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The Effectiveness of Engineering Camps as Pre-College Recruitment Tools

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The Effectiveness of Engineering Camps as Pre-College Recruitment Tools

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ABSTRACT

The purpose of this study was to explore the effectiveness of the college recruitment of summer engineering camp participants. Summer engineering camps hosted by colleges and universities have been in existence since the middle of the 20th century. These engineering camps exist to provide students with the opportunity to explore engineering, learn about different fields of engineering, work on projects, and interact with actual engineers. Additionally, these camps also often exist as a pre-college recruitment tool for the host college or university. Existing research indicates that these programs do have some influence on students becoming engineers. However, the efficacy of these programs as recruiting tools for the host college or university is largely unknown. To address this gap in knowledge, surveys were disseminated to high school age participants at the beginning and end of three residential engineering camps hosted by the University of Dayton: an underrepresented minority (URM) male engineering camp, a female only engineering camp, and a co-ed engineering camp. Participants provided a history of their previous STEM experiences, their interest in engineering, their interest in a formal visit to the host university, their interest in completing a college application for the host university, and their interest in attending the host university. Survey results indicated a significant positive increase in the number of camp participants from all three camps interested in attending the host university after their camp experience (URM male: $\Delta x = 0.47$, p=0.02; all-female: $\Delta x = 0.36$, p=0.03; co-ed: $\Delta x = 0.39$, p=0.0007). These results suggest that these camps can serve as effective recruitment tools for colleges and universities.

INTRODUCTION

In 2012, the President's Council of Advisors on Science and Technology reported that one million more science, technology, engineering and math (STEM) professionals would need to be introduced into the workforce to keep up with economic demands [1]. The council also recommended a variety of tools to recruit students to STEM programs, including the use of summer camps, research courses, and pathways from two to four-year institutions [1]. Though the time has expired for this call to action, the importance of having educated STEM professionals and engagement of students in STEM is imperative.

Engineering camps, a method of recruitment supported by PCAST, have been active since the middle of the 20th century [2]. These camps often feature hands-on activities where camp participants explore different fields of engineering that also allows them to see what engineers do [2]. Engineering camps are offered by a variety of institutions including museums, private foundations, and colleges and universities [2]. When engineering camps are hosted by a college and university, not only do the engineering camps provide the opportunity to recruit more students to engineering, but they also serve as a recruitment tool for the host institution [3]. In order to meet the needs expressed by PCAST, engineering programs would have to recruit high school students into engineering and retain these students through graduation from engineering programs. Existing research suggests that engineering camps can serve as a

moderately successful recruitment tool for the host institution [3],[4],[5]. In addition to engineering camps, camps of other disciplines, such as pharmacy camps, have experienced similar success in recruiting participants to both the discipline and the host university [6].

In terms of recruitment strategies, the identity of the institution is often a strong focus [7]. This focus may also often contain components of diversity and excellence within the identity [7]. This focus on inclusive and diverse excellence is important in that it can help students who are being recruited connect with an institution, which can help the students envision themselves as a part of the identity of the institution [7]. Engineering camps hosted by a college or university can allow participants to experience the identity of the institution and the program, and start to envision themselves as a part of that identity.

This study focused on examining the efficacy of three residential engineering camps in recruiting students to attend the University of Dayton (UD). All three of these camps were hosted by one institution during the summer of 2018. The first of these camps was dedicated to serving underrepresented minority (URM) male students who are in entering their senior year of high school. The second camp was dedicated to serving female high school students who are interested in engineering. The last camp was a co-ed camp dedicated to serving any high school student interested in engineering. These camps featured similar structures with similar activities in various fields of engineering offered by UD. Additionally these camps included focus areas in robotics, creativity in engineering, and using engineering to solve problems in developing communities. During the camps, participants were able to interact with current undergraduate engineering students, who served as camp leaders. They were also able to interact with engineering faculty members and graduate students, who serve as facilitators. They also interacted with members in industry, many of whom have some connection to the host institution, either as alumni or through the cooperative education program partner companies. Because all three of the camps were residential, the participants stayed in the residence halls and ate in the dining halls. They were also given some free time, where they were able to explore parts of campus such as the campus recreation center. These elements not only provided the opportunity for participants to develop their identities as engineers, but also see themselves as a part of the identity of the institution. Through connections to students, faculty and industry members, these students had the opportunity to learn more about the community and begin to picture themselves experiencing college life on campus. These camps are generally seen as recruitment tools for the institution, however it was not understood to what extent this was true. The purpose of the study was to explore the effectiveness of the recruitment of summer engineering camp participants to the host institution.

METHOD

To explore the efficacy of the three summer camps as a UD recruitment tool, a survey was developed. The surveys were disseminated at three engineering camps: a camp for URM males interested in engineering, a single-sex female camp, and a co-ed camp. In this survey, participants were asked to report their prior exposure to engineering through other camp experiences, classes, and extracurricular activities; their interest in engineering; any official visits to the university, and interest in visiting the university; their interest in applying to and attending the university; and demographics including gender, ethnicity, and year in school. Appendices A and B contain the full pre-camp and post-camp surveys, respectively. Participants were not required to complete either pre-camp or post-camp survey, and these surveys were completed anonymously. This study received approval from the Institutional Review Board.

The number of participants who completed the pre-camp and post-camp surveys from each camp is in Table 1. The demographics of the participants are below in Tables 2, 3, and 4, and this data was compiled from the pre-camp survey responses.

Table 1: Number of participants

	URM, Male only	Female only	Co-ed
Pre-camp Surveys Completed	32	64	100
Post-camp Surveys Completed	24	63	92

Table 2: Ethnicities of participants

	URM, Male only	Female only	Co-ed
African American or Black	59%	10%	11%
American Indian or Alaska Native	3%	1%	0%
Asian American or Asian	0%	7%	10%
Hispanic or Latinx	22%	14%	10%
Middle Eastern	0%	0%	0%
Multiracial	3%	4%	0%
Pacific Islander	3%	0%	0%
White or Caucasian	11%	62%	67%
Prefer not to say	0%	0%	2%

Table 3: Gender of participants

	URM, Male only	Female only	Co-ed
Male	97%	0%	79%
Female	0%	98%	20%
Trans male/Trans man	3%	0%	0%
Trans female/Trans woman	0%	0%	0%
Genderqueer/Gender non-conforming	0%	2%	1%
Different identity	0%	0%	0%
N/A	0%	0%	0%

Table 4: Year in High School beginning Fall 2018

	URM, Male only	Female only	Co-ed
Sophomore	0%	27%	17%
Junior	0%	38%	39%
Senior	100%	36%	43%

RESULTS

Tables 5 through 7 contain the distribution of responses that indicate participants' previous experiences with STEM.

Table 5: Previous attendance of another STEM Camp

	URM, Male only	Female only	Co-ed
Unsure	9%	3%	6%
No	53%	72%	63%
Yes	38%	25%	31%

Table 6: Participation in engineering or technical classes at school

	URM, Male only	Female only	Co-ed
Unsure	6%	8%	1%
No	22%	39%	49%
Yes	72%	53%	50%

Table 7: Participation in STEM related extracurriculars

	URM, Male only	Female only	Co-ed
Unsure	3%	5%	8%
No	56%	45%	49%
Yes	41%	50%	43%

Because the responses of the survey were anonymous, independent t-tests were performed to determine any significant differences in the change in pre-camp and post-camp responses for each group of camp participants. The average responses to the survey questions are provided in Table 8, as well as any significant results.

Table 8: Average responses to survey questions

Question (Scale)	Interest in Engineering (1-5)	Pursuing Engineering (1-5)	Visiting (1-3)	Applying (1-5)	Attending (1-5)
URM, Male only Pre	4.78	4.53	2.38	3.88	3.80
URM, Male only Post	4.79	4.58	2.50	4.25	4.27
Difference	0.01	0.05	0.13	0.38	0.47*
Female only Pre	4.81	4.55	2.25	3.81	3.64
Female only Post	4.78	4.70	2.56	4.06	4.00
Difference	-0.03	0.15	0.31**	0.25	0.36*
Coe-ed Pre	4.78	4.63	2.33	3.72	3.59
Co-ed Post	4.72	4.63	2.39	4.11	3.98
Difference	-0.06	0.00	0.06	0.39*	0.39**

*Indicates the difference between pre-camp and post-camp responses showed statistical significance, $p<0.05$

** Indicates the difference between pre-camp and post-camp responses showed statistical significance, $p<0.01$

Additionally, factorial ANOVAS were performed to examine any significant results based on combinations of factors such as camp attendance, race, gender, and year, though none of these relationships were significant.

DISCUSSION

As can be seen from the results regarding previous participation in engineering programs (Tables 5-7) and the results in Table 8 regarding interest in engineering and intent to pursue engineering, participants were already involved and were very interested in engineering upon attending the camps. This interest in engineering did not decrease significantly as a result of camp attendance. This is important to note for recruitment in that, based on the survey questions, participants' interest in engineering is not negatively affected through attendance. These results also suggest there may be some self-selection bias present in the camp attendees.

Results of the survey also suggest that these engineering summer camps may serve as an effective recruiting tool. Some significant effects of the camps on participant's desire to visit, apply to, and attend the host institution were noted (Table 8). The participants at the female only camp indicated that they are significantly more interested in visiting the host institution ($p=0.007$). Additionally, the participants from all three camps indicated greater interest in applying to the institution though this was only a significant result for the participants who attended the co-ed camp ($p=0.001$). Participants from all three camps also indicated significantly greater interest in attending the host institution ($p= 0.02$, $p=0.03$, and $p=0.001$ for the URM male camp, the female only camp, and the co-ed camp, respectively). These results suggest that these camps may be serving as effective recruitment tools for the host institution and engineering program, which follows some trends in recruitment experienced by other institutions [3],[4],[5].

Though these results are promising indicators of recruitment, they do not guarantee that the participant will visit, apply to, or attend the host institution. It is important to note that this survey did not measure participant's commitment or intent to enroll at the host institution. In order to fully assess the efficacy of the camps, participants should be sent follow-up questions within a year of attendance asking if they have scheduled a campus visit, if they have applied to the host institution, and if they plan on attending the host institution. Additionally, data from the current student body regarding who attended these engineering camps prior their enrollment attendance at the university should be examined. Once these students have been identified, this study could be further expanded to ask these current undergraduates to what extent the engineering camp they attended impacted their decision to enroll.

For this study to expand beyond obtaining an initial understanding of the effectiveness of the recruitment of summer engineering camp participants to the host institution, the survey questions should be further developed and tested for reliability and validity. Additionally, the data previously mentioned regarding the follow-up questions to past camp participants and the current student body should be collected and used to further understand the recruiting strategy.

CONCLUSION

The initial study discussed in this paper revealed that the three engineering camps hosted by the institution do have a significant, positive impact on the recruitment of the camp participants to the institution. The results of this survey also provide direction for the university through providing a deeper understanding of the recruitment strategies currently in place.

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APPENDIX A: Pre-camp survey

1. Have you attended another science, technology, engineering, and math (STEM) camp program before this camp? This includes a day camp or a camp where you stay somewhere for an extended period of time.
   - ○ Yes
   - ○ No
   - ○ Unsure
2. If you answered yes to the previous question (Question 1), please describe the camp(s) you attended.
3. Have you taken any engineering or technical classes at school? For example, a drafting or computer-aided design (CAD) modeling class, a Project Lead the Way class, or a programming class (ALICE, JAVA, Python, C++, etc.).
   - ○ Yes
   - ○ No
   - ○ Unsure
4. Do you participate in any STEM activities at school? For example, this can include being a part of academic teams such as science or math teams or being a part of a robotics team.
   - ○ Yes
   - ○ No
   - ○ Unsure
5. How interested are you in learning more about engineering?
   - ○ I am very interested in learning more about engineering.
   - ○ I am somewhat interested in learning more about engineering.
   - ○ I am neither interested or uninterested in learning more about engineering.
   - ○ I am somewhat uninterested in learning more about engineering.
   - ○ I am very uninterested in learning more about engineering.
6. How interested are you in pursuing an education and/or a career in engineering?
   - ○ I am very interested in pursuing an education and/or a career in engineering.
   - ○ I am somewhat interested in pursuing an education and/or a career in engineering.
   - ○ I am neither interested or uninterested in pursuing an education and/or a career in engineering.
   - ○ I am somewhat uninterested in pursuing an education and/or a career in engineering.
   - ○ I am very uninterested in pursuing an education and/or a career in engineering.
7. Have you visited the institution before this camp experience? This can include any other camp, program, or formal university visit scheduled through the Office of Admission and Financial Aid.
   - ○ Yes
   - ○ No
   - ○ Unsure
8. How interested are you in applying to the Institution?
   - ○ I am very interested in applying to the Institution.
   - ○ I am somewhat interested in applying to the Institution.
   - ○ I am neither interested or uninterested in applying to the Institution.
   - ○ I am somewhat uninterested in in applying to the Institution.

- O I am very uninterested in in applying to the Institution.

9. How interested are you in attending the Institution?
   - O I am very interested in attending the Institution.
   - O I am somewhat interested in attending the Institution.
   - O I am neither interested or uninterested in attending the Institution.
   - O I am somewhat uninterested in attending the Institution.
   - O I am very uninterested in attending to the Institution.
10. With which gender do you identify?
   - O Male
   - O Female
   - O Trans male/Trans man
   - O Trans female/Trans woman
   - O Genderqueer/Gender non-conforming
   - O Different identity (please state):_____
   - O Prefer not to say
11. With which race/ethnicity do you identify? (Select all that apply)
   - O African American or Black
   - O American Indian or Alaska Native
   - O Asian American or Asian
   - O Hispanic or Latinx
   - O Middle Eastern
   - O Multiracial
   - O Pacific Islander
   - O White or Caucasian
   - O An identity not listed (please state):_____
   - O Prefer not to say
12. When you return to school in the fall, you will be starting your:
   - O Sophomore year
   - O Junior year
   - O Senior year

APPENDIX B: Post-camp survey

1. How interested are you in learning more about engineering?
   - O I am very interested in learning more about engineering.
   - O I am somewhat interested in learning more about engineering.
   - O I am neither interested or uninterested in learning more about engineering.
   - O I am somewhat uninterested in learning more about engineering.
   - O I am very uninterested in learning more about engineering.
2. How interested are you in pursuing an education and/or a career in engineering?
   - O I am very interested in pursuing an education and/or a career in engineering.
   - O I am somewhat interested in pursuing an education and/or a career in engineering.
   - O I am neither interested or uninterested in pursuing an education and/or a career in engineering.
   - O I am somewhat uninterested in pursuing an education and/or a career in engineering.
   - O I am very uninterested in pursuing an education and/or a career in engineering.
3. Would you be interested in visiting the Institution again after this camp experience for another event? This can include another camp, program, or formal university visit scheduled through the Office of Admission and Financial Aid.
   - O Yes
   - O No
   - O Unsure
4. How has your experience at camp impacted your interest in applying to the Institution?
   - O My camp experience strongly increased my interest in applying to the Institution.
   - O My camp experience increased my interest in applying to the Institution.
   - O My camp experience did not impact my interest in applying to the Institution.
   - O My camp experience decreased my interest in applying to the Institution.
   - O My camp experience strongly decreased my interest in applying to the Institution.
5. How has your experience at camp impacted your interest in attending the Institution?
   - O My camp experience strongly increased my interest in attending the Institution.
   - O My camp experience increased my interest in attending the Institution.
   - O My camp experience did not impact my interest in attending the Institution.
   - O My camp experience decreased my interest in attending the Institution.
   - O My camp experience strongly decreased my interest in attending the Institution.
6. With which gender do you identify?
   - O Male
   - O Female
   - O Trans male/Trans man
   - O Trans female/Trans woman
   - O Genderqueer/Gender non-conforming
   - O Different identity (please state):_____
   - O Prefer not to say
7. With which race/ethnicity do you identify? (Select all that apply)
   - O African American or Black
   - O American Indian or Alaska Native
   - O Asian American or Asian

- ○ Hispanic or Latinx
- ○ Middle Eastern
- ○ Multiracial
- ○ Pacific Islander
- ○ White or Caucasian
- ○ An identity not listed (please state):_____
- ○ Prefer not to say

8. When you return to school in the fall, you will be starting your:
   - ○ Sophomore year
   - ○ Junior year
   - ○ Senior year