24for24: A Virtual Summer Bridge Program in Multiple 24-Minute Sessions for the Collegiate Class of 2024

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***Abstract*—The vast outbreak of COVID-19 in early 2020 precipitated many changes worldwide, including the sudden shift to online and remote learning across institutions of higher education in the United States. Those sudden shifts yielded ill-prepared remote learning experiences – dubbed pandemic teaching – that contributed to a growing fear of a drastic reduction in student enrollment in the forthcoming 2020-2021 academic year if the quality of remote engagement did not substantially improve. Institutions worldwide rapidly pivoted and sought to explore new means of effectively engaging their student populations, including incoming students, to shore up retention and matriculation in the face of a new and persisting remote learning environment. The authors of this study created a new virtual summer bridge program, named 24for24, to shore up their institution's engagement with its students. 24for24 was targeted at the incoming class of 2024 engineering majors at a primarily undergraduate institution in the Mid-Atlantic region of the United States. The summer bridge program was intentionally designed to generate excitement for the engineering major and to promote early community-building, which defines our paper's two objectives, as a means of shoring up matriculation and provide the authors a metaphorical sandbox to explore online pedagogical practices emphasizing student engagement. The quality of the program's two objectives was assessed using aggregated survey results and through qualitative observations of the matriculated cohort at the start of the 2020-2021 academic year. The authors found no measurable change in excitement for the major, yet the authors found that the summer bridge program fostered a small community made up of about 30 students who actively participated throughout the 8-week long program and continued to engage intimately with each other in the first-year engineering course at the start of the new academic year. The authors discuss perceived benefits and shortcomings of the program and speculate on means of strengthening it in a post-COVID-19 era where the threat of reduced student enrollment is ever-present due to demographic changes in the United States. The authors' inaugural execution of 24for24 revealed that there is value in engaging with students in a virtual summer bridge program remotely as a cost-efficient means of fostering enthusiasm for engineering studies, fostering a sense of belonging through community-building, and priming student mindset for success.**

I. Introduction

Bridge, pre-college, and summer transition programs between postsecondary and collegiate institutions of education often focus on the formation of community, particularly across generational divides of young, incoming students and older, established students and faculty [1]–[3]. They are classically in-person enterprises where incoming students have an opportunity to visit (and possibly reside in) a collegiate campus for an extended period of time to gain familiarity and comfort with the institution and its personnel [4].

The authors have past experiences with summer bridge programs at their mid-sized, public, primarily undergraduate university located in the Mid-Atlantic region of the United States. Those (in-person) summer bridge programs have traditionally included two elements: 1) a program-focused, one-day orientation event followed by 2) a campus-wide, nearly week-long orientation. The one-day event contains multiple activities for students and parents to come to campus, sign up for classes, meet with an academic advisor, and learn about college expectations, typically offered in late June through July. The nearly week-long orientation involves first year students moving into the dorms in August the week before classes start, and includes meeting a near-peer mentor, meeting peers in their dorm, learning how to navigate campus, and preparing for the first day of classes. Additionally, the authors have contributed for the past three years a culture-emphasizing, community-developing "engineering camp" occurring off-site for three days prior to the campus-wide, week-long, first-year orientation. All of these opportunities have been cited by our students as significant moments where they construe their first sense of belonging to the collegiate and engineering department communities.

The fast outbreak of COVID-19 in late 2019 through early 2020 precipitated drastic changes worldwide, including sudden (i.e., emergency) shifts to remote and online instruction. Alongside this sudden change was a wide proliferation of resources for effective, online teaching [5], [6]. Despite best attempts to offer quality education in this new environment, worries among institutions of higher education within the United States began to grow about a precipitous drop in student enrollment in the upcoming academic year [7]. The authors'

university shifted their one-day, in-person bridge programs to virtual platforms, and requested departments explore and adopt innovative ways to encourage matriculation. Historically, many incoming students say they decided to attend this university based on in-person visits, but with all campus visits now virtual, the worry about a reduction in student enrollment was especially prevalent.

Taken together, the authors of this paper recognized an opportunity to pilot a new remote learning experience for incoming students to foster excitement for their declared major in engineering and to foster the formation of a community in advance of the new academic year. These two objectives were strategically selected so that high excitement for the major and a sense of belonging through the formation of a community would counteract a precipitous drop in student enrollment and persistence [8]. The authors leveraged their past experiences with organizing in-person, immersive activities that fostered community among students to that of a new e-learning program offering in the Summer of 2020. The overarching goal was to buttress against anticipated drops in enrollment by fostering an online community that welcomed students into the engineering department and its culture in a remote learning format. The eight authors banded together to prototype an 8-week long summer bridge program for the incoming Class of 2024. Each virtual, weekly session was nominally scheduled for 24 minutes giving credence to the virtual bridge program's moniker: 24for24. The intervention design was centered around an entrepreneurially minded learning (EML) framework to foster curiosity, connections, and value creation for their engineering studies and engineering topics. The intervention design was also geared toward rapid team-formation and engagement to promote a sense of belonging and the formation of a virtual community.

II. Design of Engagement Framework

The authors designed the virtual summer bridge program for an interdisciplinary, ABET-accredited engineering (BSE) degree program at a regional, comprehensive university in the Mid-Atlantic region of the United States. The university is a primarily undergraduate institution (PUI) with a singular engineering department without any concentrations or foci in engineering sub-disciplines. The engineering program is project-driven and emphasizes design, complex systems, project management, and the liberal arts. Graduates from this engineering program continue in industry or graduate schools in many disparate fields, meaning that any summer bridge program oriented toward a singular disciplinary focus or engineering practice has the possibility of discouraging incoming students from finding value in this interdisciplinary degree program.

To foster excitement for the engineering major at a broad, non-discipline-specific level, the authors designed a bridge program centered around the entrepreneurially minded learning (EML) pedagogical framework [9], [10]. The EML framework posits that the three C's – curiosity, connections, and creating value – foster a mindset in engineering students where they are driven to become curious about the world around them, find connections among disparate ideas, and be empowered to recognize new opportunities to create value for themselves and others. The adoption of this framework for the bridge program mirrors its adoption across other aspects of the department's curriculum and co-curriculars, meaning that the framework also serves to ingratiate students into the department's unique culture.

In a sixteen-faculty engineering department, eight faculty volunteered to facilitate one 24-minute virtual session per week resulting in an 8-week long summer bridge program. Each session was entitled with a question inspired by one of the three C's in the EML framework and provided each facilitator maneuverability in creating the virtual activity. The activities in Weeks 1-2 were primarily grounded in curiosity, oriented toward introspection and discovering self-motivation for engineering topics. Activities in Weeks 3-4 were focused on connections, oriented toward a broad exploration of the world and how disparate ideas and notions connect to each other and to engineering topics. Activities in Weeks 5-8 were centered around creating value, oriented toward creating artifacts meant to support students' sense of engineering self and engineering community. Table I summarizes each weekly question, its key activity, and its key learning outcomes. Several sessions included targeted, post-session engagement via Slack, a commercial online collaboration tool, to reinforce session topics and provide expanded engagement beyond the initial 24-minute virtual session.

III. Recruitment Strategy and Data Collection

All incoming students who had accepted an admission offer and declared engineering as their major (n = 395) were sent an email invitation via their newly generated institutional email account to join the virtual summer bridge program. The email announcement emphasized that the sessions were available at no-cost and would serve as practical first steps into engineering projects. Participation was encouraged by promoting the formation of a remote community with engineering faculty and current engineering students at these "half-hour" sessions. Participation was also encouraged by noting that small tokens (institutional logo-emblazoned T-shirts, stickers, books, etc.) would be raffled upon confirmed attendance at each session. Participants were asked to register for each session using Zoom, a commercial communication platform to support audio and video engagement along with breakout rooms to separate attendees into smaller virtual rooms.

At the end of each virtual session, a 3-question poll was administered (see Table II) asking students:

- How much this session might help your pursuit of engineering as a major/career?
- How much you would recommend a future offering of this session to other engineering students?
- How much you enjoyed this session?

Each question was asked in a 5-point Likert scale with 1 indicating the "lowest" response and 5 indicating the "highest". The 3-question poll was devised to surmise the participant's

TABLE I

OVERVIEW OF 24FOR24, THE 8-WEEK LONG BRIDGE PROGRAM, NOTING KEY QUESTIONS, KEY ACTIVITIES, AND KEY LEARNING OBJECTIVES SOUGHT FOR EACH 24-MINUTE LONG REMOTE ENGAGEMENT OCCURRING ON THE MONDAY AFTERNOON OF EACH WEEK.

Activity Number	Question	Activity	Learning Objectives
Week 1	Where are you now?	After introducing the concept of active listening and design thinking, tenants of the engineering program, all students were randomly assigned to breakout rooms with 2-3 participants each. Participants were tasked to introduce themselves and record each other's pains, joys, anxieties, and goals in an active listening exercise.	- Introduce yourself to someone new. - Capture where you are now.
Week 2	Where do you want to go?	An ice breaker activity was used to introduce students to one another in breakout rooms and to share their personal aspirations. After the breakout session, peers described the aspirations of one another. After the initial break out, the experience was repeated except the students had a "time machine" to envision themselves in 5 years' time. These new aspirations were shared with peers and faculty alike.	- Utilize engineering and design thinking to identify aspirations and plan for future careers and experiences.
Week 3	What do I need to discover?	After sharing Albert Einstein's famous quote about thinking about a problem for 55 minutes before generating solutions in 5 minutes, students were tasked to create problem statements based on perceived needs from a bisociation activity. The bisociation activity was a series of three unrelated images to foster curiosity and connection- making.	- Find connections between disparate notions. - Engage your critical thinking skills to find needs. - Express needs as a problem statement.
Week 4	What do we need to know?	Students were instructed to explore a topic with a curiosity mindset and were dissuaded from jumping to conclusions. Students were tasked with creating as many questions as possible based on the differences observed between two videos (from a marketing perspective and from a real-world user perspective) of the same product.	- Use curiosity as a guide to find connections through observation and asking questions. - Develop questions using the question formulation technique.
Week 5	What needs to be improved in the world?	Engage students in exploring the United Nations Sustainable Development Goals to find challenges ripe for high-impact solutions. Two problem finding techniques were presented: 1) Think Like a Traveler and 2) Shift Your Perspective.	- Learn two techniques for finding real problems. - Practice exploring global challenges to identify real problems. - Understand that engineering is more than just solving problems, but also finding and framing those problems.
Week 6	How might you engineer your story?	Two activities were orchestrated to foster creative mindset in students by forming connections between two different fields - art and engineering. An initial activity focused on drafting and telling a story about the mechanisms and motions shown in an animated image. The second activity was focused on engineering a story. Students worked in teams to first read the story of Jack and the Beanstalk and then created sketches of automaton to demonstrate a scene from the story.	- Find connections between engineering and art. - Explore different mechanisms and how they can be used to create desired motion.
Week 7	What might you design to make a difference?	A creativity matrix activity was used to ideate potential design solutions between student-driven problems such as COVID-19, gender inequality, affordable education and novel technologies such as autonomous drones, bitcoin, and 3D printing. Students rapidly iterated on solutions at the intersections of these technologies and challenges.	- Describe the importance of user-centered design in complex engineering systems. - Apply design ideation approaches (creativity matrix) to identify design opportunities and rapidly iterate on solutions. - Present your solutions to peers for critique and feedback.
Week 8	How might the Class of 2024 be the best one yet?	This concluding session aimed to orient students to their new collaborative, project-driven culture in our engineering program. An activity focused on connecting incoming students to each other, to a shared future, and a shared past. This session engaged students in sharing their recent histories and current dreams with each other. A snapshot of alumni to date was examined to illustrate the abundance of opportunities through our engineering program. The session ended with a collaborative visioning exercise.	- Gain awareness of the diversity of histories, talents, and dreams across your cohort. - Establish early connections across your cohort. - Transition from a passive learner in K-12 education to a collaborative learner in engineering education.

level of excitement for the engineering major. The number of attendees was recorded to observe the extent of community formation and persistence across the 8-week bridge program.

IV. Survey Results

The results from the student survey described in the preceding section are provided in Table II. The table indicates the particular session, the number of attendees, the number of responses to the survey questions, and the mean μ with standard deviation σ for each question response. The survey results are also presented graphically in Figure 1.

Out of 395 invited students, 32 students registered for the inaugural session, with a peak of 41 students registered for the second session (see Table II). It became readily apparent that a core group of students opted to participate through the 8-week long bridge program in its entirety with a vast majority of the final group of 25 students at Week 8 having attended all 7 preceding sessions.

Survey responses for 5 out of the 8 sessions are shown in Table II. Data for Weeks 4, 6, and 7 are not available due to permanent, corrupted technology failure. Although there is no statistical significance in our findings, the available data suggests that student participants found "curiosity" driven questions (Weeks 1-2) to be slightly less helpful to them in their pursuit of engineering as a career as compared to "connection" driven questions (Week 3). "Creating value" driven questions had mixed results in our available data of Week 5 and Week 8. Yet, student responses indicated that all sessions were equally valuable enough to recommend to other engineering students, with a consistent survey response average score of 4.6-4.7 across the five weeks of available data. Similarly, student responses indicated that all sessions were equally enjoyable, with a consistent survey response average score of 4.6-4.7 across the five weeks of available data.

V. Lessons Learned for Future Design of Virtual Bridge Program

The first objective of fostering excitement for the engineering major using the summer bridge program is not demonstrated in the survey results. Survey responses across the three dimensions of the EML framework indicated perceived positive value in all types with average scores above 4.4 without an observable shift as a result of the intervention. There is no shift of statistical significance, suggesting that the participants likely self-selected and opted into the experience based on their prior level of excitement for the engineering major at this university.

The second objective of fostering community-building has mixed results. At its peak, only 41 out of 359 participants engaged in the summer bridge program, representing only 11% of the incoming class. It is worth noting that the institution maintains an open major enrollment policy with no requirements that prevents declaring engineering as a major upon admission. The number of students who actually enrolled in the new academic year was 185, which is closer to the past trends in the department of approximately 150 students. This means that the peak number of 41 participants represented approximately a fifth of the Class of 2024 engineering cohort. It is also worth noting this incoming class is the largest to date for the engineering program and may suggest that student (and family) awareness of efforts like 24for24, whether attended or not, communicated a strong commitment to undergraduate education, thusly positively impacting matriculation. Nevertheless, participation in the optional summer bridge program could be enhanced.

In the extended Slack engagement, a peak of 6 students (representing 21% of the 29 student attendees) engaged in Week 3. The other 7 sessions are characterized with 0, 2, or 3 unique persons engaging with the facilitators, representing 0 – 14% post-session engagement. Despite low engagement quantitatively, the participating students engaged in back-and-forth conversations with faculty facilitators indicative of high qualitative engagement.

Some factors that may have contributed to the low participation may very well have been related to: 1) lack of access to newly activated institutional email addresses, 2) lack of comfort in accepting an email invitation in lieu of a more active and personalized phone call invitation, 3) insecurities (health and/or economic) related to the contemporaneous COVID-19 pandemic affecting availability to sign up for a perceived 8-week long commitment, 4) an ill-timed event (Monday afternoons) during the summer months including conflict with the US Independence Day holiday, 5) lack of perceived value in signing up for the optional opportunity, 6) lack of perceived value in persisting for the duration of the optional opportunity, or 7) maintaining other interests and commitments that competed against this optional bridge program. These are all speculative, competing factors that can be better understood by inquiring with the admitted cohort to strengthen a future offering of this summer bridge program.

Yet, there were qualitative strengths in the admitted cohort as a direct result of the summer bridge program. Summer bridge programs encourage the formation of pre-college friendships that persist through the early years of a student's college experience [4], [11]. Three of the authors are the instructional faculty for the first-year engineering class where qualitative observations confirm social networks having formed a priori, demonstrable in student team-based projects and work. In the remote learning environment that persists at the start of the 2020-2021 academic year, one observation is that those students who showed up to the 24for24 opportunity are the same students who are showing up and actively participating in their first-year virtual engineering class. The summer bridge program may not have had a direct influence on student participation in class (since the students who self-selected into the optional bridge program may have had a predisposition to online learning and engagement to begin with), yet the summer bridge program may have accelerated the formation of a specific community in the admitted cohort. Lastly, 24for24 attracted a larger percentage of women ($\approx$30%) than historically represented in the first-year ($\approx$20%) and major ($\approx$25%), suggesting that this remote summer bridge program reflects

TABLE II
POLL RESPONSES AFTER EACH VIRTUAL SESSION FOR VARIOUS QUESTIONS.

Activity Number	Participants	Responses	Pursuit of Major ($\mu \pm \sigma$)	Recommend ($\mu \pm \sigma$)	Enjoyed ($\mu \pm \sigma$)
1	32	24	4.46 +/- 0.83	4.71 +/- 0.55	4.63 +/- 0.58
2	41	17	4.41 +/- 0.71	4.65 +/- 0.49	4.65 +/- 0.49
3	29	13	4.77 +/- 0.44	4.77 +/- 0.44	4.62 +/- 0.65
5	24	10	4.70 +/- 0.52	4.60 +/- 0.52	4.70 +/- 0.48
8	25	12	4.42 +/- 1.15	4.67 +/- 1.15	4.67 +/- 1.15

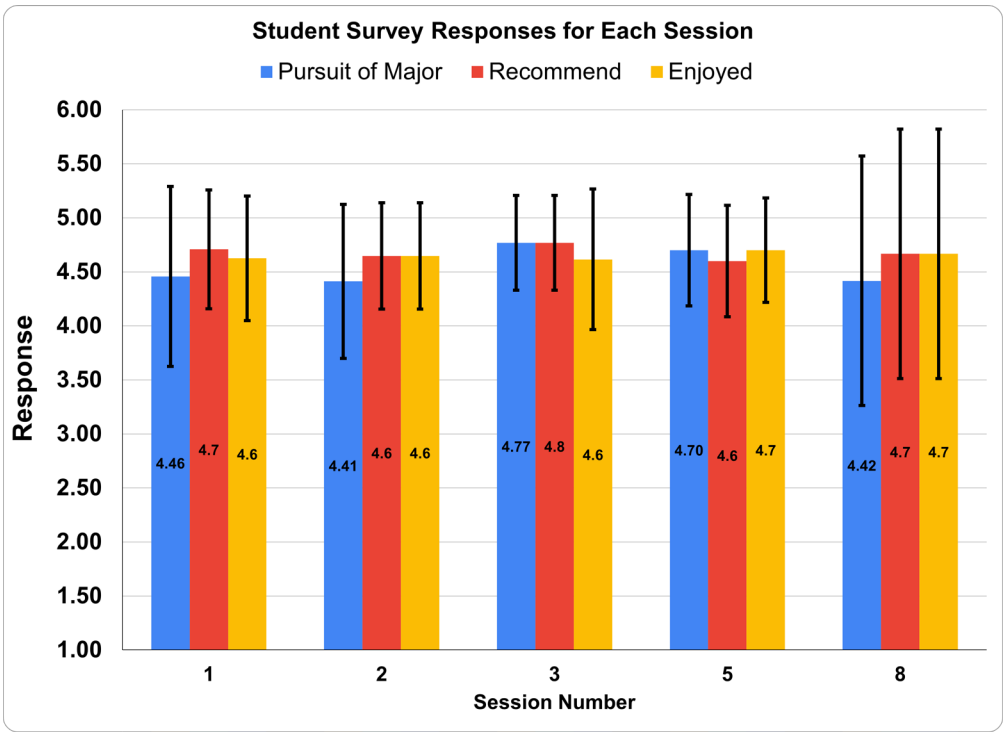

Fig. 1. Summary of student responses to three poll questions at the end of each session. "How much this session might help your pursuit of engineering as a major/career?", "How much you would recommend a future offering of this session to other engineering students?", "How much you enjoyed this session?"

other in-person bridge program findings about promoting persistence in underrepresented student populations [12].

The authors note that the virtual summer bridge program in Summer 2020 was far more cost-effective than its prior culture-emphasizing, community-developing "engineering camp" occurring off-site. The virtual offering was available at no-cost, meaning that it was accessible to more students who may have declined against an in-person event with registration fees associated with it. Moreover, the virtual offering mimicked the same extent of engagement with students who chose to opt-in meaning that it is possible to achieve the same level of excitement for the major and sense of community as an in-person experience should the experience be posited as a "required" element upon admission to the engineering major. In this inaugural offering of the virtual Summer 2020 bridge program, approximately 30 students were engaged in contrast to approximately 110 attendees to the Summer 2019 in-person offering. Better understanding the thematic elements between virtual and in-person elements are of critical importance in an era of limited budgets and increasing competition for student enrollment in the face of the demographic changes in the United States [13]. It is highly important to explore cost-efficient means of engaging students in summer bridge program offerings.

Summarily, perceived benefits found from program assessment outweigh the time and energy invested on this pilot remote learning summer bridge program. In future offerings, it is likely that a virtual summer bridge program can be repeated, specifically for its ability to foster an early community in the first semester course that admitted engineering students enter. Future sessions could be bi-weekly or monthly allowing for more on-line engagement and relationship building in between sessions. It may be, however, that the summer bridge program must be more actively advertised, perhaps by invitatory inclusion in admissions letters, to posit it as a "required" element of the engineering major upon admission. Personalized outreach (e.g., phone calls, customized emails, and handwritten letters) to admitted students can also be a means of increasing participation in optional programs [14].

The summative lesson learned is that the landscape of

higher education will continue to be drastically impacted by the effects of the COVID-19 pandemic and compounded by trends of declining enrollment due to changing demographics in the United States [13]. Novel e-learning pilots like remote summer bridge programs will need to be refined and enhanced in quick fashion in order to appeal to student interests in a time of stark competition for enrollment at brick-and-mortar (i.e., physical and in-person) college campuses. Remote summer bridge programs may be one of the critical tools for the future and post-pandemic era that are required to sustain student enrollments by fostering excitement for specific degree programs and igniting an early sense of belonging to academic communities.

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REFERENCES

[1] A. S. Coles, "School to college transition programs for low income and minority youth," *Advances in Education Research*, vol. 4, pp. 31–58, 1999.

[2] S. L. Fletcher, D. C. Newell, M. R. Anderson-Rowland, and L. D. Newton, "The women in applied science and engineering summer bridge program: Easing the transition for first-time female engineering students," in *31st Annual Frontiers in Education Conference. Impact on Engineering and Science Education. Conference Proceedings (Cat. No. 01CH37193)*, vol. 3. IEEE, 2001, pp. S1F–5.

[3] T. D. Marable, "The role of student mentors in a precollege engineering program," *Peabody Journal of Education*, vol. 74, no. 2, pp. 44–54, 1999.

[11] A. Suzuki, A. Amrein-Beardsley, and N. Perry, "A summer bridge program for underprepared first-year students: Confidence, community, and re-enrollment," *Journal of the First-Year Experience & Students in Transition*, vol. 24, no. 2, pp. 85–106, 2012.

[4] D. L. Tomasko, J. S. Ridgway, R. J. Waller, and S. V. Olesik, "Association of summer bridge program outcomes with stem retention of targeted demographic groups," *Journal of College Science Teaching*, vol. 45, no. 4, p. 90, 2016.

[5] R. E. Ferdig, E. Baumgartner, R. Hartshorne, R. Kaplan-Rakowski, and C. Mouza, "Teaching, technology, and teacher education during the covid-19 pandemic: Stories from the field," *Waynesville, NC, USA: Association for the Advancement of Computing in Education (AACE)*, 2020.

[6] N. Johnson, G. Veletsianos, and J. Seaman, "Us faculty and administrators' experiences and approaches in the early weeks of the covid-19 pandemic." *Online Learning*, vol. 24, no. 2, pp. 6–21, 2020.

[7] American Council on Education (ACE), "June Pulse Point Survey: Fall Planning, Financial Viability Top List of Concerns," 2020 (Last Accessed June 26, 2020). [Online].

[8] L. R. Hausmann, J. W. Schofield, and R. L. Woods, "Sense of belonging as a predictor of intentions to persist among african american and white first-year college students," *Research in higher education*, vol. 48, no. 7, pp. 803–839, 2007.

[9] Andrew L. Gerhart, Donald D. Carpenter, Robert W. Fletcher, and Eric G. Meyer, "Combining discipline-specific introduction to engineering courses into a single multidiscipline course to foster the entrepreneurial mindset with entrepreneurially minded learning," in *2014 ASEE Annual Conference & Exposition*, Indianapolis, Indiana, June 2014.

[10] D. Rae and D. E. Melton, "Developing an entrepreneurial mindset in us engineering education: an international view of the keen project," *The Journal of Engineering Entrepreneurship*, vol. 7, no. 3, 2017.

[12] T. L. Strayhorn, "Bridging the pipeline: Increasing underrepresented students' preparation for college through a summer bridge program," *American Behavioral Scientist*, vol. 55, no. 2, pp. 142–159, 2011.

[13] N. D. Grawe, *Demographics and the demand for higher education*. JHU Press, 2018.

[14] J. A. Kitchen, P. Sadler, and G. Sonnert, "The impact of summer bridge programs on college students' stem career aspirations," *Journal of College Student Development*, vol. 59, no. 6, pp. 698–715, 2018.