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Online Engineering and Technology Summer Camp for High School Girl Students

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Online Summer Camp for High School Girl Students

Abstract

This paper explains a community service initiative involving the delivery of a week-long synchronous online engineering and technology summer camp for high school girls at a higher education institution. The camp was supported by a grant from a federal agency and was offered at no cost to the participants. The paper discusses which factors should be considered by faculty members who plan to organize such online or in-person summer camps, which practices have been found to be effective, and what lessons have been learned.

Keywords

Summer camp, gender diversity, engineering.

Introduction

Engineering and technology play an important role in the advancement and prosperity of any nation. For advancement in the engineering and technology fields, these disciplines must be made more inclusive to all sections of society. Currently, the gender diversity statistics in engineering present a dismal picture. According to the U.S. Bureau of Labor Statistics, only 14% of full-time workers in architecture and engineering occupations are women [1]. The representation of women in electrical and electronics engineering (9.6%) and mechanical engineering (7.2%) is even lower. Studies have shown that STEM events focused on secondary school girls are effective in creating a direct pipeline to STEM programs [2,3].

This paper describes a week-long engineering and technology summer camp for high school girls conducted at a Indiana State University (ISU) with the support of Indiana Space Grant Consortium (INSGC). Studies have found that girls begin to lose interest in science and mathematics around the age of 15 [4], which typically corresponds to the beginning of high school (grades 9 and 10). Therefore, this camp was designed to introduce high school girls to the many opportunities that engineering and technology can offer as future career paths. Each day's engaging and interactive projects introduced the participants to a different area of engineering. In addition, campus activities provided them with a glimpse of college life. Furthermore, research indicates that girls need to see women role models in engineering fields in order to consider engineering as a viable career choice [5]. Accordingly, deliberate efforts were made to provide the participants with as many female role models as possible.

The summer camp had 18 participants and was conducted remotely through synchronous online sessions. Materials required to perform hands-on activities were shipped to the participants. The camp included robotics modules, 3D printing, drones, and electric circuits. Each day of the camp involved one of the principal investigators (PIs) sharing their research, industry, and educational experiences to introduce participants to the many opportunities available in a particular area of engineering and technology. Student workers also shared their experiences regarding choosing a

career in technology, college life, and their future aspirations. PIs and student workers provided remote visits to laboratories and demonstrated experiments. Finally, each PI provided training on an engaging hands-on activity related to their discipline, which participants then completed with the assistance of the student workers. Participants completed anonymous online pre- and post-camp surveys that were approved by the Institutional Review Board (IRB). Overall, the camp was well received by participants. The paper presents the results of the surveys completed by participants.

The organization of the paper is as follows: details about the summer camp, particularly the factors that should be considered by faculty members who plan to organize such camps, are presented in the Summer Camp Organization section. The findings of the pre- and post-camp surveys completed by camp participants are presented in the Results section of the paper. These survey responses represent how various camp activities were received by participants and provide feedback on the overall summer camp experience. Finally, a brief discussion of the results is presented in the Discussion section.

Summer Camp Organization

The organization of a multi-day outreach activity, such as a week-long summer camp, requires considerable planning and must not be overlooked to ensure the camp's success. Various aspects of the summer camp organization are explained under separate headings.

Timings, Location and Format

The first consideration in organizing a summer camp is determining when it will be offered, as the timing should not overlap with any major events. The author found that recruiting high school students for a camp offered in August was challenging. Based on this experience, early to mid-June or mid-July is a more suitable time to offer a summer camp. The camp described here was offered in mid-July.

It should also be determined how many days the camp will run and how long the daily activities will last. The location where the camp activities will take place should be identified. In most cases, the camp is held at a higher education institution; however, certain administrative procedures may need to be completed to obtain access to specific facilities.

In addition, it should be determined whether the camp will be conducted in person or online. If the camp is in person, organizers should consider whether participants will have the option of an extended stay beyond scheduled camp hours. Such an option can assist parents or guardians with participant drop-off and pick-up arrangements.

This camp was designed as a virtual camp due to COVID-19–related social distancing considerations. The camp was conducted over one week from 9:00 a.m. to 5:00 p.m. each day, with a one-hour lunch break. It was observed that this schedule was too long for a fully online format; online camp activities should ideally be limited to half-day sessions. This observation was also reflected in participant feedback.

Camp Activities, Budget and Human Resources

Camp activities should be selected considering the camp schedule and format (in-person or online). The budget and human resources required for the chosen activities must also be determined, including how the camp will be funded and the available budget.

This camp was funded by a federal agency. The grant proposal specified the planned activities, associated budget, and the faculty members responsible for supervising each activity. The following is a list of activities performed during this summer camp:

1. Activity 1 –Electric Circuits:
Camp participants were introduced to electric circuit concepts in a fun and interactive way through experiments using conductive ink, conductive tape, coin batteries, and Light Emitting Diodes (LEDs) [6]. These experiments were designed by undergraduate students under the supervision of the author for outreach purposes. Participants also created crafts with sewable circuits using conductive thread. All materials required for these experiments were shipped to participants with funding support. Student workers assisted participants in performing these experiments during synchronous online sessions.

2. Activity 2 –Flywheel Project using 3D printer:
This activity demonstrated the engineering design process of a flywheel. A short online lecture on flywheel design requirements and 3D printing was delivered. Camp participants drew several flywheels using pencil and paper based on their calculations and understanding. Meanwhile, undergraduate student workers 3D-printed several flywheels. After receiving participants' drawings, the 3D-printed flywheels were shown, and design details across different aspects were explained. The 3D printing process was demonstrated during the online session.

3. Activity 3 – Virtual Robots and Automation Laboratory Visit and Interactive Activity:
Participants were introduced to industrial robots through a virtual visit to the Industrial Robots and Automation Laboratory. Demonstrations of industrial robot programming were presented, and participants performed interactive activities, remotely controlling the robots with the help of student workers.

4. Activity 4 –Virtual Unmanned Systems Laboratory Tour and Drone Flight Activity:
Camp participants were introduced to careers in aviation and emerging opportunities in unmanned systems. Participants visited the unmanned systems laboratory virtually, received remote training in drone flight, and gained hands-on experience flying drones remotely with the assistance of student workers.

<u>Advertisement and Participant Recruitment</u>

Proper advertising of a summer camp is essential for recruiting participants and, therefore, crucial to the camp's success. This process involves developing camp flyers and/or postcards and distributing them to local high schools and other venues where they are likely to reach prospective participants. It is recommended to advertise the camp before the start of summer break at local schools. In addition, outreach personnel at the hosting institution can assist with this process. For this summer camp, the Outreach Director at ISU provided significant support in

advertising efforts. A structured registration process must also be established for prospective participants.

Institutional Review Board (IRB) Approval

If you plan to obtain feedback from camp participants and publish the results, as described in this paper, Institutional Review Board (IRB) approval must be obtained prior to administering any surveys. This process can take several months; therefore, it should be planned well in advance. The IRB review process typically involves the following steps:

1. Completion of required online training for research involving human subjects.
2. Preparation of necessary documentation, including a parental consent form (since high school students are minors), a participant assent/consent form, and the pre- and post-camp survey instruments.
3. Submission of the appropriate IRB application. For this summer camp, the author applied for an exempt review, which was approved. It should be noted that Steps 1 and 2 are required even for an exempt IRB review.

Results

Pre-Camp Survey Results

There was a total of 18 camp participants. The anonymous pre-camp survey was completed by 8 participants. The results of the pre-camp survey are presented below.

Question No 1) Have you met any engineer?
Response: Yes - 3; No - 5

Question No 2) Have you met any woman engineer?
Response: Yes - 3; No - 5

Question No 3) Have you met any engineer of color?
Response: Yes - 2; No - 6

Question No 4) How confident are you about knowing what is engineering? (1-10, where 1 means not at all and 10 means very confident)
Response: Average: 3.6; Standard Deviation: 1.5

Post Camp Survey Results

The anonymous post-camp survey was completed by 9 participants. The results of the post-camp survey are presented below.

Question No 1) Do you prefer an in-person camp or a virtual camp?
Response: In-Person - 8; Virtual - 1

Question No 2) Are you happy with your decision to attend this camp? (Answer with a number from 1-10, where 1 means not at all and 10 means absolutely.)

Response: Average: 8.2; Standard Deviation: 1.1

Question No 3) Would you like to recommend this camp to others? (Answer with a number from 1-10, where 1 means not at all and 10 means absolutely.)
Response: Average: 8.4; Standard Deviation: 1.7

Question No 4) Were the instructors helpful? (Answer with a number from 1-10, where 1 means not at all and 10 means absolutely.)
Response: Average: 9.4; Standard Deviation: 0.8

Question No 5) Were the student workers helpful? (Answer with a number from 1-10, where 1 means not at all and 10 means absolutely.)
Response: Average: 9.5; Standard Deviation: 0.7

Question No 6) How confident are you about knowing what is engineering? (1-10, where 1 means not at all and 10 means very confident)
Response: Average: 8.6; Standard Deviation: 1.6

Question No 7) Was the Electric Circuits activity interesting and informative? (Answer with a number from 1-10, where 1 means not at all and 10 means absolutely.)
Response: Average: 9.4; Standard Deviation: 0.7

Question No 8) Was the 3-D printing activity interesting and informative? (Answer with a number from 1-10, where 1 means not at all and 10 means absolutely.)
Response: Average: 7.9; Standard Deviation: 1.5

Question No 9) Was the Drone activity interesting and informative? (Answer with a number from 1-10, where 1 means not at all and 10 means absolutely.)
Response: Average: 8.2; Standard Deviation: 1.9

Question No 10) Was the Robots and Automation activity interesting and informative? (Answer with a number from 1-10, where 1 means not at all and 10 means absolutely.)
Response: Average: 8.6; Standard Deviation: 1.2

Question No 11) What you did not like about the camp?
Response: The most common response was camp being online, followed by it being long.
Couple of representative response quotes:

"In person would have been nice. But the camp was great."
"It was a bit long, but other than that, it was wonderful!"

Question No 12) What was the best thing about the camp?
Response: Four responses mentioned the circuits activity, a couple of responses mentioned drones and one 3-D printing. One mentioned it being focused on women and another mentioned it being informative.
Couple of representative response quotes:

"I had a lot of fun with the circuit activities and the students were super helpful and informative"
"Learning about specific areas like 3D printing and drones"

Discussion

The pre- and post-camp surveys indicate the success of this summer camp. Notably, the pre-camp survey shows that the majority of participants had not met an engineer prior to this camp, particularly an engineer of color. The surveys also show a substantial improvement in participants' confidence in their understanding of engineering, increasing from a pre-camp mean of 3.6 to a post-camp mean of 8.6.

The post-camp survey results indicate that participants were happy with their decision to attend the summer camp, were willing to recommend it to others, found the instructors and student workers helpful, and considered the various camp activities informative and engaging. The primary aspects participants did not favor were the online format and the long daily duration.

While an online format may be necessary due to various constraints, the daily duration of online camp activities should be reduced to make the experience less demanding and more enjoyable for participants.

References

[1] L. S. Anderson and K. A. Gilbride, "Pre-university outreach: Encouraging students to consider engineering careers," *Global J. of Engng. Educ*, vol. 7, no. 1, pp. 87–93, 2003.

[2] R. B. McIntyre, C. G. Lord, D. M. Gresky, L. L. Ten Eyck, G. J. Frye, and C. F. Bond Jr, "A social impact trend in the effects of role models on alleviating women's mathematics stereotype threat," *Current Research in Social Psychology*, vol. 10, no. 9, pp. 116–136, 2005.

[3] Bureau of Labor Statistics, U.S. Department of Labor, The Economics Daily, Women in architecture and engineering occupations in 2016 on the Internet at https://www.bls.gov/opub/ted/2017/women-in-architecture-and-engineering-occupations-in-2016.htm (visited January 25, 2020).

[4] A. Petroff, "The exact age when girls lose interest in science and math," *CNN Tech*, 2017.

[5] D. Milgram, "How to recruit women and girls to the science, technology, engineering, and math (stem) classroom," *Technology and engineering teacher*, vol. 71, no. 3, p. 4, 2011.

[6] Conductive Ink Pen, Jan 2021. [Online] https://www.amazon.com/Circuit-Scribe-Non-Toxic-Conductive-Silver/dp/B00OZATJ3A engineering, and math (stem) classroom," Technology and engineering teacher, vol. 71, no. 3, p. 4, 2011.