From Makers to Mentors

Building STEM Learner and Teacher Identities

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Makerspace activities and creative science, technology, engineering, and mathematics (STEM) projects in afterschool environments can help youth develop academic content and problem-solving skills while expanding what it means to do STEM (Peppler et al., 2016; Yang et al., 2025). These opportunities support students in developing a "STEM identity," defined by Chiu (2024) as "how individuals know and name themselves, who one is or wants to be, as well as to how one is recognized by others" (p. 90).

Afterschool makerspaces can be powerful contexts for learning and identity development, but educator preparation is necessary to provide these opportunities. Educators in and out of school often lack the disciplinary knowledge and the pedagogical content knowledge to lead STEM activities (Freeman et al., 2009; Haverly, 2017). More research is needed on how

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to support pre-service educators in teaching STEM, particularly through out-of-school-time (OST) programs that shape identity development. Therefore, our project investigated how facilitators benefit from these experiences and what they learn from leading STEM maker activities in OST environments.

In this article, we consider the programmatic elements that influenced STEM identity development for undergraduate facilitators and provide recommendations for supporting facilitators in OST STEM learning environments. We start by introducing our afterschool making program at two public elementary schools in California. We expand on our experiences as undergraduate facilitators leading and researching maker activities that were developed to encourage positive STEM identity development for diverse groups of third through sixth graders.

To focus on supporting undergraduate facilitators' STEM identity development, we asked the following research questions:

1. What factors support facilitators in developing confidence and competency in teaching STEM?
2. What recommendations do undergraduate facilitators have for those who want to implement afterschool makerspace activities?

We aim to support facilitators in developing confidence and competence in teaching STEM that can translate to their careers as STEM-empowered educators.

What Is the "Maker Mindset" and How Does It Help Students?

The "maker movement" has spurred engagement in science and engineering in a hands-on, informal setting, supporting youth STEM identity development (Fasso & Knight, 2020; Hsu et al., 2023). Making involves hands-on learning of STEM concepts, with a community of thinkers who design and build objects for both playful and useful ends. We define "makers" as people who investigate, wonder, and create products, or solutions to problems, using their imagination, creativity, and knowledge. Makers use a mix of tools, traditional crafts, electronics, and new technologies in a process that is learner centered and project based (Honey & Kanter, 2013; Peppler et al., 2016).

The "maker mindset" includes the values, beliefs, and dispositions of being playful, growth-oriented, failure-positive, and collaborative (Martin, 2015). Makers also leverage ideation, problem solving, and resourcefulness (Peppler et al., 2016). These values help students work together and view challenges as opportunities to learn collectively. Creation of artifacts, learning in community, and playful experimentation provide opportunities for both hands-on learning and broadening perceptions of STEM (Sharples et al., 2013). The maker movement has increased access to STEM for many, and it can be leveraged to reach historically underrepresented groups, such as girls and students of color who face additional barriers to STEM careers and opportunities (Ambrogio et al., 2018; National Research Council, 2010).

The afterschool makerspace context blurs the line between informal and formal learning and allows for "alternative cultures" within STEM. Makers often incorporate interests such as music, art, cooking, welding, software, and robotics, lowering barriers to participate and legitimizing diverse STEM identities (Calabrese Barton et al., 2017; Wittemyer et al., 2014). Educators can support diverse makers by providing an authentic, community-based context, valuing various skillsets, and encouraging students to learn from each other (Calabrese Barton et al., 2017; Holbert, 2016; McBeath et al., 2017).

Many OST maker programs leverage role models and mentoring to broaden participation. Maker mentors can help youth feel welcome and take on complex projects, encouraging creativity and problem solving (Alper, 2013; McBeath et al., 2017; Rees et al., 2015). In particular, undergraduate facilitators in a university–community partnership can be a critical resource for programs that provide STEM opportunities for school-age youth (Muller et al., 2021). College student mentors can be leveraged as "STEM ambassadors" in afterschool programs, teaching youth about STEM fields and helping them envision a future in STEM (Rees et al., 2015; Wittemyer et al., 2014). However, although leveraging the maker mindset and mentorship appear promising, more educator preparation is necessary to provide these opportunities for youth STEM development.

Developing Confident and Competent STEM Teachers: Maker Mindset for Teachers

The production of teachers in STEM fields has declined in the past ten years (Nguyen, 2025).

Furthermore, fewer than half of elementary teachers in the United States report feeling well prepared to teach science, with only 4% of elementary teachers expressing confidence in their abilities to teach engineering (Trygstad et al., 2013). This is problematic considering that in the Next Generation Science Standards, engineering is one of the four core science disciplines and features prominently in the Science and Engineering Practices that span all grade levels (NGSS Lead States, 2013).

OST facilitators express a similar lack of confidence teaching STEM content. Most afterschool programs rely on "youth workers with little science background" (Freeman et al., 2009, p. 3). Afterschool facilitators have relevant expertise in socioemotional and cognitive development, as well as teaching skills that can translate well to leading STEM projects with youth (Freeman et al., 2009; NASEM, 2025). However, very few people have formal training in both knowledge bases of STEM and OST facilitation (Freeman et al., 2009). This creates a common yet significant challenge in providing regular science programming at afterschool sites. Barriers to facilitator training include a lack of funding, focusing on non-science content areas, and limited opportunities for science-specific professional development (Bradshaw, 2015; Freeman et al., 2009). Despite the "gap between intention and implementation," afterschool program leaders are motivated to support facilitators and improve both the quantity and quality of their science offerings (Bradshaw, 2015, p. 46; Freeman et al., 2009).

Helping undergraduate facilitators develop confidence in STEM content and teaching could be one solution to address a significant need for more STEM-empowered teachers and OST staff. Teaching maker projects in an OST context provides opportunities for pre-service educators and future facilitators to build content knowledge and pedagogy related to science and engineering.

We believe that embracing a "maker mindset" as both learners and teachers can help novice educators build confidence and competence in STEM instruction. Schoolteachers and OST facilitators naturally employ resourcefulness and creativity as they design and adapt lessons. Afterschool educators often excel in flexibility and problem solving, but Carey (2024) argues that all teachers are "educational engineers"—educators who observe students, design lessons to meet their needs, and revise plans throughout the process (p. 3). Valuing this lesson design and revision process is especially relevant for OST facilitators, considering that most afterschool programs report that they "self-create" all science activities and materials (Freeman et al., 2009). Reframing engineering as everyday problem-solving can help teachers, including OST facilitators, recognize and value this role in their practice.

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In addition to reframing the lesson design and teaching process, teachers in and out of school can benefit from making connections between the engineering design cycle and everyday problems. For example, finding a way to level a wobbly table at home could help teachers reconceptualize engineering. Teachers who view engineering as more relatable are more likely to feel confidence in engaging in STEM problem-solving activities with their students (Carey, 2024). When teachers see through the lens of an educational engineer or a "maker," the potential exists to strengthen their STEM and teacher identities. OST facilitators can also benefit from demystifying a typically intimidating subject for someone without formal STEM training.

Although this work offers valuable insights, more research is needed on how facilitators develop STEM content and teaching identities, while fostering STEM identity development for the youth they facilitate. Only a handful of studies have reported on how undergraduate facilitators' STEM identities have benefited from implementing interdisciplinary projects (Cano & Arya, 2023; Martin & Betser, 2020; Marshall et al., 2019). Through this study, we seek to find ways that these experiences shift undergraduate facilitators' views of themselves as STEM teachers and learners.

Program Overview

Our program builds on the Mobile Making model, which positions undergraduate students as mentors in afterschool STEM spaces (Hansen et al., 2025). Near-peer mentoring, a research-based practice, supports both youth engagement and undergraduate facilitators' development as STEM educators (Price et al., 2023). Undergraduates facilitate STEM-focused maker projects for third to sixth graders through an afterschool program. The sessions are designed to align with the "maker mindset": hands-on, creative, and collaborative, while engaging small groups in problem solving. This program is a university–school partnership that is part of a multi-site project. In the fall of 2022, the Mobile Making program expanded to four universities throughout California and their surrounding school districts. University faculty in STEM education work with university staff, afterschool leadership, and undergraduate facilitators to provide inclusive and engaging maker activities for STEM-underrepresented youth (Hansen et al., 2025; Price et al., 2016, 2023; Siyahhan et al., 2023).

University Context

Our study context is an emerging Hispanic-serving institution and one university in the Mobile Making program. Undergraduates meet for a service-learning class titled "Makers in Out of School Time" (MOST) twice a week on campus to learn the material and finalize maker projects. Class topics include growth mindset, encouragement instead of praise, and student-led thinking. Undergraduates make, adapt, and troubleshoot maker projects to prepare for teaching youth and ensure an appropriate level of challenge. Each undergraduate facilitator devises their own lesson plan for their group of students, which allows freedom to choose how sessions run and projects are accomplished. After a few weeks developing and trying out activities, undergraduate students meet on campus once a week and at the school site for four weeks. Each quarter, undergraduate facilitators receive 12 hours of training through the service learning class before going to the school site and an additional 12 hours of experience at the site. Undergraduates are paid for the time spent at school sites and receive credit for taking the support class. In total, over the course of three years, 23 undergraduates have facilitated 25 hours of maker programming for nearly 100 elementary school students.

Afterschool Maker Sessions

Undergraduate facilitators guide elementary students from an afterschool program in developing STEM-based maker projects. The school district serves an ethnically diverse community, with 79% Latinx students and over half qualifying for free or reduced-price meals (Ed Data Partnership, 2022). Small groups pair two to five students with each facilitator. Projects include paper circuits, flashlights, scribble bots, lava lamps, catapults, roller coasters, and pinwheels (see Figure 1). Each one-hour session features an icebreaker, a lesson overview, vocabulary introduction, and hands-on project time. Students also complete weekly Maker Journal entries, documenting observations, drawings, questions, and reflections on the projects and their identities as makers.

Theoretical Framework: Teacher as Learner

The construct of "identity" can provide insight into how facilitators navigate educational pathways and develop skills relevant to science and teaching (Varelas, 2012). From a sociocultural perspective, identity is created moment by moment through actions, relationships, and culturally and historically defined norms of behavior (Calabrese Barton et al., 2013; Silseth & Arnseth, 2011). People engage in a process of "becoming" based on their performances and others' recognition (Carlone & Johnson, 2007; Urrieta, 2007).

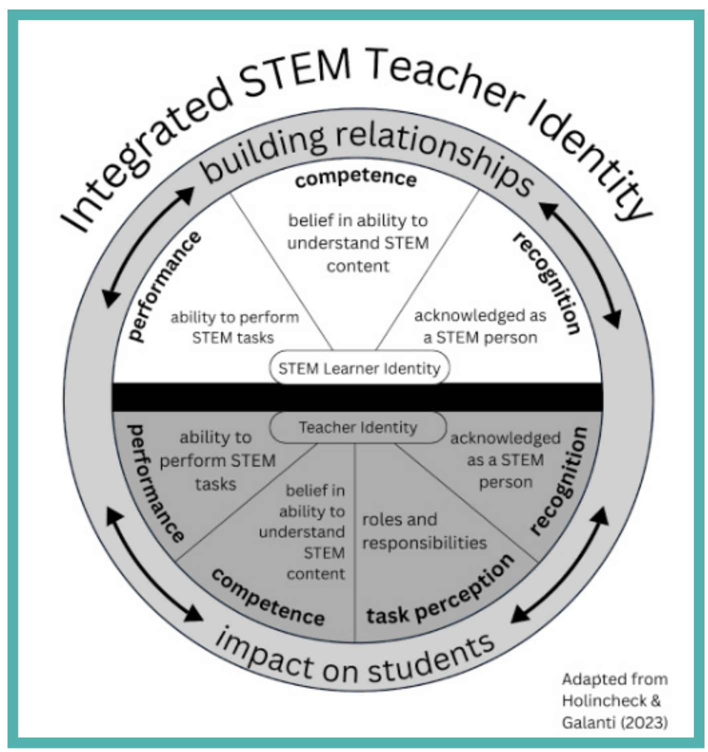
To understand STEM learner and teacher identity development for undergraduate facilitators in our program, we used the Integrated STEM Teacher Identity framework (Holincheck & Galanti, 2023). STEM identity for learners depends on the constructs of *performance, competence*, and *recognition*, as well as *STEM content interest.* The added construct of STEM content interest refers to the curiosity and a desire to learn STEM content. Mirroring the STEM learner identity, teacher identity includes similar constructs of *self-efficacy* (feeling capable in STEM teaching abilities) and *teaching interest* (curiosity and desire to learn how to teach STEM). Teacher identity also includes constructs related to teaching philosophy, methods, and goals, including *task perception* (roles and responsibilities as a STEM teacher), *motivation* (rationale for integrating STEM into the classroom), and *self-image* (awareness of abilities and their potential).

We modified Holincheck and Galanti's framework into the Integrated STEM Teacher Identity Coding Framework (see Figure 2). This framework offers insight into supporting facilitators, who are also learners, in developing STEM identities. The

Figure 1. Afterschool Maker Activities (from top left, clockwise: scribble bots, paper circuits, roller coasters, and pinwheels)

Integrated STEM Teacher Identity lens highlights the importance of supportive environments in which novice educators can lead STEM activities and grow into their roles, especially those who do not initially identify as "STEM people." It challenges the notion that one must be a STEM expert to teach effectively, showing that confidence and competence develop together. Integrating STEM and teacher identity bridges the gap between knowing STEM and knowing how to teach it. As future educators gain hands-on STEM experience, they feel better prepared to teach it in engaging ways. Ultimately, this framework aims to foster diverse, STEM-empowered educators by supporting their dual identities as teachers and learners.

Figure 2. Integrated STEM Teacher Identity Coding Framework



Research Design

A design-based research (DBR) approach was used to collect and analyze data. DBR supports the dual goals of informing local practice and providing insight into complex issues, producing a model of learning and innovation that applies on a broader scale (Barab & Squire, 2009; DBR Collective, 2003). Engagement in program design is flexible, ongoing, and codesigned with researchers and practitioners; as such, findings should be applicable and accessible to practitioners

(Anderson & Shattuck, 2012; Collins et al., 2004; Wang & Hannafin, 2005).

Research Team

The research team consisted of two faculty advisors and three undergraduate researchers who acted as teacher-researchers. Two of the co-authors were initially facilitators in the afterschool maker program and in subsequent years took on leadership roles called "STEM Ambassadors," in which they trained new facilitators and engaged in program research. One co-author participated in the research project by interviewing participants and analyzing qualitative data.

STEM learner identity included STEM efficacy (performance and competence) and recognition as a "STEM person."

Participants

A focal group of five students who participated in the program for multiple quarters were purposefully selected for interviews because of their extended participation, allowing for a more robust understanding of how facilitators' STEM identity develops over time (see Table 1 for participant demographics).

Data Collection and Analysis

We invited facilitators with more than one year of program experience to be interviewed; five participated in the fall of 2024. Three undergraduate researchers, also co-authors, conducted semi-structured Zoom interviews following Spradley's ethnographic guidelines (1979). Interviews lasted 32–53 minutes and included 18 questions about participants' roles, teaching philosophy, and STEM identity, focusing on their feelings of competence, learning, and teaching STEM content. All interviews were transcribed for analysis.

A team of four teacher-researchers performed structural coding (Saldaña, 2012) on transcripts of the interviews, according to Holincheck and Galanti's (2023) model of integrated STEM teacher identity. First-round coding included the broad categories of Teacher Identity and STEM Learner Identity (see Figure 2 for our theoretical framework). Teacher identity included the teacher role, recognition as a teacher, as well as self-efficacy as a teacher, combining the constructs of STEM teaching performance and competence. STEM learner identity included STEM efficacy (performance and competence) and recognition as a "STEM person."

Emergent subcodes such as *facilitator recommendations, connections with peers,* and *impact on students* were developed and refined through group discussion First, the research team coded one transcript together, discussing questions and revising the coding scheme.

Table 1. Participant Demographics

Participant Name	Program Role	College Major	Gender	Race	Participation in Number of Quarters (10 weeks each)
Maria	STEM Ambassador/ Facilitator	Education	Female	Hispanic/ Latino	5
Clay	STEM Ambassador/ Facilitator	Education	Nonbinary	White	5
Eleanor	Facilitator	Environmental Management and Protection	Female	Asian/ Pacific Islander, White	4
Emma	Facilitator	Education	Female	White	4
Isaac	Facilitator	Education	Male	Hispanic/ Latino	3

Note: All participants were given pseudonyms.

Then, each interview transcript was assigned to two researchers, who coded them individually before the whole group met to review any discrepancies and discuss until reaching a consensus.

Findings: Facilitator Confidence and Competency in Teaching STEM

Many undergraduate facilitators entered the afterschool maker program with hesitancy due to their self-perceptions about their knowledge and ability in STEM subjects. Although Eleanor, a STEM major, entered with a high degree of subject confidence, the other facilitators, with education majors, reported feeling like they "didn't know enough" and found science and engineering "intimidating." Facilitators often had a "bias against science" from negative experiences in school science. This led facilitators to feel nervous about teaching science, even expressing feeling like an "imposter." However, after engaging in class sessions that allowed them to practice and prepare for teaching and leading maker activities themselves, facilitators felt "successful" and "very confident," with one facilitator stating that she became a "different person from when [she] started." All five facilitators reported a shift in their confidence and competency in teaching maker-based STEM activities after their participation in the program. Our findings indicate that this shift in STEM identity stemmed from three factors: 1) a new perspective on STEM as everyday problem solving; 2) a focus on productive failure in maker activities and teaching; and 3) recognition by others as a STEM person.

Reframing STEM as Everyday Problem Solving

Facilitators felt more confident teaching when the program reframed maker-based STEM as being focused on critical thinking, rather than predetermined knowledge that the teacher transfers to the student. This shift to viewing everyone as a critical thinker and problem solver in the learning process was described as a "different way to be taught" that was important for both education and STEM majors. Viewing maker-based STEM as collaborative problem solving allowed facilitators to intentionally break down barriers to professional engineering for their students by framing the tasks as an opportunity for creativity—a much less formulaic approach than their previous, more traditional views of STEM subjects. We shifted our maker projects to design challenges that focused on the engineering design process, encouraging students to test new solutions and iterating their designs. For example, when students created spinning tops, they were given a model of a top that worked, but they were also provided with a variety of materials and given freedom to try to recreate the model or experiment with various materials while tweaking their design based on the outcome. These projects with multiple possible outcomes helped facilitators guide more open-ended, student-led sessions rather than giving step-by-step instructions.

This shift from teacher-centered practices to more student-driven problem solving allowed facilitators to see students gain knowledge through collective problem solving. Facilitators came to understand that the thinking and reasoning involved in the problem-solving process are more impactful on learning than the specific content the lesson is designed to support.

This new perceived freedom to think creatively made STEM feel more accessible to both facilitators and students. Leveraging this type of problem solving meant that facilitators and students saw the everyday relevance. One facilitator noted the importance of making the activities relate back to the students' lives. When students and facilitators could see how the content related to their world, it was easier for them to think creatively and engage in those reasoning processes because they drew on their own experiences to work through roadblocks.

Focus on Productive Failure

Another shift in mindset that changed facilitators' views on competence was the focus on productive failure. Modeling productive failure, one of the key tenets of making, influenced how facilitators viewed their teaching. By trying out the same activity multiple times, and improving it each time, facilitators reported developing more confidence. Maria stated, "We went through so many projects. We failed so many times. So that's definitely built my confidence."

Modeling productive failure, one of the key tenets of making, influenced how facilitators viewed their teaching.

For example, the facilitators tested a paper circuit project several times before teaching it, allowing opportunities to find solutions to problems. This gave facilitators confidence when failure occurred with students. When the LED bulb did not light up, they knew what areas of the project to check. Maria elaborated that expecting failure and going through it so many times took away the negative connotations with failure. It was simply part of the process. Within each moment of failure there was something to learn from the experience that helped her build a deeper understanding of the content as a learner. Each failure also increased Maria's ability to predict what could go wrong with the students' iterations of the project, which supported her preparation as a facilitator.

Throughout our study, facilitators consistently emphasized the importance of implementing and modeling a "growth mindset" for both their students and themselves as facilitators. Focusing on failure as a natural component of learning made activities more engaging for students, because no idea was off the table. This focus also shifted facilitators' views of teaching STEM. Clay expressed how developing a growth mindset was one of the areas in which they needed to shift the most in their thinking to "realize that it's not going to be perfect" and to "not beat myself up over it when things go wrong." Eleanor echoed this with her comment that "at the beginning I wouldn't have thought of a growth mindset, and how success and failure aren't exactly black and white. … [This experience] helped me adapt my mindset and seeing the success/failure definitions change, and seeing how a growth mindset can be applied more in situations into our teaching." Even though Eleanor came in with a high degree of confidence and competence as a STEM major, she reported that the program "has helped my confidence in my STEM identity, because the different style of teaching in the mindset … made me see that failure isn't really gonna take away that identity. And I think that being able to teach STEM kind of helps my confidence as well, because if I can teach it, then I can do it." These examples show the benefits of a productive failure stance for developing confidence and competency in STEM teaching for both STEM and education majors.

Not all failure, of course, is productive in complex, hands-on projects. If a project continues to fail after multiple revisions, it may be best to retire it. Conversely, if a project is too easy and requires no iteration, it misses opportunities to build confidence and problem-solving skills. Empowering teachers as "educational engineers" with a "maker mindset" helps them recognize when to push through project setbacks and when to pivot—making thoughtful, student-centered decisions.

Recognition as a "STEM Person"

Recognition from others as a "STEM person" is shown to have a positive effect on a person's STEM identity (Carlone & Johnson, 2007; Stapleton, 2015; Urrieta, 2007); the most notable form of recognition within our data was the perceived recognition from facilitators' peers. Facilitators felt a shift when they took on roles as leaders and trained other facilitators. Clay reported, "I feel most like a STEM person when we're learning the projects and I'm able to help my peers, like maybe if there's a concept that I'm familiar with I'm able to help in that way. It makes me feel like a STEM person." Similarly, Maria stated, "I felt like a STEM person. I felt like my peers saw me [as one] because I talked about my experience, and that I was confident." For both Clay and Maria, that added layer of mentoring the other facilitators supported them in developing their own STEM identity because their peers looked to them for guidance. Maria added, "It wasn't until teaching the college students [that] I felt like, 'Oh, I'm really comfortable [with the STEM content]'." It is one thing when children view an adult as a "STEM person," but it adds a level to one's own STEM identity when undergraduate facilitators are viewed as "STEM people" by their peers.

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Recommendations for Afterschool Makerspace Activities

Based on their experiences facilitating maker activities in afterschool programs, facilitators provided the recommendations that follow for those who would like to implement similar makerspace activities in their afterschool programming. The ideas of focusing on growth, iteration, and meaningful relationships connect to high-quality OST practices, including a flexible facilitation style, lessons that build on each other, positive youth peer relationships, and supportive relationships with staff (NASEM, 2025).

Recommendation 1: Focus on Effort and Growth over Perfection

Facilitators recommend promoting STEM learning in both themselves and in their students by focusing on effort and growth over perfection. As facilitator Eleanor stated, "Don't stress out about making mistakes. It's good to model making mistakes to [the students]. They need to see that it's okay as much as you do." By using a growth mindset as a guide for themselves and modeling this for their students, facilitators can promote a makerspace culture that accepts and even celebrates failure as an opportunity to learn. In turn, this lens of productive failure will support STEM identity development for both students and facilitators.

The OST context can provide the perfect context for failing productively. With a focus on flexible content driven by youth choice and not limited by school standards, facilitators can truly emphasize the learning process. In addition, OST facilitators can experiment and become more confident with STEM content with which they are less familiar, while leveraging their expertise in cognitive development, problem solving, and socioemotional skills.

Recommendation 2: Iterate, Iterate, Iterate

Facilitators also recommend choosing projects that provide opportunities for students to iterate and refine their ideas within a limited time frame. Facilitator Clay shared the importance of "choosing [projects] so you have multiple opportunities to revise and fix as you go—rather than a big project that you can only tell if it works at the very end." Testing and revising a design form a key part of the engineering design process. We recommend that facilitators narrow the scope of their projects to prevent cramming for time, or engage in a larger project across multiple days. This process allows lessons to build on each other, which is a luxury that the afterschool program space provides, as most students attend programs five days a week. Furthermore, facilitators learning through iteration can help build up both STEM learner and teacher identities.

Recommendation 3: Build Meaningful Relationships with Students

Another topic facilitators emphasized is the importance of building meaningful, trusting relationships with youth. Beyond the STEM content, undergraduate facilitators are in the position of mentors and role models for elementary students. Decades of research on OST contexts indicate the power of programs in fostering relationships between adults and youth, and how youth feel comfortable learning in OST because they can "be themselves" (NASEM, 2025, p. 177). Our facilitators shared the value of "getting on their level" by having equal roles with the students in collaborative problem solving. Isaac noted the importance of creating an interactive space where students are engaged in communicating with mentors and each other about both STEM content and their lives outside the program. He emphasized, "That is how they start to build trust. And that's how they start to listen to you. And that's how they start to engage. [Even] more is when you kind of know about them, and you're connecting with them." In other words, when students feel like you are invested in them, they become more invested in you and the projects. That sense of safety allows them to feel comfortable taking risks. Additionally, the more facilitators know their students, the more they are able to pick the right moments to challenge them, while still keeping the work fun and engaging.

Conclusion

Through the university and afterschool program partnership, undergraduate facilitators engaged in practices confirmed as high quality by OST research (NASEM, 2025) and grew in their STEM identities as both teachers and learners. All three of the findings that supported this growth in competence and confidence stemmed from learning within the university-based class. The class supported the undergraduate facilitators in developing their understanding of the STEM content and teaching practices, such as productive failure, the engineering design process, and building strong relationships with students. We see evidence of the benefit of foregrounding the maker mindset along with relationship building, which should be emphasized and supported through professional development for OST facilitators and staff.

University–community partnerships can build the skills of both pre-service teachers and OST mentors

(Bradshaw, 2015; NASEM, 2025). Postsecondary programs that include undergraduate and master's programs in youth development can allow hands-on experiences and multidisciplinary learning opportunities for those entering the education field (Evans et al., 2010). Many OST facilitators lack access to continue their education once they start working, so these partnerships can provide pre- and in-service training (Mahoney et al., 2010). University–community partnerships also create opportunities for pre-service teachers and OST mentors to work together, developing more effective teaching practices (Renick et al., 2021). Although not all afterschool programs have an existing connection to university programs, these same practices and mindsets can be supported through professional development opportunities for afterschool program teachers; alternatively, program directors can reach out to STEM and education departments at their local universities for support in developing STEM content and teaching knowledge (Bradshaw, 2015; NASEM, 2025).

In general, more funding is necessary for providing high-quality professional development for OST professionals. OST researchers have provided frameworks for assessing site needs and developing training, highlighting the necessity of time, expertise, access, resources, and support (Bradshaw, 2015). Ultimately, our research reveals the potential, given this research and teaching focus, to forge new science teacher pathways and strengthen the OST workforce pipeline.

Future Directions

Our study supports previous research that notes the important role that peer recognition plays in supporting STEM identity development (Carlone and Johnson, 2007; Stapleton, 2015; Urrieta, 2007). However, we were surprised to find that elementary-age student recognition of facilitators as "engineers" or "STEM people" did not show up in the data as a factor that supported facilitators' confidence. Future research should examine how students' perceptions of facilitators influence the facilitators' STEM identities and compare this impact to the influence of peer recognition. Another potential future direction is to follow the current cohort of trainees after graduation to see how they report that this experience affected their later competence and confidence as educators, STEM professionals, or OST staff.

We hope this article contributes to ongoing efforts to create meaningful opportunities for afterschool program facilitators to develop their identities as both STEM learners and teachers. By supporting facilitators in this dual identity development, we not only enhance their sense of competence and confidence in STEM, but also strengthen the broader pipeline of future STEM educators and OST workforce. This approach holds particular promise for addressing persistent challenges in recruiting and retaining skilled STEM educators. Ultimately, empowering facilitators in this way can lead to richer, more inclusive STEM learning environments that open the doors for a more diverse generation of students to explore and thrive in STEM fields.

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