How Outreach Camps that Incorporate Design Affects Female High School Students' Interest in Engineering and Perceptions of Engineering Design (Evaluation)

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Abstract

Outreach summer camps, particularly those focused on increasing the number of women in engineering, are commonplace. Some camps take the approach of a broad survey of engineering as a whole, while others focus on one specific discipline. Within the discipline-specific camps, there is a high degree of variability in curriculum and structure. This is apparent when considering if and how engineering design is built into the camp structure. While many studies have investigated the impact of outreach camps on engineering self-confidence among participants, few studies have sought to understand how the camp curriculum as a whole can influence these outcomes.

To begin to understand the connection between outreach camp curriculum and engineering self-confidence among participants, we studied outreach camps targeted to high school women that varied in the incorporation of design into their structure. We chose to study three camps: (1) a design-focused camp, (2) a design-incorporated camp (run by the authors), and a (3) design-absent camp. All three camps were at the same university but based in different engineering disciplines. Results from pre-post survey Wilcoxon Signed Rank tests showed that design-focused and design-incorporated camps were able to improve students' perspective of what engineering is ($p < .01$ and $p = .02$), while the design-absent camp had no change. The design-incorporated camp increased the participants' desire to be an engineer ($p = .02$) while the design-absent camp decreased the participants' desire to be an engineer ($p = .02$) and the design-focused camp had no effect. The design-absent camp also decreased the participants' overall interest in engineering ($p = .02$). Additionally, both the design-incorporated and design-focused camps increased the participants' confidence in conducting engineering design ($p < .01$ and $p < .01$), but only the design-incorporated camp had consistent improvements throughout the entire design cycle. Motivated by these results, we intend in future studies to more systematically probe the potential of different outreach curricula and structures to positively influence engineering perceptions.

Introduction

Outreach camps in science, technology, engineering, and mathematics (STEM) are found at many institutions across the United States. Often, minority groups (race, gender, socioeconomic status, etc.) are the targeted demographics of these camps. By introducing the field in a fun, hands-on environment, camp organizers hope to encourage these students to pursue these areas in college and beyond. Many engineering outreach camps are focused on increasing the number of females entering the field by helping develop their self-confidence in their abilities. Studies have shown that women's confidence in their role as a competent professional in their chosen field can be critical to long term

STEM career choice [1], [2]. These outreach camps could help lay the foundation for improved self-confidence by encouraging exploration of the field in a safe space. Thus, the impact of these outreach camps must be understood.

Many camp organizers have reported their experiences while conducting outreach camps in a variety of STEM fields [3–20]. However, there is little consistency among these reports in terms of methods or content, thus limiting comparative efforts. For example, almost all papers found in the literature used a survey of some kind to try and understand the efficacy of their summer camp, but the statistical reliability and validity of the results was often not reported. Many papers simply stated what went well and what could be improved, with very few details that would allow the reader to try and implement this camp in any form [3–9]. Only a few studies were more rigorous, [18], [20] focusing on topics such as on the long term impacts of their camp on young womens' engineering interest [15], [19], [21]. These studies are quite difficult to perform due to the logistical challenges of maintaining contact with participants and therefore are not the focus of this research. Given the considerable breadth of existing outreach literature, the background in this paper will focus on how the field discusses outreach camp structures as a baseline for understanding the consequences of incorporating engineering design in such camps.

Background

When starting an engineering outreach camp, creating the structure of the camp can be daunting. Therefore, many authors report some details of the activities and the way the camp was run. Even within these reports, there is a high degree of variability. Some simply mention the structure in a general way [8], [12]. Others give more detail, such as schedules [11], written details [5], or both [4], [10], [13], [22]. Some even shared entire camp curriculum booklets either on the web or in supplemental information [16], [23], as resources for other camps. While these articles are important, there is more discussion needed within the community beyond sharing best practices.

The literature contains less about the effectiveness of certain curricula and specific details as to what parts of these curricula elicited changes. Most studies only contain general comments about how items such as role models and general exposure to engineering/science have improved overall participant opinions and confidence in STEM [4], [12]. Other studies focused on how the camp increased participant understanding or interest in engineering, either in general or for a specific discipline [5], [6]. While some of these reports use very surface level analysis, papers like Hammack et al. used both quantitative survey results and qualitative interviews to draw deeper conclusions regarding this positive impact [20]. Some researchers made comments about how specific activities might have impacted opinions throughout the week [8], but these are rare.

Making comparisons between these reports is very difficult, as all the camps were conducted at different universities with different time scales, environments, etc. Papers that compare the efficacy of camps at the same institution are rare. Only one report was found, written by Nadelson et al. In this paper, comparisons were made between two camps run at the same institution, but with different populations, timescale, and other factors [24]. While this type of research is important, better comparisons may be drawn when more similarities exist between the camps in question, allowing conclusions to be drawn about specific aspects of the curriculum.

Within engineering outreach curricula, there is interest in how design is incorporated, if at all, into engineering camps and how that impacts participant opinions. As Dym et al. has stated, design is an integral part of engineering [25]. The Accreditation Board for Engineering and Technology (ABET) has even built engineering design into its student outcomes [26], making it prevalent in most engineering programs. Most programs utilize either a capstone [27], [28] or a cornerstone (first year) program to incorporate this design cycle [29]. Research on these programs suggests that they are highly effective at increasing self-motivation [30] and prepare students for careers as engineers [31]. Based on this prevalence of design in college [32], it makes sense to also include design in K-12 initiatives. Many camps already include an engineering design component, ranging from small design activities [8], [17] to large projects spanning the whole week [3], [11].

The most common reason for incorporating design is to give participants a taste of what engineers do in real life and to improve understanding of what engineers are [4], [11], [14]. Yilmaz et al. used engineering design concepts to try and understand how much the students learned over the course of the camp [17]. The literature emphasizes how design was incorporated within the camps. For example, multiple papers describe the process of developing one of these design-oriented camps in detail, stressing the importance of creating design projects that could be completed within the time allotted [3], [17]. Elam et al. describe negative survey results because of a project that could not be completed during the camp [8]. Once again, this is a promising start, but more could be done to understand the importance of including design in camps. The motivation for this study comes directly from the foregoing literature review and our previous camp structure investigation [33], based on which we have the following outstanding questions.

1. How does the perception of engineering change among participants over the course of the outreach camp?
2. How does incorporating design within the curriculum affect these perceptions?

Evaluation methods

In order to address these questions, we set out to compare three camps that incorporate design in different ways and see how various outcomes are impacted before and after the camp. Design was chosen as a variable due to its importance in engineering curricula at the college level. Descriptions of the camps can be found below.

Camp selection and camp structure details

Three camps were chosen for this work. All the camps are focused on female high school students and are a week long. While all three camps relate to different engineering disciplines, this study is focused on the differences in curriculum design and general camp structure. Importantly, all the camps are located at the same institution with the same evening activities, helping to reduce the effect of factors other than curriculum. Each camp's general format and design incorporation will be detailed below. All *N* values reported are for both pre- and post-surveys.

Camp 1- Design Focused

This camp has one large overarching design project. All participants work on the same general project goal in teams. They spend half of each day at the camp working on this project. Each group is required to build a working device prototype at the end of the week to show to parents on the last day of camp. The time outside the design project includes smaller activities, such as various faculty showcasing their research and a field trip to show examples of real world engineers. Very few activities have lectures and they try to focus on hands on activities as much as possible. This camp had *N*=19 participants for this study.

Camp 2- Design Incorporated

This camp has a combination of an overarching design project and an overarching curriculum guide with connected modules covering specific topics. These modules generally contained a lecture and subsequent laboratory or hands-on activity. The design project differs from Camp 1 in that each team works on different, more open ended goal. Prototypes are still built, but they do not necessarily need to be functional. There is more emphasis on connecting the design project to the discipline at large and other topics covered throughout the week. The modules consist of lecture and lab combinations, with the lectures providing additional theoretical knowledge to support the hands on lab activities. Details of the specifics of this camp structure and modules can be found elsewhere [33]. This camp is run by the authors and had *N*=15 participants for this study.

Camp 3- Design Absent

This camp has no design project in its curriculum. Instead, the structure is modular with lab and lecture combinations to showcase various aspects of the discipline. While some activities are team based, there is no large team project over the course of the week. This camp had *N*=19 participants for this study.

Survey design and data analysis

To study the changes in perceptions across the three camps, we used a between-subjects study design with camp type as the between-subjects variable. We collected data on the participants' perspectives on engineering and design using a survey that was developed from the authors' institution's evaluation center (iSTEM) and has been used to evaluate similar programs at University of Illinois at Urbana Champaign. The survey was administered the day the participants arrived and then again on the last day of the camp and can be found in the Appendix of this paper. IRB approval was received for the survey and parental consent was given before the surveys were administered. Cronbach's alpha for the pre- and post-surveys for all three camps responses were 0.9 and 0.92, respectively, confirming the internal consistency of the collected data and its suitability for further analysis.

We evaluated whether changes within the individual camps were significant using the Wilcoxon signed-rank test, which is the non-parametric version of the paired *t*-test. We chose this test because the same population took the pre and post surveys, meaning the samples were not independent [34], and our data did not satisfy the assumption of normality for the paired *t*-test. We then compared the camps to each other using the analysis of variance (ANOVA) technique. ANOVA measures differences in group means among three or more groups by comparing the within and between-group variances. We chose to use the ANOVA test on the pre-survey scores because it could help us identify any differences in group means due to self-selection. For example, the item "I'm good at designing and building things" might have a higher mean for the design-focused camp because participants who already think they are good at building things applied to that camp. If the scores of an item on the pre-survey do not show any significant differences among the camps, something about the camp likely contributed to differences in the scores on the pre and post survey. We also chose to compare the post-survey scores using ANOVA to determine if any of the camps had a bigger impact on participants' perceptions after the camp.

We chose to use a *p*-value of .05 to determine statistical significance in both the Wilcoxon signed-rank tests and the ANOVA tests. Standard error was used in all the bar graph figures in this report. *p*-values of less than .05 are denoted by * and *p*-values less than .01 are denoted by **. The effect sizes for the Wilcoxon signed-rank test were determined by dividing the z statistic calculated by the test by twice the sample size, shown in Equation 1. *p*-values and *r*-values can be found for significant responses in Tables 1 and 2. Mean and standard deviations for all survey prompts shown in this paper can be found in Table 3 in the Appendix.

$$r = \sqrt{\frac{Z}{2*N}} \tag{1}$$

Survey results and discussion

Engineering self-confidence perception survey results

A selection of the pre and post survey Wilcoxon signed-rank test results for all three camps can be found in Figure 1. There were no statistically significant differences between group means for the pre-survey questions, as determined by one-way ANOVA. No changes were expected from the initial camp populations, so this demonstrates the convergent validity of the survey data. Figure 1a highlights that only camps with significant design elements were successful in improving the campers' understanding of engineering, a common goal among outreach camps. Almost all the campers attending these camps self-select to come and would therefore be knowledgeable in engineering beforehand, explaining the relatively high pre-survey values. Seeing and experiencing the engineering design process in a university setting may make a noticeable difference because developing personal connections with real engineers (coordinators and staff) throughout the week helps give context to the discipline and thus their understanding of engineering as a whole.

Figures 1 b, c, and d show even more differences between the three camps. The design-focused camp had a significant increase in self-confidence of engineering skill, but no increase in desire to pursue engineering in college. The design-incorporated camp had opposite results, while the design-absent camp showed significant decreases in both interest in engineering and pursuing engineering in college. The r values for these statistically significant prompts (see Table 1) suggest that these camps did have a reasonable impact on the participants' opinions in these areas.

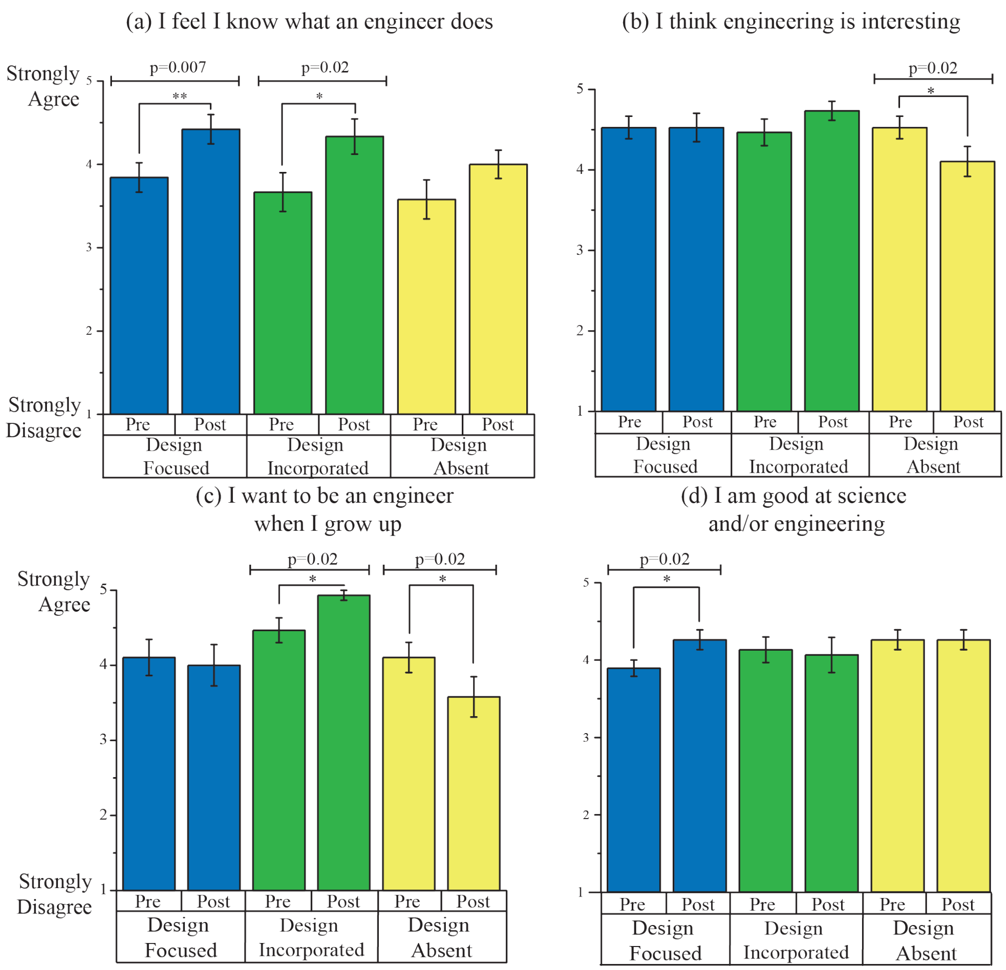

Figure 1: Campers' response to common engineering perception prompts

The results for the design-absent camp in Figure 1 are cause for concern. It seems that not including design can have a significant negative impact on attendees' opinions of engineering with respect to their own personal goals. However, simply including design does not seem to be the solution, considering that the two camps with design elements saw significant increases for different engineering perception prompts. To explore these different responses further, we examined another survey item related to factors beyond the respondents' control, and found an unexpected result (Figure 2).

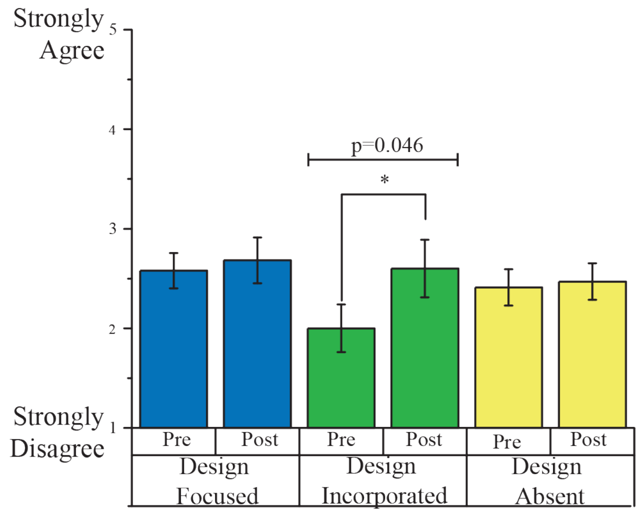

Figure 2: Campers' response to the prompt "Other factors, besides my abilities and/or determination, make it difficult for me to become a scientist or engineer". Note that N=17 for the design absent camp for this specific prompt.

The design incorporated camp, which had a strong increase in desire to go to college for engineering, was also the only camp to see a significant increase in perceived challenges beyond the respondent's control (Fig. 2). Questions like this allow for organizers to understand the impacts of context outside the camp and highlights how showcasing that engineering is attainable for all should remain a primary goal for an outreach camp.

The self-confidence results from the survey suggest that including dedicated design project elements in camp curriculum is important, given the positive significant changes or lack of change in responses for the design camps and the negative significant changes for the design-absent camp. These responses, however, do not give a clear indication as to which camp organization scheme is best. To try to further understand the reasoning behind these changes, we examined changes in design confidence and reported efficacy of camp curriculum elements to find trends within the campers' responses.

Table 1: p-values and r-values results from Wilcoxon signed-rank tests comparing pre and post-survey responses for significant perception survey prompts.

Prompt	**Camp**	***p*-values**	***r*-values**
I feel I know what an engineer does	1	0.007**	0.47
	2	0.02*	0.43
I think engineering is interesting	3	0.02*	0.41
I want to be an engineer when I grow up	2	0.02*	0.48
	3	0.02*	0.40
I am good at science and/or engineering	1	0.02*	0.43
Other factors, besides my abilities ... make it difficult for me to become a scientist or engineer	2	0.046*	0.36

Significant values are marked via * or **

Camp design incorporation and curriculum perception results

Campers were asked to report their confidence in conducting various aspects of the engineering design cycle before and after camp. The results for a select few responses can be found in Figure 3. The trends are representative of this section of the survey. Pre-survey results across all three camps were not statistically significant using ANOVA tests. Effect sizes can be found in Table 2.

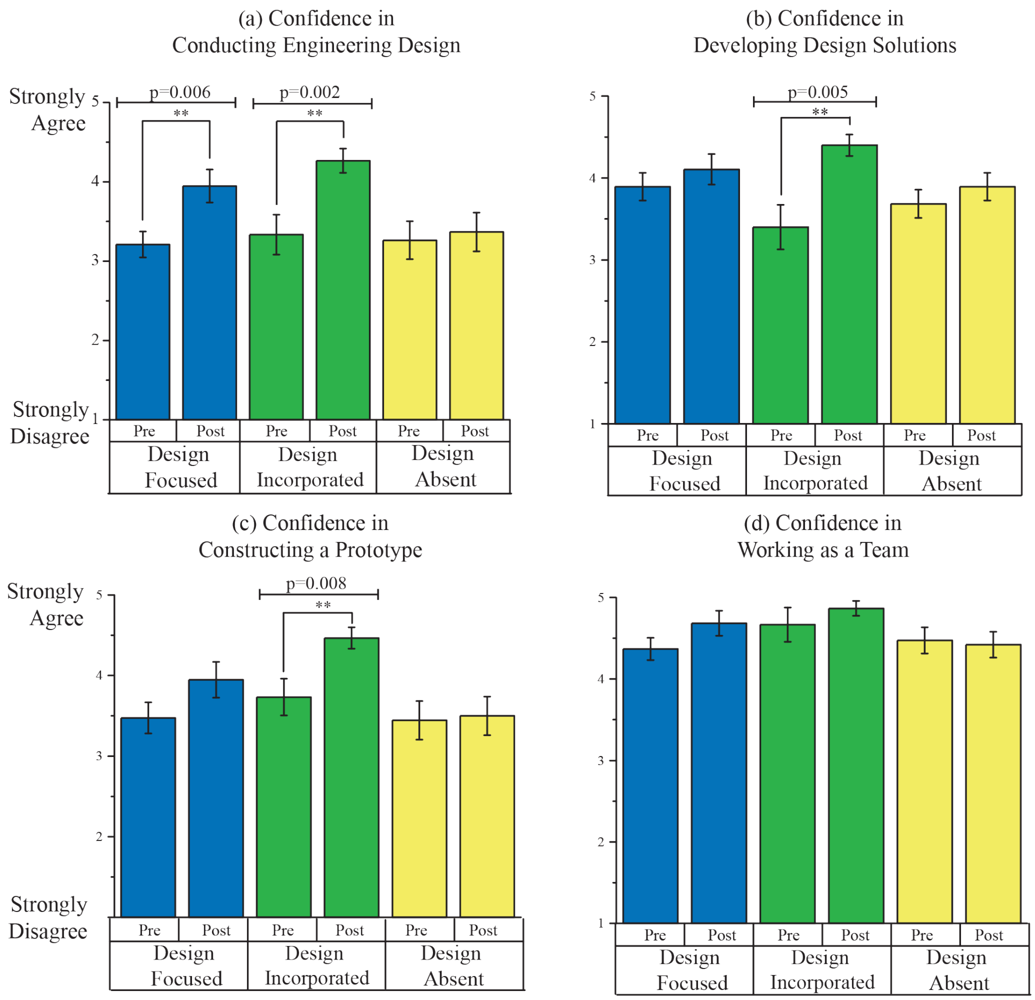

Figure 3: Campers' confidence in various design concepts before and after camp.

As expected, the design absent camp has no significant differences between the pre- and post-surveys. The differences between the design incorporated and the design focused camp, however, are notable. For survey items like "confidence in conducting engineering design" (Figure 3a), both design-based camps had a statistically significant increase with large effect sizes. As we asked more detailed questions about confidence levels during the design cycle, however, the design focused camp no longer showed significant differences in responses. This was especially interesting when considering the prompt "constructing a prototype" (Figure 3c), since the main purpose of the design focused project was to have a working prototype of a device built by the end of the week. The design incorporated camp, on the other hand, saw significant results for all the design confidence questions, apart from confidence in solving problems as a team. No camp saw a change in confidence in teamwork (Figure 3d), which is interesting given the nature of both design projects, as well as many of the hands on activities in all three camps. One result stands out as surprising (as seen in Figure 4).

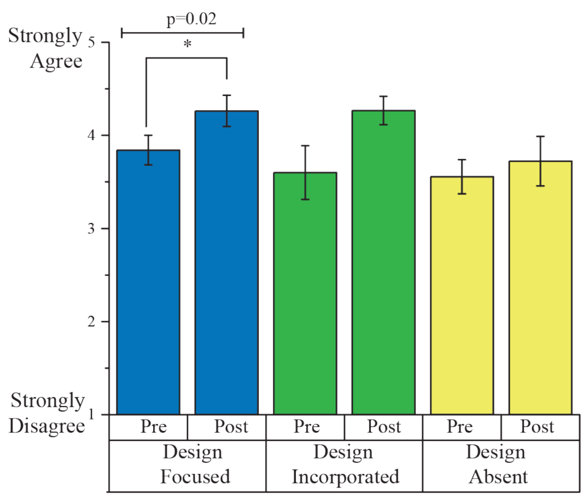

Figure 4: Campers' response to the prompt "I'm good at designing and building things".

When asked about their designing and building skills, the design focused camp is the only camp with a statistically significant result. The difference in self-reported confidence levels for specific design tasks related to building versus a more generic idea of building is an unexpected result. This could be due to the more “building” centered field for the design focused camp, but without further related questions we are unable to make definite conclusions. Results like this remind us that students may perceive topics researchers classify as similar in different ways.

Table 2: p-values and r-values results from Wilcoxon signed-rank tests comparing pre and post-survey responses for design incorporation survey prompts.

Prompt	**Camp**	***p*-values**	***r* values**
Confidence in conducting engineering design	1	0.006**	0.43
	2	0.002**	0.52
Confidence in developing design solutions	2	0.005**	0.48
Confidence in constructing a prototype	2	0.008**	0.46
I am good at designing and building things	1	0.02*	0.41

Significant values are marked via * or **

Since all camps did not include design, we also wanted to look at various aspects of the curriculum. These questions were only asked in the post survey (see Appendix). A one way ANOVA was used to determine which curriculum areas, if any, the students felt contributed to their learning in an impact way. Two of those areas are shown in Figure 5. Both of these initial comparisons were significant via the ANOVA ($F_a(2,50) = 4.84$, $p = .01$; $F_b(2,50) = 5.22$, $p < .01$). Then *t*-tests were conducted between the three different camps to determine the significant differences, checking for variances via *F*-tests beforehand.

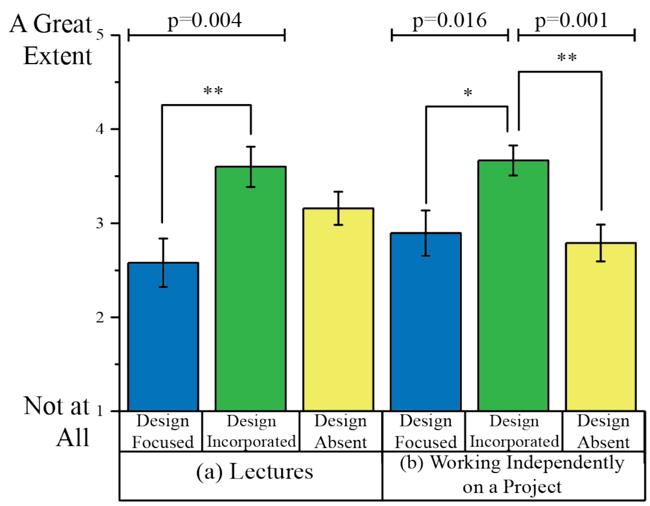

Figure 5: Campers' opinion on the effectiveness of various curriculum elements throughout the week of camp

Figure 5a shows the impact students believed lectures had on their learning. As expected from the lack of lectures in the design focused camp, the mean was much lower than the other two camps; however, it was only significantly different from the design incorporated camp. As for working independently on a project, the students reported more of an impact in the design incorporated camp than both the design focused and the design absent camp. The combination of cohesive lectures, smaller hands on labs, and a large open-ended design project may have a large impact on how the students understand information.

Based on the data, it seems that the design incorporated camp overall had the the largest number of significant increases in design confidence and engineering perception. The design focused camp also had significant increases in design confidence and engineering perception prompts. The design absent camp experienced the most significant decreases in engineering perception and no increases in confidence in design. Based on our knowledge of the camp structures, our working hypothesis is that the overarching theme in design incorporated curriculum, combined with a more open ended design project, is what led to these outcomes. Design can often be used for self-motivation [30], and it seems that was achieved with this camp. However, there are some limitations that need to be addressed with this study.

Limitations

The main limitation with this study is the lack of context for the quantitative results. The coordinators of both the design focused camp and design absent camps were shown the data and had very different responses. The design focused camp coordinator was very concerned by their outcomes and mentioned possibly making structure changes to improve on these metrics. The design absent camp coordinator, however, was not that surprised by the results. Based on the coordinator's experience, the campers in that year found themselves more drawn to the science aspect of the field, not the engineering aspect. Hence, the results from Figure 1 made complete sense to that coordinator. This made us realize that coordinator context is necessary to fully understand the quantitative data in order to give an accurate report. Additionally, having access to the details of the camp structure (such as hand outs, specific schedules, etc.) would provide an additional layer of context.

Another thing missing from this study is specific goals for each engineering outreach camp. After seeing the data, the design absent camp coordinator expressed that they were still pleased due to anecdotal evidence that the students were still very much interested in STEM and were more informed about the choices they should make when entering college. Both the context and detailed outcomes from each camp could be gained from coordinator interviews, which is the next step in this study.

The size and context of this study is also a limitation. Due to laboratory space constraints, many outreach camps (including the ones we studied) are quite small. Due to the small sample size, making overarching claims about the efficacy of camp curriculum structures is not feasible with this data set. The lack of pilot study with respect to the survey methodology is also something to consider when developing future studies in this area.

Conclusion

In conclusion, the curriculum of outreach camps is important to achieving specific self-confidence and learning outcomes. Including engineering design within the outreach camp as a separate project, rather than just built into smaller activities, seems to be very important. The way design is incorporated is also crucial. A themed curriculum with an integrated, open-ended design project seems to have the best overall outcomes as far as learning effectiveness and future engineering self-confidence goals, with a design focused curriculum following close behind. Not including design at all seems to have negative consequences towards engineering interest goals. Despite this promising data, the lack of contextual understanding of the specific experiences in each camp gives the researchers a moment of pause when drawing conclusions. This study does, however, provide an excellent initial look into how camp curricula can affect outcomes and the need for more research. Work like this can help researchers looking to start their own camps by providing some insight into how to structure their curricula.

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Appendix

Survey Data-Details

Table 3 shows the mean and standard deviation values for all graphed prompts.

Table 3: Means and Standard Deviations (SD) for all graphed prompts

Prompt	Camp	Mean-Pre	SD-Pre	Mean-Post	SD-Post
I feel I know what an engineer does	1	3.84	0.76	4.42	0.77
	2	3.67	0.83	4.30	0.63
	3	3.58	1.02	4.00	0.75
I think engineering is interesting	1	4.53	0.61	4.53	0.77
	2	4.47	0.64	4.73	0.46
	3	4.52	0.61	4.11	0.81
I want to be an engineer when I grow up	1	4.11	1.05	4.00	1.20
	2	4.47	0.64	4.93	0.26
	3	3.58	0.88	4.11	1.17

Prompt	Camp	Mean-Pre	SD-Pre	Mean-Post	SD-Post
I am good at science and/or engineering	1	3.89	0.46	4.26	0.56
	2	4.13	0.64	4.07	0.88
	3	4.26	0.56	4.26	0.56
Other factors, besides my abilities ... make it difficult for me to become a scientist or engineer	1	2.58	0.77	2.68	1.00
	2	2.00	0.93	2.60	1.12
	3	2.41	0.80	2.47	0.80
Confidence in conducting engineering design	1	3.21	0.71	3.95	0.91
	2	3.33	0.98	4.27	0.59
	3	3.26	1.05	3.37	1.07
Confidence in developing design solutions	1	3.89	0.74	4.11	0.81
	2	3.4	1.06	4.4	0.51
	3	3.68	0.75	3.9	0.74

Prompt	Camp	Mean-Pre	SD-Pre	Mean-Post	SD-Post
Confidence in constructing a prototype	1	3.47	0.84	3.94	0.97
	2	3.73	0.88	4.47	0.52
	3	3.44	1.04	3.5	1.04
Confidence in working as a team	1	4.37	0.60	4.68	0.67
	2	4.67	0.82	4.87	0.35
	3	4.47	0.70	4.42	0.70
I am good at designing and building things	1	3.84	0.69	4.26	0.73
	2	3.6	1.12	4.27	0.59
	3	3.56	0.78	3.72	1.13

Pre- and Post-Survey

These are examples of the pre and post survey used for this study.

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

2017 GLAM Pre-Survey

Motivations and Expectations for the GLAM Summer Camp

1. Why did you decide to enroll in the GLAM Summer Camp? Please select all that apply.

____ I wanted to learn about Materials Science

____ I wanted to learn about Science, Technology, Engineering, and Math (STEM) fields

____ My friends are also joining

____ People around me recommended me to participate in the camp

____ My parents signed me up for the camp

____ I wanted to fill some time during summer

____ Other (please specify) ____

2. What knowledge and/or skills would you like to learn from the GLAM Summer Camp and why? Please elaborate on your answer.

____

____

____

Perceptions of Competency and Interest in Engineering

3. Please tell us how much you agree with the following statements. Please check the box to show your answer.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I am good at science and/or engineering.					
I have the potential to become a scientist or engineer.					
I would be able to become a scientist or engineer if I work hard.					
Other factors, besides my abilities and/or determination, make it difficult for me to become a scientist or engineer.					
I am interested in science or engineering as a career.					
I feel I know what an engineer does.					
I feel good when I am doing engineering.					
I'm good at designing and building things.					
I see a connection between my interests/passions and engineering.					
I like to figure out how things work.					
Creative thinking is one of my strengths.					
I am skilled at solving problems that can have multiple solutions.					
I think engineering is interesting.					
I know how to find out more about engineering if I want to.					
I consider myself technically inclined.					
I consider myself mechanically inclined.					
I enjoy the subjects of science and mathematics the most.					
I want to be an engineer when I grow up.					
I plan to apply for an Engineering discipline when I go to college.					

Perceptions of Confidence in the Engineering Design Process

4. Please tell us how confident you are in performing the following tasks. Please check the box to show your answer.

	Not Strongly confident	Not confident	Neutral	Confident	Strongly confident
Conduct engineering design					
Identify a design need					
Research a design need					
Develop design solutions					
Select the best possible design					
Construct a prototype					
Evaluate and test a design					
Redesign					
Work as part of a team					

Perceptions of Engineering

5. Please tell us how much you agree with the following statements. Please check the box to show your answer.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
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 kinds of career fields.					
Engineers have contributed greatly to fixing problems in the world.					
Engineering is a good career choice for women.					

6. Please tell us how much you agree with the following statements.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I was provided with enough information to participate in the labs/design project					
I can see how all the subjects taught this week are connected to the overall engineering discipline					

Background Information

7. What is your name? (We ask only to link your answers during the session with your survey, if you have given us permission on the consent form).

____

8. How old are you?

______13 years old ______15 years old ______17 years old

______14 years old ______16 years old ______18 years old

9. What grad are you going into?

_____ 9th grade ______10th grade ______11th grade ______12th grade

10. With what races or ethnicities do you most identify? (Check all that apply. This question is optional.)

_____ White or European American _____ Asian American

_____ Hispanic, Latina, or Spanish _____ Native Hawaiian or Pacific Islander

_____ Black or African-American _____ Native American or Alaskan Native

_____ Other (please specify): ______________

Thanks very much for your help! Please hand in your completed survey.

UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

GBAM Post-Survey: June 23, 2017

Satisfaction with the GBAM Summer Camp

1. How would you rate the activities during the week overall? (Circle one)

Terrible	Poor	Average	Good	Excellent
1	2	3	4	5

2. Please tell us how much you agree with the following statements by selecting the appropriate box.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
This experience helped me to better understand Mechanical Engineering.					
This experience helped me to better understand the Engineering Design Process.					
This experience helped me to better understand Engineering.					
I worked with a mentor who was helpful and easy to talk to.					
I enjoyed the fact that this was an event just for girls.					

3. What knowledge and/or skills did you like to learn most in GBAM Summer Camp? Please explain.

____

____

____

____

Perceptions of Competency and Interest in Engineering

4. Please tell us how much you agree with the following statements by selecting the appropriate box.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I am good at science and/or engineering.					
I have the potential to become a scientist or engineer.					
I would be able to become a scientist or engineer if I work hard.					
Other factors, besides my abilities and/or determination, make it difficult for me to become a scientist or engineer.					
I am interested in science or engineering as a career.					
I feel I know what an engineer does.					
I feel good when I am doing engineering.					
I'm good at designing and building things.					
I see a connection between my interests/passions and engineering.					
I like to figure out how things work.					
Creative thinking is one of my strengths.					
I am skilled at solving problems that can have multiple solutions.					
I think engineering is interesting.					
I know how to find out more about engineering if I want to.					
I consider myself technically inclined.					
I consider myself mechanically inclined.					
I enjoy the subjects of science and mathematics the most.					
I want to be an engineer when I grow up.					
I plan to apply for an Engineering discipline when I go to college.					

Perceptions of Confidence in the Engineering Design Process

5. Please tell us how confident you are in performing the following tasks by selecting the appropriate box.

	Not Strongly confident	Not confident	Neutral	Confident	Strongly confident
Conduct engineering design					
Identify a design need					
Research a design need					
Develop design solutions					
Select the best possible design					
Construct a prototype					
Evaluate and test a design					
Redesign					
Work as part of a team					

Perceptions of Engineering

6. Please tell us how much you agree with the following statements by selecting the appropriate box.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
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 kinds of career fields.					
Engineers have contributed greatly to fixing problems in the world.					
Engineering is a good career choice for women.					

Perceptions of Design Projects and Labs

7. Please tell us how much you agree with the following statements by selecting the appropriate box.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
The design projects and labs were of an appropriate level of difficulty.					
The design projects and labs encouraged me to review relevant concepts and link theory to practice.					
Peer discussions were important for the success of a design project.					
The design projects and labs encouraged me to take responsibility for my learning experience.					
The design process helped me develop the ability to generate solutions to a defined problem and make informed choices as to the preferred solution.					
The design projects and labs provided me an opportunity to further develop my interpersonal and communication skills essential in a team environment.					
The design projects and labs provided me an opportunity to further develop my organizational and time management skills.					

Perceptions of Course Components

8. To what extent do the following course components contribute to your learning? Please select the appropriate box.

	Not at all	A small extent	A moderate extent	A great extent
Working with a team				
Working independently on a project				
Small questions				
Lab activities				
Lectures				
Design projects				
Interactions with course instructor(s)				
Interactions with mentors				

Future Improvements of the Existing Activities

9. Please tell us how much you agree with the following statements by selecting the appropriate box.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I would like to see more interaction between design projects, labs, and lectures offered during the week.					
I would like to see more instruction on the use of resources to assist me in my projects.					
I would like to receive more help from mentors/instructors.					
I would like to see more connection between the activities and Mechanical Engineering.					
I would like to receive more instruction on various software programs.					

10. What improvements would you recommend for this summer camp?

____

____

____

11. How likely are you to recommend this camp to other students?

Very unlikely	Unlikely	Neutral	Likely	Very likely
1	2	3	4	5

If you checked either "Very unlikely" or "Unlikely," please explain.

____

____

____

____

Background Information

12. What is your name? (We ask only to link your answers during the session with your survey, if you have given us permission on the consent form).

____

13. How old are you?

______13 years old ______15 years old ______17 years old

______14 years old ______16 years old ______18 years old

14. What grade are you going into this fall?

_____ 9th grade ______10th grade ______11th grade ______12th grade

15. With what races or ethnicities do you most identify? (Check all that apply. This question is optional.)

_____ White or European American _____ Asian American

_____ Hispanic, Latina, or Spanish _____ Native Hawaiian or Pacific Islander

_____ Black or African-American _____ Native American or Alaskan Native

_____ Other (please specify): ______________

Thank you very much for your help! Please hand in your completed survey.