



# Implementing a Hybrid Summer Transition Program

## OPEN ACCESS

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The mission of the Virginia Commonwealth University Louis Stokes Alliance for Minority Participation (VCU LSAMP) program is to increase the retention and graduation rates of students from underrepresented racial and ethnic groups in science, technology, engineering, and mathematics (STEM) majors and those who matriculate into graduate programs. VCU LSAMP offers a hybrid summer transition program (HSTP) focused on facilitating the high school to college and two-year to four-year college transition process for students majoring in STEM disciplines. The goals of the program are to 1) build community among a cohort of students, 2) orient students to VCU, 3) prepare students for the academic rigors of their first year in a STEM discipline at VCU, 4) expose students to opportunities and careers in STEM, 5) engage them in the VCU LSAMP program, and 6) provide financial support. Five distinct components of the VCU HSTP are 1) a six-week online summer component, 2) a 1 week on-campus orientation, 3) a Design Project Challenge, 4) a transfer student track, and 5) an academic year component. Evaluation data reveals that the HSTP assisted participants with adjustment to the college schedule and setting, facilitated the formation of study groups, and increased overall motivation to graduate. The online courses helped familiarize students with both the academic topics in their chemistry and mathematics classes and the behaviors and norms of STEM majors. On average, participants in the HSTP had higher retention (85%) and graduation (73%) rates when compared with their peers (81% and 64%, respectively). Furthermore, those students who complete the online classes' requirements had a higher probability of receiving a grade of B or better in their first mathematics or chemistry class.

**Keywords:** hybrid summer transition program, student success, community building, first year students, transfer students, LSAMP

## INTRODUCTION

Founded in 2007 and funded by the National Science Foundation (NSF) Louis Stokes Alliance for Minority Participation (LSAMP), the Virginia-North Carolina Louis Stokes Alliance for Minority Participation (VA-NC Alliance) is a consortium of community colleges, historically black colleges and universities (HBCUs), predominantly white research institutions (PWIs), and a national research laboratory<sup>1</sup> The VA-NC Alliance's goals are to:

diversify the science, technology, engineering, and mathematics (STEM) workforce with a focus on increasing the number of African American, Latinx/Hispanic, and Native American students, and students from Indigenous populations successfully completing baccalaureate degree programs, and increase and diversify the number of students that matriculate to graduate STEM programs.

Each institution has designed evidence-based programs informed by research to achieve the goals of the Alliance and to meet the unique needs of their students within their institutional cultural contexts.

As part of the VA-NC Alliance, the Virginia Commonwealth University LSAMP (VCU LSAMP) program has implemented its own set of community building, retention, and professional development programs to help achieve the overarching VA-NC Alliance goals of diversifying STEM and increasing graduate school matriculation rates. The VCU LSAMP anchor program for the past 7 years has been its hybrid summer transition program (HSTP).

This paper describes the hybrid summer transition program's evolution, implementation, and findings from assessment and evaluation data. An institutional context is provided and an overview of all VCU LSAMP activities. Each of the HSTP components are presented along with the research which informed the design and implementation of each component. Finally, the HSTP assessment results are presented.

## LOUIS STOKES ALLIANCE FOR MINORITY PARTICIPATION @VIRGINIA COMMONWEALTH UNIVERSITY

Virginia Commonwealth University (VCU) is a comprehensive, urban, public research university which enrolls approximately 30,000 undergraduate, post-baccalaureate, graduate, and professional students in 11 schools and three colleges.<sup>2</sup> Of those ~30,000 students, more than 20% of them are enrolled in a STEM undergraduate, graduate, or certificate program. Of the approximately

6,000 STEM majors, 28% identify with a racial or ethnic population that has been traditionally underrepresented in a STEM discipline. In the fall semester of 2020, approximately 24% of new VCU STEM students were transfer students. Similar to other large public institutions, VCU faces daunting challenges in its effort to provide a learning environment that is inclusive, that meets the needs of students with very different pathways to and preparation for college, and that is easily scalable given the constraints and complexities of a large university. Thus, VCU has invested in several initiatives and programs for both faculty and students. For example, VCU offers an Institute on Inclusive Teaching in STEM,<sup>3</sup> a faculty development program, Inclusive and Equitable Teaching Faculty Learning Community,<sup>4</sup> and the Leaders for Inclusive Learning Program<sup>5</sup>; all of which are geared toward institutional transformation to make VCU more inclusive and meet the goals established in the Diversity Driving Excellence theme of the University's Strategic plan.<sup>6</sup> In addition, the university has instituted a diversity and inclusion campus ratings system that provides diversity, inclusion, and engagement scores for each major unit on campus.<sup>7</sup> Furthermore, VCU has created several programs to meet the needs of its students, including the Acceleration Program,<sup>8</sup> the Summer Scholars Program<sup>9</sup> and the federally funded TRIO<sup>10</sup> and IMSD<sup>11</sup> programs to name a few. The VCU LSAMP program is one such program and it has evolved over the past decade and a half to meet the changing needs of its students and within the financial and other constraints placed on the program.

The VCU LSAMP program has offered various programs over its 13 years history. During this time several studies have been conducted to evaluate the programs and assess the influence those programs have on students' decisions to remain in STEM disciplines (Alkhasawneh and Hobson 2009; Alkhasawneh and Hobson 2010; Alkhasawneh and Hobson 2011; Alkhasawneh and Hargraves 2012; Alkhasawneh and Hargraves 2014; Brinkley et al., 2014; Griggs et al., 2016; Griggs and James, 2019). The current day VCU LSAMP programs include a hybrid summer transition program for new students including first time freshmen and transfer students, a spring transition program for new transfer students, a peer mentoring program, an academic success seminar in the fall semester, and career readiness series in the spring semester. In addition, several scholarships are offered including an emergency fund scholarship for which the need became glaringly evident after the first financial crisis in 2008–2009 and again with the COVID-19 pandemic. The program has an active listserv where work, research, volunteer, professional development, and scholarship

<sup>3</sup><https://lsamp.virginia.edu/about-our-alliance/> last accessed May 11, 2021.

<sup>4</sup><https://ctle.vcu.edu/initiatives/communities/> last accessed May 11, 2021.

<sup>5</sup><https://intranet.chs.vcu.edu/sponsored-programs/find-funding/internal-funding/leaders-for-inclusive-learning-program/> last accessed May 11, 2021.

<sup>6</sup><https://quest.vcu.edu/> last accessed May 11, 2021.

<sup>7</sup><https://inclusive.vcu.edu/dashboard/> last accessed May 11, 2021.

<sup>8</sup><https://dhsd.vcu.edu/programs/high-school/vcu-acceleration-vcua/> last accessed May 11, 2021.

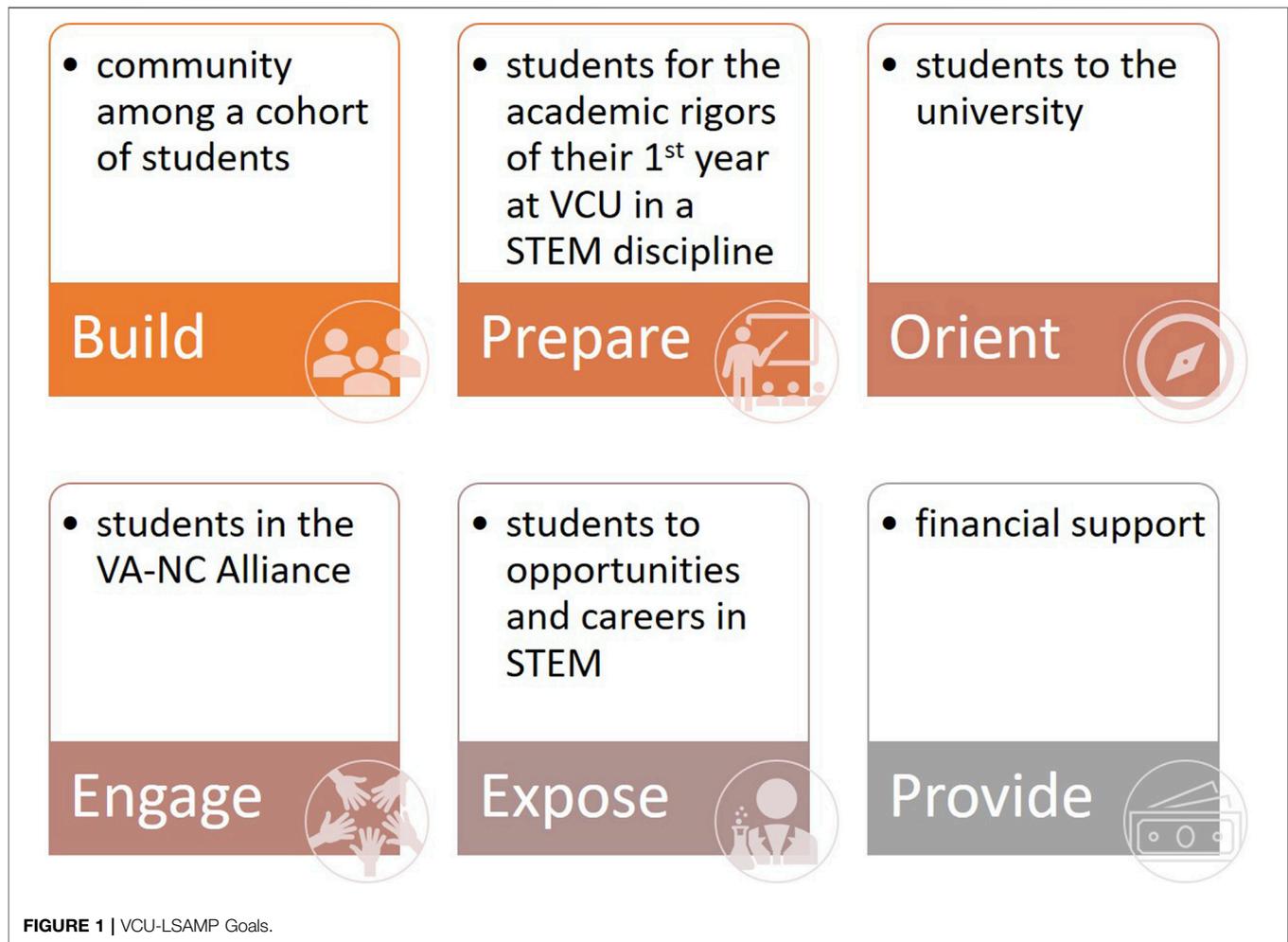
<sup>9</sup><https://summerscholars.vcu.edu/> last accessed May 11, 2021.

<sup>10</sup><https://trio.vcu.edu/> last accessed May 11, 2021.

<sup>11</sup><https://healthdisparities.vcu.edu/researchtraining/undergraduate-programs/imsd/> last accessed May 11, 2021.

<sup>1</sup><https://lsamp.virginia.edu/about-our-alliance/> last accessed May 11, 2021.

<sup>2</sup>VCU's 11 schools and three colleges are: School of the Arts, School of Education, School of Social Work, Wilder School of Government and Public Affairs, School of World Studies, Robertson School of Media and Culture, School of Business, School of Medicine, School of Pharmacy, School of Nursing, School of Dentistry, College of Humanities and Sciences, College of Engineering, and College of Health Professions.



opportunities are shared as well as social events. Each semester the program holds an end of semester celebration, honoring the accomplishments of its graduating seniors. As the program has evolved over the years and the characteristics of each VCU LSAMP class is manifested, special events are planned to cater to the interests of the students. Together all these activities represent a robust collection of programs offered to the VCU LSAMP scholars. The cornerstone of the VCU LSAMP program is the hybrid summer transition program (HSTP).

### History and Evolution of the Summer Transition Program @Virginia Commonwealth University

The VCU LSAMP program first began in September 2007. At that time, prevailing wisdom and current literature had shown the importance of academic and social integration for the success of students (Pascarella and Terenzini 1980; Tinto, 1987; Strage 1999). Furthermore, studies have shown the importance of residential pre-college transition or bridge programs (Walpole et al., 2008; Stolle-McAllister et al., 2011) and peer mentoring (Budny et al., 2010; Rose et al., 2010; Hall and Jaugietis, 2011) in increasing the retention and graduation rates of students in

STEM disciplines. Thus, the first VCU LSAMP programs consisted of a four-week summer transition program and a peer mentoring program which took place during the regular academic year. This paper focuses on the summer transition program. The goals of the summer transition program (Figure 1) are to:

- Build community among a cohort of students,
- Orient students to VCU,
- Prepare students for the academic rigors of their first year in a STEM discipline at VCU,
- Expose students to opportunities and careers in STEM,
- Engage students in the VCU LSAMP program, and
- Provide financial support.

In the inaugural VCU summer transition program (summer 2008) students earned six college credits in a precalculus course (4 credits), a study skills course (1 credit), and a science and engineering seminar (1 credit). Students also participated in professional development, social and community building activities, and toured local companies and research laboratories. Students were assigned an upper-class mentor with whom they met once a month during the academic year.

**TABLE 1** | Summer Transition Program Topics for the varied modalities in which the program has been offered.

Mathematics topics	Chemistry topics	Study skills topics
<b>On-campus summer transition program</b>		
Real numbers	Chemistry basics	Study skills
Equations and inequalities	Measurements	Time management
Exponents and polynomials	Matter	Networking
Lines and systems	Atoms, ions, and molecules	
Functions and graphs	Formulas	
Rational expressions	Equations and moles	
Geometry		
Trigonometry		
<b>On-line summer transition program</b>		
Real numbers	Math and algebra	Study skills
Equations and inequalities	Measurements	Time management
Exponents and polynomials	Matter	Networking
Lines and systems	Atoms, ions, molecules	
Functions and graphs	Stoichiometry	
Rational expressions	Simple reactions	
Radical expressions	Thermochemistry	
Geometry		
Trigonometry		
Exponential and logarithms		
Limits and continuity		
<b>Hybrid summer transition program</b>		
Real numbers	Scientific notation	Introductions and VCU resources
Equations and inequalities	Units of measurement	Handling microaggressions
Exponents and polynomials	Elements and symbols	Time management and creating a schedule
Lines and systems	Molar mass and calculations	Finding study spaces and forming study groups
Functions and graphs	Equations for chemical reactions	Mindfulness
Rational expressions	Types of reactions	Effective listening and note-taking strategies
Radical expressions	Chemical quantities and reactions	Reading skills and test preparation
Geometry		Presentations
Trigonometry		Resume development, networking, and personal brand
Exponential and logarithms		
Limits and continuity		

Eighteen students enrolled in and completed the on-campus program. The program had an 88% freshman-sophomore retention rate and a 61% six-year graduation rate of whom over half graduated with a STEM degree. While these figures were not optimal, they were higher than the VCU average at that time, which had an 83% freshman-sophomore retention rate and 50% six-year graduation rate for all students. As the program matured, it was tailored to suit the needs of the students and financial constraints of the program. Introduction to Chemistry was added to address student performance in General Chemistry (CHEM 101), which was shown to have a high rate of students earning a grade of D or F or withdrawing from the course (D, F, and W rate) especially among those students who identify as African American, Latinx/Hispanic, Native American, or are from Indigenous populations (AALANAI).

The on-campus summer transition program was offered from 2008 to 2011. The program typically enrolled between 15 and 21 participants, all of whom had gained full admission to an undergraduate STEM program at the university and had committed to attending VCU in the fall semester. Initially students were all enrolled in credit bearing courses; however,

to reduce the financial burden of the program (paying for six credits for in state and out-of-state students) and to increase flexibility in the topics covered in the classes, the program switched to only offering a one credit bearing study skills seminar course and customized mathematics and chemistry courses (non-credit). This also made the program more appealing to students who may have placed into a higher mathematics class and thus were reluctant to “re-take” a precalculus class for which they had already received credit or placed out of. Furthermore, students placed in a lower-than-expected math class had the opportunity to retake the university math placement test at the end of the summer and place into a more advanced mathematics course. The mathematics and chemistry courses covered topics that had been identified by instructors as fundamental topics in which most students needed remediation or a refresher (**Table 1**). Students stayed in residential housing, were provided all meals, textbooks and supplies, and participated in field trips, laboratory visits, social activities, and orientation activities. Students who successfully completed the program by the end of the summer earned academic credit for the seminar course and a stipend, the amount of which was

**TABLE 2 |** VCU LSAMP Summer Transition Program modalities.

Summer transition program year		
<b>2007–2008</b>	Program location/duration:	On-campus–4 weeks
	Average cohort size:	18
	Courses offered:	Precalculus, investigations in learning (study skills), science and engineering seminar
	Academic credit:	6 credits
	Financial incentive:	None
<b>2009–2011</b>	Program location/duration:	On-campus–4 weeks
	Average cohort size:	18
	Courses offered:	Precalculus, introduction to chemistry, study skills
	Academic credit:	1 credit
	Financial incentive:	Max \$200 awarded at the end of the summer
<b>2012</b>	Program location/duration:	Online–3 weeks with the option to continue courses
	Average cohort size:	33
	Courses offered:	Precalculus (ALEKS), introduction to chemistry (ALEKS), study skills
	Academic credit:	0
	Financial incentive:	Max \$300 awarded at the end of the summer
<b>2014–2019</b>	Program location/duration:	Hybrid (~6 weeks online and ~1 week on-campus)
	Average cohort size:	34
	Courses offered:	Precalculus (ALEKS), introduction to chemistry (ALEKS), study skills
	Academic credit:	0
	Financial incentive:	Max \$600 awarded at the end of the summer

dependent upon their performance in the mathematics and chemistry classes. The decision to use financial incentives to increase student engagement with course work follows the positive engagement trends observed in literature in increasing student responses on end of year evaluations and on mile marker examinations (Goodman J., Anson R and Belcheir 2015; Sansgiry et al., 2006).

In 2012 the directors of the VCU LSAMP program made the decision to offer the summer transition program only in an online format. This change was motivated by the budget reduction experienced by the VCU LSAMP program and to increase participation. For example, in a typical year the on-campus program would cost approximately \$40,000 for twenty students vs. the online program only \$17,000 for double the number of students. Students who already had summer jobs or alternative plans for the summer were more willing to participate in an online program instead of an on-campus program. Furthermore, with advances in technology/software and the likelihood that more students had previous experience with online courses, the directors hypothesized that an online program would be well received and effective in achieving the goals of the programs. The online summer transition program (OSTP) was a three-week program and used an adaptive web-based intelligent assessment and learning tool, ALEKS<sup>12</sup> (Assessment and LEarning in Knowledge Spaces), for both the chemistry and mathematics preparatory courses. An online study skills course was also offered for the students utilizing a web-based learning management system, Blackboard.<sup>13</sup> Students who completed 70% of the ALEKS curriculum earned a

stipend and the opportunity to retake the university placement test for math. The students were also allowed to continue the work on ALEKS throughout the fall semester, and if they were able to meet the 70% threshold by the end of the fall semester, they could still earn the stipend. All students, regardless of their completion rate, were assigned a peer mentor at the end of the summer for the academic year.

The program directors compared the costs, student outcomes, and assessments of the online and on-campus programs and found that the online program resulted in approximately a 40% decrease in overall costs and a 50% increase in participation (Table 2). In a comparison of on-campus transition program students and OSTP students who successfully completed the program (i.e., students who completed 70% of topics in the three courses), the students' academic performance in their mathematics and chemistry courses was comparable. Even though a stipend was offered to students who completed 70% of the ALEKS course topics in the mathematics and chemistry preparatory courses, only 70% of the OSTP students completed enough topics to earn the stipend by the end of the summer. While students in the online program believed the program helped prepare them for the academic rigors of their first year in a STEM major especially in mathematics and chemistry, they did not feel the program fostered community among the participants. They also did not feel that the program exposed them to opportunities and careers in STEM or oriented them to the various academic resources at VCU, two goals of the transition program. More comparison results are discussed in Brinkley et al. (2014). As a result of the OSTP comparison study findings, the VCU LSAMP leadership team designed a hybrid summer transition program and began offering the Hybrid Summer Transition program in the summer of 2014.

<sup>12</sup><https://www.aleks.com/>

<sup>13</sup><https://www.blackboard.com/>

## THE LOUIS STOKES ALLIANCE FOR MINORITY PARTICIPATION HYBRID SUMMER TRANSITION PROGRAM @VIRGINIA COMMONWEALTH UNIVERSITY

During a typical offering of the hybrid summer transition program (HSTP), the program is advertised to new students (freshmen and transfer) who have accepted admission to VCU, selected a STEM major, and who identify as a person from a racial/ethnic minority traditionally underrepresented in the STEM field, i.e., African American (Black), Latinx/Hispanic, Native American or are from Indigenous populations (in the Americas). Students are sent materials detailing the benefits of the program encouraging them to apply. Program facilitators select students from applications received based on essay responses, applicants' availability, and academic achievement. It is important to note that program facilitators try to ensure that a cohort has students with varying academic ability and achievement. Selected students are notified and given 2 weeks to commit to participation in the HSTP. The program tries to accept all applicants. However, when all applicants cannot be accommodated, students are able to participate in the Online Summer Transition program. Those who elect not to participate in the program remain on the VCU LSAMP listserv during the regular academic year. Upon acceptance students sign commitment forms acknowledging their understanding of program requirements and expectations.

The HSTP is intentional about selecting full time VCU faculty teach the ALEKS courses, providing the students an opportunity to build relationships with faculty and dismantling the stereotype that faculty want to see you fail or do not care about your performance in their classes. Program facilitators and coordinators are selected from graduate students who are participants in the nationally recognized Preparing Future Faculty Program,<sup>14</sup> are specializing in human development, or are developing an expertise in a STEM discipline and have also identified research interest in STEM education. All selected graduate students may be classified as Ph.D. students or are in their final stages of their Masters degree program. All facilitators receive continuous support and training from faculty and staff in their respective disciplines, the VCU School of Education, the VCU College of Humanities and Sciences, and the Office of Multicultural Student Affairs. Upperclass VCU LSAMP students are invited to serve the incoming cohort as peer mentors. Students are required to complete an application including a personal statement. Peer mentors are selected based on their current academic standing, essay responses, and availability. Students who are selected are required to participate and complete mentor training provided by Mentor Virginia.<sup>15</sup> Those who do not complete the training are not allowed to serve in a peer mentor capacity.

The approximately seven-week HSTP begins in early July with the online component and concludes in mid-August with a

weeklong on-campus portion which includes an intensive Design Project Challenge, campus orientation, and peer mentoring introduction. A transfer student track is included in both the online and on-campus phases. The online component consists of three courses: study skills, mathematics, and chemistry. The study skills course utilizes Blackboard and the mathematics and chemistry courses utilize ALEKS. All students in the program take the ALEKS mathematics and chemistry courses regardless of their mathematics or chemistry course placement, however two study skills courses are offered, one tailored to the needs of first-time freshmen and the other to transfer students.

The one-week on-campus enrichment experience includes an intensive Design Project Challenge in which teams of 3–5 students are exposed to the concepts of ideation, design, research and in some cases prototyping. Students are tasked with posing unique design solutions to challenges facing society, all while exploring career options in STEM. Additionally, the on-campus orientation consists of research laboratory and industry tours, a ropes challenge course, student panels, an advising session, and continuation of the chemistry, mathematics, and study skills courses. The program concludes with an oral presentation and poster session during which the design projects are presented and judged and winners announced. All students participate in a final capstone community building exercise during which they reflect on the week's activities and lasting impressions. As created, the hybrid summer transition program offered both opportunities and incentives together to prepare students for a successful first year at VCU.

The program established a built-in incentive structure. While there are several academic, social, personal, and professional benefits to participating in the program, monetary rewards were also shown to motivate students to higher academic achievements; in addition to providing some students with much needed financial aid (Angrist et al., 2009). To qualify for the on-campus portion of the program students must successfully complete by a mid-summer date 1) all assignments given in the Study Skills course, 2) master 40% of the ALEKS chemistry topics, and 3) master 40% of the ALEKS mathematics topics. These qualifying HSTP students are granted early arrival into their residence halls. The HSTP students move into their residence halls one-week earlier than other students living on campus so they can participate in the on-campus portion of the HSTP. HSTP students are eligible for a modest stipend per course if they complete the following: 1) all assignments given in the Study Skills course, 2) mastered 80% of the ALEKS chemistry topics, and 3) mastered 80% of the ALEKS mathematics topics or a 25 point increase from their initial knowledge check (whichever is the lesser). Students who successfully complete 100% of the ALEKS chemistry topics can enroll in the General Chemistry course, waiving the prerequisite mathematics course requirements (if needed). The ALEKS® mastery levels were determined based on placement requirements established expectation by the in VCU chemistry and mathematics departments. The Design Project Challenge culminates in an oral and poster competition. The presentations are judged by STEM professionals from industry. Monetary awards are given to members of the teams who placed

<sup>14</sup><https://graduate.vcu.edu/development/faculty.html>

<sup>15</sup><https://mentorva.org/training/>

first, second, and third in the oral and poster competition. At the completion of the fall semester, students who earned a cumulative 3.0 GPA and have attended all the weekly fall seminar sessions receive an additional stipend.

## Study Skill Course

Universities have employed a variety of programs primarily designed to assist incoming students successfully transition to, and academically succeed in higher education settings. These university programs offer incoming students academic support in various formats such as peer and faculty mentoring (Johnson et al., 2007), individual academic advising and monitoring (Heisserer and Parette, 2002; Bloom, 2016), and specialized curriculum including study skills courses (Schwarz, 2016; Hacisalihoglu et al., 2020). Historically, these programs were designed to capture incoming freshmen students who may be academically underprepared. In some cases, students are encouraged or even required to participate in such programs based on factors such as high school GPA or ACT/SAT scores (Abrams and Jernigan, 1984). Study skills courses offered to incoming freshmen and/or transfer students in these programs typically cover various skills to improve academic self-efficacy through workshops on time management, reading techniques for textbooks, effective notetaking, resource utilization (e.g., libraries, student's services, etc.), and study/exam-taking techniques. VCU offers two such elective 1 credit courses, UNIV 101 Introduction to the University and UNIV 102 Investigations in Learning. Following this model, the HSTP study skills course is designed to provide the necessary skills and tools for incoming STEM students, first-time freshmen and transfer students.

## Freshman Course

The HSTP freshman study skills course introduces participants to tools and strategies to prepare them for academic success. Throughout the course, students explore the following topics: 1) resources and microaggressions 2) time management, 3) study group etiquette, 4) learning styles, 5) mindfulness 6) listening and note-taking, 7) reading skills and test preparation, 8) presentation development, and 9) resume development, networking, and personal brand (Table 1). The course is designed to engage students prior to arrival on campus with a broad review of each of the nine modules during this online time period. Prior to arrival students focus on designing a plan of study for their coursework throughout the summer, including mathematics, chemistry, and study skills preparation. The plan of study is then modified throughout the duration of the program and utilized as a template for the start of the fall semester. Once on campus, students are immersed in exercises related to each of the nine modules and engage in reflection on how their learning has evolved during each class period and in comparison to self-paced review during the online portion of the program. These reflections are continued during the fall seminar course.

During the on-campus, portion students are held to course norms such as arriving to class on time, submitting assignments prior to the due date, and engaging in open dialogue. These

norms establish accountability and are designed to foster habit formation. Prior to the beginning of each course period, the goals and objectives for the lesson are intentionally placed on the board, again establishing a routine for the students. It has been shown that more than 40% of the actions people perform on a daily basis are habits (Duhigg, 2012). Therefore, reiterating the course norms and goals daily initiates a habit loop for students to take with them beyond the on-campus portion of the HSTP and into their first semester as college students. These practices are revisited with students during the fall seminar course and emphasized with peer mentors to continue to reinforce the habits.

During the first module of the HSTP study skills course, students are engaged in icebreaker activities to increase participation, continuity among the group, and to provide important information about VCU resources that are in place for student success. Additionally, facilitators discuss microaggressions describing the history, identifying microaggressions (specifically focusing on racial microaggressions), and potential coping mechanisms to address microaggressions. During the second module, students learn about the basics of time management techniques. Interactive activities such as case studies are reviewed, compared, and discussed. Important components of these interactive activities address enhancing organization, avoiding procrastination, work-life balance, and focusing on self-care activities (e.g., hanging out with friends/family, watching TV, etc.). Examples of case studies include comparing weekly schedules of midterms and an exam free weekly schedule. Furthermore, students are tasked with applying discussed techniques by creating a typical weekly schedule outlining social events, mentoring meetings, office hours, coursework, and class times.

Module 3 focuses on identifying appropriate study spaces, a topic of particular importance considering the emergence of remote learning surrounding the rise of COVID-19. Additionally, the importance of study groups is highlighted. Previous research has suggested that study groups are effective for increasing comprehension and grade point averages (Taraban et al., 2000). Along with identifying proper support structures and learning environments, students are encouraged to explore various learning styles in module 4, to align strategies for success with preferences in retaining material. These preferences such as visual, auditory, reading/writing, and kinesthetic learning provide students with an awareness of personally effective styles. In module 5, the concept of mindfulness is placed into practice. Mindfulness practices have been shown to enhance college student learning (Yamada and Victor, 2012). The HSTP participants explore the health benefits of mindfulness in their daily routines, including decreased stress/anxiety, improved concentration, and increased self-awareness and emotional wellbeing.

The primary topics of module 6 include honing effective listening skills and improving note-taking strategies. Group discussions are facilitated to compare, contrast, and apply current techniques. Additionally, the effects of using technology while note-taking are compared to traditional long-hand note-taking. In module 7, students are asked to discuss and complete activities on reading skills and exam preparations.

The last two modules prepare students for effective communication. In module 8, students gain tools for creating effective and captivating oral and poster presentations. They also learn how to properly address questions related to their presentations. In module 9, the final module, students focus on career preparation through a resume development workshop. They learn the power of networking and begin to cultivate a personal brand.

### Transfer Student Course

Researchers point out that both community colleges and 4-years institutions have responsibilities for ensuring the academic success and transition for transfer students (Jain et al., 2011). While the majority of the early research on STEM education has focused on early experiences at the K-12 and postsecondary levels with regard to examining their educational pathways, in more recent trends, scholars have turned their attention to understanding community college students' self-concept (Starobin and Laanan, 2005) and self-efficacy (Johnson et al., 2012) within STEM education. Community college ensures that students are ready and prepared academically, while 4-years institutions assist with transfer and transition (Berger and Malaney, 2003). Historically, community colleges have been identified as an important path for students of color, particularly for women of color entering higher education. Furthermore, community colleges offer more affordable tuition, flexible scheduling, smaller class sizes, access to faculty, and childcare compared to most 4-years institutions. As a result, community colleges may accommodate nontraditional students (e.g., students who may be older and/or have greater family and financial responsibilities) that have chosen to take a nonlinear path to degree completion (Pérez and Ceja, 2010). Thus, it was important to offer a transfer student track in the HSTP. Moreover, previous literature has highlighted the impressive rates of increase of AALANAI students within the community college system; however, despite this increase of students, low transfer rates by men and women of color make their recruitment into STEM from community college populations problematic, placing greater emphasis on the need for a program specifically tailored to the transfer students.

A unique variation of the study skills course is designed specifically for transfer students in the HSTP. Similar to the freshman study skills course, the following overarching topics are discussed: 1) resources and microaggressions, 2) time management, 3) study group etiquette, 4) learning styles, 5) mindfulness, 6) listening and note-taking, 7) reading skills and test preparation, 8) presentation development, and 9) resume development, networking, and personal brand. However, the presentations are customized to be more relevant to transfer students. In a similar manner the discussions vary to include nuances to fit the experiences of transfer students. The topics include:

- Finding and utilizing university resources.
- Fostering, advocating, and building positive (academic and social) relationships: peer to peer and faculty to student.

- Comparing and contrasting how these issues were handled while at their community college vs. how their approach may need to vary at VCU.

Moreover, each presentation on time management, note-taking, and study group etiquette consists of a quick overview and various interactive activities. Students reflect on previous experiences and scenarios are presented to spark a conversation about the pros and cons of various techniques. While mindfulness and resume development may be approached the same whether at a community college or a university, listening and note-taking skills or reading skills and test preparation may have to change when students now find themselves in a large lecture class of 300 or more students. Furthermore, by creating a community among the transfer students they are also building connections and a support network with their peers.

### Chemistry Course

ALEKS<sup>®</sup> is an online learning system using artificial intelligence to assess and provide instruction to students on a variety of topics (Table 1). This system provides an initial knowledge check testing students' previous topic mastery. Upon completion, students are provided with a personalized topic list to study and increase proficiency within the subject. This personalization allows students to learn at their own pace and only cover the topics needed. The VCU LSAMP program chose ALEKS in part because several incoming students were already familiar with the software because of prior use in high school. In addition, the VCU Chemistry and Mathematics departments have chosen ALEKS as their official preparation software for their required placement tests. Both departments have developed customized ALEKS courses by choosing the most important topics to master for first-year/transfer students and personalized videos covering the topics.

Traditionally VCU has used placement tests to determine which class level the student will start with during their first semester. In the Chemistry department, students must score at least a 30 out of 50 to be placed in General Chemistry (CHEM 101) their first semester. If students are unable to achieve this score, ALEKS can be used to show proficiency and thus be eligible to still register for the class. Students must achieve a 100% mastery of the ALEKS Introduction to Chemistry topics before registering for the General Chemistry course. Because of these requirements VCU LSAMP chose to use ALEKS and provides it free of charge to students in the HSTP. This allows the student to prepare for both placement tests and cover topics in a low stakes' environment. Professors and teaching aides provide online office hours during the summer to cover tough topics more in depth and provide a space for questions on the material. During the on-campus portion this shifts to in-person sessions. Each day students attend class taught by a Chemistry professor.

These hour-long sessions are a mix of oral presentations and hands-on worksheets. The topics covered align with the students' first 2 months of General Chemistry. Through ALEKS students review the topics and obtain a basic level of understanding. The on-campus sessions provide an opportunity to observe the structure of a college Chemistry class and increase their

foundation before fall classes begin. Previous research showed 9 out of 10 students who completed ALEKS with 100%, passed the Chemistry placement exam (70% or better) and scored an average of 86.7 vs. 73.9 for the overall class during exam 1 (Polo 2011). Although the HSTP program requires students to only achieve 80% ALEKS Chemistry topics mastery to earn the stipend, HSTP students must master 100% of the ALEKS Chemistry topics to also place into the General Chemistry course otherwise Chemistry Department CHEM 101 prerequisites<sup>16</sup> must be met.

## Mathematics Course

The Department of Mathematics and Applied Mathematics piloted ALEKS Precalculus in 2015 after the VCU LSAMP program had already been using it for 2 years. After a successful pilot, half of the precalculus sections each semester used ALEKS while the other half maintained the large lecture format. During this time, a two-years study was conducted to verify that the performance was equitable across both instructional models. The ALEKS sections performed slightly worse on mechanical problems but showed a marked improvement on conceptual-type questions. For the 2019–2020 school year, all sections of the course were moved to the ALEKS model. Also, over this time, the university changed from the historical math placement test for incoming students to the ALEKS placement test.

Based on their scores on the placement test, students in the LSAMP program typically place into one of three math courses: College Algebra with Applications (Math 141), Precalculus (Math 151), or Calculus I (Math 200). Some students in the program who come with AP credits, dual enrollment credits or transfer college credits enter Calculus II, III or Differential Equations. Students who place in a class below calculus and want to enroll in a higher level can also use ALEKS to prepare for a placement retest. Students have been able to use the experience in LSAMP to improve their math skills and in turn, their math placement test score before classes begin. Students who place into the higher-level mathematics courses, utilize the LSAMP ALEKS mathematics course as a refresher, honing skills, and math techniques.

The math portion of the LSAMP HSTP begins with students working on ALEKS independently at home. The ALEKS template is the same as the one used for VCU's precalculus course during the school year (**Table 1**). The first step is to take the initial knowledge check. The artificial intelligence engine of ALEKS adapts to each student changing the difficulty and type of questions based on the student's responses. As the student progresses, the system determines the topics that a student is "ready to learn."

During the independent learning portion, the instructor holds weekly office hours for students to ask questions or to get

clarification on a topic. The students come on campus for the last week of the program and attend an hour-long math session each day. To earn the stipend for the precalculus portion, a student must master 80% of the ALEKS mathematics topics. However, for students who placed into college algebra (below precalculus), they are able to earn the stipend if they achieve 75% mastery of topics or a 25 point increase from their initial knowledge check score, whichever is the lesser. As an example, a student placed into college algebra and scored a 46% on the initial knowledge check. If that student improves their performance to a 71% mastery by the completion of the program, they would receive the stipend.

The goals of the on-campus portion of the math component of the program are 1) strengthen students core math skills, 2) alleviate the stress and worry some students may experience about math, 3) advance a student's mathematical knowledge, and 4) provide students a true, clear picture of what the experience in their math course will be when the semester begins. Every attempt is made to group students with mixed abilities to allow more peer-to-peer learning. This also allows students to realize their own capabilities at explaining concepts to their peers.

The material presented during this portion of the program is determined by gathering information from both ALEKS and the students. ALEKS provides a wealth of data and reporting including "topics attempted but not yet learned". (Topics in ALEKS can be unlearned, learned, or mastered.) Any topic that falls into this category with a percentage of 10% or greater is compared to the topics covered in college algebra and precalculus. These topics are key to the students' success in future math classes and are covered during this week. Exponent rules are an example of one such topic that typically makes the list. The week before students come to campus, they are surveyed about what math topics they find most difficult and intimidating as well as the topics that interest them the most. This information is compiled and constructed into a series of activities and lessons to solidify understanding of the selected topics.

## On-Campus Orientation

During the one week on-campus portion of HSTP, students move into their academic year residence halls a week prior to all other students, enabling them to form and strengthen intra-cohort connections. The goals aligned with the co-curricular portion of HSTP are to 1) familiarize students with campus resources, 2) expose students to various career options within STEM, and 3) build community among participating students, faculty, and staff. Along with the curricular aspects of the program, students are immersed in a dynamic array of activities ranging from hands-on workshops, guest lectures, and engagement with professional advisors in preparation for the fall semester (**Figure 2**). At the beginning of the week, participants engage in team bonding through obstacle course challenges including high and low ropes activities. Each cohort is challenged with stepping outside of their comfort zone, trusting in their team members to overcome obstacles and complete the assigned tasks. The bonds formed between the students during these early activities contribute significantly to

<sup>16</sup>MATH 141, MATH 151, MATH 200, MATH 201 or satisfactory score on the VCU mathematics placement test within the one-year period immediately preceding the beginning of the course; and CHEM 100 with a minimum grade of B or satisfactory score on the chemistry placement exam/assessment within the one-year period immediately preceding the beginning of the course.

Time	Sunday August 11	Monday August 12	Tuesday August 13	Wednesday August 14	Thursday August 15	Friday August 16	Saturday August 17
8:30 AM			Study Hall 8:30 am - 10:00 am ENG W Hall Room 401	Study Hall 8:30 am - 10:00 am ENG W Hall Room 401	Study Hall 8:30 am - 10:00 am ENG W Hall Room 401	Study Hall 8:30 am - 10:00 am ENG W Hall Room 401	
9:00 AM		Patent Seminar/Libray Tour Cabell Library 203 9:00 am - 10:30 am					Oral Presentation: 9:00 am - 11:00 am ENGR West Hall Atrium & Auditorium Lunch 11:00 am - 12:00 pm Poster Symposium 12pm - 2pm
9:30 AM							
10:00 AM			Study Skill Course 10:00 am - 11:00 am Eng. W Room 401	Study Skill Course 10:00 am - 11:00 am Eng. W Room 401	Academic Advising 10:00 am - 11:00 am Eng W Hall Rm 401	Engineering Lab Tour 10:00 am - 11:00 am Eng W Hall Rm 401	
10:30 AM	Check-in 10:00 am - 12:00 pm						
11:00 AM		PreCalculus: 11:00 am - 12:00 pm Eng W Hall Rm 401	PreCalculus: 11:00 am - 12:00 pm Eng W Hall Rm 401	PreCalculus: 11:00 am - 12:00 pm Eng W Hall Rm 401	PreCalculus: 11:00 am - 12:00 pm Eng W Hall Rm 401	PreCalculus: 11:00 am - 12:00 pm Eng W Hall Rm 401	
11:30 AM							
12:00 PM		Lunch 12:00 pm - 1:00 pm	Lunch 12:00 pm - 1:00 pm	Lunch 12:00 pm - 1:00 pm	Lunch 12:00 pm - 1:00 pm	Lunch 12:00 pm - 1:00 pm	
12:30 PM	Welcome Orientation Lunch Eng E Hall Rm 1232 12:00 pm - 2:00 pm						
1:00 PM		Chemistry 1:00 pm - 2:00 pm Eng E Room 1232	Chemistry 1:00 pm - 2:00 pm Eng E Room 1232	Chemistry 1:00 pm - 2:00 pm Eng E Room 1232	Chemistry 1:00 pm - 2:00 pm Eng E Room 1232	Chemistry 1:00 pm - 2:00 pm Eng E Room 1232	
1:30 PM							
2:00 PM							
2:30 PM	Meet and Greet Activity 3:00 pm - 4:00 pm Cary Street Gym - MAC Exercise Room	Dr. Donna Jackson Tompkins-McCaw Library Room 2-010 2:30 pm - 4:00 pm	Forensic Science Tour 2:30 pm - 4:00 pm	DCLS Lab Tour 2:30 pm - 4:00 pm	Engineering Lab Tour 2:30 pm - 4:00 pm Eng E Room 1232	Free Time 2:30 pm - 4:00 pm	
3:00 PM							
3:30 PM							
4:00 PM	Free Time 4:00 pm - 5:00 pm	Free Time 4:00 pm - 5:00 pm	Free Time 4:00 pm - 5:00 pm	Free Time 4:00 pm - 5:00 pm	Study Skill Course 4:00 pm - 5:00 pm Eng E Room 1232		
4:30 PM						Teambuilding Activity 4:00 pm - 6:00 pm Monroe Park	
5:00 PM	Dinner 5:00 pm - 6:00 pm	Dinner 5:00 pm - 6:00 pm	Dinner 5:00 pm - 6:00 pm	Dinner 5:00 pm - 6:00 pm	Dinner 5:00 pm - 6:00 pm		
5:30 PM							
6:00 PM						Dinner 6:00 pm - 7:00 pm	
7:00 PM	Project Class - Redcap Survey 6:00 pm - 9:00 pm Eng E Hall Rm E1239	Project Class 6:00 pm - 9:00 pm Eng E Hall Rm E1239	Project Class 6:00 pm - 9:00 pm Eng E Hall Rm E1239	Project Class 6:00 pm - 9:00 pm Eng E Hall Rm E1239	Project Class 6:00 pm - 9:00 pm Eng E Hall Rm E1239	Project Class 7:00 pm - 9:00 pm Eng E Hall Rm E1239	
8:00 PM							
9:00 PM							

FIGURE 2 | VCU-LSAMP Sample Orientation Week schedule.

the participant engagement, buy-in, and accountability throughout the remainder of the program.

Students are introduced to on-campus and off-campus facilities and centers such as the university library, the writing center, engineering laboratories, forensic science laboratories, the Division of Consolidated Laboratory Sciences, the Office of Multicultural Student Affairs, and the Well (a student wellness center). They hear from speakers including representatives from Career Services and Financial Aid and engage in interactive discussions with both undergraduate and graduate student panels to gain insight into student life. To provide time to practice what they have learned in their classes, students participate in a study hall session.

Students' physical presence on campus enables them to become acclimated to the campus, providing them with the confidence to navigate their whereabouts at the commencement of the fall semester. The full schedule and team building exercises help students form bonds with each other. At the conclusion of the on-campus portion of HSTP, students gather in a circle to reflect on their experiences. Each participant holds onto a thread and shares something that they

have learned throughout HSTP and/or something that they valued during their experience. They then pass along the thread to the next person until everyone in the circle has had an opportunity to share. The circle becomes a web of connections, symbolic of the relationships they have created throughout their experience in HSTP (Figure 3). During this final reflection activity, the overwhelming response from students is that what they value the most from their HSTP experience are the friendships they make throughout the summer, especially during the orientation week, and the family they create within VCU LSAMP.

### Design Project Challenge

A unique feature of the HSTP is the Design Project Challenge (DPC). The DPC was first introduced with the advent of the HSTP. The goal for the Design Project Challenge is to introduce students to topics of project ideation, design, research, and product prototyping. The desired learning outcomes of the design challenge are as follows:

- Engage students in personally relevant STEM inquiries
- Develop communication skills



**FIGURE 3** | VCU-LSAMP Closing community building activity.

Foster team building and social integration  
 Build confidence as a STEM student  
 Expose students to the concepts of product design and research

Student design teams consist of 3–5 students with similar interests but may differ in major. Each team brainstorms and defines a unique societal problem to address, specifically ones that are personally and/or culturally relevant and interesting to them. Seminars provide instruction on topic development, research techniques, and discussing additional resources in the collegiate setting. A project pitch is incorporated into their development process. Students present their ideas to other program participants, VCU LSAMP staff, and other college faculty members from College of Engineering, College of Humanities and Sciences, School of Business, and School of Medicine. An environment of creative and critical thinking and peer collaboration is enhanced with students' participation in "mini-challenges." The design process concludes with formal research papers and posters of their project. At the closing ceremony each team delivers an oral presentation to be judged. The top three teams are awarded additional stipends and a chance to continue their project with the additional guidance of the design course instructor, VCU faculty, and support from VCU's entrepreneurial, cross-discipline da Vinci Center for Innovation.

While the overall structure of the Design Project Challenge has remained the same, the competition has evolved over the years. Each team is required to write a concept paper, design a poster, and give an oral presentation at the end of the week. However, in the more recent years teams can develop physical prototypes of their ideas in addition to the written requirements. As a result of increased interest in prototyping, hands-on activities, including the use of open-source electronic prototyping platform Arduino, utilizing the university's 3D printer, and an introduction to patenting information by the university's library has been included. Additional metrics have been

added to design team formation, including a personality assessment prior to the on-campus experience.

### Academic Year Components

While the HSTP is the cornerstone component of the VCU LSAMP program, two other programs complement the HSTP, the Peer Mentoring Program and the fall semester Academic Success Seminar. Students who participate in the HSTP are expected to also attend the Academic Success Seminar (as indicated in their commitment form).

### Peer Mentoring Program

Multiple studies have identified social integration into the college community as an important factor toward the retention of students (Tinto, 1993; Holland et al., 2012; Collier, 2017). There is significant evidence of mentoring contributing to an overall positive relationship between students, their major, and their university. Traditionally, LSAMP upperclassmen are assigned mentees during the on-campus portion of the summer hybrid program. Utilizing the near peer model (Zaniewski and Reinholz, 2016), a selected VCU LSAMP upperclassmen are matched with one or two freshman students based on similarity in majors, career goals and personal interests, and social identities. The goal of the mentorship program is to help new students become acclimated to college life and feel integrated in VCU LSAMP. Mentors are required to correspond with their mentee(s) at least once every week by email, phone, or video chat. Mentors are also instructed to meet with their mentee(s) in person on at least a monthly basis. A common response in the evaluation survey for the Mentorship Program expressed the satisfaction of students having someone to go to with their questions. Most students identified their mentors as a positive source of support and felt comfortable discussing academic and non-academic topics with them. These responses illustrate an observation from a study by Meyers et al. at Notre Dame, stating that students felt more comfortable reaching out to upperclassmen vs. faculty (Meyers et al., 2010).

## Fall Semester Academic Success Seminar

To achieve the goals of continued engagement in the VCU LSAMP program a fall academic success seminar was introduced as a required component of the HSTP. This custom designed course for VCU LSAMP students continues the themes covered in the HSTP Study Skills course and is similar to the UNIV 101 Introduction to the University and UNIV 102 Investigations in Learning, courses offered by VCU, neither of which are required courses. Providing structured dedicated time to reinforce concepts covered during the summer study skills course and an opportunity for students to see their friends from their cohort was found to be important to the participants in exit surveys. This seminar also provides VCU LSAMP directors an opportunity to check in with the students, monitor their self-reported academic progress and become aware of any academic needs such as tutoring, internships, recommendations, etc. Upper-class LSAMP students also attend the Academic Success Seminar on occasion to say hello and catch up with the directors and meet the new cohort. These weekly meetings not only provide content but also an opportunity to continue to build relationships. Research has shown this form of proactive advising and holistic care is beneficial to students (Heisserer and Parette, 2002; Packard et al., 2013; Bloom, 2016; Lane, 2016).

The Academic Success Seminar meets once a week during the fall semester (Table 3). This course gives students an opportunity to discuss their first-year experience. The tools and techniques students learn in the course help them to combine their skills, knowledge, and talents to assist them in recognizing what motivates them and helps them transition into a successful college career. Questions explored during the course include:

- What are your key strengths?
- What are your core values?
- What are you passionate about?
- Who should sit on your personal advisory board?
- How does emotional intelligence fuel knowledge and talent?
- How will you recognize and deal with bias?
- How to “lean in” against the odds?
- What do resilience and conflict resolution look like?

During the course students were asked to complete reflection exercises such as journaling, discussion circles, and personal assessments (e.g., Strengths Finder, Let Me Learn etc.). Students are also asked to read selected materials, watch Ted Talks, and listen to Podcasts.

## PROGRAM OUTCOMES AND FINDINGS

### Methodology

Between 2014 and 2019 over 200 students participated in the HSTP program ( $n = 201$ ).<sup>17</sup> The participants majored in one of

<sup>17</sup>Due to the uncertainty resulting from the COVID-19 pandemic, only the Online Summer Transition program was offered in 2020, thus the data from summer 2020 is omitted from the program analysis.

the 15 undergraduate STEM<sup>18</sup> disciplines offered at VCU, identify as AALANAI,<sup>19</sup> and approximately 65% of the participants were women. Findings are reported from data collected from the HSTP 2014-2019 programs. Academic achievement data was gathered from 2014-2020. Program staff observations of the participants were also used. The evaluation data reviewed were from end of program surveys administered at the completion of each summer (2014-2019), bi-annual focus groups and interviews that were conducted in 2016 and 2018, and survey data that was collected from an in-progress research project that was administered in 2018. Three 50-minute focus groups were asked to respond to seven open-ended questions (see Table 4). Two groups were facilitated by program staff and the third was conducted by a non-program affiliated graduate education researcher. For the interviews, more than two dozen students were interviewed by program staff to explore the student perceptions of the impact of the program more fully. All enrolled VCU LSAMP students were invited to participate in the focus groups and interviews, thus multiple cohorts were represented in the focus groups and during the interviews. Students signed up to attend the focus groups or participate in an interview. The goal of the focus groups and interviews was to explore the student perceptions of the impact of the program more fully.

Qualitative data from the focus groups and interviews were analyzed following Creswell’s description of the systematic process of data analysis in grounded theory (Creswell, 1998). Select members of the research team first reviewed recordings of the focus groups and interviews independently to develop codes and identify themes in the responses to the questions. They then met to review their findings and developed, sorted, compared, and contrasted codes and categories until no new codes were created. Data from the program evaluation and research surveys, focus groups, interviews, participant observation present a comprehensive picture of the outcomes of the HSTP program over several years. Academic achievement data collected includes performance in HSTP classes and university courses, retention, graduation, and declared major data. All data are presented in aggregate per IRB approval (HM#20001406).

### Academic Outcomes

The six-year graduation rate for HSTP students was 72.7% (HSTP summer 2014), which is approximately 10% points higher than the university average for the same population (AALANAI students) over the same time period. Of the HSTP students

<sup>18</sup>VCU STEM majors include bioinformatics, biology, biomedical engineering, chemical and life science engineering, chemistry, computer engineering, computer science, electrical engineering, environmental sciences, forensic science, mathematical sciences, mechanical engineering, pre-engineering/undeclared engineering, physics, science. Information systems is a VCU STEM major but does not admit students in their freshman year. Transfer students may declare information systems, but no LSAMP students in the HSTP have majored in information systems.

<sup>19</sup>The NSF defines historically underrepresented racial and ethnic minorities in STEM as African Americans (or Black), Alaska Natives, Hispanic Americans (or Latinx), Native Americans, Native Hawaiians, and Native Pacific Islanders.

**TABLE 3** | Fall Academic Success Seminar topics.

Week 1	Welcome, introductions, syllabus instructions, review student schedules
Week 2	Reflection on the summer
Week 3	Let me learn assessment
Week 4	How do I study for... given how I learn...?
Week 5	Discovering your core values and VIA strengths assessment
Week 6	Explore resilience and mindfulness or exploring your strengths
Week 7	Mid-semester updates and check-in
Week 8	Unconscious bias or social identity <sup>a</sup>
Week 9	Who are your “FAV 5”?—building your personal advisory board
Week 10	People of color in leadership or reflection on AALANAI excellence <sup>a</sup>
Week 11	Resume workshop and interacting with company representatives or industry panel <sup>a</sup>
Week 12	Interviews—charting your course or financial planning
Week 13	Undergraduate research or graduate student panel <sup>a</sup>
Week 14	End of semester check-in and celebration

<sup>a</sup>Topics not covered in the fall Academic Success Seminar are covered in the spring Career Readiness Series.

**TABLE 4** | Focus group questions.

1. From where does your confidence in completing your degree at Virginia Commonwealth University in your current STEM discipline come?
2. What types of experiences have led you to your current academic and career goals?
3. How have your experiences in the summer transition program influenced your current academic and career goals and your confidence in graduating from VCU?
4. What role if any do you feel the summer transition program has played in you becoming engaged in scholarly or academic pursuits including conducting research, attending office hours, supplemental instruction, academic advising, professional development, study groups, etc.?
5. What makes a good student in STEM and what types of things do successful STEM students do?
6. Did participation in the summer transition program provide you with information about these “academic norms” and do you think participation in the summer transition program helped you academically; for example, an increased GPA?
7. How has the summer transition program influenced your integration into the VCU community socially?

who have graduated ( $n = 61$ ), 59% ( $n = 36$ ) graduated with a degree in a STEM discipline. It is worth noting that several HSTP students declare a STEM major when entering VCU because of their interest in pursuing a career in a healthcare related field, however, once our students come to VCU they learn of other majors, such as nursing, clinical radiation sciences, or health, physical education, and exercise science which will allow them to pursue their career aspirations, but with a STEMH degree. Thus, if we consider students who graduated with a STEMH degree (STEM plus health field), then the graduation rate increases to 70.5% ( $n = 43$ ). Overall, the graduation rates for students in the HSTP exceeded the university graduation rates for all AALANAI students (Table 5). Likewise, HSTP students persisted at higher rates when compared to the VCU AALANAI student population, with the exception of the HSTP 2018 class. Seven students from the HSTP 2018 cohort did not return to VCU the fall semester of 2020. These students were in good academic standing. While this attrition rate is higher than the university average, we hypothesize that many of the students did not return because of COVID-19 restrictions and the new modality with which many of their STEM courses and laboratories were being offered. We are following up with these students to inquire about their reasons for not returning to VCU.

Student performance in their first mathematics class and chemistry class was also tracked. Students who mastered more than 60% of the topics in the ALEKS mathematics course had an increased likelihood of earning a grade of

“A” or “B” in their first mathematics class (Figure 4). Of the HSTP students who enrolled in a mathematics class in their first year ( $n = 199$ ), the majority of HSTP students enrolled in either precalculus or calculus ( $n = 143$ ). However, HSTP students also enrolled in College Algebra with Applications, Calculus II, Differential Equations, Statistics, or no math at all ( $n = 2$ ).

Students who mastered more than 60% of the topics in the ALEKS chemistry courses had an increased likelihood of earning a grade of “B” or better in their first chemistry class (Figure 5). The majority of HSTP students enrolled in Chemistry 101. Chemistry is not required for all STEM majors thus there are fewer students who enrolled in chemistry during their first year. Furthermore, the Department of Chemistry instituted more stringent prerequisite requirements for students to enroll in General Chemistry. Thus, our data sample for Figure 5 has only 59 students in comparison to the mathematics enrollment numbers.

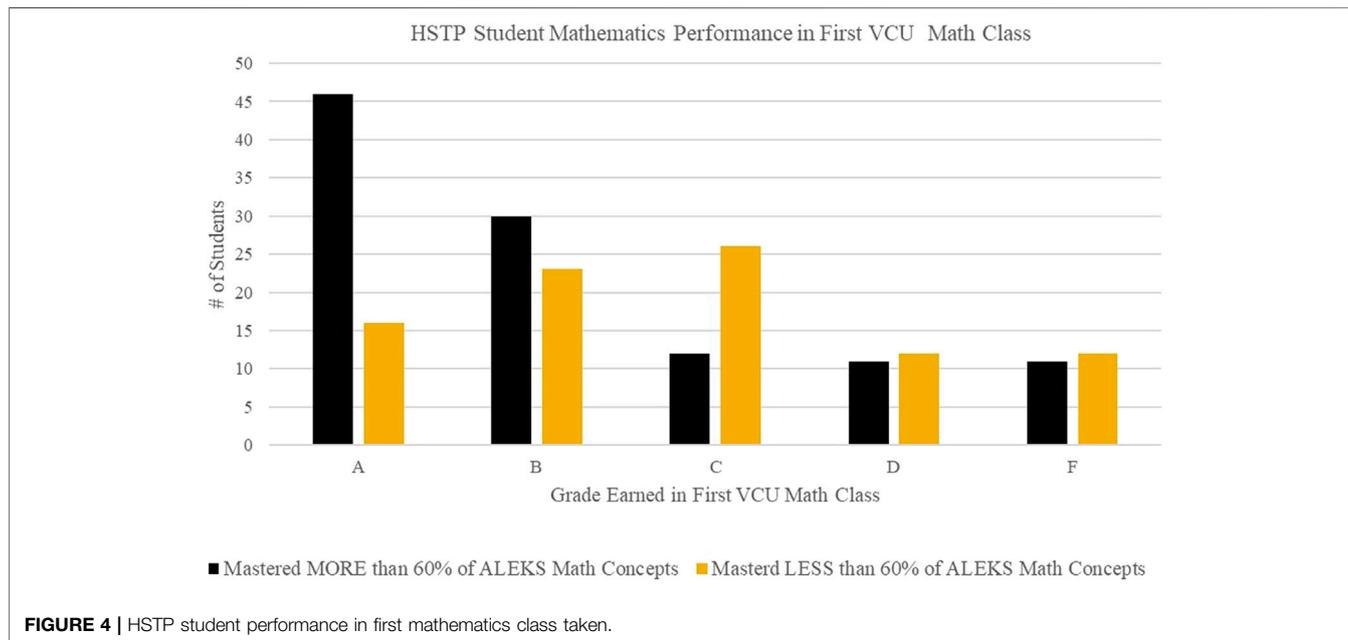
However, findings thus far indicate that students within the program who did well with the ALEKS courses do better in their mathematics and chemistry courses than the students in the program who did not do well with the ALEKS courses.

## Hybrid Summer Transition Program Evaluations—Exit Surveys

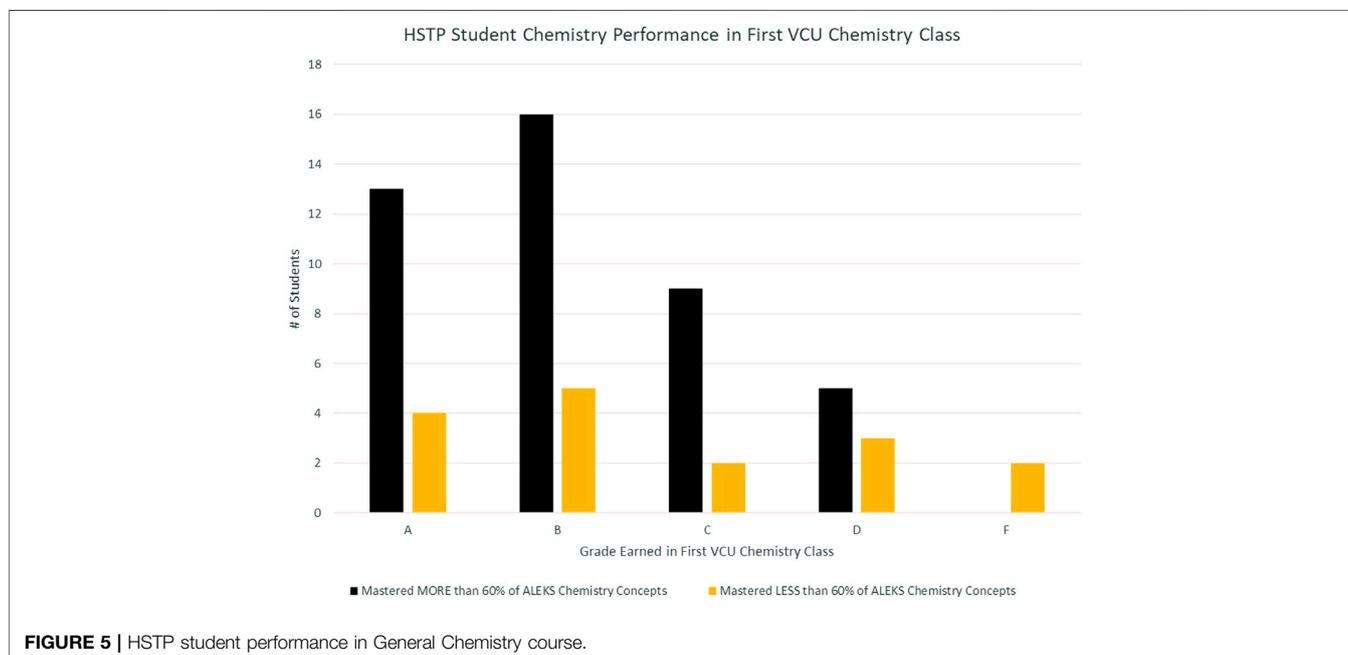
Students were given exit surveys at the conclusion of the HSTP to help program directors better understand participants’

**TABLE 5 |** Retention and graduation data for HSTP students compared to all AALANAI VCU students.

	2014	2015	2016	2017	2018	2019
HSTP student data						
# of HSTP participants	22	41	49	26	30	33
STEM retained	40.91%	43.9%	44.9%	65.4%	30% <sup>a</sup>	63.6%
Persisting	4.5%	14.6%	30.6%	73.1%	63.3%	84.9%
Graduated	72.7%	56.1%	40.8%	7.6%	–	–
VCU AALANAI student data						
Persisting	2.8%	8.9%	24.6%	67.7%	71.3%	81.1%
Graduated	63.5%	57.8%	40.0%	3.1%		



**FIGURE 4 |** HSTP student performance in first mathematics class taken.



**FIGURE 5 |** HSTP student performance in General Chemistry course.

**TABLE 6 |** Exit Survey Questions.

Questions that pertained to student preparation for first year courses.

1. I feel the online portion of the summer transition program was effective in preparing me for my college courses in MATHEMATICS.
2. I feel the online portion of the summer transition program was effective in preparing me for my college courses in CHEMISTRY.
3. I was self-motivated to learn the course material throughout the online portion of the program.

Questions that pertained to overall experience

1. What activity did you enjoy the most during the week on campus? Why?
2. What activity did you enjoy the least during the week on campus? Why?
3. Was there an activity or speaker you wish had been included during the on-campus program? If yes, please explain what you would have liked to have seen incorporated and why?

perception of the impact of the HSTP on their academic preparation, their evaluation of various activities, and how successful the HSTP was in achieving the desired outcomes. In the exit survey, students were asked to rate statements given in **Table 6** using the following scale; strongly agree, agree, disagree, and strongly disagree. Nearly 90% of the students who participated in the survey reported either strongly agreeing or agreeing that the online portion helped prepare them for their first-year mathematics course. Additionally, more than 90% of the students who completed the survey reported feeling that the online portion prepared them for their first-year chemistry course. Similarly, approximately 90% of the students reported feeling motivated to complete the ALEKS curriculum. In addition to the scaled questions students were asked free response questions to allow an opportunity for them to elaborate on the specific activities and in what aspect they were affected. **Table 6** shows the open-ended questions.

Among all the program activities the ropes course/team building was the most favored among the students. Students who cited the experience identified the activity as an effective platform to build bonds, trust and get to know one another.

“I enjoyed being able to connect to people I did not even know or would not have even talked to before the event.”

During the evaluation of survey responses to the first free response question students also reflected favorably on the study skills courses. Many were able to draw direct connections between the course topics and the current academic journey.

“I enjoyed the Study Skills class and the field trips the most. This is because during the study skills class we learned so much about accepting that we will face failure in school, however, we shouldn’t let it overcome us. We also learned the importance of taking time out for yourself despite all the craziness of being a student. I enjoyed the field trips because they allowed me to explore other professions that I considered.”

“Listening to the study skills lecture because it was very relevant to me and will be relevant in my life in the future, both academically and not.”

The collaborative project-based learning environment was the final program activity to be heavily noted by the students as a favorable experience. Students openly discussed frustrations in the project scope and time commitment but enjoyed sharing their ideas with their peers and expert faculty members.

In contrast the students cited the lab tours and presentations as the activities least favored. While some categorized the formal presentations as informative, many described the scope as limited. Students in the program came from several different STEM disciplines, thus it was important to have presentations from across the various STEM fields. For example, the tour of the Virginia Department of Forensic Science may have been interesting to the several forensic science majors and less enjoyable for the electrical engineering students. In contrast, the tour of the Wright Virginia Microelectronics Center might be more enjoyable to the physics and engineering majors and less so for the math and biology majors. The presentations prepared were largely geared to the engineering discipline, including the methodology with the design project. However, students desired increased representation in other STEM disciplines, college affinity groups and administrative personnel. Additionally, students believed that the dense schedule prevented them from completing additional tasks within their ALEKS programming.

## Focus Groups and Interview Findings

Overall, whether in focus groups or interviews, when participants were asked about how the HSTP specifically influenced their current academic career goals participants frequently referred to the peer support system the program provides. They also noted the significance of seeing people from similar backgrounds who shared similar passions. Most of the respondents noted that the HSTP gave them confidence and decreased anxiety in approaching professors. Multiple students also discussed how participation in the HSTP decreased their anxiety at the start of the school year, since they were already familiar with the campus and had a network of friends once they returned for the fall semester. Findings from the focus groups provide compelling evidence that participants in the hybrid summer transition program experience a caring educational environment (Gilligan, 1982; Noddings, 1984; Noddings, 2013; Lane, 2016) which is fostered and strengthened as they continue with LSAMP.

In many ways the program helped them adjust to college schedule/setting, gave them people to form study groups with

and overall increased their motivation to do well and finish the program. Students' comments also serve as evidence that they value their membership in the community established by the HSTP and feel a responsibility to succeed and to remain integrated into that community. The realization that many AALANAI students entering STEM disciplines do not complete their programs of study has motivated them to finish their current degrees because they do not want to be another statistic. They formed a sense of accountability to one another. Students were asked in focus groups and interviews if they felt the HSTP contributed to academic success. While the students could not definitively say the HSTP improved their academic performance, they did note the significance of being familiar with both the academic topics in their chemistry and mathematics classes, along with the behaviors and norms to which the study skills class exposed them.

The focus group findings suggest much of the HSTP's impact on student integration at VCU is related to the social networks students developed while participating in the program. This finding is supported by other studies that have documented the benefits provided by cohort-development in summer transition programs (Stolle-McAllister et al., 2011; Lane, 2016). However, the findings also suggest many HSTP participants entered the program with high levels of perceived self-esteem, high motivation, and well-formed career goals, and students provided only few examples of how participation in the HSTP helped them develop in those areas. The HSTP may be one of many tools that motivated, engaged students are able to wield to build their own local communities in which they hold valuable academic and social capital. A more comprehensive exploration of the qualitative findings from the focus groups are presented in Griggs et al. (2016) and from the interviews are presented in Griggs and James (2019), Brinkley et al. (2014).

## Design Project Challenge Evaluation

Given that the Design Project Challenge (DPC) was a unique feature introduced in 2014 with the creation of the HSTP, special focus was given to evaluating this aspect of the program in 2018. The HSTP participants from 2015 to 2018 were surveyed and asked to reflect on the impact of the DPC on their academic pursuits and on their interest in undergraduate research and product design and innovation. The invitation was sent to all HSTP participants from these cohorts ( $n = 146$ ). The survey had an 18% response rate ( $n = 27$ ). In addition, an invitation was sent to all students from the 2015–2018 HSTP cohorts to be interviewed of which 3 students volunteered to participate.

Recurring themes observed from the survey and interviews were that the DPC taught them how to develop their ideas and present their work in a professional manner. Individuals responded positively to working with other students with shared academic interests and expressed a sense of accomplishment when presenting their final project at the Closing Ceremony. One student reflected that,

“I feel as though it really pushed us to think and work with each other in order to achieve something.”

These learning outcomes and student feedback mirror the factors identified in (Reisel et al., 2015) that outlined effective components of

a successful research experience. As expected, the brief duration of the DPC does limit the ability to train students in STEM research technical skills, in agreement with Adedokun et al. (2014). However, feedback from the survey suggest that despite the limited time frame the DPC extends freshman student's awareness of the research process and product design, effective communication, and possible STEM careers. One student shared,

“By preparation, it gave me a glimpse on how I'd be approaching my assignments and compiling research in my classes. Also, it gave me a new perspective on my strengths and weaknesses when it comes to communication skills and teamwork projects like such.”

Students' motivation to continue to persevere within STEM disciplines was explored and whether exposure to research and design at the onset of college education serves as a key component of that motivation. A majority of survey respondents report that participating in the HSTP DPC, prepared them for their undergraduate discipline (Figure 6A). Students made the following remarks:

“(The Design Project Challenge) definitely made me more comfortable with thinking within my discipline.”

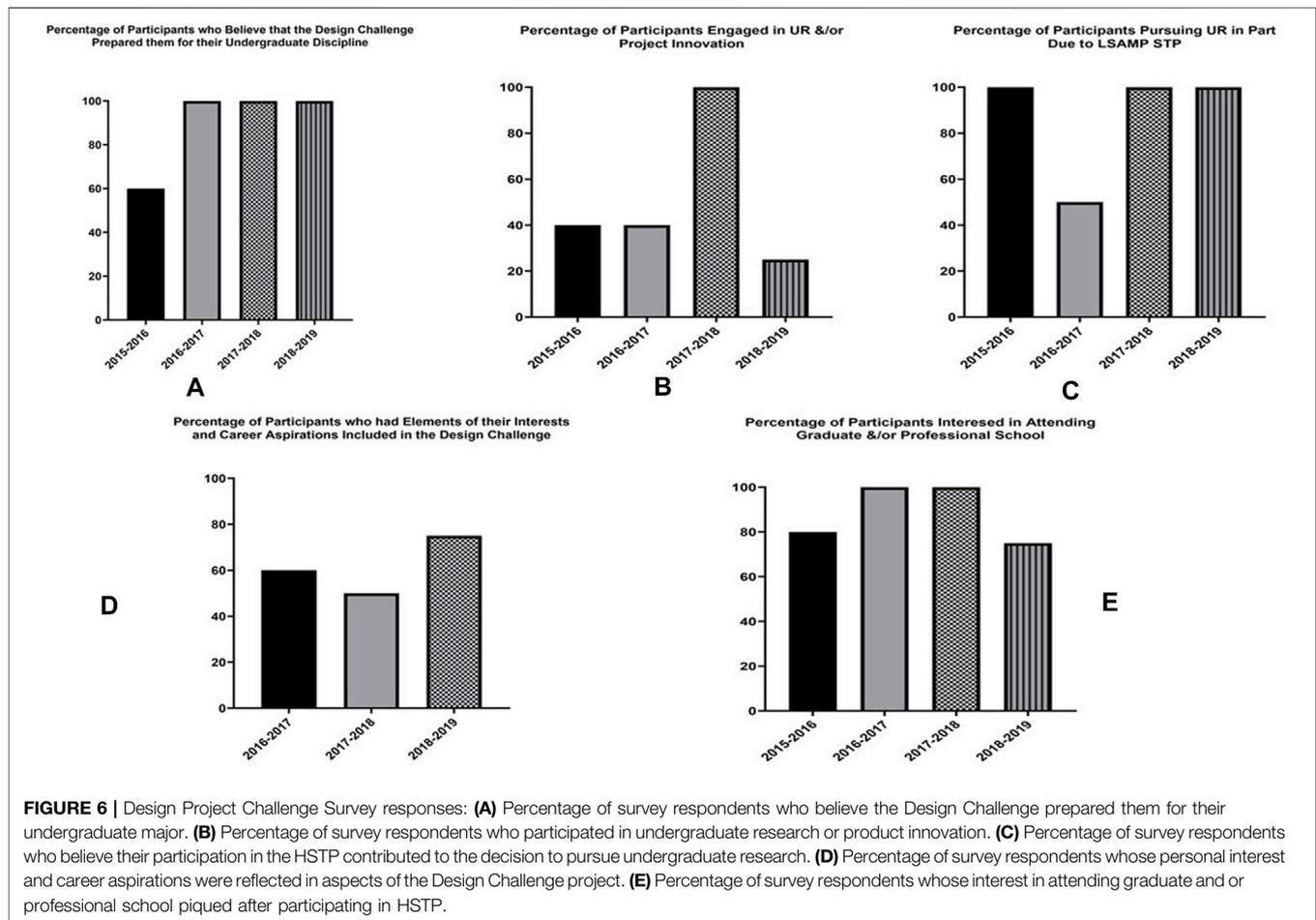
“The Design Challenge introduced me to the struggles and benefits of teamwork and communication and has prepared me for later study involving partners and teams.”

While all of the respondents from the 2017 HSTP reported engagement in undergraduate research or product innovation, this was not consistent across all cohorts (Figure 6B). Of these students, 50–100% attributed their engagement in undergraduate research to their participation in HSTP (Figure 6C). To probe the role of students' career aspirations in their experience within HSTP, students were asked to elaborate on their aspirations. 50–75% of survey participants stated that elements of their interests and career aspirations were included in the DPC (Figure 6D).

As stated earlier, a primary goal of the VA-NC Alliance is to increase and diversify the number of students that matriculate to graduate STEM programs. With this goal in mind, students were asked if participation in HSTP increased their interest in pursuing graduate degrees in STEM programs. 75–100% of survey participants reported interest in attending graduate and or professional school after participating in HSTP (Figure 6E). Regarding their experience in the DPC, one student expressed:

“As a person who is interested in going into research as a profession, I think the project planning/research aspects of the challenge were most relevant to my career interests.”

The DPC was able to foster a link between students' personal interests and career aspirations. In addition, the top three teams are given the opportunity to continue working on their projects throughout the school year. This offers continuation of their



training, increasing their exposure to research and design, and strengthening their interests in STEM fields.

## CONCLUSION

Results show that the HSTP which consists of a brief residential experience (to familiarize students with campus and their peers) combined with online academic support (e.g., ALEKS) is achieving its intended goals of building community among a cohort of students, orienting students to VCU, preparing students for the academic rigors of their first year in a STEM discipline at VCU, exposing students to opportunities and careers in STEM, engaging them in the VCU LSAMP program, and providing financial support. While some argue that students who participate in such programs might be highly motivated students who would already be on a successful academic trajectory, literature suggests many of these highly motivated students still need assistance in building the social, academic, and professional capital needed to be successful in STEM programs at the collegiate level (Stolle-McAllister, 2011). Based upon the findings presented in this paper, participation in the VCU HSTP is sufficient in building this capital in AALANAI students majoring in a STEM discipline.

## LIMITATIONS

This paper presents program evaluation data and data from portions of an ongoing research study. As such there is no control group with which findings can be compared. In addition, data from focus groups and interviews are only from students who remained active in the program and voluntarily participated in the interviews and focus groups. Thus, the findings are susceptible to both selection bias and response bias and may not reflect the experiences of nonparticipants or students who dropped out of the program. As the data is collected through formative assessment tools, many of the questions reflect a method of inquiry posed to improve the program and not necessarily measure the impact of the program. Qualitative data are only from points in time in the program and were not collected annually, thus they only reflect a subset of the population of all VCU HSTP students.

## DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available because the data set consist of program evaluation data and aggregate student academic performance data. Per IRB approval

this data is protected. Requests to access the datasets should be directed to rhobson@vcu.edu.

## ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Virginia Commonwealth University Institutional Review Board. The patients/participants provided their written informed consent to participate in this study.

## AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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**Conflict of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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