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Transitioning to a Virtual Engineering Summer Bridge Program: Planning and Implementation (Experience)

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Abstract

This paper discusses the transition of an established residential Summer Bridge Program to a virtual learning experience due to the COVID-19 restrictions of summer 2020. The program aims to increase retention of first-year engineering students through a curriculum focused on academic readiness in math and chemistry, professional development, familiarity with campus and available resources, and a broad-based knowledge of engineering fields and the engineering design process. Outside of the curriculum, participants build community and a sense of belonging with social, professional development, and philanthropic programming. With the constraints of remote instruction, math readiness and community building were prioritized as crucial outcomes for participants in the virtual experience.

Due to concerns about student retention and program completion, special consideration was given to designing the curriculum and schedule of this virtual program, and to fostering student and family engagement leading up to the program. Various models for math instruction, interpersonal engagement, and academic support were considered during planning. In the implemented program, participants were enrolled in one of three math courses based on preassessment exam results. To increase peer-to-peer engagement, each student participated in a team-based design project and group mentoring. Current engineering students were hired as coaches to facilitate mentoring group discussions and help provide oversight during project work. Additional student staff served as dedicated tutors assigned to one of the math courses. Tutors were made available both inside and outside of class to provide tutoring and mentorship. The program was administrated via synchronous Zoom conferencing with supplemental content provided through the University's course management system (CMS). Physical program materials were distributed by mail before and throughout the duration of the program.

Post-program survey data and anecdotal feedback indicate that participants' confidence in their preparedness to pursue an engineering degree increased following completion of the program. While the available data also suggest participants were able to make social connections with select peers and staff, considerable work can be done to diversify and increase social connections during future virtual programs. Additional redesign of program content will also focus on increasing activity-based learning.

Background

The AT&T Summer Bridge Program at the University of Oklahoma is a 4-week residential program for rising freshman planning to pursue an engineering degree. The program aims to increase retention of first-year engineering students through a curriculum focused on academic readiness in math and chemistry, professional development, familiarity with campus and available resources, and a broad-based knowledge of engineering fields and the engineering design process. Outside of the curriculum, participants develop personal relationships with their peers, near-peer counselors and tutors, and faculty and staff within their college. Small cohort sizes and highly structured programing have given the AT&T Summer Bridge Program a reputation for being an intensive and immersive pre-engineering experience. Alumni of the program report greater confidence in their preparedness for their transition to life on campus and the engineering curriculum, as well as greater familiarity with engineering majors, expectations, and career paths [1,2].

In response to the COVID-19 pandemic, the University of Oklahoma suspended on-campus programs and instruction during the summer 2020. Therefore, program designers decided to transition the engineering Summer Bridge Program to an online format. The change to a virtual space prompted a re-evaluation of the intended program outcomes and a redesign of the program structure. Two main questions were considered during the redesign process: what are reasonable requests and expectations of students and their families under current circumstances? and which of the program's goals have the greatest value for promoting long-term persistence of program participants in engineering degrees?

Program Redesign and Planning

The in-person AT&T Summer Bridge Program allows program and professional staff to create an intense and immersive experience which models a balance of academic, extra-curricular, social, and self-care activities for rising first-year students. Without these supporting structures within the online program, it was important to revisit the expectations for program participation. Special consideration was given to designing the curriculum and schedule, and to fostering student and family engagement leading up to the program to drive student and family engagement and buy-in for the virtual experience.

Overall concerns about low engagement and program completion due to screen-fatigue and low buy-in were considerations in the program redesign. Although screen-fatigue was a concern, retaining synchronous communications, especially for near-peer and peer-to-peer interactions, would contribute significantly to the overall feel of the virtual program. The program would center on synchronous Zoom conferencing with supplemental content provided through the University's course management system (CMS), Canvas. It was decided that mandatory attendance and participation should be limited as much as possible to address program goals; and a narrowed program scope would be essential within the context of limited time and participant bandwidth. In addition to cultivating and managing participant and family engagement and motivation through purposeful messaging and communication were identified as important elements for program retention. Events and requirements were determined not only by their ability to support he primary goals of the virtual program, but by the academic and professional value that might be perceived by participants and families. Of the program's traditional benefits, math readiness and community building were prioritized as crucial outcomes in the virtual experience.

Considerations for Curriculum Preparedness in Math

The unique and varied circumstances surrounding virtual education and school closures in the spring prompted concerns about participants' preparation for a transition into the college classroom. Despite using a for-credit math course model during the AT&T Summer Bridge Program, alternative models of math instruction were considered to address curriculum readiness in the online program. Two variations on the non-credit math seminar were considered: the first focused on general math skills readiness and review, and the second being a modified implementation of the Wright State engineering mathematics model [3, 4]. In addition, a model of personalized self-study utilizing the McGraw Hill ALEKS® system was considered in an implementation similar to what was used in prior online summer bridge programs [5].

These models provided options to address curriculum readiness in a lower-stakes environment, allowing participants greater leeway in their transition to college-level coursework. The Wright State engineering mathematics seminar and individualized study plan approaches were thought to have higher potential to inspire long-term engagement and buy-in when compared with a general math skills seminar due to the integration of engineering fundamental concepts and the ability for students to set their own individual goals, respectively. However, non-credit math and chemistry seminars had been implemented in prior years' programs with lower engagement and student buy-in for such non-credit versus credit academic activities. Anecdotally, interest in participating in the bridge program increased significantly following the introduction of math courses offered for college credit; the number of enrolled participants nearly doubled the year course credit was introduced. With the ongoing concern about motivation and engagement during an online program, the for-credit course model was considered the best choice for addressing the program goal of fostering math curriculum preparedness.

Math courses offered through the AT&T Summer Bridge Program (college algebra, pre-calculus & trigonometry, and calculus I) are offered in partnership with the University's Department of Mathematics and coordinated by first-year math, course-specific specialists. This team suggested a just-in-time instruction model which utilizes extended instructional time to integrate introduction of new on-level topics with remediation of shortfalls in students' prerequisite knowledge and skills to address any remaining concerns about students' preparedness to enter an accelerated college-level course. Such courses were piloted in recent years with a focus on calculus instruction. Additional offerings for lower-level math courses were in development at the time and have been implemented in the academic year following the online Summer Bridge Program. This model of extended instruction and just-in-time learning were implemented in the final virtual program.

Participants were enrolled in one of the three math courses, based on a preassessment examination administered virtually through the University's Assessment Center. Completion of the preassessment no later than one-week prior to the start date of the program was required. Courses were taught synchronously via the Zoom platform with additional course resources provided through Canvas. Section enrollments were capped at 15 students. Each course section was assigned two tutors (current upperclassmen engineering students with prior tutoring experience) who assisted with in-class activities and oversaw nightly tutoring and study-hall. Study-hall hours were come-and-go times set aside for participants to receive assistance and mentorship from program tutors, and to form study groups with classmates. Each course section was provided a designated Zoom breakout room for one-on-one work with the tutor. Additional breakout rooms were made available for study groups.

Considerations for Community Building and Interpersonal Engagement

In prior years of the program, community building was aided by the participants' immersion in shared activities and spaces. Participants were able to establish a community with their peers, program staff (current upperclassmen engineering students), faculty and professional staff; they were also provided opportunities to identify with the engineering community at the University. Addressing both outcomes to some degree was identified as essential within the online program.

With limited synchronous "face-to-face" time for interpersonal interaction, one question in designing activities was how to balance providing a breadth of contacts and the amount of time concentrated on deepening specific relationships. Supplying exposure to a wide variety of different organizations and leaders within the engineering community, while facilitating opportunities for participants to create fewer, but deeper, relationships within the cohort was deemed an appropriate compromise. Throughout the program, participants were given opportunities to see and interact with all participants within the cohort; however, participants were assigned to standing small groups for more substantive interactions. In addition to their math class sections, each participant was assigned to two small working groups which would meet throughout the duration of the program, herein referred to as the mentoring and project groups.

The two sets of working groups provided a framework for ensuring each participant had ongoing connections with a smaller subset of students within the cohort. Providing a goal or task to these groups would give purpose to the continued group interactions. Secondary goals of the program (cultivating knowledge of campus resources and opportunities, professional and personal development topics, engineering majors and fields, and the engineering design process) were leveraged to provide the purpose and motivation for the working groups. The first two goals were paired and became the foundation for mentoring group activities; the final two goals informed the project group activities.

Initial brainstorming for mentoring and project group activities embraced creative and out-of-the-box approaches. Some of the most innovative programming suggestions came from the future program staff (tutors and coaches). Project groups were initially conceptualized as a broader "problem solving" group that could work together to work on a set of smaller problems or puzzles throughout the duration of the program. Some ideas within this vein were leveraging available STEM-based virtual labs, identifying engineering or programming-based puzzle computer games, requesting small thought experiments based in different engineering disciplines from faculty around the college, and facilitating collective storytelling (i.e. tabletop role playing games) requiring implementation of engineering problem solving strategies. While many of these suggestions were novel, each was thought to have potentially limited appeal which might prove isolating to some subset of participants. A group-based engineering design project would allow participants to engage in a genuine and open-ended objective; A hands-on engineering project has been a cornerstone activity in the AT&T Summer Bridge Program since its initial formation; continuing to implement an engineering project as the "project" group activity was determined to be the best path forward. Design of the project component aimed to create a novel problem which was achievable using virtual interactions and limited working time. Additionally, special attention was paid to ensuring equitability in the prototyping and build phases of the design process. Further discussion of the project component is provided in a companion paper [6].

Acclimating to campus and becoming familiar with different on-campus norms, rules and resources in the in-person bridge program allow the participants to approach their first year at the University with greater confidence than they might have felt without the program. Although learning opportunities to address these issues would be presented in a mix of planned programming and informal interactions between staff and participants, emphasis in program coordination would traditionally focus on intentional presentation of information through planned programmatic elements. In the virtual program, a loose structure of discussion topics and a small number of formal presentations were planned to stimulate ongoing conversations between participants and program staff through mentoring groups. Participants were assigned to groups of six to eight students and assigned a coach who would serve as the moderator and group members' main touchpoint throughout the program duration.

The stated purpose of mentorship group discussions was to provide participants with an introduction to tools and resources available on campus to support their future success. To meet these objectives, and more importantly to provide structure and purpose to group conversations during the formation of the groups' relationships in the early stages of the virtual program, discussion topics and supporting resources were curated for introduction by the coaches. These topics included housing and dorm essentials, on-campus parking rules, and other frequently asked questions. Participants were encouraged to ask questions or voice worries about the topics being addressed, and coaches shared their own experiences. The program's professional staff encouraged coaches to allow participants to direct the conversations and to encourage all to contribute. When additional questions or topics of interest were introduced during freeform discussion, these topics were incorporated into later prompts for use by all mentorship groups. As such, the personal and professional development topics list covered during the program became a mixture of pre-determined must-know information for a first-year college student and those identified by the participants.

In addition to the topics and materials gathered for direct use in mentorship group discussions, additional presentations and activities were planned with faculty, staff, and students around the engineering community and University. Participants were able to connect directly with representatives from the University's health services, financial services, disability and accessibility resource, and career services centers as well as talk with their coaches about how to the utilize such services as each participant's needs may change throughout their time at the University of Oklahoma. Faculty from each department within the Gallogly College of Engineering shared information about the academic and professional opportunities available within their disciplines, allowing coaches to talk with their groups about determining major and minor areas of study, identifying undergraduate research or internship opportunities, and utilizing office hours, among other topics. Finally, participants were invited to meet with the director, select faculty members, and the advisor for their major program.

Interactions with faculty and staff allowed participants to gain familiarity and comfort with academic and student support services offered by the University experience. To provide a broader perspective into life as an engineering student, coaches organized roundtable discussions featuring additional students from within the engineering community. Topics for roundtables ranged from finding on-campus jobs to establishing oneself as a leader in student organizations. Roundtable panelists encouraged program participants to continue the conversations on social media and email, allowing participants to further grow their networks within the engineering community. Program staff also coordinated extra-curricular, "Fun Friday" events meant to bring the cohort together as a whole community in a no-pressure, entertainment setting; events included a dorm room cooking challenge, a talent show, a pet showcase, and the program's picture day. Students were invited to take part as event contestants, and otherwise encouraged to participate through Zoom's non-verbal feedback, chat features, and on-camera reactions.

It was hoped that students would utilize evening study-hall time to form study groups to further create community ties amongst the cohort. Unfortunately, this activity proved hard to incentivize, presumably due to study-hall participation being voluntary.

Finalizing program schedules

To address concerns about total on-camera time per day, the total length of the program was extended from four to six weeks and the required time for synchronous Zoom class activities was limited to 4.5 hours per weekday: 2.5 hours for math instruction and 2 hours for additional activities. Non-mandatory, synchronous math tutoring was offered for an additional 4 hours each evening Sunday through Thursday during the program duration. Short mandatory weekly "floor meetings" were held on Sunday evenings in conjunction with study hall to frame the upcoming week's schedule and activities; however, in practice these events were perceived as low-value meetings and poorly attended by program participants. Figure 1 shows the general weekly program schedule.

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
9:00-11:30		Math Class	Math Class	Math Class	Math Class	Math Class
11:30-12:30		Lunch	Lunch	Lunch	Lunch	Lunch
12:30-1:30		Academic enrichment presentation	Personal or professional enrichment presentation	Academic enrichment presentation	Personal or professional enrichment presentation	Fun Activity!
1:30-2:30		Engineering project working time	Mentorship group discussion time	Engineering project working time	Mentorship group discussion time	
2:30-3:00						
3:00-4:00						
4:00-5:00						
5:00-9:00	Study Hall	Study Hall	Study Hall	Study Hall	Study Hall	

Figure 1: Example Weekly Program Schedule

Additional Specifics of Program Execution

The following section pertains to some of the miscellanea around general execution of the virtual program not covered within the previous section on planning of larger program elements.

Communication Plans

Gaining buy-in from participants and families before the start of the program was deemed a potential factor in maintaining engagement early during the program. One month prior to the start of the program, participants and parents/guardians began receiving weekly newsletters. Student newsletters highlighted upcoming deadlines, spotlighted program staff, and prompted student participation in Buzzfeed-type quizzes for the next week's newsletter. Parent newsletters also highlighted upcoming deadlines, but also invited parents/guardians to attend a family orientation session. Two synchronous Zoom family orientation sessions were held to provide families a broad understanding of the expectations for their participants during the Summer Bridge Program. Additional time was allowed for asking questions and "meet-and-greets" with the program's professional staff.

Multiple channels of ongoing communication were utilized with participants during the program. Program content was mostly delivered synchronously via Zoom sessions, however additional program documentation and resources were provided through a Canvas course. This asynchronous program content was underutilized by many participants, however the Canvas course proved to be a valuable reference document for program staff as they mentored program participants. Over thirty-nine percent of participants did not access at least half of the asynchronous program content, compared to only thirteen percent of participants who utilized all of these materials. Each math course had a stand-alone Canvas course, which was not associated with the program course. Staff-led use of social media, namely GroupMe, was the most effective form of asynchronous communication with program participants. This mode was not adopted by all participants, but it was effective in creating an asynchronous mode of communication for most members of the cohort, including cohort-wide and small group channels.

Tactics for Ongoing Engagement

After addressing issues of initial buy-in, additional consideration went into incentivizing continued engagement in the non-math sections of the virtual program. Coaches, tutors, and peers were an important element in keeping participants accountable for calling in to the synchronous sessions. A digital badging system was implemented to encourage asynchronous engagement through the program Canvas course**.** Figure 2 shows the number and type of digital badges available to program participants. Additionally, program staff implemented a team-based points system putting mentoring groups in direct competition to incentivize attendance and participation in synchronous program events. Digital badges do not appear to have had an incentivizing effect for the vast majority of program participants, however issues with the implementation and branding may have been contributing factors in this outcome. On the other hand, the point system did contribute to some added level of non-mandatory study-hall attendance during the first half of the program.

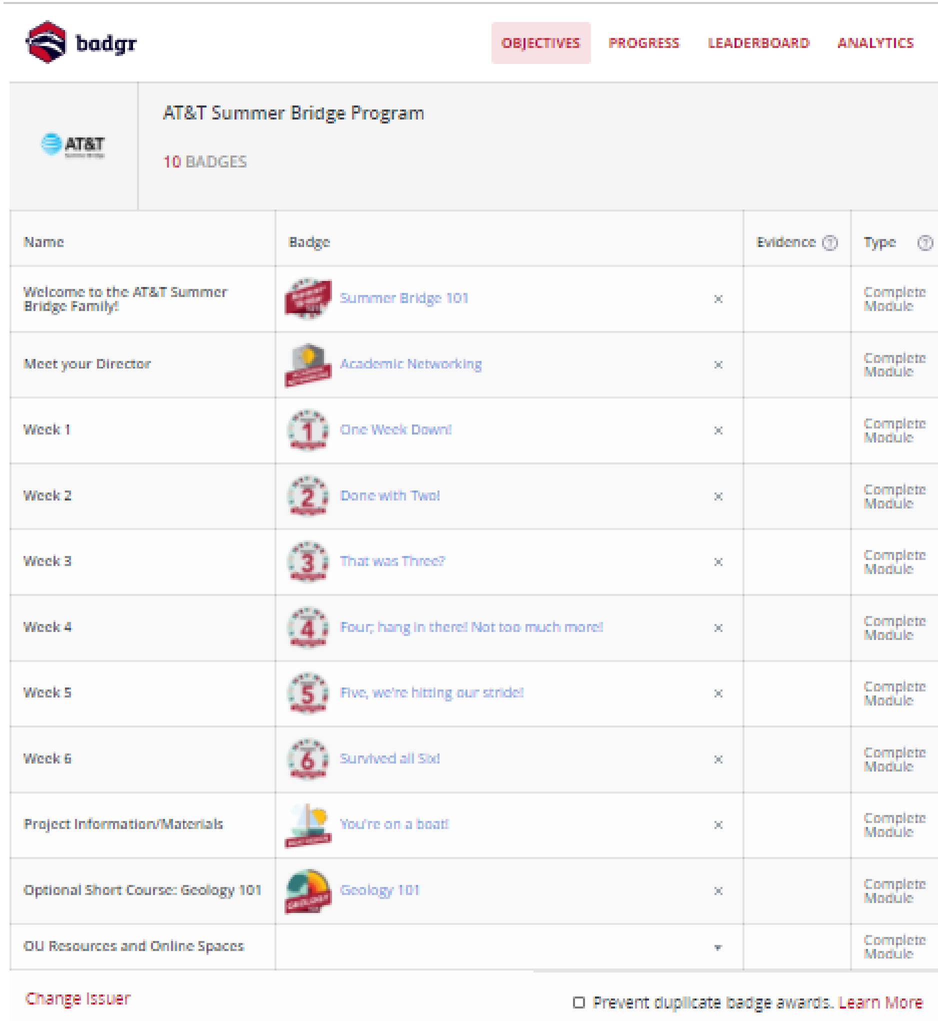

Figure 2: Screen Capture of Digital Badging Interface Used and Badges Offered

Distribution of Program Materials

The AT&T Summer Bridge Program has historically been an all-inclusive program, providing participants with the necessities for their educational experience through the duration of the program including textbooks, project materials, program swag, and access to needed technological resources. To maintain equity of access to the program's educational elements and foster a sense of community and belonging among the cohort, distribution of physical materials to program participants before and during the program duration was prioritized during the program execution. Shortly before the start of the program, packages were mailed to each program participant using the United States Postal System (USPS) via the University's central mail services. Initial packages included: the course workbook for the participant's math course (College Algebra and Pre-Calculus students only), a program t-shirt and additional branded swag, a set of engineering project materials, and a care-package of individually wrapped snack foods. Calculus students were each provided a digital textbook rental instead of a physical course book. Delays of USPS mail services preceding and during the program dates were an unanticipated issue. These delays resulted in uneven access to necessary program supplies, especially with supplemental engineering project materials mailed later in the program.

The program professional staff received no requests for technology assistance.

Outcomes and Lessons Learned

Participants were asked to provide weekly formative feedback through short survey on the program Canvas course. Additionally, participants were asked to complete a summative feedback survey about their wholistic experience during the program. Formative survey completion was sparce, with a total of 16 responses of the 152 possible over the first four weeks of the program. Fifty-five percent of program participants completed the summative program survey. The following discussion will utilize data collected from the post-program survey.

The data collected indicated high satisfaction with overall program experience among respondents. Post-program survey data and anecdotal feedback indicate that participants' confidence in their preparedness to pursue an engineering degree increased following completion of the program. All programmatic elements (math instruction, tutors, coaches, student success seminars and guest speakers, and engineering project) were deemed very beneficial by more than half of respondents, with math instruction and program coaches receiving the largest number of students identifying these elements as "very beneficial," see Figure 3 for a summary of respondent feedback. Free response comments indicated participants enjoyed community building programmatic elements, with the engineering project and coach group interactions being rated as the most enjoyable elements. The responsive-design approach to curating mentor group discussion topics assisted in directly addressing participant concerns; 95% of respondents indicated the discussions prepared them for their transition to the University. Many respondents indicated the program would benefit from more interactive activities in place of formal presentations and round-table discussions, especially activities which would foster relationships with diverse groups of participants. Ninety-five percent of respondents enjoyed the special "Fun Friday" events, but 24% felt these activities did not contribute to their ability to bond with other program participants. While the available data also suggest participants were able to make social connections with select peers and staff, considerable work can be done to diversify and increase social connections during future virtual programs. Additional redesign of program content will also focus on increasing activity-based learning. Although the data collected has been used to determine general trends and areas for improvement, a larger focus on collecting formative feedback will need to be a more important component of future iterations.

Design of the program schedule was intended to allow participants flexibility to address the different circumstances and outside requirements. Although consideration was given to making the virtual program accessible, future work could consider program redesign to address situations with limited internet access to high-quality internet or a choice of synchronous activity scheduling for working students.

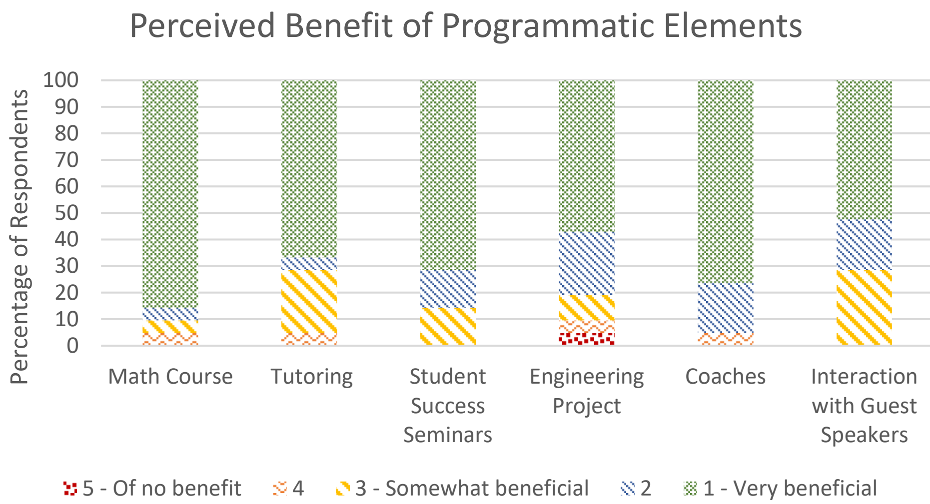

Figure 3: Perceived value of select elements of virtual bridge program

References

[1] T. Cameron, L. Morales, and L. Whiteman, "Building and Sustaining an Effective Bridge into Engineering for Underrepresented Students at a Predominantly White Institution," in *28th Annual National Conference on Race & Ethnicity in American Higher Education*, Washington, DC, United States of America, 2015.
[2] O. Caruthers, C. Garcia, R. Johnson, and L. Morales, "Building and Sustaining an Effective Bridge into Engineering for Underrepresented Students in a Predominantly White Institution," in *31st Annual National Conference on Race & Ethnicity in American Higher Education*, New Orleans, Louisiana, United States of America, 2018.
[3] N.W. Klingbeil, R.E. Mercer, K.S. Rattan, M.L. Raymer, and D.B. Reynolds, "Rethinking engineering mathematics education: A model for increased retention, motivation and success in engineering," in *ASEE Annual Conference and Expo*, Salt Lake City, Utah, United States of America, 2004.
[4] N.W. Klingbeil and A. Bourne, "A National Model for Engineering Mathematics Education: Longitudinal Impact at Wright State University," in *120th ASEE Annual Conference and Expo*, Atlanta, Georgia, United States of America, 2013.
[5] M. Harkins, "Engineering Boot Camp: A Broadly Based Online Summer Bridge Program for Engineering Freshman," in *123rd ASEE Annual Conference and Expo*, New Orleans, Louisiana, United States of America, 2016.
[6] C. Dalton, A. Quiroga, and B. Reed, "In-Person Team Engineering Design Project to a Virtual Setting," in *2021 ASEE Annual Conference and Exposition*, Virtual Meeting, 2021.