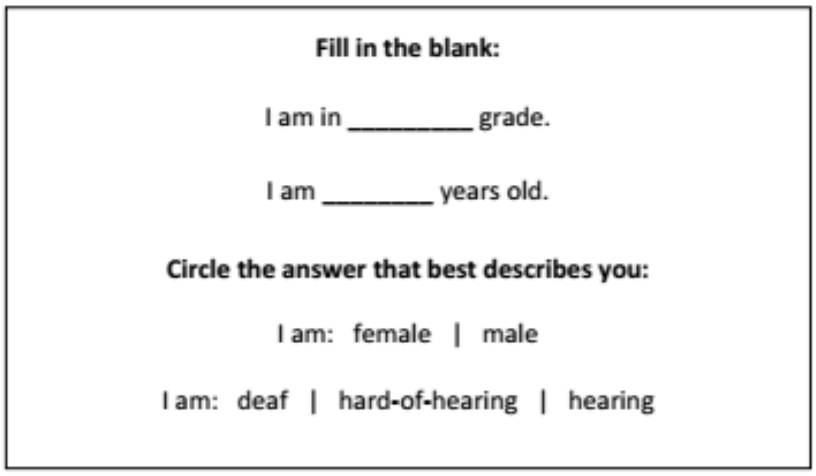


*Figure 2: Example of Daily Activity Survey, back*

These surveys were designed to give the instruction team an idea of which activities had the greatest impact with the deaf students and which could be improved upon.

The final surveys were used to compare pre- and post-program opinions of engineering. The final surveys contained many of the same questions as the pre-survey so as to directly compare student opinions before and after the workshops. The surveys also asked questions regarding the confidence in the students' own abilities as they relate to engineering careers. Examples of these questions are located in Table 2.

*Table 2: Questions sampled from the post-survey as they relate to the students' confidence in their skills.*

| **Post-Survey Questions** |
|---|
| My confidence in problem solving got… better, worse or stayed the same. |
| My confidence in building and designing things got… better, worse or stayed the same. |
| My ability to brainstorm solutions to problems got... better, worse or stayed the same. |
| My ability to think of many different possible ways to solve a problem got… better, worse or stayed the same. |
| My ability to use the design process (brainstorm, design, build, test, redesign) got… better, worse or stayed the same. |

A total of eight students opted to participate in the program with parent/guardian permission. The ages of the students ranged from 11 to 18 and included one senior in high school. The group consisted of five females and three males between the ages of 11 and 18, including one senior in high school.

**Engineering Challenges**

In this paper we outline the daily survey results for three engineering challenges conducted at the Metro Deaf School. The first of these engineering challenges tasked the participants to design a parachute that will "safely" land a rubber ducky on the ground. A limited amount of material was supplied for each team and they were advised to use supplied materials creatively. Before sharing what the activity was, a video was shown which helped explain air resistance via visual animations. Time was allotted for brainstorming and drawing idea concepts before being allowed to construct a parachute.

The second engineering challenge, "The Egg Drop Challenge", tasked the participants to engineer something that could protect an egg from falling to the ground. We had a competitive aspect to this activity in which we challenged the participants to compete with the goal of determining whose design could protect the egg from the highest height. Similar to the first engineering challenge, teams were formed and time was given before construction of the design for brainstorming and drawing concepts.

The last engineering challenge reviewed in this paper, assigned the participants a project in which they were to design a water filter to clean dirty water. Again, supplies were given and time for brainstorming was given; teams were formed and a competition was constructed to see whose filter could clean the water the best. The following Table 3 outlines each engineering challenge along with its supplies and objective defined in our lesson plan for that day.

*Table 3: Supplies and Engineering Challenge Objective Defined in Lesson Plans*

| Engineering Challenge | Supplies Given | Objective |
|---|---|---|
| Parachute Design Challenge | Paper<br>Tissue Paper<br>Paper Clips<br>Coffee Filters | To relay the scientific concept of air resistance by challenging the participants to design a parachute. |
| Egg Drop Challenge | Paper<br>Paper Clips<br>Masking Tape | To promote understanding of what sort of engineering design can protect an egg from falling on a hard floor. |
| Engineer a Water Filter Challenge | Sand<br>Dirt<br>Water Bottle<br>Coffee Filters<br>Other filter materials | To encourage creative thinking using the given materials to design a water filter. |

**Results**

Compiled in Table 4 are the results of the eight students' responses to the daily activity surveys. Activity 1, Activity 2, and Activity 3 are the Design a Parachute Challenge, Egg Drop Challenge, and Engineer a Water Filter Challenge, respectively. Throughout all results tables it must be noted that "N/A" implies an answer was never selected or written by the student. They responded on a one to five ranking scale where one is 'strongly disagree' and five is 'strongly agree'.

*Table 4: Answers to Daily Activity Survey*

| Student | Grade | Age | Gender | Deaf/Hard of Hearing/Hearing | Activity | This Activity Made Me Think | I See The Connection Between This Activity And What Engineers Do | This Activity Was Fun | This Activity Allowed Me To Be Creative |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 6 | 12 | Male | deaf | 1 | 5 | 5 | 5 | 5 |
| | | | | | 2 | 5 | 4 | 5 | 5 |
| | | | | | 3 | 5 | 5 | 5 | 5 |
| 2 | 6 | 12 | Female | deaf | 1 | *N/A* | *N/A* | *N/A* | *N/A* |
| | | | | | 2 | 5 | 5 | 5 | 5 |
| | | | | | 3 | 5 | 5 | 5 | 5 |
| 3 | 12 | 18 | Male | deaf | 1 | 2 | 3 | 5 | 3 |
| | | | | | 2 | 4 | 2 | 5 | 2 |
| | | | | | 3 | 3 | 2 | 5 | 3 |
| 4 | 7 | 13 | Female | deaf | 1 | 2 | 1 | 2 | 1 |
| | | | | | 2 | 1 | 2 | 1 | 2 |
| | | | | | 3 | 1 | 1 | 2 | 1 |
| *5* | *N/A* | *N/A* | *N/A* | *N/A* | *1* | 1 | 3 | 5 | 2 |
| | | | | | *2* | *N/A* | *N/A* | *N/A* | *N/A* |
| | | | | | *3* | *N/A* | *N/A* | *N/A* | *N/A* |
| 6 | 8 | 14 | Female | deaf | 1 | 4 | 3 | 3 | 4 |
| | | | | | 2 | 4 | 3 | 4 | 4 |
| | | | | | 3 | 4 | 4 | 4 | 4 |
| 7 | 7 | 13 | Female | deaf | 1 | 5 | *N/A* | *N/A* | *N/A* |
| | | | | | 2 | 3 | 1 | 5 | 1 |
| | | | | | 3 | 2 | 2 | 3 | 2 |
| 8 | 6 | 11 | Female | deaf | 1 | 5 | 5 | 5 | 5 |
| | | | | | 2 | 5 | 5 | 5 | 5 |
| | | | | | 3 | 5 | 5 | 5 | 5 |

| Key | | | | |
|---|---|---|---|---|
| Strongly Disagree | Disagree | Neither Agree Nor Disagree | Agree | Strongly Agree |

Table 5 and Table 6 above display the pre-program and post-program short answer responses, respectively. The short answer questions mostly identify confidence levels regarding engineering amongst the students. A few questions also probe for areas of improvement in similar future programs. Student 3, 5, and 7 did not participate in the Post- Program Survey.

*Table 5: Pre-Program Short Answer Responses*

| Student | Gender | Grade | Ethnicity | What do you think it means to be an engineer? What things do you think an engineer is good at? | How might your favorite subjects in school be used by an engineer? | Can you imagine yourself as an engineer? Why or why not? | What are you hoping to gain or learn from this club? |
|---|---|---|---|---|---|---|---|
| 1 | Male | 6 | White | I'm good at engineer science! | Computer and more | Yes because I'm good engineer | making website in computer |
| 2 | Female | 6 | White | Art, building | math make things | Because of I want become Inventer. And I love sci. | I want to learn more sci, engineer too. |
| 3 | Male | 12 | Asian | different a tape line | I learn math and science check in engineer. | I think a little hard for different build redio-Rce engineer. | I learn about basketball club |
| 4 | Female | 7 | Hispanic | I don't know, I don't know language | Language art, math | No? | not sure. |
| 5 | Female | 7 | Hispanic | Computer job | science used in computers | yes, it's a job | ASL signs related to engineering |
| 6 | Female | 8 | White | I not know mean engineer. I think so engineer is good. | My favorite is technology. | I think so want to learn technology. | I want learn cool club |
| 7 | Male | 12 | Black | Not know. Computer lab pp | Math, science learn | yes cook | sport track of field learn |
| 8 | Female | 6 | White | I think know means engineer. I know engineer is good at science | My favorite is science | Why not I can become engineer at science! | I hoping to learn more about electric things! |

*Table 6: Post-Program Short Answer Responses*

| Student | How many stars would you give the whole Engineering Exploration program? | What did you like most about the program? | What do you think it means to be an engineer? What things do you think an engineer is good at? | Can you imagine yourself as an engineer? Why or why not? | Did your understanding of what an engineer does change after attending this club? If so, how? | If you were in charge, what would you change about this program? | Would you recommend that other students participate in events like this? | Why did you choose the previous answer? |
|---|---|---|---|---|---|---|---|---|
| 1 | 5 | Making robot! | I'm good to learning! | Yes, because I'll teaching other children | always wiring green paper | I'm better teaching about robot! | yes | because it is fun! |
| 2 | 5 | gave me creative | make something. Good at math. | yes, because I am good math. | yes, learn about engineering. | no change | yes | because of engineer are fun. |
| 4 | 1 | nothing | see into science, see other different. | but because not good engineering is hard. | so too good and nice science | very work of science cool and not skill to science and I good skill easy art and matter so nic science other fun. | maybe | *N/A* |
| 6 | 4 | yes cool thing | I am good Art yes good | yes make cool things | I want how make cool things | I want learn cool thing | maybe | I want draw |
| 8 | 5 | I like put dirt water on bottle then put cotton balls then will change to clean water | Engineer is science. Engineer is good at science | I can imagine myself as an engineer | I understanding engineer. How engineer changes well engieer changes because too hard, need to changes to easy | I will change stem club makes better and fun and more technology! | Yes | because I want more kids to join and learn more creativity! |

Table 7 and Table 8 portray responses on a one to five scale to questions that were asked before the program began. These questions aimed to identify the students' current outlooks on engineering before being taking part in our engineering challenge activities.

*Table 7: Pre- Program Survey Questions Responses*

| Student | Engineers are innovative | Engineers are creative | Engineers do work that is hands on | Engineers do work that is fun | Engineers do work that allows them to help their community and/or society | Engineers work in many different kinds of career fields |
|---|---|---|---|---|---|---|
| 1 | 5 | 5 | 5 | 5 | 4 | 5 |
| 2 | 5 | 5 | 5 | 5 | 5 | 5 |
| 3 | 3 | 4 | 4 | 5 | 3 | 1 |
| 4 | 3 | 3 | 3 | 3 | 4 | 3 |
| 5 | 2 | 3 | 3 | 1 | N/A | 4 |
| 6 | 2 | 1 | 2 | 1 | 2 | 2 |
| 7 | 1 | 1 | 1 | 1 | 1 | 1 |
| 8 | 5 | 5 | 5 | 5 | 5 | 5 |

| Key | | | | |
|---|---|---|---|---|
| Strongly Disagree | Disagree | Neither Agree Nor Disagree | Agree | Strongly Agree |

*Table 8: Pre-Program Survey Questions Responses*

| Student | Engineering is a good career choice for Deaf students | Engineering is about art and design | Engineering is about math and science | I would consider myself good at math and science | I would consider myself good at art and design | I would consider myself as a good candidate for engineering |
|---|---|---|---|---|---|---|
| 1 | 5 | 5 | 5 | 5 | 5 | 5 |
| 2 | 5 | 5 | 5 | 5 | 5 | 5 |
| 3 | 5 | 4 | 5 | N/A | 3 | 1 |
| 4 | 3 | 5 | 3 | 3 | 4 | 3 |
| 5 | 4 | 1 | 5 | 5 | 1 | 2 |
| 6 | 1 | 2 | 2 | 2 | 1 | 2 |
| 7 | 1 | 1 | 1 | 1 | 1 | 1 |
| 8 | 5 | 5 | 5 | 5 | 5 | 5 |

| Key | | | | |
|---|---|---|---|---|
| Strongly Disagree | Disagree | Neither Agree Nor Disagree | Agree | Strongly Agree |

Table 9 and Table 10 summarize post-program survey responses on a one to five scale that corresponds to similar questions asked in Table 7 and Table 8. The purpose of these questions were to analyze how the students' outlook on engineering changed over the course of the program.

*Table 9: Post-Program Survey Question Responses*

| Student | Engineers are innovative (They come up with new ideas and inventions) | Engineers are creative | Engineers do work that is hands-on. | Engineers do work that is fun. | Engineers do work that allows them to help their community and/or society | Engineers work in many different finds of career fields. | Engineering is a good career choice for Deaf students |
|---|---|---|---|---|---|---|---|
| 1 | 4 | 5 | 4 | 5 | 5 | 5 | 5 |
| 2 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 4 | 2 | 3 | 2 | 2 | 4 | 3 | 3 |
| 6 | 4 | 4 | 5 | 4 | 3 | 4 | 5 |
| 8 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |

*Table 10: Post-Program Survey Question Responses*

| Student | Engineering is about art and design | Engineering is about math and science | I would consider myself to be good at math and science | I would consider myself to be good at art and design | I would consider myself as a good candidate for engineering | Before these activities, I knew what an engineer did | After these activities, I know what an engineer does | I see a connection between my interests/passions and engineering |
|---|---|---|---|---|---|---|---|---|
| 1 | 5 | 5 | 5 | 4 | 4 | 3 | 4 | 4 |
| 2 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 4 | 3 | 4 | 4 | 2 | 2 | 2 | 3 | 3 |
| 6 | 4 | 3 | 4 | 5 | 4 | 3 | 4 | 4 |
| 8 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |

Table 11 displays the students' responses in the post-program survey in which they assess whether any progress was made on confidence and abilities that relate to engineering.

*Table 11: Student Assessment on Confidence and Increase in Engineering Abilities*

| Student | My confidence in problem solving… | My confidence in building and designing things… | My ability to brainstorm solutions to problems… | My ability to think of many different possible ways to solve a problem… | My ability to use the design process (brainstorm, design, build, test, redesign)… |
|---|---|---|---|---|---|
| 1 | 3 | 2 | 3 | 3 | 2 |
| 2 | 3 | 3 | 3 | 3 | 3 |
| 4 | 3 | 2 | 3 | 2 | 1 |
| 6 | 4 | 3 | 4 | 3 | 3 |
| 8 | 3 | 2 | 3 | 3 | 3 |

| Key | | | |
|---|---|---|---|
| (1) Got Worse | (2) No Progress | (3) Progress Made | (4) I Don't Know |

**Discussion**

Looking at the results from the surveys, a few trends can be seen regarding student confidence, interest, and progress. It is quite evident that students who came in with high confidence, knowledge of, and interest in engineering, were the ones who left with positive remarks. They assessed themselves as gaining progress in confidence and engineering abilities portrayed in Table 11. Looking in particular at students 1, 2, and 8, pre- and post-survey responses displayed in Tables 7, 8, 9, and 10 were rather positive. They were also the students to consistently answer the questions in Table 4 positive, for example, stating that the engineering challenge made them think creatively, or that they saw a connection with engineering.

Interest is also found in the students who showed less confidence, knowledge of, and interest in engineering during the pre-test survey. Only students 4 and 6 would fall under this category and the results are quite striking when looking at their responses between the pre- and post-program surveys. During the pre-program survey questions in Tables 7 and 8, student 4 responds an

unsure answer for three out of every four questions while agreeing to the rest. On the other hand, student 6 disagrees or strongly disagrees with every question, including the question asking if they would consider them self a good candidate for engineering.

However, the post-program survey showed positive results. In the post-survey, student 6 changed disagreeing answers to agreeing answers for four out of every five questions displayed in Tables 9 and 10. Student 6 now agreed that they would make a good candidate for engineering, understand what it is, and that it coincides with their passions. They also responded for three out of the five questions in Table 11 that they made progress in confidence and engineering abilities, while the other two were answered as unsure of progress made. Positive reviews were also given to the activities displayed in Table 4.

Regarding student 4, who was mostly unsure during the pre-program test, this student now disagrees with statements that were originally answered as unsure and decided they were not good at art and design while initially stating they were. They also became unsure as to if engineering is about art and design while initially agreeing, but still maintain the belief that engineers benefit the community. Overall, student 4 responded in the post-survey that engineering was not fun for them and that they were not a good designer or a suitable candidate for engineering. Poor reviews were also given to the engineering challenges, which is portrayed in Table 4. Nevertheless, in Table 11, student 4 did claim that progress was made in their confidence of problem solving and the ability to brainstorm solutions, but apparently lost ability to understand and use the design process.

Upon the instructor team's reflection, consideration has been taken to determine what they think needs improvement and how they can change a lack of confidence and promote interest and engineering. One potential area of improvement could be putting surveys fully into an ASL, visual medium to avoid the necessary understanding of the English language. They think this would greatly increase the quality of the responses. To further integrate ASL, the team would suggest answers also being given in ASL via a visual medium. Presenting the questions in ASL and finding a way for the students to respond in their native language would increase the viability of the answers as some student are not ASL-to-English proficient.

The program as a whole would benefit from more ASL-fluent team members as to be fully adaptable in the space with the students. The team found that students were frustrated with having to wait for the attention of an interpreter or an ASL-fluent instructor in order to ask a question, clarify something or get help with their project.

As this program strives to be as deaf-friendly as possible, the team intends to grow the instructor team to include more ASL-fluent students. A nearby university has an interpreting program and the team intends to recruit students from their program to join the Engineering Exploration team. This will increase the ease of communication and allow for transitioning between team members in future years. A modified program is being written and will build on team observations, survey results and feedback from deaf school instructors and other related professionals.

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