Implementation of a Virtual Job Shadowing Experience for STEM Students Participating in a Corporate-STEM Connection Program

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Abstract

This evidence-based paper investigated the impact of a virtual job shadowing program on first-year university students' retention in STEM majors, knowledge of STEM careers, and motivation to continue in STEM majors. Research shows that most students enter STEM majors with little knowledge of what a career in their specified major does. In order to address this problem, this study provided first-year students the opportunity to job shadow a near peer mentor who was participating in a cooperative education program. As a result of the impact of Covid-19 on intervention activities, the development of a virtual job shadowing experience for first-year students was designed and implemented. This paper outlines the details of implementation of such a virtual experience, the challenges encountered, and students' overall experience with the virtual program. The virtual shadowing experiences consisted of virtual meetings between the first-year student and a near peer mentor. During the meeting, the mentor and first-year student conversed about the company where the co-op student was working, major-specific coursework, career-related information, skills required by the profession, goal-setting strategies, and how to overcome challenges. The main questions investigated include: (1) what learning experiences were provided to first-year students?; (2) to what extent were students satisfied with their virtual shadowing experience?; (3) what strengths were identified to ensure implementation fidelity? and (4) what areas for improvement were identified to ensure the quality of the virtual learning experiences?

During the 2020-2021 year, 34 students participated in at least one virtual shadowing experience at one of 25 companies who participated in the program. Data collection included a survey completed by students before and after they had experienced the program, post program surveys by student mentors, and focus group interviews with first-year students. Results show overall positive experiences from the virtual program. Of those who responded to the survey regarding the virtual shadowing experience (n=28), 93% somewhat or strongly agreed that the experience met their expectations, 96% somewhat or strongly agreed that the experience allowed them to learn about industry, and 92% somewhat or strongly agreed that they would recommend the experience to others. In addition, 83% responded that they enjoyed their experience "a lot". Results from the student survey also show 85% of students stated that the job shadowing experience makes them want to continue in their major. This paper addresses how the implementation can be improved and what services may need to be added for future virtual job shadowing experiences to improve students' learning experiences in a virtual job shadowing program.

Introduction

Research shows that most students enter STEM majors with little knowledge of what a career in their specified major does. Many educational programs aim to help students develop an interest in STEM fields, understand the concepts behind the discipline, and encourage students to believe they can be successful in STEM careers. Our program, Zip to Industry, attempted to bridge the

gap between student educational knowledge and knowledge of what a typical day in a STEM career looks like for first-year STEM students. Students were given the opportunity to shadow a near-peer mentor, such as students currently enrolled in an internship or co-op educational program.

The first two years of running this program were held in-person, with first-year STEM students shadowing their mentors during sessions that lasted up to four hours. However, with the emergence of the Covid-19 pandemic in the third year, our program was interrupted and we needed to adapt to meet this new situation. As such, our team developed a virtual experience that attempted to emulate many of the key elements from the first two years (that were offered in-person).

Virtual Shadowing

Published research on virtual job shadowing is fairly limited, but some literature exists that looks at the benefits of virtual experiences, specifically in the era of Covid-19. For example, a recent work has shown that virtual programs can increase the knowledge, understanding, and experience in STEM related subjects for students [1]. While it may be commonly known that internships and on-the-job experiences help undergraduate students, specifically underrepresented students in the STEM field [2], virtual experiences for students remains a rather new research topic.

As it relates to virtual shadowing experiences, a recent work from Gill [3] emphasized that college students involved in virtual work experiences engage in a work environment that better reflects future career working conditions and may give these students an advantage in their future careers. As the world continues to become more digital in nature, having the skills to participate in this working environment will become ever more important. Research has also shown that students who participate in remote learning or remote workplace experiences are better able to evaluate their career choice pursuits [4] and decide whether this potential job path is right for them.

Virtual shadowing programs also help solve some modern issues that exist today in traditional job shadowing or internship programs. Such issues include providing more opportunities to more students (specifically to disadvantaged students), allowing caregivers the flexibility to remain at home, and cutting the need for transportation that some may lack [3], [4]. Studies by Fung, Bayerlein, and Stoeger have also concluded that minority and underrepresented students benefit from having an e-mentorship [1], [4], [5]. As we move towards a more virtual world, and strive for more diversity in STEM related careers, virtual shadowing programs provide solutions and opportunities for these situations.

While there is literature that shows some benefits of virtual programs [6], other research identifies the trade-off of running a virtual program versus an in-person one. For example, in a study involving medical technology students, Yu [7] found that traditional internship students performed better with decision making, goal achievement, communication skills, and knowledge retention than students who received a virtual experience. Medical technology interns from the traditional internship program faced more real-world experiences and were better engaged than those in the virtual internship group. However, more research is needed to determine the applicability of these conclusions beyond the medical technology area.

Another important issue that has been explored is how businesses that offer and host virtual experiences ultimately feel about the use of a virtual platform. While some research studies [3], [4] indicated that some businesses may find it difficult to adapt or accept a virtual way of doing work, one research work by Dent and White [8] shows that businesses may react positively to implementing a virtual experience.

In light of the limited research that exists within the virtual experience space, our team reports the results of implementing virtual job shadowing experiences during the pandemic, including students' overall perceptions of the virtual program.

Methods

A. Student Selection

As it relates specifically to the third year of the program (i.e., the virtual experiences), 129 students were invited to participate in this study prior to the start of the Fall 2020 semester through emails sent to incoming first-year STEM students. This email contained an invitation to participate in the intervention program and a preliminary survey that students had to complete. The survey included questions about their interest in participating in the program, background questions related to their STEM experiences in high school, commitment to the major, as well as scales on STEM interest, self-efficacy, and perceptions of barriers and supports for completing their major. Of the students who received an invitation email, 35 students did not respond, 2 students accepted but later dropped from the program, 1 student accepted but later changed their major to a non-STEM major, 1 student declined the intervention, and 1 student was no longer enrolled with the university at the time of the intervention cohort selection. Of the students who expressed interest in the program and who completed 70% of the survey, 50 students were randomly selected to take part in the intervention program, with an oversampling of female and minority students. By the end of the program, 34 students completed at least one experience, as 16 students dropped from the program without completing any activities, likely due to a loss of interest as the semester progressed, and availability during the scheduled experiences.

From the remaining students in the pool, a matched comparison group of students were selected using gender, race, major and GPA as selection variables to the extent that it was possible. At the beginning of the intervention, the two groups had similar ACT scores and high school GPA (no statistically significant difference between the two groups on these measures), which indicated the two groups were comparable on these dimensions. Table I presents a summary of the demographics of the intervention and comparison groups.

B. Program Implementation

Moving a job shadowing experience online presented many challenges in an attempt to emulate the aspects of the in-person experience (from the first two years) in order to ensure consistency in the program. While the in-person shadowing experience from prior years consisted of a four-hour visit for each experience, the research team settled on one-to-two hour virtual experience sessions with the co-op students, as longer time frames were not feasible virtually. Co-op students who served as near-peer mentors were instructed to focus the topics of conversations on the skills required for a STEM career, setting career goals, overcoming challenges in a STEM major, as well as sharing company-related information or questions.

While students are unlikely to obtain the same experience virtually as they would in person, these one-to-two hour discussions and activities were an alternative given the restrictions of a global pandemic. During the course of the virtual program, 34 students participated in at least one virtual shadowing experience at one of the 25 companies who participated in the virtual program. A total of 62 experiences were completed for an average of 1.8 experiences per student. It is noted that two first-year students were paired with one mentor in each virtual experience.

Table I- Student Demographics of Comparison and Intervention Groups

Cohort Demographics	Comparison Students		Intervention Students	
Gender				
Male	27	79%	22	65%
Female	7	21%	12	35%
Prefer Not to Answer	0	0%	0	0%
Race/Ethnicity				
American Indian	1	3%	0	0%
Asian-American	1	3%	1	3%
Black or African-American	1	3%	1	3%
Biracial	1	3%	0	0%
White, Not Hispanic	30	88%	29	85%
Hispanic or Latino	0	0%	2	6%
Prefer Not To Answer	0	0%	1	3%
All Minorities	4	12%	4	12%
Total	34	100%	34	100%

Data Collection

Various data were collected to help answer the questions posed by this research study. Data collection procedures were reviewed and approved by the Institutional Review Board at the university.

1. A post-shadowing survey was sent to the intervention students and their co-op mentors following each shadowing experience. Survey questions focused on documenting the activities during shadowing experiences, students' satisfaction with the experience and their interactions with their mentors. Similarly, co-op and intern students who served as mentors were also asked to complete a post-shadowing survey following each shadowing experience. The mentors reported the types of activities completed during shadowing and the content of their discussions with their matched mentees. A total of 53 responses were received from first-year students corresponding to 53 shadowing experiences (out of a total of 62 experiences) and 26 responses from the mentors (some mentors were paired with more than one first-year student).

2. An end-of-program survey was sent to the intervention students asking them to rate their satisfaction with the program overall, with 28 students out of 34 completing this survey, for a response rate of 82%.

3. Focus group interviews were conducted with a sub-sample of intervention students virtually at the beginning of spring semester 2021. The purpose of the focus groups was to gather input from participants for formative evaluation to inform program improvement.

4. Retention-in-major data were collected through institutional research databases for intervention and comparison students at the beginning of Fall 2021.

Results

A. Program Activities

While virtual shadowing may be limited in exposing students to an authentic work environment, survey results indicated that first-year students engaged in a range of activities during that time. For example, 47% participated in a video overview of the company, 26% participated in a meeting, and 15% observed some aspects of hands-on work. This is in contrast to the program's prior years when over 80% of students participated in a tour of the company, and over 60% observed hands-on work. From the survey results, the virtual experiences tended to focus on discussions and reflections with the co-op mentors, which is expected given the format. A summary of activities reported in the post-experience survey by students (53 responses), and mentors (26 responses) is provided in figure 1.
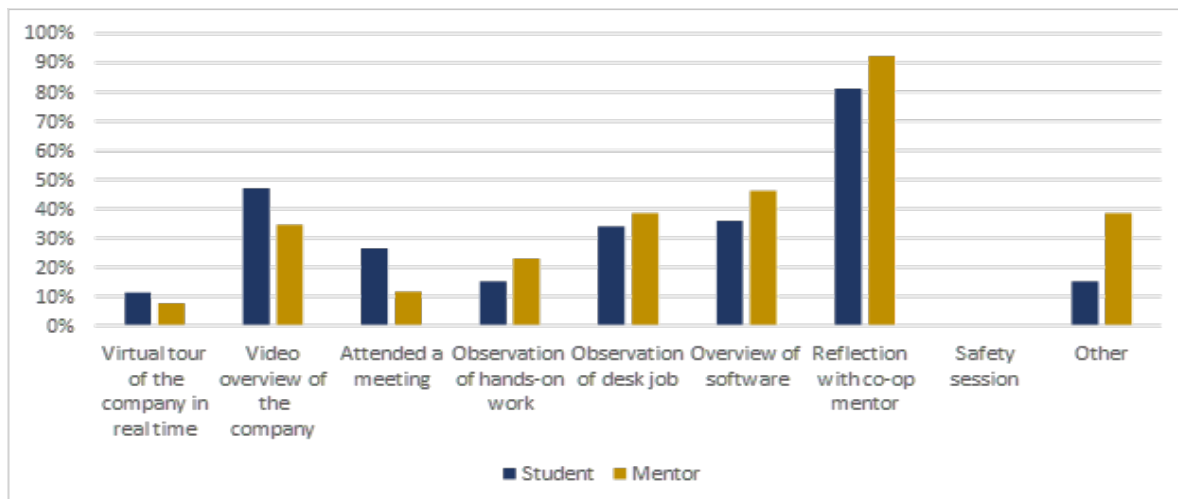

Fig. 1. Intervention activities students participated in during their virtual job shadowing experiences.

In addition, in focus group interviews, students commented on the value of learning about a specific company, or an engineering field, while recognizing the limitations of a virtual environment. For example, one first-year student stated:

> "I not only got an interaction with an intern, but also interacted with a manager which was really cool. They both gave me tons of insight into the CAD modeling of civil engineering and site development ... I thought it was a cool experience. I would definitely do it again."

Several students also brought up how the virtual nature of experience made it easier to participate even if they lost some connection to real world work experiences and missed out on observing or participating in hands-on activities.

B. Program Impact

In terms of program impact, retention data from year 1 to year 2 indicate that the virtual intervention had a positive impact on students who participated in the program. Students in the intervention group were retained in STEM majors at 85% (Fall-to-Fall), compared to a retention rate for the comparison group at 71% (Fall-to-Fall). A Chi Square analysis of association between the two groups showed the difference in retention was not statistically significant, χ^2 (1, N = 68) = 2.138, p = .05. We also saw a modest increase in retention at the institution for students who participated in the intervention program (91%), compared to the matched group of students who did not participate in the intervention (82%). However, the difference was not statistically significant. The retention rates are shown in figure 2.
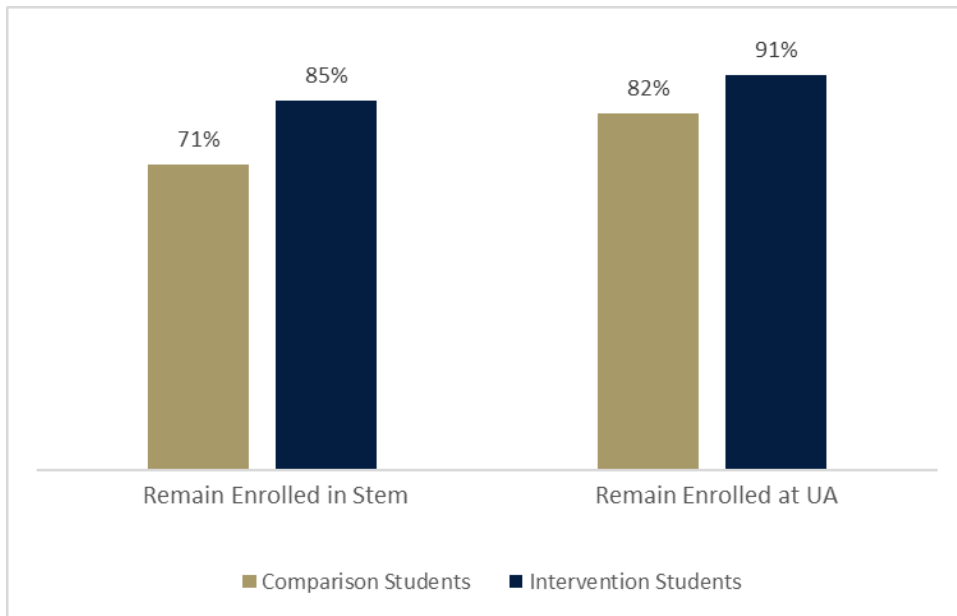

Fig. 2. Fall-to-Fall Retention Rates of Intervention and Comparison Students.

For comparison, STEM retention of all students who received an invitation to participate (N=129) in the study was 68%. This is 17% lower than the students (N=34) who participated in the intervention program. Female retention of all students (N=29) was 86%, which is 6% lower than the retention of female students in the intervention (N=12). Male retention of all students (N=99) was 63%, which was 22% lower than the male students who participated in the intervention (N=22).

Students were asked to complete a survey at the end of each experience and 52 responses were received. Results from these responses indicated that students were satisfied with the overall virtual shadowing experiences. When students were asked about their overall experience, 83%

stated they enjoyed the shadowing experience a lot, and 94% said they were happy to participate. More than 90% of students reported that they have learned something new. In addition, 100% of the students said that this experience made them want to continue their declared profession (15% said "somewhat" and 85% said "a lot"). Details of students' responses are listed in Table II.

Table II- Intervention Students' Perception of Virtual Job Shadowing Program

Statement:	Not at all	Somewhat	A lot
I enjoyed the shadowing experience.	0%	17%	83%
The experience was fun.	0%	42%	58%
The experience was boring.	85%	13%	2%
The experience was interesting.	0%	15%	85%
I'm glad I did this shadowing experience.	2%	4%	94%
I learned something new.	2%	13%	85%
This experience makes me want to continue with my declared major.	0%	15%	85%
I think my peers would like this shadowing experience.	2%	27%	71%

Students were also asked about the quality of the mentoring experiences they received during their shadowing visits. The results indicated very positive interactions as shown in Table III. The most positive interactions reported by students included "the mentors shared information about their own experiences", and "the mentor shared career related information with me". The lowest reported interaction was "the mentor shared goal setting strategies".

Table III - Perceptions of Interactions with Mentors (N=52)

	SD	D	N	A	SA
The mentor was knowledgeable about my career and profession.	0%	2%	4%	37%	58%
I felt comfortable talking to my mentor about my career goal.	0%	0%	12%	27%	62%
The mentor spent time to reflect on the shadowing experience with me.	0%	2%	15%	25%	58%
The mentor explained the sets of skills required by the profession.	0%	2%	8%	40%	48%
The mentor spent sufficient time with me on the industry site.	0%	4%	8%	19%	69%
The mentor shared information about their own experiences.	0%	0%	2%	17%	81%
The mentor shared goal setting strategies.	0%	10%	19%	33%	38%
The mentor introduced me to many career related work experiences on the industry site.	0%	6%	6%	42%	46%
The mentor shared career related information with me.	0%	0%	6%	35%	60%
I learned so much from my mentor.	0%	4%	13%	31%	52%
I would recommend the shadowing program to my peers.	0%	0%	8%	29%	63%

Strongly Disagree (SD), Disagree (D), Neither Agree nor Disagree (N), Agree (A), Strongly Agree (SA)

Table IV - Mentor Responses to Interactions with First-Year Students (N=26)

	SD	D	N	A	SA
I spent time with first year student to reflect on the shadowing experience.	0%	12%	4%	46%	38%
I explained the sets of skills required by the profession.	0%	0%	4%	69%	27%
I spent time with the first-year student on the industry site.	19%	15%	12%	38%	15%
I shared information about my own experiences.	0%	0%	0%	19%	81%
I shared goal setting strategies.	0%	4%	23%	50%	23%
I introduced the first-year student to career related work experiences on the industry site.	4%	8%	4%	54%	31%
I shared career related information with the first year student.	0%	0%	0%	50%	50%

Strongly Disagree (SD) Disagree (D) Neither Agree nor Disagree (N) Agree (A) Strongly Agree (SA)

In addition to completing a survey after each shadowing experience, students were also sent a survey about their overall experience at the end of the program in April 2021. Of those who responded to the survey regarding the virtual shadowing experience (n=28), 93% somewhat or strongly agreed that the experience met their expectations, 96% somewhat or strongly agreed that the experience allowed them to learn about industry, and 92% somewhat or strongly agreed that they would recommend the experience to others.

Table V- Satisfaction with Virtual Experience Overall

Statement	SD	D	N	A	SA
The virtual shadowing experience met my expectations.	0%	7%	0%	52%	41%
The virtual shadowing experience allowed me to learn about industry.	0%	0%	4%	32%	64%
I would recommend virtual shadowing experience to others.	4%	0%	4%	21%	71%
It was challenging to find out information about industry from virtual shadowing.	29%	32%	14%	18%	7%

Strongly Disagree (SD) Somewhat Disagree (D) Neither Agree nor Disagree (N) Somewhat Agree (A) Strongly Agree (SA)

When asked if any aspects about the virtual experience met or exceeded their expectations, students commented that they appreciated that it was easier to attend, they felt comfortable conversing with their mentors, they were able to make connections with representatives of the company, and they were pleased with the amount of information that was provided through the experience.

Table VI- Aspects of the Experience that Met or Exceeded Expectations

Theme	Frequency	Sample Student Comment
Easier to attend	2	*I liked how it was able to be worked around our class schedule. I also liked all of the information we were able to get from the experiences.*
Made a connection to mentor/people in company	7	*I liked that we were able to speak with students who were also inco-ops and only a few years older than us in a similar place in their lives*
Diversity of info provided	6	*The PowerPoint presentations of the virtual experiences were very informing and had a lot of detail which exceeded my expectations. The amount of shadowing opportunities also exceeded my expectations since we are in a pandemic.*
Effective discussion platform	3	*It was very open and involved, allowed for the participants to askquestions and get quick responses.*

The survey also asked students to provide suggestions for how to improve the virtual shadowing experience. The two most popular suggestions were a tour of the company and an opportunity to meet more people in the company. Detailed descriptions of areas of improvement are reported in Table VII.

Table VII- Suggestions to Improve Virtual Experience

Theme	Frequency	Example comment
Tour	4	*I wish some companies would take us on virtual tours of the company so it felt more like an in-person experience without it actually being an in-person experience.*
More info/meet more people	4	*Describe what aspects of the job no one talks about and wants to avoid.*
Hands-on	1	*Have tours of the companies and see hands-on work rather than word of mouth descriptions and slideshows.*
More organization	2	*I think a company overview as well as a schedule for the day would be helpful and more organization would make the experience more enjoyable*

Discussion

Compared with earlier implementation of the program that occurred face-to-face, fewer students completed the virtual shadowing experiences, as 16 students out of the 50 who were initially selected dropped out of the program at the beginning stages, without completing any activities. This is likely due to the delay in starting the experiences compared to prior years. It was such a turbulent time in Fall 2020 for co-ops and employers that starting early in the fall semester was not feasible. The Engineering co-op department were delayed in placing co-ops as the economic and virtual nature of the pandemic left many companies waiting later to accept co-ops. Since employers do not want co-ops who have just begun their experiences acting as representatives of the company, the beginning of shadowing was delayed until October or November depending on the discipline. By that time, a number of first-year students dropped out of the program, likely due to getting too busy to engage with the shadowing program.

Additional mentor training would also improve the connections between first-year students and co-ops. However, it is difficult to do so because 1) employers do not want mentors spending extra time in preparation during work hours, 2) there are no incentives provided for mentors to use their own time to prepare or attend training, and 3) to be beneficial, the training would need to be more site specific than the general training provided, and resources in staff time and mentor availability were not present in 2020-2021 for that type of training. It is worth noting that the inclusion of two students per mentor/virtual experience was valuable, as students appreciated the ability to listen as the other mentee asked questions.

Finally, the role of the project coordinator was instrumental in the success of these virtual experiences. Setting up co-op experiences requires establishing relationships with industry, and these experiences involve commitments from the university, the employer and the student. In a virtual shadowing setting, there was potential for negatively impacting the relationship between the university and industry in case a student failed to attend the virtual experience. This was proactively mitigated by the project coordinator through consistent reminders to the first-year students, including initial involvement in the virtual meeting to ensure all the participants arrive. We found this practice to be important to the success of this program.

Conclusion

Owing to the Covid-19 pandemic, we modified our job shadowing program to offer virtual job shadowing experiences. Our virtual job shadowing experience highlights one way an online platform can be used as an alternative learning experience when in person experiences are not available, or to complement an existing in-person shadowing program. Online programs can reach more people and have the ability to connect people from further away. A virtual job shadowing experience could connect first-year students around the world to near-peer mentors and give them workplace knowledge they would otherwise go without. An online platform also mitigates socioeconomic factors as well since some students may not have the transportation required for an in-person shadowing program.

Acknowledgment

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