Execution Details and Assessment Results of a Summer Bridge Program for Engineering Freshmen

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Peter Nelson was appointed Dean of the University of Illinois at Chicago's (UIC) College of Engineering in July of 2008. Prior to assuming his deanship, Professor Nelson was head of the UIC Department of Computer Science. In 1991, Professor Nelson founded UIC's Artificial Intelligence Laboratory, which specializes in applied intelligence systems projects in fields such as transportation, manufacturing, bioinformatics and e-mail spam countermeasures. Professor Nelson has published over 80 scientific peer reviewed papers and has been the principal investigator on over $30 million in research grants and contracts on issues of importance such as computer-enhanced transportation systems, manufacturing, design optimization and bioinformatics. These projects have been funded by organizations such as the National Institutes of Health, the National Science Foundation, the National Academy of Sciences, the U.S. Department of Transportation and Motorola. In 1994-95, his laboratory, sponsored by the Illinois Department of Transportation, developed the first real-time traffic congestion map on the World Wide Web, which now receives over 100 million hits per year. Professor Nelson is also currently serving as principal dean for the UIC Innovation Center, a collaborative effort between the UIC Colleges of Architecture, Design and the Arts; Business Administration; Medicine and Engineering.

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Execution Details and Assessment Results of a Summer Bridge Program for First-year Engineering Students

Abstract

This paper reports the execution details and the summary assessment of a Summer Bridge Program (SBP) that is a part of an ongoing National Science Foundation (NSF) Scholarships in Science, Technology, Engineering, and Math (S-STEM) project in the College of Engineering at the University of Illinois at Chicago. The project supports 18 Scholars (academically-talented, low-income engineering students). The primary goals of the SBP are facilitating Scholars' transition to their first-year and improving their academic success. To achieve these goals, the SBP is implemented as a two-week on-campus intensive experience that occurs in the summer before the student's first year. The first round of the SBP was completed in Summer 2018 and the current paper offers the details, lessons learned, and a brief evaluation of the SBP. Based on the assessment data, it is concluded that the SBP was successful in achieving its stated goals. The evaluation results and the lessons learned from the SBP execution can be used to build a sustainable Summer Bridge Program for all first-year engineering students in the future.

1. Introduction and Related Works

In the United States, a global leader in Science, Technology, Engineering, and Math (STEM), the issue of underrepresented minority (URM) has received a considerable attention over the recent years [1]. Of particular importance to the University of Illinois at Chicago, as a Minority Serving Institution, is that racial/ethnic URM students are often also low-income students. Furthermore, recruiting and graduating low-income engineering students is a challenging problem. Solutions have focused primarily on broadening access via outreach, aggressive recruitment and remediation-based interventions to retain these students to graduation [2].

Summer bridge programs have played an important role in overall student success by facilitating students' transition to their freshman year [3]. The S-STEM Summer Bridge Program (SBP) reported in this paper is a two-week, on-campus, resident, and intensive experience for the Scholars. This program is offered in the summer before their first semester. We offer an assortment of activities that are integrated into the Scholar's academic experience, and each activity is linked to the framework of practice and targets at least one engineering identity dimension.

The number of reports that discuss STEM bridge programs, including peer-reviewed publications, has increased during the past 25 years [4]. Ashley et al. [4] created a systematic and detailed review of the literature on STEM summer bridge program. In their review, they provided the goals of each of 46 published reports on 30 unique STEM bridge programs and whether the program was successful in meeting these goals. Among the existing literature reporting STEM summer bridge program, the length of the programs varies widely from three days [5] to eight weeks [6]. It also includes one online bridge program for which there is no set length [7].

STEM summer bridge programs are created to achieve a variety of goals. These goals can be categorized into sets: Academic success, psychosocial, and department-level goals [4]. In the first category, remediation, improving student content knowledge, maximizing student GPA, increasing research participation, increasing student retention and increasing student graduation rate have been taken into consideration. For example, Yoder [8] identified summer bridge programs as a best practice for retention in engineering. Pickering-Reyna [9] also showed that students who participate in summer bridge programs are more likely to be retained in their major. Tomasko et al. [10] found that URMs who attended the summer bridge program had higher third-year retention rates in their STEM discipline in comparison with the general population of students admitted to STEM majors at the same university. Strayhorn [11] reported that these programs were especially beneficial for low-income, academically underprepared students. Moreover, Brown [12] found that college students who were high-achieving usually had access to a summer bridge program prior to entering their first year.

In the second area, increasing interest in the major [13], [14], improving student sense of belonging [15], [16], [17], increasing student sense of preparedness [17], [18], increasing student self-efficacy [17], [19], and networking with students [20], [21], [22], and faculty [15], [23] can be considered as sub-goals. Finally, recruiting students to the majors [13], [14] and enhancing diversity in the major [15], [24] are considered sub-goals for the third category.

This paper presents a detailed report of a Summer Bridge Program (SBP) as a part of an ongoing National Science Foundation (NSF)-supported project, which was developed for supporting academically-talented, low-income STEM students (Scholars). In the project, we recruit 30 Scholars (Cohort 1: 18 Scholars starting Fall 2018 and Cohort 2: 12 Scholars starting Fall 2019) and support them during their undergraduate studies in the College of Engineering. Tables 1 and 2 show the major, gender, and race information of the first cohort of the Scholars.

Table 1. Scholars' majors

Major	BioE	ChE	CME	ECE	CS	IE	ME	Total
Number of Scholars	1	2	4	2	4	1	4	18

* BioE: Bioengineering, ChE: Chemical Eng., CME: Civil & Materials Eng., ECE: Electrical & Computer Eng., CS: Computer Science, IE: Industrial Eng., ME: Mechanical Eng.

Table 2. Scholars' general information

Information	Gender		Race

	F	M	First Generation	Hispanic	African American	Asian	American Indian	White
Number of Scholars	8	10	8	8	2	3	2	3

The remaining sections of this paper are as follows: Section 2 describes the SBP architecture and its main objectives. The different components of the SBP and their impacts on the Scholars will be presented in Section 3. Section 4 will contain the evaluations and results. Lastly, the conclusion and future work will be presented in Section 5.

2. Summer Bridge Program Architecture

The SBP is an immersive, two-week, residential experience designed to prepare S-STEM Scholars for transitioning into college and sustaining success throughout their undergraduate years by fostering confidence, a sense of belonging, and trust. A pedagogical approach is adopted in which the following aspects are cultivated:

1. Academic success
2. Peer and faculty mentorship
3. Professional goals
4. Community involvement
5. Emotional support

The Summer Bridge Program takes a multipronged approach to encourage success for participants. For the entire duration of the SBP, each Scholar is paired with a "student ambassador". For Cohort 1 Scholars (recruited for Fall 2018), student ambassadors consisted of academically successful juniors and seniors who were also leaders of professional societies. These Cohort 1 Scholars will, in turn, serve as student ambassadors for Cohort 2 Scholars (to be recruited for Fall 2019). Under the mentorship of student ambassadors, the Scholars take part in a variety of daily activities including a moderated reflection session at the end of each day.

The program is structured as follows:

- It takes place during the summer prior to entering college.
- It spans two full weeks, from Sunday through the second Saturday.
- Each Scholar is paired with a student ambassador throughout the course of the program.
- On-campus housing is provided to the Scholars. A resident coordinator is present at all times to handle logistical, operational, and emergency matters.
- Multifaceted daily activities are administered, including lectures on mathematics, science, communications, social justice and ethics (e.g., construction of racial identity, identifying inequalities), workshops on technical writing, coding, robotics, and resume building, hands-on team challenges (projects), professional tours, social and shopping trips, and personal time.

- All projects are team-based where two to three Scholars collaborate under the guidance of ambassadors. Each project is a challenge for which each team must design a solution.
- The themes for the hands-on projects span across mechanical, industrial, biomedical, electrical, computer, civil, and chemical engineering, with multiple projects being cross disciplinary.
- Professional field trips include visits to local municipal facilities, engineering organizations and national laboratories, with an emphasis on positive impact on the community through engineering means and interactions with engineers, scientists, managers, and operators.
- Lectures and seminars are administered by trained personnel.
- Daily assessment is conducted. Assessment methods include reflection activities to contextualize their experiences, evaluative questionnaire, personal interviews, and individual and focus-group presentations.

3. Summer Bridge Program Components

Table 3 summarizes the daily events of the Summer Bridge Program, followed by detailed description of each component.

Table 3. The SBP daily events

<table>
<tr><td rowspan="7">Week 1</td><th>Sunday</th><th>Monday</th><th>Tuesday</th><th>Wednesday</th><th>Thursday</th><th>Friday</th><th>Saturday</th></tr>
<tr><td>Arrivals</td><td>Campus tour</td><td>Math I review</td><td>Intro. to BioE</td><td>Math I review</td><td rowspan="4">CAD/3D printing</td><td rowspan="6">Social outing:
Museum of Science and Industry</td></tr>
<tr><td rowspan="2">Welcome/ Meet & greet with mentors</td><td>Resume building I</td><td>Physics I review</td><td>Resume building III</td><td rowspan="3">Field trip
Makerspace/ Student Orgs.</td></tr>
<tr><td>Shopping</td><td>Resume building II</td><td>Math I review</td></tr>
<tr><td rowspan="2">Neighborhood tour</td><td>Coding I</td><td>Coding II</td><td>Scavenger hunt</td></tr>
<tr><td>Learning your educational system I</td><td>Intro. to ECE</td><td>Intro. to ME</td><td>Field trip:
MHub</td><td>Coding III</td></tr>
<tr><td>Intro. to SBP</td><td>Reflection</td><td>Learning your educationa l system II</td><td>Learning your educational system III</td><td>Recreational center</td><td>CAD hands-on</td></tr>
</table>

<table>
<tr><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">Reflection</td><td>Physics I review</td><td rowspan="2">Reflection</td><td rowspan="2">Reflection</td><td rowspan="2">Reflection</td></tr>
<tr><td>Reflection</td></tr>
<tr><td rowspan="7">Week 2</td><td>Team challenge</td><td>Robotics</td><td rowspan="2">Field trip
Architecture Boat tour</td><td rowspan="2">Technical writing</td><td>Field trip: UI Labs</td><td rowspan="2">Artificial Intelligence</td><td rowspan="2">Focus group presentation</td></tr>
<tr><td>Math II review</td><td>Intro. to IE</td><td>Intro. to ChE</td></tr>
<tr><td>Physics II review</td><td>Learning your educational system IV</td><td rowspan="2">Field trip:
Millennium Park</td><td>Intro. to CS</td><td>Learning your educational system V</td><td>Coding IV</td><td rowspan="2">Individual presentation</td></tr>
<tr><td rowspan="3">Recreational Sports Center</td><td>Intro. to CME</td><td rowspan="2">Social Justice Initiative</td><td>Sticker printing hands-on</td><td>Learning your educational system VI</td></tr>
<tr><td>Nano Lab</td><td rowspan="2">Sticker making hands-on</td><td>ECE hands-on</td><td>Math II review</td><td rowspan="2">Wrap-up meeting</td></tr>
<tr><td>CME hands-on</td><td>IE hands-on</td><td>Math II review</td><td>Chemistry review</td></tr>
<tr><td>Reflection</td><td>Reflection</td><td>Reflection</td><td>Reflection</td><td>Reflection</td><td>Reflection</td><td>Send-off</td></tr>
</table>

We divide all activities into four main categories: Lectures, workshops, field trips, and hands-on projects and team challenges. These are described in detail below.

3.1. Lectures

Lectures are categorized into four main parts including review classes, introduction to engineering fields, learning your educational system, and resume building.

- Review Classes: Incoming Scholars may not be fully prepared for the level of difficulty of college STEM course work, and many bridge programs have attempted to remediate students to meet the requirements for entry into the major [25]. Review classes in Math I, Math II, Physics I, Physics II, and Chemistry focus on basic and essential mathematics, physics, and chemistry skills to help the Scholars become better prepared for their STEM majors.

- Introduction to Engineering Fields: The purpose of this component is to introduce the Scholars to different types of engineering including bioengineering, chemical engineering, industrial engineering, mechanical engineering, civil and materials engineering, electrical and computer engineering, and computer science - as disciplines and as major programs offered at University of Illinois at Chicago. It intends to familiarize the Scholars with career options, path to graduation, research areas (undergraduate and postgraduate), and future outlook. Each of these sessions is typically a 30- to 45-minute presentation followed by a lively Q&A.

- Learning Your Educational System: Since every Scholar is expected to spend the next few years at the university, orientation and navigating the myriad aspects of the university are a critical factor to their success. The goal of this session is to introduce to the Scholars the university's mission, its subsystems or elements (e.g., administrative structure, resources and facilities, etc.), stakeholders (e.g., university administration, faculty, teaching assistants), relationships (e.g., the provost reports to the chancellor) and the mechanism for revision or feedback (e.g. teaching evaluations). A total of six one-hour sessions are scheduled for this lecture.

- Resume Building: The goal of this component is to prepare the Scholars for successful acquisition of an internship and eventually a full-time position. It also provides the Scholars with an opportunity to begin establishing a network, understand the components of a high-quality resume and online professional profile, and evaluate internship opportunities. By participating in this activity prior to entering college, the Scholars are expected to be able to start planning a career path during their first year. A total of three one-hour sessions are scheduled during the two-week program, and are facilitated by professional staff from the university career center.

3.2. Workshops

The SBP programming includes a variety of informational and skill-based workshops including social justice initiative, coding, computer-aided design (CAD) and 3-D printing, automation and robotics, technical writing, artificial intelligence, and Nano Lab.

- Social Justice Initiative: The goals are to provide a framework by which those in the sciences and engineering can see the real-world applications of their work, understand the possibilities to support communities in need, and address social justice issues. The activities provide the Scholars with an understanding of how identity and social issues intersect with our society and engineering, and the need for critical thinking in all of the sciences and engineering fields.

- Coding: Computer programming skills play an increasingly important role in different STEM majors. Each session is designed to introduce to the Scholars fundamental concepts in coding, common applications in everyday problems, and what college-level programming classes may entail.

- CAD and 3-D Printing: Through the use of 3-D modeling software and rapid prototyping, this workshop emphasizes the importance of visualization skills in STEM career. The Scholars work on simple design projects where ideas can quickly be materialized into a prototype. Like coding, CAD is a conceptual and a procedural skill that takes time to master. This workshop, therefore, aims spark interest among the Scholars by previewing the power and usefulness of CAD.

- Automation and Robotics: Crucial in today's and future STEM jobs, robotics has become a must-learn topic among engineering students across disciplines. This workshop is designed to show the importance and intricacies in combining elements of mechanical engineering, electrical engineering, and computer science to automate an electro-mechanical device. In this workshop, a visual-based software environment is used to design and control the movement of a simple robotic arm.

- Technical Writing: Writing skill is essential in engineering practice, and mastery requires an early start. The goals of this workshop are to introduce technical writing as an everyday skill, define its qualities, dissect the components of good writing, and discuss its use in engineering.

- Artificial Intelligence (AI): In this workshop the Scholars receive an introduction on Machine Learning and AI, and an understanding of their applications in daily life. Through hands-on demonstrations, the Scholars can begin to appreciate the connection among coding, machine and the human needs.

- Nano Lab: Nanotechnology is becoming ubiquitous in the study and application of engineering, and this workshop aims to showcase the many uses of nanomaterials and manufacturing methods.

3.3. Field trips

To impart a sense of community engagement and interactions with engineers, scientists, managers, and operators, several field trips are planned during the two-week program. In addition to a tour of the campus and surrounding neighborhoods, the Scholars also learn about the location and functions of various academic departments, laboratories, classrooms, student organizations, health and wellness facilities, the library, cafeterias, emergency services, etc. Moreover, the following professional tours and recreational outings are planned:

- College of Engineering Makerspace and MHub: The purpose of the tour of these two makerspace facilities is to introduce the Scholars to modern commercial manufacturing tools such as advanced 3-D printers, CNC mills, laser cutters, vinyl cutter, large format printer, etc. The Scholars also learn about how the Makerspaces serve the university and its greater community.

- Museum of Science and Industry: Besides learning, the main objective of the field trip is for the Scholars to establish a social-emotional connection with the city, community and their cohort.

- City Excursion: While a majority of the Scholars are in-state residents, many come from different cities. A guided, exploratory tour of the city center can enhance a sense of belonging among the Scholars. The excursion includes cultural and historical exploration via a river boat tour, an appreciation of the arts and nature by walking through city parks offering live music, famous sculptures, and other amenities.

- UI Labs: UI Labs is driving the digital future of manufacturing and cities by leveraging a network of hundreds of partners from university, industry, startups, government, and community groups, to address problems too big for any one organization to solve on its own. This tour provides an opportunity for the Scholars to learn about such a synergy and the relevance of their intended study in advancing research to improve lives.

3.4. Hands-on projects and team challenges

Self-efficacy is a student's perception of his or her ability to complete a task [26] and plays an important role in student retention. Therefore, we have designed a series of team-based experiential projects involving various engineering majors, to improve Scholars' sense of self-efficacy and problem solving as an engineer. Each team is given a goal, and the team achieving the best outcomes wins the challenge. Among the projects are 3-D modeling design contest, sticker making and printing, structural design, planning and build, optimization of a process with constraints, and interactive device using a microcontroller.

4. Evaluations and Results

During the SBP, we use five types of assessment including both quantitative and qualitative methodologies. Formative and summative assessments are also conducted. Formative assessments provide feedback during the instructional process while learning is taking place, while summative assessments take place after the learning has been completed.
Our evaluation methods are as follows:

4.1. Daily reflection

At the end of each day – typically after dinner, we assigned a specific time for a mediated reflection activity to evaluate the events of the day. The Scholars are prompted to recall their experience and share how they feel about each activity with each other and their ambassadors. We use the information to revise our scheduling and plan for the next day and make changes in the program execution as necessary. As a sample data point, some Scholars lamented that the campus tour was rather physically tiring, and preferred activities with more fun and challenges. Based on this feedback, we immediately designed a scavenger hunt for exploring different parts of the campus for the following day. All in all, daily reflection hours have been observed to be an excellent opportunity for the Scholars to know each other and strengthen the bond between them and their ambassadors.

4.2. Weekly surveys

At the conclusion of each of the two weeks, a blended formative-summative survey is administered to assess the Scholars expectations. Results from the survey are used to formulate modifications to the scheduling, specific activity content, personnel involved, etc.

4.3. Personal interviews

An assessment is created to evaluate the Scholars' academic background. The results will be analyzed and published in a future paper.

4.4. Focus-group presentations

At the conclusion of the program, a focus-group presentation by the Scholars was facilitated to collect information about their level of satisfaction in each program component. The Scholars are assigned to five different focus groups and asked to discuss their overall experience, including what they like or dislike about the SBP.

Using this information, the team of investigators on the grant and key personnel met to discuss the feedback received on each component. The team discussed each component and during this discussion the team decided whether each component should be kept in the program, improved with minor or major changes, or substituted. The team also discussed aspects of each component such as the length of the component and the content delivered. Table 4 represents the results of Scholar satisfaction of the SBP's components and the needed action for each component by considering the focus group evaluations.

Table 4. Scholars satisfaction of the SBP's components and actions based on the focus group results (G: focus groups, L:like/D:dislike, 1= low, 5= high, 5/5: 5 out of 5 groups)

Component	G1	G2	G3	G4	G5	Overall satisfaction (%)	Action Decided by the Project Investigators
MHub	L-5	L-5	L-5	L-5	L-5	5 / 5 - 100%	Keep

Artificial Intelligence	L-5	L-5	L-5	L-5	L-4	5 / 5 - 96%	Keep
Boat Tour & Millennium Park	L-5	L-5	L-5	L-4	L-5	5 / 5 - 96%	Keep
Makerspace	L-4	L-5	L-4	L-4	L-5	5 / 5 - 92%	Keep
Museum of Science & Industry	L-4	L-5	L-5	L-4	L-5	5 / 5 - 92%	Keep
Robotics	L-4	L-5	L-5	L-3	L-5	5 / 5 - 88%	Keep
CAD hands-on	L-4	L-5	L-4	L-4	L-5	5 / 5 - 88%	Keep
Social justice initiative	L-3	L-5	L-5	L-4	L-5	5 / 5 - 88%	Keep
CAD/3D printing	L-4	L-4	L-4	L-4	L-5	5 / 5 - 84%	Keep
CME hands-on	L-3	L-5	L-5	L-4	L-4	5 / 5 - 84%	Keep
Recreational Sports Center	L-4	L-5	L-3	L-4	L-4	5 / 5 - 80%	Keep
Reflection activity	L-5	L-3	L-3	L-4	L-4	5 / 5 - 76%	Keep- minor changes
IE hands-on	L-3	L-4	L-3	L-4	L-4	5 / 5 - 72%	Keep- minor changes
Learning your educational system	L-3	L-3	L-4	L-4	L-4	5 / 5 - 72%	Keep- minor changes
Resume building	L-4	L-4	L-5	L-4	D-3	4 / 5 - 95%	Keep
ECE hands-on	D-3	L-4	L-5	L-4	L-4	4 / 5 - 85%	Keep
Sticker making/printing	L-3	L-5	L-3	D-1	L-5	4 / 5 - 80%	Keep
Review classes	D-2	L-3	L-3	L-5	L-3	4 / 5 - 70%	Keep- minor changes
Intro. to Eng. field	L-4	L-3	L-4	L-3	D-2	4 / 5 - 70%	Keep- minor changes
Nano lab	D-2	L-4	L-3	L-4	D-3	3 / 5 - 73%	Keep- minor changes
Technical writing	L-3	L-3	D-2	L-3	D-3	3 / 5 - 60%	Keep- minor changes
Coding	D-2	L-3	D-2	D-2	D-2	1 / 5 - 60%	Major changes
UI Labs	D-1	D-2	D-2	D-3	D-2	0 / 5 - 0%	Substitute

*For calculating overall satisfaction, first we count the number of groups, which like the activity and then calculate the percentage using the following equation:

$$Satisfaction\ percentage = \frac{Total\ satisfaction\ sccore\ among\ the\ groups\ which\ liked\ the\ module}{Total\ possible\ satisfaction\ score\ (number\ of\ groups\ which\ liked\ the\ module \times 5\ (the\ highest\ achievable\ level))}.$$

As Table 4 shows, visiting MHub was the most popular component of the SBP. The Scholars found it as one of the most useful and applicable resources provided by the university to its students. If the satisfaction level for a component dips below 80 percent, improvement is deemed necessary. As an example, while all five groups liked the "Reflection Activities," it received an overall satisfaction score of 76%, prompting a closer look at the written comments which expressed a popular dissatisfaction in the activity's format and duration.

The "Coding" session received a satisfaction score of only 60%, well below the 80% threshold. By perusing their written suggestions, we found that most Scholars did not have any experience in programming, the workshop content was too difficult for them, and the instructor could not communicate with them appropriately. Since learning how to code is critical especially for engineering students, we decided to make major modifications to this component, including selecting a different instructor and using a different language.

Table 4 also shows that our goals for the "UI Labs" field trip were not met. Many Scholars commented that too much technical details were presented by the tour guide, and that a clear connection between the Scholars' majors and technical field trips was much needed.

4.5. Individual presentations

To gather qualitative data on how the SBP affected them, during the concluding ceremony of the SBP, each Scholar was invited to prepare and deliver a presentation to an audience consisting of Cohort 1 Scholars, ambassadors, some key organizing personnel, and family members. The presentations were video-recorded and subsequently reviewed. Table 5 summarizes the talking points, including which parts of the SBP have had the most impact on them, and how they will use their learning going forward.

Table 5. Scholars individual presentation results*

Gender	Favorite part/s	Things learned	Information will be used in the future
F	SJI**, Museum of Science and Industry, CME hands-on	MHub, different fields of Eng., educational system	Importance of the relationship between engineering fields, campus/off-campus resources, course selection
F	Meeting and getting to know all my fellow Scholars	Building a resume, class expectations	Contacting the ambassadors, mentors, and fellow Scholars
M	different fields of Eng., hands-on	Different resources at the University and their opportunities	Contacting the ambassadors, mentors, and fellow Scholars
M	Architecture Boat tour	MHub	Contacting the ambassadors, mentors, and fellow Scholars

F	Museum of Science and Industry	ECE hands-on materials	Apply her knowledge in her field
M	Lectures, field trips, recreational sport center, hands-on	Importance of programming, student Orgs., resume building	Python programming
M	Museum of Science and Industry, Architecture Boat tour	MHub, codding, mentorship	Better utilization of the resources
M	Museum of Science and Industry, UI Labs, MHub, hands-on	Student Orgs.	Determination
M	Interactive relationship with ambassadors	Different resources at the University, Educational system	Better utilization of the resources, building resume to apply for internship
F	Hands-ons	Mentorship	Better utilization of the resources
F	Mentorship	Makerspace, MHub	Confidence
M	Communication and teamwork	Different resources at the University, Educational system	Better utilization of the resources
M	Museum of Science and Industry	Makerspace, MHub	Utilizing the knowledge of Makerspace and MHub to finish projects earlier and faster
F	Bonding with other Scholars, mentorship	Picking the right major, sense of preparedness	Better utilization of the resources and mentorship
F	Bonding with the other Scholars	Different jobs in each major	Better utilization of the resources

* One of the Scholars was absent on the last day.
** SJI: Social Justice Initiative

It can be seen that scientific field trips such as Makerspace, MHub, and Museum of Science and Industry are the most favorite parts of the program. Moreover, bonding with other Scholars and mentorship are considered as one of the most successful goals achieved during the SBP. Also, the majority of the Scholars have plan to utilize the knowledge and resources that they learned through the program.

While we have been able to measure the satisfaction level of the Scholars with respect to the mediatory course interventions, a quality assessment of such interventions is not possible immediately after the SBP. Our goal is to compare the grades of the Scholars in certain introductory math and science courses with the grades of another comparable cohort of the first-year students who were not subject to this intervention. Through this comparison, we will determine the quality of the remedial courses.

5. Conclusions and Future Work

Data collected from these evaluations indicate that the Scholars expectations have been largely met. For most Scholars, the SBP has been a valuable experience. As stated earlier, the most important goals of this program are academic success, peer and faculty mentorship, professional goals, community involvement, and emotional support, and we have designed each component of the SBP to achieve these goals. The assessment data show that the Scholars value their experience as a whole and plan to utilize their acquired knowledge during their education at the University. Also, all 18 Scholars in Cohort 1 successfully finished their first semester at University Illinois at Chicago and advanced to their second semester. While it is hard to quantitatively measure the impact of the SBP on this academic success, we believe that the SBP has had a significant contribution to this success.

Ashley et al. [4] made some recommendations to enhance the quality of STEM bridge programs. We now review some of their suggestions as well as what we have done or plan to do to make improvements in the future:

- Create an initiative to document and publish bridge program descriptions, goals, and outcomes: It is important for the findings to be documented in peer-reviewed journals that are readily accessible, in order to establish and disseminate evidence of a successful bridge program. This paper is the beginning of such an effort. We are currently working on a future paper detailing an analysis of the personal interview results.

- Report lessons learned from prior (unsuccessful) iterations to guide the development of future programs: The complexity of interventions such as bridge programs are well recognized by design-based research, which acknowledges that design and evaluation are iterative processes that help to inform each other [27]. As mentioned, the SBP is a part of an ongoing project to support highly-talented, low-income students. In total, two cohorts will have completed the SBP by the end of this project. Cohort 1 includes 18 Scholars recruited in Fall of 2018; Cohort 2 will consist of 12 Scholars to be recruited in Fall of 2019. The SBP presented herein has been developed for Cohort 1, and all aspects that were effective will be repeated for the next SBP for Cohort 2, while improvement will be continuously made. We intend to eventually compare our findings from the two iterations of the SBP and publish our results in a peer-reviewed journal.

- Report more details of bridge program implementation: In this paper, we attempt to report all the SBP components such as everyday activities (Table 3), the goal of each component, the size of the overall program, the characteristics of the Scholars, etc. A similar level of detail can be expected in the future papers.

- Align bridge program goals and measured outcomes: To prevent disconnectedness between the stated goals and outcomes, we have engaged in a backward design approach. Backward design is a model for course or program development, and it recommends first outlining desired goals, then determining acceptable evidence, and finally planning experiences and instruction [28]. A similar strategy will guide our effort in the development of the next SBP.

Based on our assessment results, we have identified all the SBP components that need attention, from minor changes, such as review classes and technical writing, to a complete overhaul such as the UI Labs field trip. The evaluation results and lessons learned from the SBP execution can ultimately be used to build a sustainable Summer Bridge Program for all first-year engineering students in the future.

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