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Design of an Interactive Multidisciplinary Residential Summer Program for Recruitment of High School Females to Engineering

Dr. Paula Ann Monaco, Texas Tech University

Dr. Paula Monaco, E.I.T., successfully defended her dissertation research Spring 2016 and will begin a career in the water/wastewater reuse treatment. Paula has led multiple outreach summer programs at TTU and provides support to student organizations within the college of engineering. Her technical research focuses include; anti-fouling and scaling RO technology and pharmaceutical and personal care product screening to predict environmental exposure from passive treatment discharges.

Aimee Cloutier, Texas Tech University

Aimee Cloutier is a Ph.D. student studying Mechanical Engineering at Texas Tech University. She earned her B.S. in Mechanical Engineering from Texas Tech in 2012. Her research interests include biomechanics, rehabilitation engineering, prosthetic limb design, and STEM education.

Mr. Guo Zheng Yew, Texas Tech University

Guo Zheng Yew is currently pursuing his doctorate in civil engineering at Texas Tech University with a focus on finite element analysis and glass mechanics. Prior to his graduate work in the United States, he obtained his Bachelor's degree from Malaysia and has participated in research projects involving offshore structures in Malaysia.

Maeghan Marie Brundrett, Texas Tech University

Current PhD student at Texas Tech University in the Department of Civil and Environmental Engineering. Main research focus is on the fate and occurrence of chlorate in the environment and its use as an alternative solution for remediation of the salt marshes impacted by the BP Horizon oil spill.

Dylan Christenson, Texas Tech University

B.A. Liberal Studies and M.A. Education from Vanguard University of Southern California. M.S. Civil Engineering Texas Tech University. Currently pursuing a PhD in Civil and Environmental Engineering with focus on the biological treatment of waste water for re-use applications. I am passionate about both engineering and education. I am specifically interested in student motivation, formative assessment, service learning, and the influence of the affective domain.

Dr. Audra N. Morse, Texas Tech University

Dr. Audra Morse, P.E., is the Associate Dean for Undergraduate Studies in the Whitacre College of Engineering and a Professor in the Department of Civil and Environmental Engineering at Texas Tech University. She leads the Engineering Opportunities Center which provides retention, placement and academic support services to WCOE students. Her professional experience is focused on water and wastewater treatment, specifically water reclamation systems, membrane filtration and the fate of personal products in treatment systems.

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Abstract

The need to inspire and recruit female high school students to study engineering is well known. Texas Tech University (TTU) reports the female population is 18%,[17] similar to the national average. Outreach programs are a common means of exposing students to different engineering disciplines and a variety of employment opportunities for engineers. Traditional forms of outreach programs such as seminars, information sessions or research activities are often less interactive and less student-centered. A week-long summer program was implemented at TTU to provide a holistic design experience to expose students to a higher education environment. The program consisted of interactive discipline specific lessons, a multidisciplinary group project, professional development sessions, and recreational activities. The goals and design of the summer program, Engineering – Get Into Real Learning (E-GIRL), aimed to interest and recruit junior and senior high school females to pursue engineering by introducing six engineering disciplines through interactive, problem-based learning. Further, the camp aimed to provide female students with a positive experience and a chance to develop personal, interpersonal and technical engineering skills. Using a flipped classroom structure, students were given supplemental readings prior to each engineering discipline's discipline specific lesson providing background knowledge for each activity. Students were tasked to work in groups on an open-ended project applying knowledge of the six disciplines introduced throughout the program. Problem-based learning through the assigned project allowed students to develop skills such as teamwork, oral communication, time management and project management. During the final program session, students gave an oral presentation to peers, parents and program instructors detailing their design solutions to a real-world problem. Evaluation instruments of the outreach program's design included pre- and post-questionnaires for assessment of the interactive sessions, and their impact on the development of engineering skills and the understanding of information presented. Assessment results led to the conclusion that students were able to identify areas of improvement for self-development of engineering skills, exhibited better comprehension of engineering as a career, and distinguished among various disciplines of engineering. Responses provided by students led to the conclusion that the implementation of the presented residential outreach program curriculum achieved the goals of educating and exciting female students about engineering careers.

Introduction

The underrepresentation of women in science, technology, engineering, and mathematics (STEM) is an issue that has been persistently addressed for the past two decades. Women hold nearly half of the jobs in the United States but still account for fewer than 25% of STEM employees.[2] The achievement of gender balance in STEM is recognized as important for the promotion of equal opportunities but is perhaps more important for strengthening scientific explanations through diverse perspectives.[3]

Despite efforts to recruit and retain women in STEM fields, the gender gap is, disturbingly, increasing.[16] This disparity is especially prominent in engineering. Literature suggests women comprise over 50% of the overall undergraduate student body, while women represent only 18% of the student population in engineering.[7] Issues of recruitment and retention are caused by a complex combination of factors, but there is empirical support for the belief that high school context is a crucial factor in determining future plans to pursue STEM.[6,9] Currently, only 13% of high school females express interest in STEM,[16] and only 1%-4% express interest in engineering,[8] but the gender gap can be reduced by 25% or more in schools which support girls' interests in STEM.[9] Further, it has been shown that outreach programs targeting certain factors have been effective for the recruitment of women to STEM.[7]

In literature, attempts to identify factors influencing recruitment and retention of women in STEM have converged to several themes. The first major issue is that of actual versus perceived ability in STEM. Although mathematical abilities are now roughly equal for male and female students,[9] female students consistently struggle with poor self-efficacy in STEM.[4,8,10] Women begin to underestimate their STEM abilities starting in middle school,[1] causing female students to lose interest in STEM in high school.[12] Particularly in engineering, women display poorer self-assessment on tasks than men.[9] The issue of self-efficacy may be partially linked to a second major theme of social factors and expectations. STEM teachers often express higher expectations for boys than for girls.[3,12] Additionally, women are more likely than men to develop an extrinsic sense of self-worth which is fortified by positive reinforcement and praise from others, and lack of encouragement can often be viewed as discouragement.[14]

Another primary cause of recruitment and retention issues is that STEM curriculum does not reflect the preferences more common to women. Female students belong to a subgroup which responds better to courses emphasizing a smaller amount of material covered in depth than a broad range of topics[3,12] and emphasizing real-world problem solving.[5] In general, women also tend to choose career paths that are either personally meaningful[14] or which have potential to help society or improve quality of life.[3,5,9,12] These altruistic tendencies lead many females who do enter STEM fields to choose those related to the life sciences;[12,16] similarly, many women with STEM degrees can also be found in education and healthcare.[2] By contrast, engineering is viewed as a profession which places higher value on external rewards such as economic production, money, prestige, and power[9] and is therefore less appealing to those whose career choices are more likely to be driven by intrinsic factors.

Finally, a critical factor to the success of outreach efforts is the creation of an environment which is supportive of women. Institutions with a history of commitment to diversity tend to be more successful in recruitment,[7] and institutions which have already established a critical mass of women have a much easier time maintaining a more balanced gender ratio since the presence of women creates the perception that women have the abilities and interests to succeed in engineering.[5] Female role models and special mentorships for women have also been helpful for increasing self-efficacy.[4,8]

This paper presents the implementation of Engineering – Get Into Real Learning (E-GIRL), an outreach program to encourage high school women to pursue engineering degrees and careers. Thirty-seven students attended the week-long, residential summer program during which they worked in multidisciplinary engineering teams to solve a real-world problem (in this case, designing a hydraulic fracturing site). Support for program participants' completion of the project was provided through undergraduate mentors and through graduate instructors who offered lessons and interactive activities to guide the students through six engineering disciplines. This paper focuses on the overall structure and goals of the camp and general assessment of curriculum design.

E-GIRL Structure

The summer program was designed to excite and recruit females to pursue higher education and engineering majors. The residential program allowed students to visit Texas Tech University (TTU) and experience a week as a college student. The week-long program included individual classes, a multidisciplinary project, information sessions, and recreational activities. Program assessment was performed throughout the week's activities to gain knowledge about the participants' perception of the summer program's design.

E-GIRL program curriculum was designed to achieve the following goals: to recruit high school aged women to pursue STEM related studies at university, namely TTU, to introduce and expose participants to varying engineering disciplines roles, careers and base theories, and to excite students to study engineering through interactive learning and problem-based learning. The camp aimed to highlight multidisciplinary work and group collaboration through a real-world problem. Finally, the camp aimed to introduce students to a college style classroom and schedule to better prepare and inform them of the expectations of higher education.

Application and participant selection process

E-GIRL was advertised through TTU's website to alert high school students of the opportunity to participate in the inaugural summer program. Participants were asked to submit an application packet to provide program organizers with information to gauge student interest in the program and the benefits of the program to students. Application materials included participant information, list of organizations and/or community service involvement, list of any honors or awards, list of math and science classes completed and in progress, as well as short answers and an essay describing expectations and why they are interested in pursuing engineering. Two teacher reference forms were submitted along with a current transcript.

Following reception of participant application packets, the summer program organizers evaluated students based on a scale of 1 to 5. Each category of the application packets was scaled "1" for poor, "2" for below average, "3" for average, "4" for above average, and "5" for excellent. Due to the rigor of the week-long schedule introducing engineering concepts to high school female students, program organizers aimed to ensure that capable students would participate in the program.

Participant demographics

From the submitted applications, 37 students were selected to participate in the residential summer program. Participants represented varying demographic and geographical backgrounds. Student levels ranged from 9th to 11th grade and traveled from regional, state, and international locations to participate in E-GIRL. Figure 1 shows the ethnic breakdown of the program participants. Please note that some students identified with multiple options and this has been included in the presented percentages. Two participants traveled from Rome, Italy and represent the 5% of the other population reported as they identified as European.

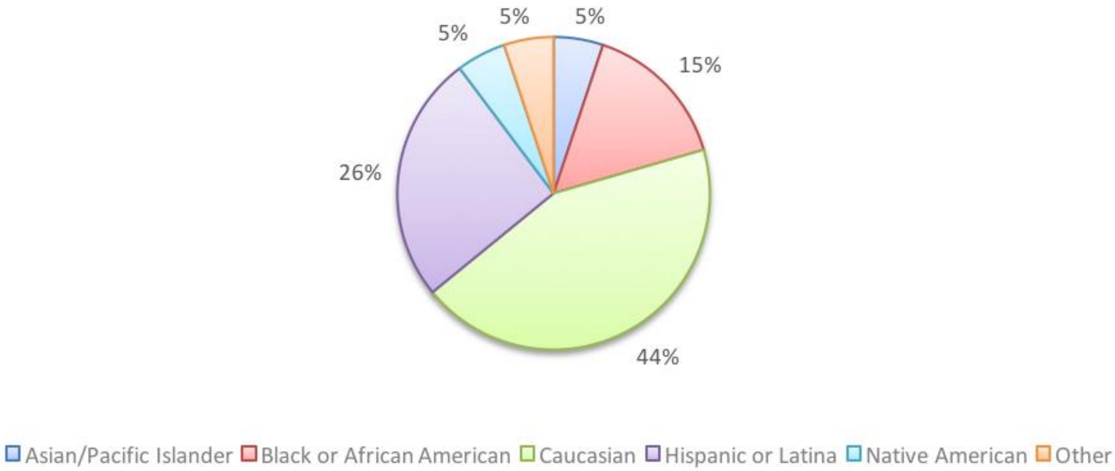

Figure 1: Participant ethnic background breakdown

The majority (62%) of the participants live in suburban-type communities. Participants traveled from homes located regionally (West Texas), in multiple states (California, Colorado, Georgia, Oklahoma, and Texas), and internationally (Italy). Representation from various geographic backgrounds exposed participants to other cultures. Figure 2 illustrates the count of students from urban, suburban or rural communities and breakdown of student ages at the time of participation. The majority of participants were seventeen years old entering their final years of high school. Seventeen of the participants said they have attended other engineering camps, competitions, or other events aimed to enhance interest in engineering.

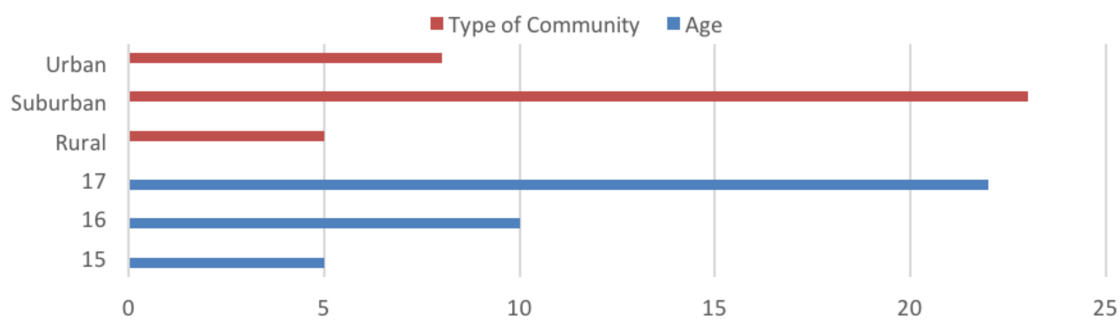

Figure 2: Participants type of community and age

Instructors and counselors

Discipline specific lessons were taught by instructors with various expertise, backgrounds and education levels. There were six discipline specific lessons taught, and the instructors included a combination of full time faculty members, instructors and graduate students. The majority of the instructors were women, providing participants with practicing female engineering role models. A group of women counselors were selected to serve as mentors and provide campers with a chance to interact with current engineering undergraduates from eight engineering disciplines. Counselors stayed with participants in the dorms and were present for all program activities. Counselors served many roles throughout the program, none more important than mentoring participants.

Information sessions

Information sessions provided participants an introduction to skills and topics typically not included in traditional engineering courses. Communication skills are vital for a successful engineering career; thus, one of the goals of the summer program was to provide participants with the opportunity to practice and receive feedback on presentations. Toastmasters was an information session introducing students to presentation formats and providing tips for public speaking. The information sessions also provided students with the opportunity to learn more about TTU and served as a recruitment opportunity. Laboratory courses are a part of offered degree programs, making an introduction to lab safety another opportunity for participants to experience components of an engineering major.

Recreational time

Participants were provided time to explore recreational facilities and themed social events to balance out technical and information sessions. Time in the evenings was important for highlighting the social aspect of university life. Recreational time also provided a casual setting for participants to ask counselors questions about their experiences in an undergraduate engineering program. Overall, the relationships developed during recreational time aimed to improve teamwork within the tasked project.

Discipline specific Lessons

Flipped classroom structure

Six discipline specific lessons were designed as part of the program's curriculum to introduce a variety of engineering majors offered at TTU. An objective of the curriculum was to introduce and inform participants of different engineering disciplines and career roles. The disciplines covered included civil, electrical, environmental, industrial, mechanical and petroleum engineering. Each discipline was covered during a 90-minute session led by an instructor specializing in their respective discipline. A short reading covering key themes and background knowledge for each discipline was provided in a portfolio for participants at the beginning of the week. Participants were expected to review readings to gain a foundational understanding of topics to be discussed during in-class lessons. Pre-class readings limited the time devoted to lesson lectures leading to extended times for interactive learning. Discipline lessons resembled a flipped classroom to provide participants with problem solving skills to be applied through the E-GIRL's curriculum.

Interactive learning and hands-on activities

Topics addressed during each lesson were designed to provide participants with an understanding of key components of the six disciplines covered in the curriculum. Paired with outside readings, students participated in hands-on activities applying the content to a design project. Instructors were tasked with developing an activity to allow students to develop problem solving skills applicable to the major group project assigned as part of the program curriculum. Activities also provided an example of design requirements various engineering disciplines apply to the oil-and-gas industry. The civil engineering lesson provided students with an interactive lesson covering foundation designs and infrastructure needed for production sites. The electrical engineering session provided an activity for students to learn about the use of sensors for the detection of water level. Students were given the opportunity to construct their own sensors and test the design. The environmental engineering session explored water/wastewater treatment through three separate activities: coagulation/flocculation, filtration and disinfection. The industrial engineering session introduced assembly line/supply chain concepts through a paper airplane simulation activity. The mechanical engineering lesson included the design of a pump to transport water from a lower to higher elevation. During the petroleum engineering session, students were introduced to laboratory simulators highlighting fluid flow, the role of proppants in maintaining fracture openings, and the effect of permeability on production of hydrocarbons.

Group Project

A comprehensive group project was included in the E-GIRL summer program curriculum to develop project management, teamwork and communication skills among participants. Students were grouped into teams of four or five and assigned various engineering roles. Participants were expected to submit conceptual designs developing, justifying, documenting design and developing a cost analysis for the construction of a hydraulic fracturing well as tasked in the project statement. The project statement was presented to participants at the beginning of the program, providing them with background information prior to attending various engineering classes. Background information from the six discipline specific lessons was designed to provide teams with the knowledge of the potential roles that civil, electrical, environmental, industrial, mechanical, and petroleum engineers have in the development of fracturing sites. Each group was provided a different fracturing site location with unique site constraints to diversify design selections based on individual site parameters. Study time and team meetings were included in the week’s schedule to provide time for groups to work together to meet project objectives. The project provided students with an activity developed to simulate design prompts from undergraduate engineering design courses and challenged participants to develop organizational skills, time management skills, contribution to group tasks, and technical presentation.

Technical Presentation

Teams presented conceptual designs through a 15-minute oral presentation. Each team member was required to speak during the oral presentation, describing her role in the final product. Following the oral presentations, a question-and-answer session allowed the audience to gain clarity or further inquire about the teams’ presented information. The audience comprised of lesson instructors, counselors, fellow E-GIRL participants and parents, giving participants an opportunity to present information to people with broad levels of understanding of the subject matter. The variety of audience backgrounds imparted to participants the importance of technical communication where in some situations either the speaker or the listener (or both) is the expert.

Program Assessment

This paper presents results obtained from participant responses on application essays, as well as pre- and post-program short answers on a questionnaire. These responses highlight students' perception of the impact the designed program curriculum had on the growth of their understanding of engineering. Yew et al. (2016) presents detailed results covering the evaluation of E-GIRL curriculums discipline specific lessons.[18] Monaco et al. (2016) presents assessment of student performance during the group project and oral presentation.[11]

During the application process, students were asked to complete a personal essay describing their interest in pursuing engineering and participating in E-GIRL. Additionally, students were asked to provide personal achievements and past experiences that would make them successful participants during the summer program. Applicant essays were coded by a group of five reviewers determining themes present. During the initial round of review, a representative list of themes was determined based on a sample of essays from the total number submitted. From the representative list, a total of 37 essays were coded providing information about the frequency of themes present in applicants' essays.

Pre-questionnaires were administered to participants during the introduction session of the program to gauge self-development scores on engineering skills, understanding of engineering and ability to identify separate disciplines. Short answer responses from the questionnaire also asked students what their expectations were for the summer program, and why they are motivated to become engineers. Below is a list of questions included on the pre-questionnaire:

- In your own words define engineering.
- Differentiate between various disciplines within engineering. Summarize key areas of focus for each discipline.
- Explain why you want to become an engineer. How you believe you can make a difference as an engineer?
- Describe what you would like to experience at this camp.

Information on student demographic backgrounds and interest in applied math/science career fields such as engineering was collected from the pre-questionnaire. An adaptation of the assessment instrument by Nadelson on surveying student backgrounds and interest was applied to the administered pre-questionnaire.[12] The complete pre-questionnaire can be found in Appendix A.

Similarly, the post-questionnaire asked students to define engineering, differentiate among disciplines, report why they want to become engineers and note why their answers may have changed. The final short-answer question differs from the pre-questionnaire to ask participants to identify areas of the camp activities that could be improved upon. The administered post-questionnaire is presented in Appendix B.

Results and Discussion

Primary influence to become an engineer

Understanding of participants' influence to become engineers is important for ascertaining which practices are most effective for recruiting females to study engineering. Through the pre-questionnaire assessment tool, students were asked to choose which people were their biggest influences to become engineers from the following list: parents, teacher, school counselor, friend, brother/sister, other relative, community member, or other. Students were encouraged to select all that applied to their situation, and the results in Figure 3 show the percentage each category was selected per 37 responses. Parents and teachers together make up 59% of the responses which students identified as the biggest influence to participants' interest of becoming engineers. Interestingly, school counselors were the least selected category, highlighting that high schools can improve this effort to introduce women to engineering opportunities.

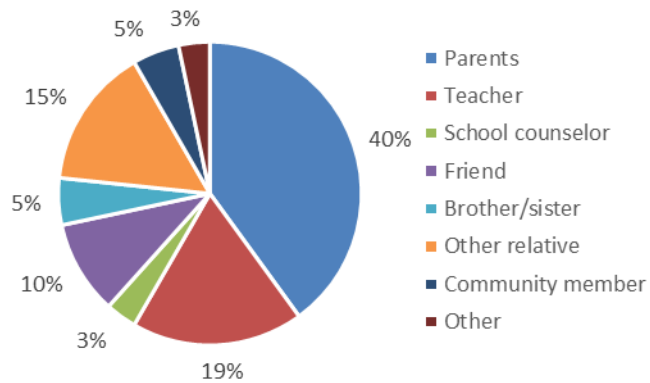

Figure 3: Participants' biggest influence to become engineers

Motivation to participate during E-GIRL program

Coding and identification of recurring themes from application essays provided an understanding of what motivates students to participate in outreach engineering programs such as E-GIRL. Listed below are the themes identified from application essays that participants submitted:

·Improvement of systems and design
·Help improve society and people
·Problem solving
·Interest in science topics
·Interest in math topics
·Participant is confident in science topics
·Participant is confident in math topics
·Create and imaginative solutions
·Engineering design
·Teamwork (collaboration)
·Pursue engineering career
·Female empowerment and impact on status quo
·Money
·Specific discipline names mentioned
·Learn about engineering
·Experience engineering and university classes
·Experience real college and university social
·Learn about multiple disciplines
·STEM Exposure School (Elementary)
·STEM Exposure School (middle)
·STEM Exposure School (HS)
·STEM Exposure (outreach programs/camps)
·STEM Exposure (Personal)

Frequency of the themes present in application essays provided better understanding of motivations and expectations students had when choosing to participate in E-GIRL. Approximately 32% of the participants stated that they are motivated to pursue engineering because they would like to improve systems and designs. Another prominent theme is that participants are motivated to study engineering to help improve society and people. Students discussed global thinking within their responses as well, stating interest in providing solutions to developing areas and stating interest in adapting engineering skills globally. Responses agree with previous literature claiming that women may be motivated to pursue engineering disciplines related to social interests and improving quality of life.[3,5,9,12] The third most frequent theme (11%) highlighted participant motivation to learn more about engineering for future career and education decisions.

In the pre-questionnaire, students were asked to select from a list of categories contributing to their motivation to pursue engineering. Figure 4 details the responses students provided. Some students selected multiple categories, and Figure 4 depicts the percentage each category was selected by 37 participants. Here, it is again clear that altruistic tendencies are a major contributing factor to the female students' desire to pursue engineering, in agreement with previous literature. It also appears that students' interests played a major role in their decision to pursue engineering. This finding may reflect students' desire to choose careers that are personally meaningful, which has also been demonstrated in literature as a relevant factor in female students' career decisions.[14]

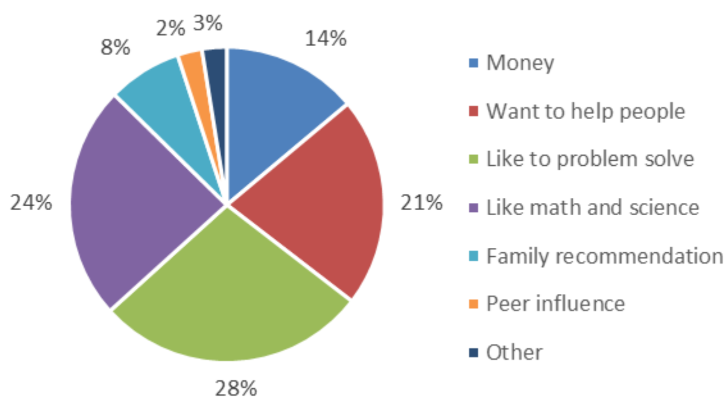

Figure 4: Percentage of participants' motivation to become engineers

Participant expectations of E-GIRL summer program

Application essays provided themes concerning students' expectations for the summer program. Approximately 8% of essays assessed identified students' expectation of learning more about engineering roles and careers available. Students also expressed a desire to learn more about engineering and TTU environment.

Administered on the pre-questionnaire, students were asked to describe what they would like to experience from the E-GIRL program. Assessment of short answers identified the major themes in student responses. From a sample set of five answers, the following themes were determined:

- Learn about engineering
- Experience engineering and university class
- Experience real college and university experience (socially)
- Experience engineering problem/project
- Learn about multiple engineering disciplines
- Learn about pursuing an engineering career

The responses from 36 participants (one participant was late to the start of camp) resulted in the five most frequent themes: learn about multiple engineering disciplines (61% of the responses), learn about engineering (58%), pursue engineering career (39%), experience engineering and university class (33%), and experience engineering problem/project (33%). Results provide a good representation of student expectations and match with goals of E-GIRL curriculum design.

Participant-perceived confidence in mathematics and science

Prior to participation in the summer program, students were asked to rate their perceived interest and success in math and science activities. Table 1 presents responses from the participants and the average rate for students' math/science interest and math/science success. Students were asked to provide a rate using the scale (1 "Do Not Like" to 10 "Like A Lot") gauging interest and (1 "Low success" to 10 "Very high success") gauging level of success. Compared to science, students slightly rated their math skills higher for both interest and success with an average of 8.28 for both categories. Average rating of science skills for interest and success were 7.97 and 7.92, respectively. More 10's were selected by students as their perceived rate for math interest and success (12 and 11, respectively). By contrast, the numbers of students who selected 10's for science were approximately half of those selected for math.

Table 1: Rate of participants perceived math/science interest and math/science success

Math Interest Score	**n**	**Math Success Score**	**n**	**Science Interest Score**	**n**	**Science Success Score**	**n**
1	0	1	0	1	0	1	0
2	0	2	0	2	0	2	0
3	1	3	0	3	0	3	0
4	1	4	1	4	1	4	0
5	2	5	2	5	2	5	2
6	1	6	3	6	2	6	1
7	3	7	4	7	6	7	12
8	10	8	7	8	12	8	9
9	6	9	8	9	7	9	7
10	12	10	11	10	6	10	5
Average	8.28	Average	8.28	Average	7.97	Average	7.92
Std. Dev.	1.83	Std. Dev.	1.68	Std. Dev.	1.50	Std. Dev.	1.32

Definition of engineering before and after program participation

One of the program's goals was to introduce engineering and provide a representative definition of engineering and various opportunities available. Short answer responses from both pre- and post-questionnaires asked participants to define engineering in their own words. The pre-questionnaire required students to define engineering in their own words drawing from previous knowledge before participating in any program activities. Participants were asked before participating in any program activities and drawing from previous knowledge. Responses prior to participation in E-GIRL curriculum described numerous themes and definitions with a general understanding of roles and impacts engineers provide. Figure 5 presents a word cloud illustrating key words present in student responses and representing a large variety in how participants defined engineering. Math and science were frequently present in student responses as well as the notion that engineers solve problems and improve the world and society.

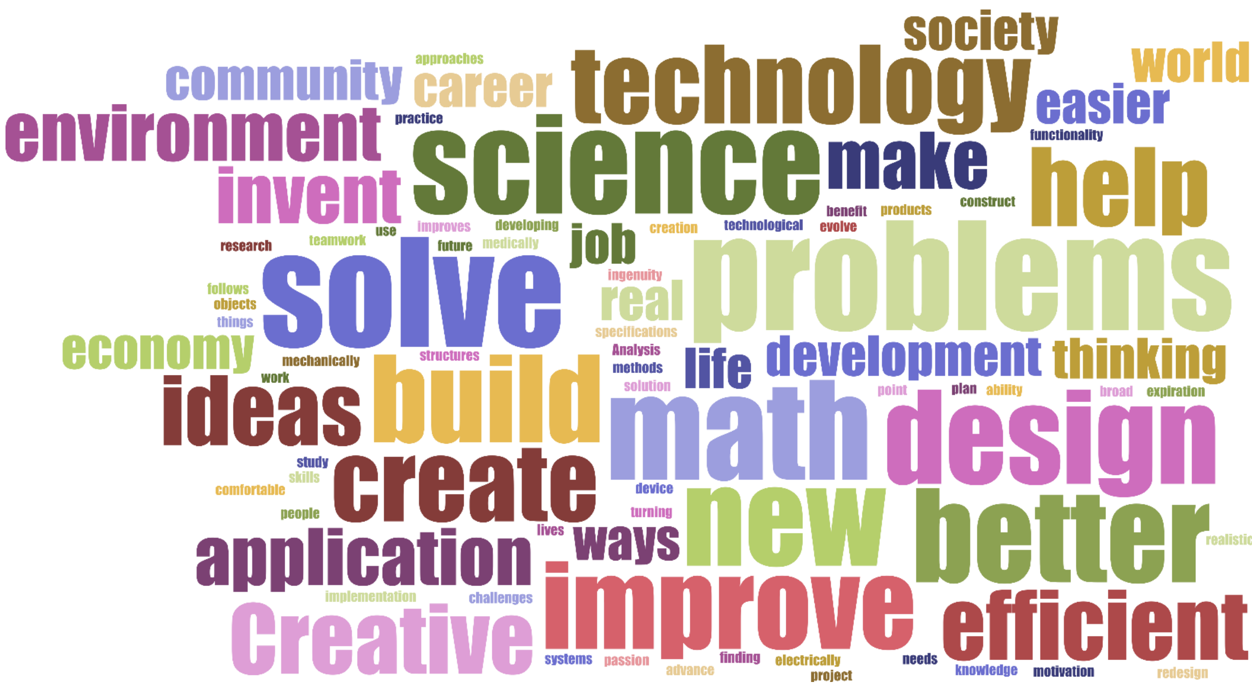

Figure 5: Participant response frequency when asked to define engineering before E-GIRL

Post-questionnaire responses to the same question revealed more structured responses. Figure 6 is a word cloud highlighting key themes from students' responses following completion of E-GIRL. Similar themes are still present, such as the notion that engineers address problems using math and science skills. More precise engineering technology and roles became main themes after students attended the program. Following participation, students were able to articulate and define engineering. Students stated imagination and creativity more in their definition of engineering following completion of the program, presumably due to the inclusion of design projects and interactive lessons. The theme of including disciplines in the definition of engineering is present after completing the program but was not present in responses at the start of the week. Students' use of engineering disciplines in their definitions confirms the impact the program's curriculum goals had on students' understanding of engineering roles. Identification of the disciplines' roles in the definition of engineering also provided assessment of students' ability to recognize career options.

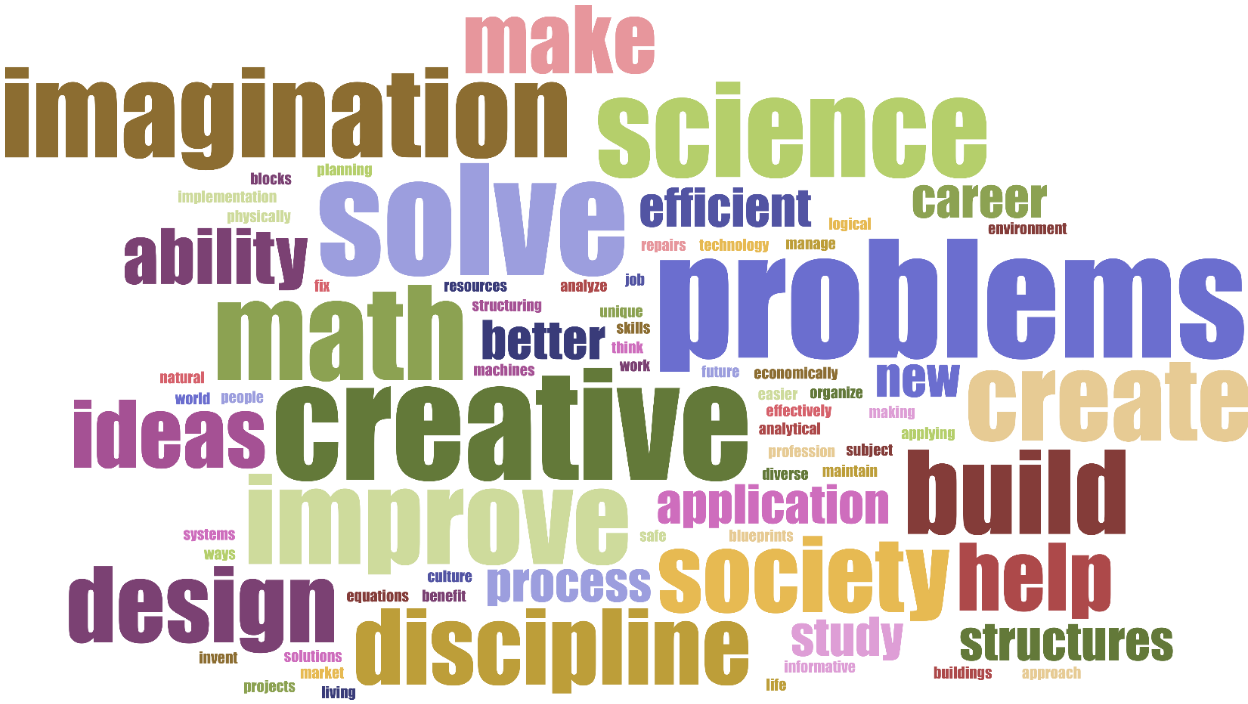

Figure 6: Participant response frequency when asked to define engineering after E-GIRL

Were expectations met after summer program?

The post-questionnaire question asked students to identify areas of the camp activities which could be improved upon. Key themes were identified from the student responses as follows:

- Time for activities (46%)
- Time for project (14%)
- Free time (35%)
- Difficulty (project) (41%)
- Difficulty (activities) (22%)
- Background knowledge (35%)
- Communication (41%)

Themes represent the time they were mentioned in student response. The responses provided feedback for curriculum organizers for improvement of future programs. Students consistently expressed a desire for more time, both in reference to classroom activities and time to complete and understand their project. Communication among participants, instructors, and counselors needed improvement, which is to be expected during the first year implementing a new program design. Difficulty of project and activities were mentioned by participants because they were not used to the rigor of a college curriculum. The responses from the students strengthen the curriculum's goals to introduce and prepare students for an engineering education. In addition to exciting participants about studying engineering, the program exposed students to engineering curriculum aiding them with clarity to make career decisions upon high school graduation. Some students also described their enjoyment of the camp, particularly the chance to learn from peers and make social contacts with a group of like-minded students.

Concluding Remarks

The design of E-GIRL curriculum successfully excited female students about engineering careers. The structure and activities provided participants with a unique opportunity to experience a week as an engineering undergraduate student both academically and socially. Interactive lessons and the group project introduced students to engineering problems and current problems engineers (hydraulic fracturing) are working to solve. Since female students tend to prefer problem solving with real world and social connections,[5] a project focused on hydraulic fracturing, a timely and controversial issue with social and environmental ties, was a fitting choice. Activities introduced multiple disciplines to participants and enlightened them about career path for various disciplines. Assessment activities allowed program designers to understand the impact activities had on students' desire to pursue engineering careers and higher education. The structure of the activities added to previous knowledge of participants and introduced the creative and imaginative nature engineering designs exhibit. The general reception to the E-GIRL program was positive as a result of activities during the week. Students' responses to questions regarding factors which influenced their decisions to pursue engineering generally agreed with previous literature, revealing a desire to improve or make a difference in the world[3,5,9,12] and to choose careers which align with their personal interests.[14] Students appeared to rate their own abilities relatively high in both science and math, which itself does not support previous literature stating that women tend to struggle with self-efficacy in STEM.[4,8,10] It is unknown whether comparison to a corresponding group of male students would reveal a gender gap in self-efficacy; however, since all participants of E-GIRL chose to attend and already had some interest in an engineering career, it is likely that their perception of their own abilities in math and science may be higher than for a more diverse population of female students.

Future Work

Funding by a grant from Halliburton has been awarded to TTU for summer 2016 to continue the E-GIRL program. Following the first year, areas for improvement of the curriculum have been identified by participants and program organizers. Communication between organizers and participants is an area of improvement. Training for instructors and counselors will be held to provide all parties with information and project prompts better informing them of program expectations. Another area of improvement is to make the curriculum more representative of industry roles engineers have outside the oil-and-energy sector. Assessment will continue to occur during summer 2016 E-GIRL to collect longitudinal data of E-GIRL impact long-term to the increase (number or percent) of women into engineering careers. Finally, assessment to track future career and majors participants select will be collected using post-surveys administered once participants graduate high school.

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Appendix A: E-GIRL Complete Pre-Questionnaire Administered

eG.I.R.L. ENGINEERING: GET INTO REAL LEARNING

GO HALLIBURTON

Engineering Skills Assessment

Name: ____________________ **Date:__________________**

Rank each of the skills listed below in order of how important you believe they are for an engineer to have (1 being most important, and 22 being least important). Then, on a scale of 1-5, how well developed you are in that skill (1 being not developed at all, 5 being fully developed).

Skills	**Importance for Engineering (Rank 1-22)**	**Self-Development Score (Rate yourself on a scale of 1-5)**
1) Problem solving skills		
a) Ability to be creative		
b) Think globally		
c) Think analytically		
d) Attention to details		
e) Technical understanding (knowledge of subject)		
f) Math and science skills		
2) Project management		
a) Organizational skills (tasks, deadlines, etc.)		
b) Organizational skills (people)		
c) Time management (meeting deadlines and submittals)		
d) Utilization of resources		
3) Teamwork		
a) Contribution to group tasks		
b) Help others with tasks		
c) Leadership skills, ability to lead tasks		
d) Conflict resolution		
4) Communication skills		
a) Group communication of needs, accomplishments and next steps		
b) Technical writing (including written reports)		
c) Oral presentations		
d) Listening skills		

Please print legibly your response. Answer all questions thoroughly and completely.

In your own words define engineering.

Differentiate between various disciplines within engineering. Summarize key areas of focus for each discipline.

Explain why you want to become an engineer. How you believe you can make a difference as an engineer?

Describe what you would like to experience at this camp.

Please answer the following demographic questions.

1. What is your age?
    a. 14
    b. 15
    c. 16
    d. 17
2. Please specify your ethnicity.
    a. Asian/Pacific Islander
    b. Black or African American
    c. Caucasian
    d. Hispanic or Latina
    e. Native American
    f. Other, please specify__________________
3. Description of type of community of the primary location you grew up:
    a. Rural
    b. Suburban
    c. Urban

Please answer the following about your interest in applied math/science career fields such as engineering.

1. Who has been the single biggest influence to become an engineer? Please circle all that apply.
    a. Parents
    b. Teacher
    c. School counselor
    d. Friend
    e. Brother/sister
    f. Other relative
    g. Community member
    h. Other, please specify _________________________
2. What makes you want to be an engineer?
    a. Money
    b. What to help people
    c. Like to problem solve
    d. Like math and science
    e. Family recommendation
    f. Peer influence
    g. Other, please specify _________________________

3. Rate the level of how much you like math (1 “Do Not Like” to 10 “Like A Lot”)_______

4. Rate the level of success you have with math (1 "Low success" to 10 "Very high success") _______

5. What do you like or not like about math?
   ____
   ____
   ____

6. Rate the level of how much you like science (1 "Do Not Like" to 10 "Like A Lot")_______

7. Rate the level of success you have with science (1 "Low success" to 10 "Very high success") _______

8. What do you like or not like about science?
   ____
   ____
   ____

9. Do you know someone who is an engineer (outside of school)? If yes, who?
   ____

10. At what age did you consider being an engineer? _________________________________

11. Have you ever attended an engineering camp, competition, or other event that enhanced your interest in engineering? (Examples: Discover Engineering Day, e-Camp, TEAMS competition, Science Olympiad, Future City Competition, FIRST Robotics, etc.)
   ____
   ____
   ____

Appendix B: E-GIRL Complete Post-Questionnaire Administered

eG.I.R.L.
ENGINEERING: GET INTO REAL LEARNING

GO
HALLIBURTON

Engineering Skills Assessment

Name: ____________________ **Date:__________________**

Rank each of the skills listed below in order of how important you believe they are for an engineer to have (1 being most important, and 22 being least important). Then, on a scale of 1-5, how well developed you are in that skill (1 being not developed at all, 5 being fully developed).

Skills	Importance for Engineering (Rank 1-22)	Self-Development Score (Rate yourself on a scale of 1-5)
5) Problem solving skills		
g) Ability to be creative		
h) Think globally		
i) Think analytically		
j) Attention to details		
k) Technical understanding (knowledge of subject)		
l) Math and science skills		
6) Project management		
e) Organizational skills (tasks, deadlines, etc.)		
f) Organizational skills (people)		
g) Time management (meeting deadlines and submittals)		
h) Utilization of resources		
7) Teamwork		
e) Contribution to group tasks		
f) Help others with tasks		
g) Leadership skills, ability to lead tasks		
h) Conflict resolution		
8) Communication skills		
e) Group communication of needs, accomplishments and next steps		
f) Technical writing (including written reports)		
g) Oral presentations		
h) Listening skills		

Please print legibly your response. Answer all questions thoroughly and completely.

In your own words define engineering.

____
____
____
____
____

Differentiate between various disciplines within engineering. Summarize key areas of focus for each discipline introduced during lectures.

____
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Explain why you want to become an engineer. How you believe you can make a difference as an engineer? Did your answer change after completing the camp? If yes, explain why.

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Identify areas of the camp activities that could be improved upon.

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