Leveraging the U.S. Army JROTC Program to Increase the STEM Workforce Pipeline

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Introduction

Numerous reports have documented our country's critical and growing need for STEM savvy workers –from technicians and middle-level managers to engineers and scientists. According to the Innovation and STEM Fields issue of the New American Economy, the number of advertised STEM jobs outnumbered unemployed STEM workers by more than 13 to 1 in all but 10 states [1]. Compounding the growing demand for STEM workers is the declining interest in STEM by high school graduates, especially among those populations typically underrepresented in STEM.

However, there is a large, diverse, and unique population that has largely been left untapped by the traditional STEM education approaches, the students who participate in the Junior Reserve Officer Training Corps (JROTC). The JROTC program was established in 1916 and is a jointly funded program between the federal government and local school districts. The program's goals include reducing the high school drop-out rate, improving school attendance and academic achievement, and preparing young people for careers in the military. With more than 500,000 participating students, JROTC is the largest youth training and development program in the United States [2], [3]. The character development education offered by the JROTC program is especially effective with at-risk youth and the program has higher-than average representation for minority students, approximately half are female, and is strongly represented in schools serving economically disadvantaged populations [2], [3]. Thus, the JROTC student population is an untapped population who could be engaged in STEM academics and careers. However, this population has been somewhat overlooked by STEM interventions, evaluations, and research. Thus, this article shines a light on this large and diverse group of youth by reporting on one STEM intervention implemented with this population, the JROTC STEM Leadership Academy.

The JROTC STEM Leadership Academy is a 6-day, 5-night residential summer camp that engages exiting 9th, 10th, and 11th grade JROTC students, called cadets, in STEM learning while showing them applications of STEM as career opportunities. It is recognized by the US Army Cadet Command as an alternative to the required annual Junior Cadet Leadership Challenge (JCLC) camp that is offered to 10% of the national JROTC population. The Academy has three focus areas: JROTC, STEM Learning, and Workforce Experiences. The JROTC component serves as the foundation upon which the STEM Learning and Workforce Experiences are built. It consists of engaging cadets in the traditional JCLC activities including drill and formation, rappelling, drown proof training, land navigation, and military leadership. The STEM Learning component consists of engineering design challenges that center around a locally relevant STEM industry (e.g., aviation, advanced manufacturing). Each challenge requires students to apply their high school mathematics and science content knowledge to design a technological solution to the problem posed. Finally, the Workforce Experiences serve to reinforce the 21st Century workforce skills learned and practiced during JROTC and STEM activities by letting students see first-hand the industries, jobs, and people that make up the STEM workforce in their community. These three components are then woven together to form a well-connected series of engaging events that help students begin to picture themselves in STEM careers.

The short-term goals of the Academy are to 1) increase student STEM content knowledge, 2) increase interest in STEM fields and careers, 3) increase STEM self-efficacy, 4) increase teamwork self-efficacy, and 5) increase awareness of STEM jobs. The long-term goal is to support students' trajectory toward careers in STEM fields.

In 2018, with funding from the National Science Foundation, a three-year mixed-methods longitudinal study was launched to study the effect this blended JROTC and STEM intervention had on JROTC cadets. The study was guided by three research questions:

RQ1: What are the unique and synergistic contributions of the (1) JROTC program, (2) STEM learning, and (3) workforce experiences, when implemented in a residential summer program, to broaden STEM career interest, preparation, and aspirations, especially for students from underrepresented populations?

RQ2: What are the short-term (immediately after intervention) interest, preparation, and aspirational shifts that occur in student cadets as the result of the blended JROTC and STEM intervention?

RQ3: What are the long-term (up to 3 years after intervention) interest, preparation, and aspirational shifts that occur in student cadets as the result of the blended JROTC and STEM intervention?

Theoretical Framework

Given the ultimate goal of the Academy is to influence the choices students make after high school, it was important to understand the inputs and constructs that lead to a person ultimately choosing a STEM career. Social Cognitive Career Theory (SCCT) [4], has been used by many studies to explore the impact of STEM interventions on interest, goals, and career choices [5], [6], [7]. SCCT is based on Bandura's model of reciprocal determinism, which suggests performance is the result of the interaction between personal, behavioral, and environmental factors which accounts for the relationship between past and future behaviors [4]. The theory is particularly useful as it suggests causal connections between person inputs, environmental factors, and behaviors over time [4]. Thus, SCCT provides a strong theoretical framework to guide the study of this unique population and the impact of different STEM and workforce experiences.

Figure 1 presents the set of variables (or constructs) and their relationship to each other within the SCCT model. The model begins with person inputs and background environmental influences. Person inputs are individual difference variables such as race, ethnicity, sex, and gender. Background environmental influences are the environmental influences or contextual factors that precede learning experiences and lay the groundwork for an individual's interest and choice goals trajectory [4]. Learning experiences, help students develop and refine skills, identify personal performance expectations (outcome expectations), and form a sense of self-efficacy to be successful in a vocation. Interest is defined as "patterns of likes, dislikes, and indifferences regarding career-relevant activities and occupations" (p. 88) [4]. Interest is considered by many to be a highly influential factor in career choice and is related to self-efficacy or belief in one's ability to successfully execute actions to reach a performance goal [4]. Interest is content-specific and develops in a series of phases usually triggered by situational influences [8]. Once sparked, interest should be supported by additional experiences or social interactions if that interest is to be maintained and result in the individual choosing to stay engaged [8]. Maintaining interest in STEM over time is a major challenge for middle and high school students [9]. Thus, short-term interest in STEM, triggered by a single intervention like the STEM Academy, has the potential to set students on a path toward STEM careers but may not have long-term effects if experiences after the intervention do not foster sustained interest. If interest is maintained and internalized, the student will begin to set goals and intentions for future activities, choice goals, which lead to specific activities related to those interests. Finally, choice actions take the form of exploring new career possibilities, enrolling in an extracurricular club, or taking advanced coursework [4], [10].

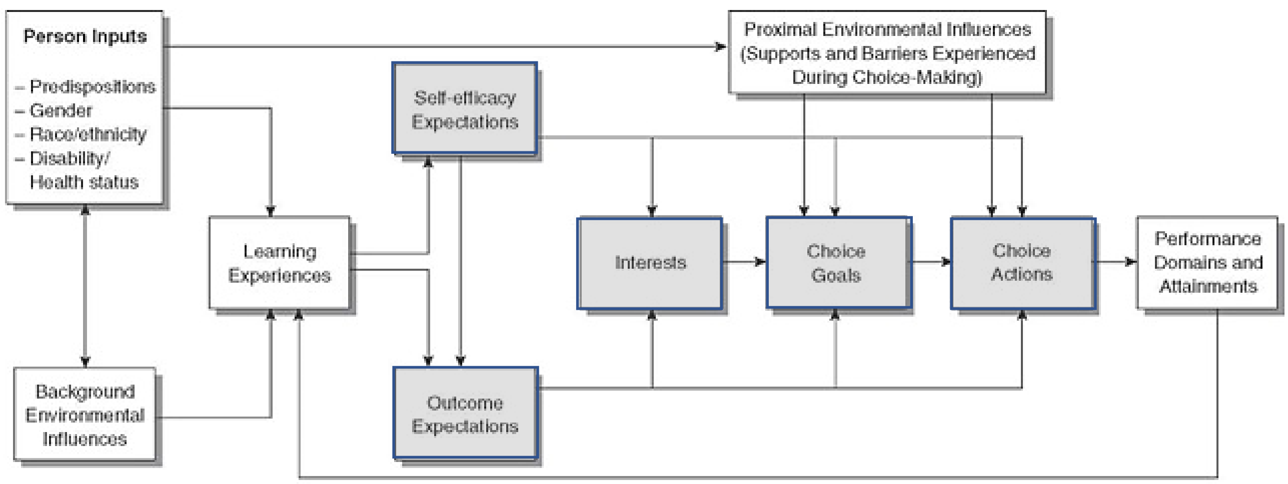

Figure 1. Target Constructs of Social Cognitive Career Theory

The goal of the JROTC STEM Leadership Academy is to produce students who are more likely to continue along the STEM workforce pipeline. Since SCCT accounts for the dynamic interaction between an individual's background, person inputs, and learning experiences that lead to shifts in self-efficacy, interest, outcome expectations, choice goals, and choice actions, the research team decided to root the project's research design in SCCT's theoretical framework and focus on the five target constructs (shaded in Figure 1) for studying short-term and long-term impacts.

Participants

The US Army Cadet Command requires every JROTC program to offer a summer JCLC camp to 10% of its population. Therefore, the number served by the Academy is approximately 160 cadets per year as the JROTC population in this school district was approximately 1600 students. Students are selected to participate in the summer camp based on additional criteria set forth by Cadet Command: 1) student must have at least a 2.5 GPA, and 2) student must have completed a school year of JROTC. Finally, program leaders wanted to target students early in their high school career to allow more time for students to make shifts in their academic work, so preference was given to exiting 9th and 10th grade students. JROTC instructors from all 12 public high schools in the largest school district in the state followed these guidelines to recruit students to participate in a JROTC summer camp. Once all names and permissions were collected, we applied an unequal random assignment methodology to assign approximately 160 cadets to the treatment group (the JROTC STEM Leadership Academy) and 30 cadets to the control group (a traditional JCLC camp). The reasons for unequal randomization concerned our interest in learning more about the aspects of the Academy and to accommodate the logistical limitations of both programs. For example, available slots for students sent to the JCLC camp from a single school district are limited to no more than 30. Additionally, each district is required to send along 4 JROTC instructors to support the JCLC camp, taking away from the number of JROTC instructors available to teach at the Academy. The STEM Academy is designed to serve up to 160 students and decreasing this number could have unanticipated impacts on the study of the Academy model. The limited size of the comparison group to 30 per year, assuming a medium effect from an independent t-test comparison without covariates, resulted in a slightly underpowered design (.71).

The timeline of the project allowed for two cohorts of cadets to be studied, the 2018 Academy and the 2019 Academy along with their counterparts in the control JCLC camp. Thus, a total of 314 cadets participated in this study (see Table 1).

Table 1. Cadet Participants by cohort

	2018	2019
Participants	127 Academy 32 JCLC	125 Academy 30 JCLC
Gender	52% Female 48% Male	45% Female 55% Male
Race/Ethnicity	44% African American 37% Caucasian 19% Asian, Native American, Multiracial	33% African American 40% Caucasian 27% Asian, Native American, Multiracial

The data collected in 2018 and 2019 on these exiting 9th, 10th, and 11th grade cadets has allowed time for analysis of the short-term results. The first group of graduating seniors from the 2018 cohort graduated in 2020 for a total of 49 participants. Of that number only 44 cadets who graduated in 2020 completed the study (44 interviewed and 31 surveyed). Therefore, we will report on short-term impacts with confidence but hold our judgement in reserve regarding long-term impacts until more students complete their senior year. We anticipate an additional 111 cadets to graduate in May 2021, from either the 2018 and 2019 cohorts, and are conducting final data collection now.

Methods & Instrumentation

Given the interconnectedness of the SCCT constructs, the data collection and analysis methods needed to be diverse enough to capture a complex and dynamic process. Therefore, a mixed-method randomized design was used to compare the treatment group (Academy cadets) to the control group (JCLC camp cadets) in both short-term and long-term effects.

The primary data collection instrument was a 70-item questionnaire with 12 subscales that looked at four major outcomes: 1) workforce skills, 2) STEM competencies and interest, 3) future plans, and 4) camp satisfaction. Listed in Table 2, these subscales were either developed by the research team to detect specific constructs (e.g., confidence describing industries), or adopted for use because they had prior evidence of validity and reliability (e.g., STEM Semantics Survey). All subscales were tested and found to be reliable and sufficient to cover the constructs under study. This instrument was administered to all cadets prior to and upon completion of their JROTC camp experience (Academy or JCLC camp) as well as at the end of their spring semester of their senior year of high school. The instrument also includes open-ended response questions to help better understand the student experience in his/her own words. This instrument was developed to measure indicators of impact on the SCCT constructs of outcome expectations and self-efficacy.

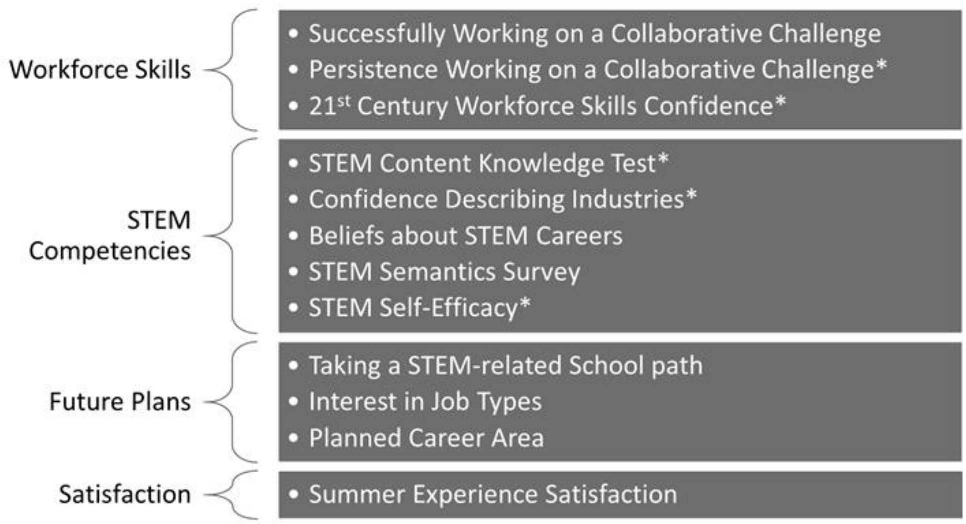

*Figure 2: Outcomes and Subscales of the Pre/Post Test. Note: * indicates significant differences favoring Academy Cadets.*

To supplement the pre/post assessment we collected qualitative data through interviews and student reflection journals. At the end of each day of the Academy, students were given reflection prompts about the day's activities. Students kept an electronic journal which captured a record of all their responses to each prompt. These journals were analyzed and compared against the findings from the pre/post survey to better understand student attitudes toward STEM, big ideas students took away from the Academy, and verify quantitative results.

Furthermore, to study the interests, choice goals, and choice actions of students long-term, we developed a 15-item interview protocol that is administered to each student during the spring semester of their senior year. This protocol includes questions about 1) students' academic choices in high school, 2) JROTC and their camp experience, and 3) plans and actions related to their future career choice. The purpose of the interview is to 1) uncover clues about what career goals students have, 2) hear first-hand about influences for their career choice, 3) listen for how the JROTC camp (Academy or JCLC camp) affected them, and 4) document any actions students took to achieve their goals (e.g., enroll in college, enlist in military, enter workforce).

To examine short-term impacts an analysis of posttest differences was completed for all 12 sets of variables. We used ANCOVA to determine the significance of the differences. The analysis of covariance is an appropriate data analysis strategy for pretest-posttest control group designs like the one we used here. The ANCOVA helps reduce error variance related to individual differences and yields results (when assumptions are met) that show differences at posttest independent of pretest performance. In addition, open-ended response items were coded and mined for themes related to the four target outcomes: 1) workforce skills, 2) STEM competencies and interest, 3) future plans, and 4) camp satisfaction.

Data collection and analysis of the long-term impacts is still underway. It involves using a repeated-measures mixed-model ANOVA to look at the profiles of the different treatment groups over time. This helps us better detect the stability of short-term shifts over the course of students' high school years after treatment. Additionally, each interview transcript is analyzed for target constructs related to long-term effects including: 1) interest, 2) choice goals, and 3) choice actions.

Finally, it should be noted that analysis began with testing the effectiveness of the unequal randomization into treatment and control groups. We examined the 11 sets of variables at pretest (excluding the posttest only items) to determine what characteristics separated campers from non-campers, and to determine whether the randomization led to equivalent groups. There was no significant difference between those cadets who attended a camp (Academy or JCLC) and those who did not attend a camp. Our comparisons between the STEM Academy group and the JCLC control group were all nonsignificant in both cohorts thus the two groups were relatively equivalent prior to the camps. This evidence allows us to conclude that our sample is representative of the larger JROTC population in this region.

Results

Looking back at the research questions, the first question was related to linking outcomes with one or more of the three program inputs: JROTC, STEM Learning, and Workforce Outcomes. Before this question could be answered, however, it was important to confirm that target changes manifested into real shifts in student knowledge and attitudes. Thus, identifying the short-term outcomes was essential to answering the first research question. After two years of replicating quantitative and qualitative findings, we can report that Academy cadets are significantly different from control JCLC camp cadets in five areas post intervention (see Table 2).

Table 2. Quantitative differences favoring Academy cadets over control cadets

Scale	2018	2019
Persistence Working on a Collaborative Challenge	$F(1, 160) = 0.99$, $p = .32$	$F(2, 576) = 8.29$, $P < .0005$ $F(2, 576) = 2.65$, $P = .072$ $F(2, 576) = 5.37$, $P = .005$
21st Century Workforce Skills Confidence	$F(1, 154) = 3.42$, $p = .07$	$F(2, 552) = 12.08$, $p < .0005$
STEM Content Knowledge Test	$F(1, 184) = 3.35$, $p = .024$	$F(2, 575) = 3.76$, $p = .024$

Confidence Describing Industries	F (1,156) 29.78, p < .00005	F (2, 546) = 1.58, p = .21 F (2, 541) = 0.87, p=.42 F (2, 549) =3.17, p =.043
STEM Self-Efficacy	F (1, 154) = 0.47 p = .49	F (2, 556) = 11.67, p < .0005

Note: When a scale is no longer used, multiple F statistics are reported for each item that belonged to that scale.

To support these findings, cadet journal reflections and responses to the open-ended items provide additional evidence that the outcomes detected over two years quantitatively are indeed outcomes in their lives. For example:

The most valuable thing I learned…was leadership and gained confidence in myself.

My favorite part was designing the robot then failing and succeeding. Both are equal in satisfaction since both help me understand more about the mechanics of my robot and the EDP.

The most valuable thing I heard during this academy was that women in stem fields were accepted and normalized even though these fields are male dominated, it was reassuring to know that while there would still be challenges to face as a woman in stem many employers and employees saw women as competent and equal to men.

The most valuable thing for me would have to be being a part of JROTC. It was the basis of my first real learning of community and leadership and a first look into my real options as a career.

One of the most valuable things I heard or saw at stem camp were all the job opportunities around mobile that include stem.

The confirmation of these outcomes led to a refinement of the program logic model which depicts the program components on the outside and short-term impacts on the inside with the ultimate long-term goal in the very center (see Figure 3). The Venn diagram is used to illustrate the relationship between the program components and the replicated outcomes. The overlap in the circles is meant to represent overlap in impact. For example, the positive impact on 21st century workforce skills was reported in journals and open-ended responses:

We communicated much more than usual, and we made a success of a robot.

The most valuable thing I did at camp was learn to work effectively with others who think differently than me.

Teamwork and that failure is [a] *way through success.*

These statements demonstrate that students are using their 21st Century workforce skills in STEM and workplace settings. Thus, this construct is placed where the STEM Learning and Workforce Experiences overlap.

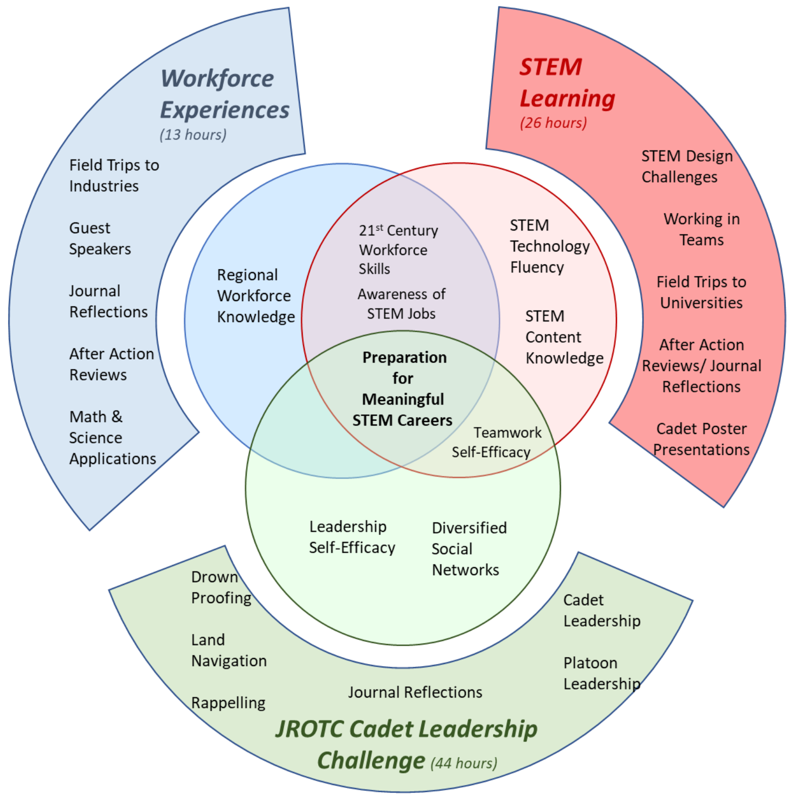

Figure 3. JROTC STEM Academy Logic Model

At this time analysis of the long-term data is still underway. To date only 44 of the 314 participating cadets have completed their senior year. Forty-four were interviewed about their post high school plans, and 31of those responded to the senior year questionnaire that included items and scales that were used pre- and post-camp. Because of the small sample size and the impact of COVID on the senior year experience of these students, the results should be interpreted with caution. Highlights of these data are described below.

One variable we tested was confidence in 21st Century skills like teamwork, leadership, and so on. Below are the means on 1 to 5 scale, with a 5 indicating high confidence in 21st century skills. A two-way mixed model ANOVA found a Group x Time interaction effect. The multivariate result was $F(2, 22) = 3.74$, $p = .04$. As can be seen looking at the table of means in Table 3, the gap in scores between the STEM Academy and JCLC camp was significantly larger in the senior year. At the senior survey time, there was a 0.60 gap between the STEM Academy and JCLC respondents. The STEM Academy group showed stronger confidence in 21st Century skills two years following their Academy experiences.

Table 3. Means and Standard Deviations for Twenty First Century Skills as a Function of Group and Time

	Group	Mean	Std. Deviation	N
Pretest	JROTC Control Camp	3.95	0.74	5
	JROTC Academy	3.75	0.49	20
	Total	3.79	0.53	25
Posttest	JROTC Control Camp	3.79	0.65	5
	JROTC Academy	3.91	0.61	20
	Total	3.89	0.61	25
Senior Year	JROTC Control Camp	3.87	0.39	5
	JROTC Academy	4.46	0.41	20
	Total	4.33	0.46	25

Likewise, two years after completing the Academy, cadets reported the impact of practicing teamwork and leadership skills while at the camp. Below are some quotes from the interviews of 2020 graduating seniors.

It definitely inclined me to stay within the program and continue forward and like move up because I saw people at the JROTC STEM Camp that were like a higher rank than me and I saw the leadership they had and the teamwork and the social ability you know like that and it was inspiring.

I learned that you know come together, working as a team, and being a leader because I had a leadership role the last time I went there.

I learned like you know like how to build things while we were over there, and it just showed me a lot while I was over there and it also showed me how to work together as a team at stem. It just impacted me a lot while I was over there.

I can say like I know when before I even got to JROTC I wouldn't consider myself a leader but when I got there it seemed like I met people and they taught me a lot of different things that I wouldn't know before and it had an impact on my life.

A second scale that showed a difference between the groups was a subcomponent of the STEM self-efficacy items that addressed efficacy for design. Efficacy for design is a student's confidence in their ability to engage in engineering design challenges. Here too we found an interaction between group and time. The Huynh-Feldt sphericity corrected result was F (1.60, 36.69) = 4.22, P < .04). As can be seen in Table 4 below, for this subgroup of graduating seniors, the difference in favor of the Academy group was larger at the time of the senior interviews than at prior times. The STEM Academy subgroup scored much higher during the senior year than the small subgroup from the JCLC academy on items related to design self-efficacy.

Table 4. Means and Standard Deviations for Design Efficacy a Function of Group and Time

	Group	Mean	Std. Deviation	N
Pretest	JROTC Control Camp	2.70	.45	5
	JROTC Academy	2.50	.44	20
	Total	2.54	.44	25
Posttest	JROTC Control Camp	3.00	.40	5
	JROTC Academy	2.63	.66	20
	Total	2.70	.63	25
Senior Year	JROTC Control Camp	2.65	.68	5
	JROTC Academy	3.09	.44	20
	Total	3.00	.51	25

In addition to the quantitative results, data coded from the interviews of 45 participants (33 Academy and 11 JCLC control camp) resulted in a frequency count of 21 cadets choosing to enter a STEM field (e.g., engineering, nursing, computer science, etc.). Of those, 16 were Academy cadets (48%) and 5 were from the control JCLC camp (45%). Thus, the proportion of students who reported choosing a STEM field was equivalent in both groups. Again, this sample is very small, and we will continue to look for differences between these two groups as more students complete the senior year interviews and questionnaires. We have seen differences in confidence and beliefs from this small sample that favor the STEM Academy. Whether these hold in future analyses is not clear, but they do suggest that there was an impact of the STEM Academy, but not yet one related to career choice.

Discussion

Applying SCCT to help us organize these results, we can draw some conclusions about the short-term impacts on constructs including self-efficacy, outcome expectations, and interests. Furthermore, we can cautiously use the early results from the first cohort of graduating seniors to give us insights into cadets' choice goals and choice actions.

By focusing on short-term goals, the program leadership were able to refine their program logic model and determine the measurable impacts of the Academy when compared to a control group. The Academy intervention seems to have a positive impact on cadets' STEM content knowledge, STEM self-efficacy, 21st Century workforce skills, and knowledge of STEM careers. These are all positive indicators that the Academy can impact student self-efficacy and outcome expectations. Furthermore, 21st Century workforce skills and STEM self-efficacy are two outcomes that may last through to senior year if early data is an accurate indicator of a pattern in the larger sample. What is still to be determined is whether the Academy leads to more students entering a STEM career pathway. Currently, the findings show that while attitudinal and self-efficacy shifts tend to be long lasting for Academy cadets versus the control cadets, the rate at which students are entering STEM career fields is no different between the two groups.

Finally, two limitations are noted for the study of long-term impacts: 1) small sample size, and 2) the COVID pandemic. Because we are still collecting longitudinal data and expect to add over 100 cases to the study by May 2021, the current sample size is small which reduces the power of the study. It is important to note that another factor from the SCCT model may have come into play to limit interpretation of our findings. This factor is proximal environmental influences, which are external to the individual but influence both goals and actions. The COVID pandemic was a likely significant proximal environmental influence on post high school plans. For example, COVID led to many universities moving to online instruction. This may have led some students to postpone postsecondary education. Further, plans may have also been influenced by students leaving high school early. Seniors were told that they had completed requirements for graduation and not to return to school the last quarter. Hence, during this time any influences of teachers or counselors on students who had not yet decided on their next steps may have been lost. Additionally, the desire to make long term plans might have been lost in the uncertainties about the future that were raised by COVID. Hence it is likely that the decisions students made were impacted by the COVID pandemic—something that we would not have had to address in typical years.

Conclusions

The purpose of this study was to shine a light on a diverse and unique population of high school students, JROTC cadets, as these students make up the largest youth training and development program in the United States yet have largely been left untapped by traditional STEM education approaches. Results from this study have shown that cadets make gains in five STEM and workforce related areas and two of which, 21st Century workforce skills and STEM Self-Efficacy seem to last through the end of high school. Unfortunately, we do not have enough data to draw conclusions about student choice goals and choice actions. Regardless of the career field the student selected, if one of the long-term impacts of the Academy is on efficacy in this area, then there is some evidence to suggest the investment in the STEM Academy has paid off.

References

[1] New American Economy. (2017). *Sizing up the gap in our supply of STEM workers: Data & analysis.* New American Economy. https://research.newamericaneconomy.org/report/sizing-up-the-gap-in-our-supply-of-stem-workers/

[2] Goldman, A., Schweig, J., Buenaventura, M., & Wright, C. (2017). Geographic and demographic representativeness of junior reserve officer training corps. Santa Monica, CA; Rand Corporation

[3] Kamarck, K. N. (2020). Defense Primer: Junior Reserve Officers' Training Corps (JROTC). *In Focus.* Congressional Research Service. December 2, 2020.

[4] Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a Unifying Social Cognitive Theory of Career and Academic Interest, Choice, and Performance. *Journal of Vocational Behavior, 45*(1), 79-122. doi:http://dx.doi.org/10.1006/jvbe.1994.1027

[5] Christensen, R., Knezek, G., & Tyler-Wood, T. (2015). Alignment of Hands-On STEM Engagement Activities with Positive STEM Dispositions in Secondary School Students. Journal of Science Education and Technology, 24(6), 898-909.

[6] Dika, S. L., Alvarez, J., Santos, J., & Suárez, O. M. (2016). A Social Cognitive Approach to Understanding Engineering Career Interest and Expectations among Underrepresented Students in School-Based Clubs. Journal of STEM Education: Innovations & Research, 17(1), 31-36.

[7] Pema, E., & Mehay, S. (2009). The Effect of High School JROTC on Student Achievement, Educational Attainment, and Enlistment. Southern Economic Journal, 76(2), 533-552. doi:10.4284/sej.2009.76.2.533

[8] Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. Educational Psychologist, 41:2, 111-127, doi: 10.1207/s15326985ep4102_4

[9] Rice, L., Barth, J. M., Guadagno, R. E., Smith, G. P. A., & McCallum, D. M. (2013). The Role of Social Support in Students' Perceived Abilities and Attitudes toward Math and Science. Journal of Youth and Adolescence, 42(7), 1028-1040.

[10] Rogers, M. E., & Creed, P. A. (2011). A longitudinal examination of adolescent career planning and exploration using a social cognitive career theory framework. Journal of Adolescence, 34(1), 163-172. doi:http://dx.doi.org/10.1016/j.adolescence.2009.12.010