social and cultural barriers for STEM participation. Doing so helps (1) students from minoritized and/or economically disadvantaged backgrounds build a strong sense of belonging in STEM, (2) colleges retain underrepresented students in the field once they become interested in STEM, and (3) professional fields produce a strong and diverse STEM workforce (Eisenhart & Allen, 2020; Jelks & Crain, 2020; Lock et al., 2019). To secure the diverse workforce, it is essential to promote and ensure STEM participation and persistence by historically underrepresented groups of students (Chelberg & Bosman, 2019). As underscored by the NSF (2022), science and technology have never been more important to the nation: “Society is confronted by a growing set of become with regard to science."

Regarding the relationship between science learning and science identity, studies have reported that successful learning and attainment in science bolstered the learners' senses of belonging and competence and thereby solidified their science identity (Carlone & Johnson, 2007; Hernandez et al., 2018b; Hudson et al., 2018; Lock et al., 2019; Robinson et al., 2018). In this context, science identity is an outcome of successful learning. However, another line of research has demonstrated that science identity fostered persistence, retention, engagement, and aspiration in science among minoritized students (Chen et al., 2021; Estrada et al., 2018; Garcia et al., 2020; Gholson & Wilkes, 2017). In this latter context, science identity is a predictor of further learning, persistence, and engagement in science. Taken together, science identity might have a bi-directional relationship with learning, such that science identity is not only an outcome of successful learning in science (i.e., development of research skills) but also a predictor of further learning and commitment. Both aspects of science identity, i.e., either a predictor or an outcome of learning/attainment, are crucial for educators who strive to build and implement intentional and effective educational programs aimed at developing scientists from diverse backgrounds. However, educators would benefit greatly if it is known whether science identity predicts further learning and growth or is an outcome of learning science within their specific STEM training programs. If such a direction is revealed, training programs can use this knowledge to prepare increasingly more meaningful contexts of learning where to graduate education to support NIH’s goals of diversifying the nation’s biomedical research workforce by engaging such as biomedical and chemical engineering, and in behavioral science disciplines such as health science, kinesiology, linguistics, nutritional science, sociology and psychology.

The cohort-based learning community and mentored research are the two pillars within the two-year Scholars Program of the CSULB BUILD Program. Although the pillars are distinct, the components of the pillars closely intertwine and reinforce the effects of one another. In the learning community, Scholars acquire knowledge and skills that guide robust research. The knowledge and skills cultivated in the learning community are applied, tested, and consolidated in the mentored research whose rigor would intensify over the course of two years. The learning community provides the student trainees with the multi-layered system of support and guidance, which involves interactions with BUILD training directors, near-peer graduate student mentors (see Abeywardana et al., 2020), and faculty research mentors.

As Scholars apply knowledge and skills that are acquired in the research curriculum onto the faculty mentored research, they also prepare multiple research presentations and research reports as part of the graded requirements for the learning community. The Scholar trainees are also given the opportunity to participate in discipline-specific skill development workshops (e.g., statistics, assays, 3-D printing) and GRE preparation workshops. What is beneficial for the trainees is that for all of these activities in the Scholars Program, the trainees can seek feedback, guidance, and support from the program's training directors and near-peer graduate student mentors as well as their faculty research mentors. Program data and evaluation data demonstrated that over the two-year training, students showed growth in their understanding of research (both as a career path and in terms of research skills: writing, presentation skills, and data analysis; Vu et al., in press). Moreover, the gains were similar for all Scholars regardless of their academic disciplines or underrepresented group status.

The Scholars Program starts with an 8-week program, titled the Summer Undergraduate Research Gateway to Excellence (SURGE). The SURGE component plays a critical role in cultivating scholars' science identity because students are introduced to research and the pathway to a Ph.D. during the SURGE. Moreover, the SURGE concludes with a celebration where Scholars present their research projects in front of their family members. The involvement of family members provides an important opportunity for Scholars to solidify a network of social support. As demonstrated by researchers, social support from family members, peers, and teachers is a primary factor that helps minoritized students commit to a STEM field (Alshahrani et al., 2018), and others' recognition of the learner as a science person is an essential ingredient in the development of sound science identity (Kalender et al., 2019; Le et al., 2019).

During the first year in the program after the SURGE, Scholar trainees attend a national student research conference, which again reinforces the undergraduate researchers' science identity. Scholars are required to apply for a summer research experience (SRE) at an R1 university or other research-intensive organization for their second summer in the program. This SRE allows them to experience what it would be like to conduct research as a graduate student early on. The culminating experience of the Scholars Program is applying to graduate schools in their second year so the trainees could continue embodying the types of knowledge, skills, and dispositions that are expected of a researcher who nicely represents the field as a competent science person.

Table 1. Bivariate Distribution of the Participants

Variables		Track			Chi-Square
		Biomedical	Behavioral	Total	
Gender	Male	18	3	21	14.42***
	Female	16	29	45	
Minority Status	Yes	15	18	33	.97
	No	19	14		

Results

Factor Analysis of Year 1 and Year 2 Science Identity and Science Learning Measures

To examine the factor structure of Year 1 and Year 2 measures of science identity and science learning, an exploratory factor analysis was conducted, with six Year 1 and Year 2 items of science identity (three items per year) and fourteen Year 1 and Year 2 items of perceived learning (seven items per year). After entering all 20 items, factors were extracted with Principal Axis Factoring and the extracted factors were rotated using Equamax with Kaiser Normalization. The results showed strong divergence across items loading onto four distinct factors. These factors separated the science identity and learning items from each other and across the two time points. As shown in Table 2, Factor 1 was comprised of the seven Year 1 items of perceived learning and explained 33.22% of the variance. Factor 2 involved the Year 2 items of perceived learning, which explained additional 26.75% of the variance. Factor 3 was comprised of the three Year 1 items of science identity and explained additional 13.71%

Items	Factor			
	1	2	3	4
scientific information to different audiences.				
Y2_Learning Community has contributed to my professional development.	0.07	**0.89**	0.20	0.00
Y2_Learning Community clarified research career steps.	-0.08	**0.88**	0.03	0.25
Y2_Learning Community clarified for me which field of study I want to pursue.	-0.08	**0.87**	0.20	0.11
Y2_Learning Community has prepared me for graduate school.	0.06	**0.85**	0.23	0.23
Y2_Learning Community helped me develop scientific research project ideas.	-0.15	**0.79**	-0.16	0.10

Testing Research Questions 1 and 2

After confirming the appropriateness of treating the science identity and learning measures of Year 1 and Year 2 as separate but interrelated constructs, we proceeded to run analyses to test the two research questions utilizing the composite scores. To address Research Questions 1 and 2, two regression analyses were conducted. In both analyses, two independent variables (from Year 1 and Year 2) were simultaneously entered. In the first regression analysis, Year 2 Perceived Learning composite score was the criterion variable and Year 1 and Year 2 Science Identity composite scores were the predictors. In the second regression analysis, Year 2 Science Identity composite score was the criterion variable and Year 1 and Year 2 Perceived Learning composite scores were the predictors. The results from the two regression analyses are summarized in Table 4.

Table 4. Two Multiple Regression Analyses

Variables	B	*SE* B	β
Analysis 1 (DV: Year 2 Perceived Learning)			
Year 1 Science Identity	.08		
Year 2 Science Identity	1.01		
Analysis 2 (DV: Year 2 Science Identity)			
Year 1 Perceived Learning	-.04		
Year 2 Perceived Learning	.07		

high levels of science identity by the end of Year 1, either from earlier science-related experiences prior to the Scholars Program or during the first year in the Scholars Program probably largely due to the intensive SURGE summer component as our prior study implied (Vu et al., in press). This could then imply that the Scholars Program was quite successful in cultivating science identity among its participants from early phases in the program or succeeded in maintaining science identity that Scholars brought into the program. Additionally, results from the second paired-samples t-test revealed that trainees' ratings of their learning in the learning community at the end of the second year were significantly higher than those at the end of the first year, suggesting that the Scholar trainees continued to learn research knowledge and skills well into their second year in the training program. This finding could indicate another set of success in the Scholars Program, as it appears that the program effectively advanced participants' learning to prepare them for careers as research scientists during the courses of two years in the Scholars Program.

In relation to the major goal of this study, which was to expand our understanding about the roles that science identity plays in one's learning, the results revealed that science identity is a predictor (rather than an outcome) of students' learning of research skills when this particular undergraduate research training program was concerned. This finding is intriguing and significant as it might suggest that it is important for training programs to develop sound science identity that enables participants to continually learn. As discussed earlier, however, it is still probable that science identity and learning might grow concurrently while maintaining bi-directional and dynamic relationships with each other, where science identity could be both a predictor of learning and an outcome of learning over time, depending on: (1) the specific contexts where learners carry out their learning of research skills or conduct science-related performances, as well as (2) the specific developmental phases where the learners are located. If it is so, the findings in the present study are applicable only to the contexts of learning and students'

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