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Engineering Virtual Design Competition – A Solution for High School Summer Outreach During the Pandemic and Beyond (Evaluation)

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Abstract

Aspects of society and culture that encompass the response to COVID-19 have impacted all lives, including those of K-12 students and their families. The ongoing COVID-19 pandemic offers a complex context in which students can experience ambiguity with an engineering design challenge as an iterative process of divergent-convergent thinking while focusing on the big picture. Students can learn with an emphasis on systems thinking, making decisions in a collaborative team environment; and managing uncertainty in social processes [1]. The conversations around how schools could function during the pandemic offered a unique opportunity to engage students in problem solving about a situation that they are experiencing themselves.

In the US Southwest, three state universities came together during the early stages of the 2020 pandemic lockdown to create a virtual design competition for high school students. The TriU Partnership, including engineering college deans, faculty, and college recruitment and outreach staff from Arizona State University, Northern Arizona University, and the University of Arizona, was formed as an outgrowth of a National Science Foundation, INCLUDES project [2]. One of the aims of this project was to increase engineering awareness and interest amongst a broad population of the state and thereby enhance entry into the state's four-year university engineering programs.

The TriU Partnership served 96 high school students from 4 different states in a virtual educational event offered in June 2020. Twenty-five teams of students were asked to consider the challenges their high schools faced in achieving a safe reopening in a pandemic. Over six days, participants attended online seminars, consulted with experts and worked with engineering undergraduate mentors to come up with creative engineering solutions for protective equipment, hallway traffic patterns, bell schedules and social distancing in various high school settings. Final submissions included a detailed engineering notebook, a live online presentation, and interviews with a team of expert judges. The expert judge panel was composed of engineering faculty and industry partners. Teams also submitted prototypes and, in some cases, complete CAD drawings.

In this paper, we tell the story of the TriU engineering partnership, share the logistics of the virtual design challenge, talk about lessons learned and share results. Data sources include student survey responses, daily exit tickets, and materials produced such as their final presentation, notebooks, and solutions. The TriU Partnership will continue each summer with each university taking the lead, in turn to offer the design challenge as part of their normal outreach efforts.

1. Introduction and Background

In the early months of the COVID 19 pandemic, summer STEM education programs across the nation struggled to adapt. With in-person experiences out of the question due to the unknown risks of the virus [3, 4], many engineering enrichment programs were canceled. Determined to offer their community something during this difficult time, the Engineering Deans from three southwestern universities came together to discuss options. The objective for this relationship was open-ended vis-à-vis the pre-college engineering program that was to be designed, developed, and offered. The task of defining and implementing the specific collaboration between the three state institutions was handed down to each colleges' recruiting and outreach teams. The overall goal was to enhance awareness of engineering among high school students in the state to advance entry into engineering.

The leadership of the state's three engineering schools (Deans, Vice Deans, Associate Deans, Assistant Deans) had taken part in a day-long session at the Society of Hispanic Professional Engineers Annual Conference in November 2019 where there had been discussion about collaborating together to advance entry and persistence to graduation in engineering across the state universities as outlined by the Board of Regents. This was an outgrowth of the National Science Foundation (2017) INCLUDES design and development launch pilot that the lead university had with area community colleges and school districts. That initial meeting set the context for further collaborations. The pandemic of 2020 had initially slowed the intended collaboration across the engineering programs; however, the pandemic later served as the impetus to begin a joint effort to increase awareness of engineering.

Normally in stiff competition for the top students, state funding and even football victories, a collaboration like this was unusual and was at first met with some consternation by some staff. However, in late April 2020, at the direction of the three college Deans, a few key people from each of the colleges of engineering gathered via Zoom teleconference. The cordial meeting lasted an hour and the group decided it could create some sort of online Engineering experience for 11th and 12th graders. It was unclear what the experience would entail or how it would be delivered to students; this was the first meeting of the TriU Engineering Partnership.

A few weeks went by and the pandemic ravaged the nation, and the world. The magnitude of a complete global shutdown and the effects on higher education became evident. The complete shift to online instruction for summer and then fall had faculty and administrators scrambling. Could meaningful instruction still happen? What software tools could be leveraged? How would faculty and students adapt? A rolling parade of cancellations plagued each colleges' summer offerings for high school students: everything in May, then June, then July and August was canceled. The months of hard work and planning for the summers' educational events were now for naught and this reality had negative effects on the morale of both faculty and staff. Almost as an afterthought, the TriU Partnership circled back to the idea of an online event and held its first TriU Committee planning meetings on May 8, 2020. Working as one team and on a tight time schedule, the TriU Committee brainstormed ideas, decided on a direction and freely shared resources. After many long meetings, The TriU Committee decided to create a virtual engineering design competition called "The Challenge 2020," during which participants would consider the obstacles their high schools faced in achieving a safe reopening in a pandemic and

then come up with engineering solutions. Business offices, Marketing & Communications, and Risk Management teams had to coordinate between all three institutions. This was a daunting task but as each of these entities sat in on TriU Committee meetings they joined the "Can do" attitude of the group and became excited about the dynamic and the comradery. Not surprisingly, having the opportunity to create something new and meaningful for students during this difficult, unprecedented time was therapeutic and healing for individuals who work in education.

The TriU Committee had little to no experience setting up Zoom meetings for over 100 people and had no idea how receptive to 4-5hrs/day of online Zoom programming the high school participants would be. There was a real risk that the whole thing would flop. However, the Committee's experience in planning K-12 camps with experiential activities was successfully translated into an engaging socially relevant challenge supplemented with expert presentations, online panel discussions, faculty presentations and short video vignettes about engineering and what engineers do called, "coffee chats." Faculty and other members of the university/local industry/community volunteered to serve as expert content speakers and judges. Undergraduate students volunteered their time to serve as Challenge team mentors who led the small group sessions as high school student teams worked to solve the problem. Engineering Deans hosted a casual panel discussion full of good-natured banter and details about how they came to choose an engineering career.

2. Building a virtual design competition

The TriU Challenge Committee developed the theme for this challenge around a topic relevant to high school students - social distancing in schools during a pandemic. The first step was to determine student outcomes. The Committee agreed the teams should deliver a final project that required participants to demonstrate the engineering design thinking process [5, 6].

1. Define the problem in their own words.
2. Provide documentation of their design decisions in the form of written reflection, sketches, and evidence from data.
3. Build a prototype as part of their solution (a simulation, drawing or a physical object)
4. Present their solution to others.

The Committee then recruited a broad range of experts including those in education, engineering, health care, and counseling services to help define the parameters of the challenge and the format by which it was delivered. The problem needed to be narrow enough for students to grasp and address in a short period of time but broad enough to foster creativity. The resulting challenge focused on physical locations and the nature of human interactions in those spaces.

> *Choose a physical space on a school campus and consider the challenges that will be faced in that space during social distancing. You may choose the gym, cafeteria, football stadium, auditorium, science lab, classroom, or any other space on a school campus in which students gather. Once you have identified a space on which to focus, conduct an analysis of the space, keeping in mind the following questions:*
>
> *a. Who uses the space and how do they interact?*
> *b. What activities occur there?*

c. *What features of the space matter most, and what quality of those features must be maintained during social distancing?*
d. *What are some design considerations that we should keep in mind as we modify existing features and implement new ones?*

Based on your analysis of the space, identify one social distancing challenge that your team will address in that space. Propose a solution to address the challenge to ensure the space can be safely used when social distancing is the norm.

The experience was designed so participants would learn about and receive resources related to engineering practices [7, 8]: a) the engineering design process [1] and human centered-design [9], b) the engineering habits of mind [10], and c) engineering notebooks [11]. The committee gathered materials that could serve as references about the pandemic, such as health guidelines and suggestions for schools. These sources include the US Department of Education [12], Arizona Department of Education [13], Arizona Department of Health Services [14] the World Health Organization [15], and the Centers for Disease Control and Prevention [16].

Once the challenge was defined and student outcomes determined, a recent engineering graduate led the effort to develop a roadmap for participants that outlined the expectations, deliverables, and a format for digital engineering notebooks. This individual was also responsible for formally presenting this information on the first day of the challenge. The key emphasis was on guiding participants to use engineering design thinking and engineering practices [17, 18] as they responded to the challenge.

The Committee broke into sub-groups and appointed leaders to address marketing and recruitment, judging and awards, engineering career videos, registration, guest speakers, expert panelists, risk management, online event production, undergraduate mentor recruitment and training, surveys, and general production of the event. For the most part, each university was charged with contributing to the completion of sub tasks under each component of the event. For example, each university was responsible for recruiting engineering student mentors, judges, panelists, and engineers to contribute career videos. The lead university took responsibility for the registration system, artwork and web design, budget oversight, and virtually hosting the event. Many of the experts who supported the challenge development volunteered to deliver workshops, serve as speakers, mentor teams, and participate in panel discussions.

Gathering participants in a short period of time was surprisingly easy. The marketing department at the lead university wanted time to carefully create well-crafted artwork and language for fliers and the event website before formally launching registration to the public. So, the committee built the online registration form and quietly conducted a “soft launch” on May 19, 2020, reaching out only to teachers in their direct networks. A formal marketing campaign launched on May 26, 2020 with all three universities publicly announcing the event. To the committee’s surprise, when registration closed on June 11, 2020, 99 high school students had signed up. Three participants dropped out before the event started, leaving 96 students involved in the four-day program.

Time	Day 1	Day 2	Weekend	Day 3	Day 4
9:00am-9:50am	Welcome from Engineering Deans Welcome Message from State Superintendent of Public Instruction Presentation of The Challenge	Welcome to Day 2 and Housekeeping Items Keynote Speaker	Independent Work Time	Coffee Chats	Recruitment presentations from all three universities
10:00am-10:50am	Schedule and Expectations Overview Maintaining Your Engineering Notebooks	Group C Team Meetings		Deans Panel	
11:00am-12:00pm	Introduction to Engineering Design	Group B Team Meetings		Live Presentations to Judges	
12:00pm - 1:00pm	Group B Team Meetings: Brainstorming session facilitate by engineering mentor	Group A Team Meetings		Lunch Break	Lunch Break
1:00pm-2:00pm	Group A Team Meetings: Brainstorming session facilitate by engineering mentor	Educational Spaces and Your Future Education		Live Presentations to Judges	Live Awards Announcement Conclusion of Program
2:00pm-3:00pm	Group C Team Meeting: Brainstorming session facilitate by engineering mentor	How to Make an Evidence-Based Pitch		Judge's Deliberations	
3:00pm-4:00pm	Panel of Experts	Finding and Citing Reputable Sources			
4:00pm - 4:30pm	Debrief	Debrief			
Deliverables	Exit Ticket Physical space analysis due by 6pm.	Exit Ticket Solution ideas due by 6pm.	Slide Decks due by noon on Sunday	Exit Ticket	Post Survey

Team meetings | Challenge-related content | Deliverables | Judging | Other

Figure 1. The Challenge 2020 Schedule

The Challenge 2020 event launched on June 18, 2020 with a formal welcome from the engineering deans from all three institutions and from the state's superintendent of public instruction. A committee member gave a detailed overview of the challenge, including a deep dive into how to maintain an engineering design notebook [11] while teaching engineering practices with an emphasis on engineering design thinking [19]. Notebooks were a valuable tool

not only for participants to keep track of their work, but also for committee members to monitor progress and determine areas in need of additional support. For example, an additional session on conducting research to better understand the problem space was added to Day 2, when committee members noticed a general lack of reputable sources in the team's notebooks. On the first two days teams met with mentors in groups A, B or C during the early afternoon and participants had a time for individual group work or a lunch break while other teams met.

Hosting a virtual event posed obstacles, especially given the general lack of experience in delivering events online. The lead university enlisted their IT team to participate in a test of the event via Zoom the week before the event launch date. The test was a critical learning experience for committee members and garnered valuable insight into appropriate Zoom settings and functions and, most importantly, how to use them. The IT team attended the actual event so they could support facilitators and participants and immediately troubleshoot issues.

The program culminated with participant teams presenting their solution ideas to a panel of judges representing engineers and engineering faculty. In the end, 84 students on 22 teams formally presented their solution ideas to judges. Solutions were diverse and included a ventilation system for school bathrooms, a device for collecting spittle from brass instruments, and an exo-suit to protect students from germs, to name a few. The three teams that did not present their solutions conveyed that they were unable to complete the work because they never jibed as a team. As a result, the Committee will spend more time building team dynamics in subsequent years.

To address questions and concerns from teams along the way, the committee set up and monitored a Google Form to serve as a virtual Help Desk. Help Desk submissions became a valuable tool before and during the event to not only determine areas where teams needed additional support but also to gauge participant attitudes toward the program. This, combined with daily exit surveys and the reflection section of their engineering notebooks, illuminated team conflicts, highlighted components of the program that participants found more or less engaging, and pinpointed areas where the committee could improve in the next iteration of the event.

3. Data Collection, Methods and Results

High school students from four different states participated in a virtual educational event offered in June 2020. After placement in twenty-two teams, students were asked to consider the challenges their high school faced in achieving a safe reopening in a pandemic. Students were allowed to sign up as a team of friends, as a team representing their high school or as an individual to be placed on a team by the TriU Committee. Prior to attendance, participants were given a pre- survey asking questions about their interest in engineering, and other relevant topics. At the end of each day of the event, participants were given an exit survey via SurveyMonkey with questions regarding the sessions during the day. Small adjustments to the event programming were made on the fly based on responses to the daily exit surveys. On the last day of the event, participants were given a post- survey to allow event organizers to examine interest in engineering and plans for attending a four-year university, community college, or trade/technical school.

3.1 Participants

Participant demographics are reported in Table 1. A majority of the students were from Arizona (n=93, 97%) with three friends or relatives of Arizona students joining in from Ohio, New Jersey, and New York. Participants were rising juniors (n=50, 52%), rising seniors (n=41, 43%), and high school freshmen and sophomores (n=5, 5%). However, due to issues with internet connectivity, loss of interest or a lack of signed paperwork, twelve participants dropped out during the event. Eighty-four participants were ultimately engaged in the activities from start to finish and submitted their final presentations.

Table 1. The Challenge 2020 Participant Demographics

Demographics	**N**	**%**
Minority Status	**96**	
Asian or Pacific Islander*	35	36%
White	33	34%
URM**	17	18%
Multiple	7	7%
Other / Not provided	4	4%
Sex	**96**	
Female	39	41%
Male	56	58%
Other	1	1%

* Asian or Pacific Islander - This category was not separated out to offer choice of Native Hawaiian or other Pacific Islander who are considered as URM students.
** URM- Under-represented minorities include African American (n=4), Hispanic or Latino (n=13).

3.2 Instruments

A pre-program survey was administered to elicit intent for participation in The Challenge 2020, interest in becoming an engineer, and plans for higher education after high school. Questions used in each of the surveys were adapted from program evaluation questions deployed in past high school outreach events. 89 responses were received. An important aspect of any extracurricular activity is to understand the reasons behind student choice in joining an out-of-school program. One pre-program question asked participants "Why did you decide to sign up for The Challenge 2020? (check all that apply)." Twelve possible responses were provided, for example, "I like competitions," or "My parents strongly suggested it." Participants were allowed to choose as many reasons as they wished and could also fill in their own reason. A relative importance analysis [20] was used to rank the reasons why students decided to take part in The Challenge 2020 (Table 2).

The top two reasons indicate that this particular virtual challenge attracted students who had high awareness in STEM in general and were likely seeking an opportunity that would allow them to engage in creative problem solving, something they enjoy doing—associated with engineering identity [21, 22].

Table 2. Relative ranking for reasons why students chose to participate in The Challenge 2020

Reason	Relative Index	Overall Ranking
I like engineering, science and math activities	0.888	1
I enjoy creative problem solving and design	0.831	2
I am interested in learning from university professors and other experts	0.803	3
I wanted something interesting to put on my college applications	0.770	4
I care about what happens with social distancing at my school in the fall	0.730	5
I like competitions	0.725	6
I like working on teams	0.685	7
I am bored with the shutdown/pandemic and wanted something to do	0.685	7
My parents strongly suggested it	0.680	9
I am curious about what a virtual design competition is	0.680	9
I have some friends who talked me into it	0.652	11
My regular camps and summer activities were canceled	0.624	12

Interestingly, students also indicated that they expected to learn from university faculty and experts by participating in this extracurricular activity. This is an important insight that pre-college engineering education efforts aimed at yielding students into engineering undergraduate programs need to attend to carefully while designing program experiences. Specifically, The Challenge 2020 had planned for and assembled expert panels related to the topic and also had engineers drawn from industry and academia to share their journey, interests, and their professional work in a manner that was accessible to high school students [23].

Students also noted that they were interested in the challenge topic as it affected their lived experience [24, 25] in the spring semester and would continue to impact them in the upcoming academic year. Furthermore, another aspect of self-selection bias evident is that students seemed to have had experience working on teams and competitions—attributes often associated with engineers [26].

The daily exit surveys were designed to give specific program evaluation feedback to help improve program design for the next iteration [27]. In addition to learning about what students

found useful, the key formative evaluation feedback that emerged was the need to provide structured feedback as students developed their understanding of the problem and also include opportunities for students to interact with mentors [28]. This was implemented via a Help Desk (described earlier) that was monitored continuously. Furthermore, mentors held open Office Hours via Zoom so that student teams could ask questions and receive input about their team's problem and solution space.

A post-program survey was administered to elicit specific feedback about The Challenge 2020 experience, interest in becoming an engineer, and plans for higher education after high school. 52 responses were received. Students were asked questions about their participation in this experience by rating: i) their overall experience, ii) how much they had learned, iii) the use of their time to take part in the program.

Pre-post survey questions and the daily exit survey questions can be found in the dropbox here: https://www.dropbox.com/sh/29wso9si92y56mw/AABACJD2kDzQbsZv0EgNcMnua?dl=0

3.3 Results

The timing of the recruitment effort for the Challenge 2020 and the recruitment methods used occurred at the very end of the academic year. Due to the shutdown, most schools offered only virtual programming, and very few educators had direct physical access to targeted students. These factors perhaps limited access to those who had not considered engineering and who would have benefited from exploring engineering via this type of a problem-solving and immersive program. The Challenge 2020 program flier was forwarded to email listservs of science educators, mathematics educators, chess team coaches, and American Indian educators' network and so on. The program was also announced on LinkedIn and other social media (e.g., Twitter, Facebook) pages of the three engineering schools. The program attracted a student population that already had very high interest in becoming an engineer and attending a four-year degree program at a university.

Overall, of the 89 students who reported their interest in becoming an engineer, 84% (n=75) expressed high interest, 9% (n=8) expressed medium interest, and 7% (n=6) expressed low interest. Similarly, 71% (n=68) expressed interest in attending one of the state universities or another 4-year degree granting university; 21% (20) did not know yet; 1% (1) mentioned interest in attending a technical or trade school.

The Wilcoxon signed-rank test, a non-parametric statistical hypothesis [29, 30], was used to compare the matched paired (pre-post, n=52) data for student interest in becoming an engineer and plans for higher education after high school. This paired difference test [31] did not show any significant changes post-program. In specific, a Wilcoxon Signed-Ranks Test indicated that post-program interest in becoming an engineer was not statistically significant than pre-program interest in becoming an engineer, $Z=1.94$, $p<.000$. However, post-program, with regard to plans for higher education after high school, a small statistically significant change was found via the Wilcoxon Signed Ranks Test in comparison to pre-program data, $Z=2.48$, $p<.000$ with a small effect size of 0.34. We could not expect to change student interest or opinions about engineering

when participants entered the program with a very high level of interest in becoming an engineer and indicated very high expectations for themselves about attending a 4-year university.

However, of those who completed the post-program survey (n=52), when asked if their experience in The Challenge 2020 had affected their level of interest in engineering, a significant majority, 71% (n=37) indicated they were more interested in engineering, 27% (n=14) noted that they felt about the same way about engineering as when they started the experience (which was high to begin with), and 2% (n=1) noted less interest in engineering than when they started the experience.

Many students, 90% (n=47), found the experience valuable and was worthy of their time and 10% (n=5) stated that they were unsure that their participation in the experience was a good use of their time. Reasons provided by those who were unsure that the time spent was worthwhile included issues related to lack of participation from their team members. One such student said, "The time spent working on the project was very useful, but much of the other hours of content did not give me any productive information." And another student said, "Felt really boring at times, but the group work made up for some of that." From a program evaluation perspective, those who noted that they were not sure that the experience was worthwhile, specifically noted they found some of the online meetings to be long, asked to have fewer non-project topic related presentations, and asked for more motivated and enthusiastic team members. Barring one of these five students, all others indicated that they would recommend the next year's Challenge to a friend. And four of these five students indicated that they learned an exceptional amount (n=3) or more than usual (n=1).

When we set out to design this virtual challenge experience, we were curious to see if students would leave the program feeling that they had "learned" something worthwhile. 90% (n=47) found that they learned an exceptional amount or more than the usual, 8% (n=4) about as much as usual, and 2% (n=1) almost nothing. Those who had rated on the high end of the scale found that the experience made them feel less anxious about the pandemic and helped them learn more about the Coronavirus. Other students noted that they appreciated the opportunity to work in a team, the freedom to engage in creative problem solving, and to understand the complexity of the challenge. Many said that they learned about engineering, enjoyed learning about and using engineering practices, working in a team, communicating with team members who were people they had not worked with before, learning to present and communicate their ideas to outside experts, and so on. Furthermore, students noted that they learned a lot about life as an engineer, learned to think like engineers, and gained information that will help them make decisions about college. One particular student noted that she was able to use her artistic skills and combine it with engineering—and indicated her changing perception of engineering. In this case an often-held stereotype that engineering does not need art or doesn't need creativity was affected in a positive manner through this experience.

When asked to rate The Challenge 2020 experience, 25% (n=13) rated it as "one of the best academic programs I have participated in", 64% (n=33) rated it as "better than the average academic program", 12% (n=6) rated "about average academic program" and 2% (n=1) rated "worse than the average academic program." Students noted that they found the experience to be fun, engaging, educational, and a productive use of time. Students found that they learned how

projects would be conducted in college and had a preview of what capstone projects in engineering may look like.

When asked if they would like to see any changes, the isolation they had experienced due to the pandemic related social distancing norms came to the fore; students noted that if the program experience were offered in-person it would make working in teams better and more enjoyable.

Participants rated their undergraduate mentors very highly and appreciated their guidance. Participants noted this about their mentors, “Our mentor is a fantastic human being, and really helped us improve our project”, “Our mentor was exceptional at helping us”, and “Our mentor encouraged us to think outside the box and come out of our shells.”

In conclusion, only 2% (n=1) noted that they would not recommend the virtual challenge to a friend. The remaining 98% (n=51) noted that they would recommend the virtual challenge to a friend. These students noted things like, “It was insightful to know what it takes and what it is like to be an engineering student at one of three state universities”, “learning about and hearing different perspectives”, “hearing from professionals”, and “talks from those of different backgrounds and experiences.”

4. Lessons Learned

Reflecting on the outcomes of this competition, the TriU Committee gained many insights that will support future iterations of this event.

Near peer mentors ・Enlisting the support of undergraduate engineering students to serve as near peer mentors will be a permanent element moving forward. Participants indicated in exit surveys that they enjoyed working with their mentors during team meetings above all other scheduled sessions and rated mentors very highly in post survey responses. In future events, TriU Committee will conduct a deeper exploration of the relationship between near peer mentors and participant attitudes toward STEM, specifically, the role of mentorship in helping K12 students relate to those like them in engineering. In addition, near peer mentors will be trained to foster team dynamics to ensure that all teams complete the challenge.

Engineering identity development ・Pre-survey responses regarding why students chose to participate revealed that most already had a strong interest in STEM and creative problem solving, traits strongly associated with engineering identity. This pre-existing inclination toward engineering among participants presents an opportunity for the TriU Committee to provide programming that continues to foster identity development and set students on a clear academic pathway to engineering.

Relevant, well-timed topics ・Daily exit survey responses indicated that students preferred sessions that: i) directly related to the challenge theme, ii) allocated time to work in teams with mentors, and iii) provided opportunities to gain knowledge or skills that would help them succeed. They also indicated that some sessions were too long. For future iterations, the TriU team will select programming that caters to participants’ desire to be productive, keeping sessions brief, relevant, and direct. In addition, more time will be allotted for team meetings.

Social relevance · In pre-surveys, many students indicated that they cared about the topic - how to address social distancing while in school - and that it was a motivating factor for participation. The committee will carefully consider topics that are proven to be highly relevant to high school students moving forward.

Open and frequent communication · The daily exit surveys and Help Desk form were valuable tools in staying in contact with participants. This allowed the committee to address problems and concerns quickly. Improvements were often made "on the fly" based on student feedback.

Tech matters · The committee recognized early on that technology is unpredictable. In an online setting, one bad internet connection can derail an entire event. This, coupled with a general lack of experience with virtual events, resulted in the Committee taking every possible precaution, including enlisting the lead university's IT team to support before and during the event, running multiple tests of the online platform that mimicked the event day conditions, and providing clear instructions to participants, panelists, staff, speakers, mentors, and judges. On the day of the event the IT team monitored the chat for participants experiencing problems and worked with participants to address technical issues with very little disruption. As a result, the event ran smoothly. One area for improvement, however, came to light during the committee's post-event debrief. The Zoom host indicated feeling overwhelmed with monitoring chat, creating breakouts, managing the waiting room, and facilitating transitions - sometimes all at once. For this reason, these duties will be split amongst multiple committee members making sure that the event facilitator and Zoom host roles are distributed amongst many individuals.

Online events provide access to a diverse group of students · Barriers to student access were minimal because participants needed only $20, a computer or smart phone and internet access to participate. The application fee of $20 was waived for those with financial need. Since no one was attending on campus, this opened opportunities to many students who could not normally travel to campus for an expensive, overnight event. At the same time, the learning was authentic and meaningful. With more time to advertise and promote the event, we expect to recruit more participants from under-represented groups in engineering.

5. Conclusion

The COVID 19 pandemic served as a meaningful topic for organizers and participants alike; bringing together three state universities to work together in a TriU Partnership. Ultimately, the TriU partners put their heads together and reimagined the traditional summer STEM camp. The authentic, if not urgent nature of the challenge topic assigned to teams, was motivating and naturally portrayed engineers as problem solvers and people who make the world a better place. The positive energy of the TriU Partnership was contagious, and the data showed that student participants were engaged, inspired and eager to learn more.

The pre-program question about the reasons students signed up for the event revealed interesting insights into high school student motivations to attend a summer outreach program. Daily exit surveys and pre/post survey data built a road map for future virtual design activities and other online events. While participant interest in engineering did not increase, 84% (n=75) expressed a

high interest in engineering on the pre-program survey, 90% (n=47) of post-program respondents found the Challenge 2020 experience valuable and was worthy of their time, and 90% (n=47) found that they learned an exceptional amount or more than the usual during the program. The positive outcome of the Challenge 2020 event has encouraged the TriU Partnership to offer a virtual design completion annually and plans for The Challenge 2021 are well underway with the event scheduled for mid-June 2021.

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