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Students' Perceptions of Engineering Educators: Building Relationships and Fostering Agency in Outreach (Fundamental)

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Students' Perceptions of Engineering Outreach Educators: Building Relationships and Fostering Agency in Outreach (Fundamental)

Abstract

University-led engineering outreach programs reach approximately 600,000 K-12 students each year. Often, these programs are facilitated by undergraduate engineering outreach educators (EOEs), who increasingly are positioned as role models for students. To take up EOEs as role models, students first must notice characteristics of EOEs and then relate this information to themselves and their own interests and motivations. However, little is known about what students actually notice about EOEs during outreach. Drawing from student interviews, this paper addresses the research question: *What do elementary students perceive about their interactions with engineering outreach educators?*

As part of an engineering education outreach program, students engaged in 12-16 weeks of hands-on activities led by undergraduate EOEs. Sixty-eight fifth-grade students participated in 15- to 30-minute semi-structured interviews. Participants represented seven classrooms in four suburban schools in the northeastern United States. During the interviews, students described their experiences with EOEs during the outreach program. Utilizing open coding and thematic analysis, we found that students noticed the design/content of activities, relational components, and instructional moves present during interactions with outreach educators. In other words, they noted what is provided, who provides it, and how it is provided. Of greater interest, however, was that students noticed how the relational components and instructional moves together worked in service to the purpose of outreach (the "why").

While it is important to provide students with opportunities to engage with the technical content of engineering, relationship building in these spaces may be equally important. Our work suggests that EOEs might provide affective or emotional support to students, supporting them to feel capable and successful during outreach. This work may inform how we think about and conceptualize the role of outreach educators, in that EOEs may serve as a "greeter", welcoming students into and helping them feel like they belong in engineering. This paper will discuss implications for engineering outreach and how to support EOEs as they balance delivery of content and building relationships that foster student agency and success in engineering.

Introduction

Introducing children to role models during STEM outreach programming is believed to be an effective means to inspire interest and exploration in STEM study and careers [1-2]. This approach is based on the idea that if children see and interact with these role models, they can learn from them, get excited, and possibly follow in their footsteps. Outreach settings can utilize role models to serve different functions depending on program goals, including demonstrating particular skills and practices, showcasing what is possible or attainable, serving to inspire interest in, or helping to see something as valuable [3]. The assumption is that seeing and interacting with role models will positively impact aspirations toward STEM [4] and self-efficacy and interest in content areas with which the role model is affiliated [5-6]. Research suggests that when students identify similarities between themselves and STEM role models,

they come to recognize possible future selves in STEM [3, 7-8] or increase their sense of belonging by countering negative stereotypes and bolstering their STEM identity [6, 9].

Universities have developed outreach programs that seek to educate and inspire teachers and students about engineering. The engineering outreach educators (EOEs) who lead these programs interact with and potentially influence thousands of K-12 students each year [10]. While EOEs often are presented as role models to participants, less is known about whether children actually perceive them as such. Some research suggests that the more often outreach educators engage in disciplinary or "teacher-like" interactions, the more they are viewed as an instructor or teacher rather than a role model [11]. However, when interactions with outreach providers are more informal in nature, highlighting outreach providers' enthusiasm for STEM and focusing on developing personal connections, students are more likely to identify these providers as role models [11-12].

Our initial goal was to gain a better understanding of whether students view these outreach educators as role models. In the first year of the project, we directly asked students to identify their role models and whether they thought of their EOEs as role models. Consistent with previous research on children's role models [13], students most often mentioned family members as role models, followed by celebrities (e.g., athletes, singers), teachers and fellow classmates, with only a handful citing EOEs. Reasons provided by students for choosing these role models were split among what role models do as careers or hobbies, how role models treat people, and personal attributes of role models. While these initial findings provided insights into who children's role models are, they also suggested that children this age may think of role models differently than we had expected, viewing them within the frame of behavioral models who demonstrate things like fairness, friendliness, and how to be a good person.

This led us to shift our focus to the mechanisms that lead students to identify EOEs as role models. To perceive EOEs as role models, students first must notice characteristics of EOEs and then relate these characteristics to themselves and their own interests and motivations [3]. As a result, we began to question what students actually notice about EOEs during outreach. Therefore, the current study focuses on students' perceptions of their interactions with outreach educators. We believe that interactions that occur in this context are a precursor to students being able to see and take up EOEs as possible role models. Therefore, this study asks: *What do elementary students perceive about their interactions with engineering outreach educators?*

Methods

Context

The study took place within the context of a university-led engineering education outreach program designed to engage elementary students in hands-on engineering design challenges and foreground engineering design practices. Led by pairs of undergraduate engineering outreach educators (EOEs), students in fifth-grade classrooms participated in engineering design challenges for one hour each week for 12 to 16 weeks. Each EOE pair consistently worked with one classroom for one to two semesters during the school year. All activities took place in the students' classrooms during the school day. The curriculum was developed by the outreach program staff and EOEs, and EOEs worked with the classroom teachers to tailor the curriculum to the classrooms, taking into consideration local curriculum frameworks, EOEs' engineering knowledge, and students' interests.

A core goal of the program was to engage students in engineering activities that supported student agency and solution diversity. In a typical design challenge session, the EOEs introduced the design challenge to the entire class by stating a problem and defining solution criteria and constraints. After this whole-class introduction, students worked in design teams consisting of two to four students to create a tangible design solution. In general, students used familiar craft materials, small electronics, robotics, or computer-aided design software to envision and build solutions to challenges.

EOEs participated in training throughout the school year. Training was provided by the outreach program manager and director who have backgrounds in engineering, education, engineering education, and engineering education research. Prior to their first classroom visit, EOEs participated in 5-10 hours of training, which served to (1) orient EOEs to the goal of the outreach program (i.e., engaging students in open-ended engineering activities that support engineering practices including problem scoping, iteration, and solution diversity); and (2) support EOEs in building rapport with students, develop classroom management skills, and gain familiarity with educational tools they might not have used (e.g., LEGO robotics and Squishy Circuits). The program training emphasized the importance of relationship building between EOEs and the elementary students so that EOEs were prepared to support students to feel successful in engineering and to see engineering as connected to their interests and identities. Additionally, EOEs attended weekly meetings which allowed for discussion of topics related to the program (e.g., refining materials and activities, supporting engineering practices) and opportunities to meet with mentors (e.g., staff, faculty, post-docs, and Ph.D. students in engineering education) to refine EOEs' planned activities.

Participants

As part of the larger study of the outreach program, research team members conducted semi-structured interviews with 68 fifth-grade students. A convenience sample of students was utilized. Specifically, interview sessions were only scheduled with teachers who indicated that their classrooms were available to participate during a specific one-week time frame. Prior to the scheduled interview session, the research team created a class list and noted students from whom parental and student consent had been obtained. At the interview session, students were selected from this list making attempts to gender-balance interviews. Participants represented seven classrooms in four suburban schools in the northeastern United States. Participant gender and race/ethnicity were identified by parents on study intake forms. In this sample, 37 students (54%) were female and 31 students (46%) were male. Table 1 presents student race and ethnicity data. While our analysis is not specifically guided by feminist or critical race theory, we wish to be transparent about who is included in this research, as silence about gender and race of study participants contributes to biased interpretations in research [14].

Table 1. Race and Ethnicity Data for Participants

Race or Ethnicity	***N***	***%***
Asian	8	12%
Black or African American	7	10%
Hispanic or Latinx	15	22%
White or Caucasian	26	38%
Multiracial	6	9%
Not listed	6	9%

At the end of the school year and after the intervention program had ended, members of the research team conducted 15- to 30-minute semi-structured interviews with consenting students. All interviews were audio-recorded and transcribed. The interview protocols consisted of groups of items that asked students to describe their experiences with engineering in the outreach program, their career interests and aspirations, and attributes of and identification of their role models. While we did directly ask students whether they viewed their EOEs as role models, the current study does not present those findings as we are more interested in the steps leading to possible role model uptake. Therefore, this study explores what students notice during outreach, focusing on students' perceptions of their interactions with EOEs. We intentionally focused on students' positive perceptions of the outreach space, as this enabled us to better understand what students viewed as assets and affordances of the outreach space rather than the deficits or shortfalls experienced. Specifically, we examine students' responses to the following interview questions:

1. What did you like most about working on projects with your engineering outreach educators?
2. What did you like about the way your engineering outreach educator helped you?

Minimal research exists on students' perceptions of teachers and outreach educators. Therefore, we utilized inductive open coding to center the students' experiences with their engineering outreach educators during the outreach program [15-16]. One researcher read through all student responses to the first interview question, adding a researcher-generated descriptive label to each response. Next, the researcher read through the student responses again, generating an initial list of codes. Finally, the researcher utilized thematic analysis to group student responses into broader categories [17]. This process was repeated for the second interview question.

Some student responses included multiple codes. In these instances, each unique category was coded. For example, one student response might be coded for both design/content and instructional moves while another student response might only be coded for design/content. However, if a student mentioned multiple aspects within the same category, the category was coded only once. Namely, if a student mentioned multiple aspects of the design/content, the response was only coded once for that category. Finally, while responses to the two survey questions were coded separately, similar categories were identified across both items, so the results will be presented together.

Results

We present two primary findings that address our research question, *What do elementary students perceive about their interactions with engineering outreach educators?* First, students noticed the design/content, the relational components, and the instructional moves present during interactions with outreach educators. In other words, they noticed what is provided, who provides it, and how it is provided. Second, students focused on the reason for outreach, namely the "why", and felt outreach educators supported the exercise of student agency and students' ultimate success in the outreach setting. While we present these as distinct aspects of outreach, we recognize that these features may occur simultaneously during interactions.

Children Notice the "What", "Who" and "How" of Outreach

When describing their experiences in the engineering outreach program, children noticed the outreach design/content ("what"), the relational components of interacting with EOEs ("who"), and the instructional moves ("how") made by EOEs. Students' perceptions illustrated the nuance that exists within these categories. While we present these as distinct aspects of outreach, we recognize that in reality these features overlap such that students often mentioned multiple aspects in combination.

Design/Content – the "What." In identifying what they liked about working on projects with their EOEs, unsurprisingly, students mentioned the engineering projects that they completed. While some students identified the specific projects that they liked (e.g., egg drop, Makey Makey), more often students described aspects of the projects, such as attributes of the projects, actions or skills required to complete the projects, and the variety of projects presented to them. Students identified multiple project attributes. For example, they described projects as fun or new or unique to them. Some students liked that projects were easy, while other students liked the projects because they were hard. Students indicated that they enjoyed working on projects because of the actions or skills needed to complete the projects, including building, testing, and designing. Finally, students enjoyed the variety of activities presented during the outreach program. Relatedly, students enjoyed when their EOEs connected the projects under an overarching theme (e.g., sustainability, traveling to a remote planet, designing musical instruments) throughout the semester, though not all EOEs chose to do so. Table 2 presents sample student statements for each of the three design aspects.

Table 2. Sample Student Statements by Aspects of Design/Content

Aspects of Design Content	**Sample Student Statements**
Attributes of the Projects	The **Makey Makey**… we've **never done [it] before in our whole lives**…Yeah, I liked it because **it was new**. They [EOEs] would do stuff that was **hard and easy and fun** at the same time.

Actions or Skills Used	I just like **designing** it and **testing** it and seeing if it works. That we **built** a lot of fun things…when we built a parachute for the egg drop.
Variety of Projects or Themes	That there would be always a **theme** to it...It was a **spy theme** kind of. I liked how they gave us a **bunch of different** really fun projects.

Note. Keywords appear in **bold text.**

Relational Components – the "Who." When describing what they enjoyed about working with their EOEs, students mentioned attributes of the EOEs. Specifically, students identified characteristics of the EOEs, noticed EOEs' helpfulness, and noted the relatability of the EOEs. Table 3 presents sample student statements for each of the relational components.

Personal Characteristics of EOEs. Students mentioned multiple characteristics of their EOEs and their personalities. Many students described their EOEs as nice, kind, and friendly, often recounting instances in which EOEs demonstrated these characteristics. Students described EOEs as being fun or funny, and imbuing the outreach sessions with humor. These instances of humor seemed to resonate with students who recalled amusing moments when EOEs made them laugh or smile or joked around with them. Other personality characteristics noted included EOEs' creativity, high energy level, and positive outlook.

Engineering Outreach Educators as Helpful. Students described EOEs as helpful, noting three primary ways this was evident: 1) EOEs were attentive to students and were willing to help students; 2) EOEs ensured everyone received help; and 3) EOEs tailored help to individual students or design teams. First, students perceived EOEs as attentive, noticing when students needed help. Multiple students recounted examples of EOEs touching base with each group or coming over to groups when they noticed students struggling or when students raised their hands to request help. When multiple students needed help simultaneously, EOEs communicated that they saw students who wanted help or had raised their hands. Second, in addition to seeing them as attentive, students noticed the how EOEs helped all students, ensuring that everyone who needed help received it, even if time was short or many students wanted help at the same time. Students also perceived that EOEs were willing to work with them until they were able to proceed on their own. EOEs did not rush from one student to the next; rather, they made sure to give each student the help they needed before moving on to the next student even if this took an extended amount of time. Third, students noticed that not all groups needed the same type of help, commenting on the EOEs' ability to tailor help based on the needs of specific students or groups.

Engineering Outreach Educators as Relatable. Finally, students noted the relatability of EOEs. Although this theme was mentioned by only five students, we include it because it represents a personal connection made between the student and their EOEs. To make this connection, students had to notice information about or characteristics of the EOE and then relate what they learned to themselves. Students perceived EOEs as relatable based on a shared interest

or personality trait (e.g., likes to dance, is shy or has a sense of humor). Relatability also was noticed as a result of the nature of the perceived relationship, such that some students viewed EOEs more as friends than teachers, connecting with them on a more informal level. Finally, one student identified relatability by noting noted a potential future connection with EOEs, such that students could look back to what they learned from their EOEs if they chose to become engineers in the future. While noticing characteristics of EOEs might be easy for students, the secondary step of relating the similarity or difference in these characteristics to themselves may be more difficult, which may explain why this theme was identified for fewer students. It is worth noting that the training meetings encouraged EOEs to build relationships with students through sharing information about the EOEs' interests, hobbies, pets, and engineering experiences.

Table 3. Sample Student Statements by Aspects of Relational Components

Relational Component	**Student Statements**
Characteristics of EOE	They were **super fun**. And they were always **excited** to teach us new stuff. They were always **energetic**, they were always **nice** and they were always fun to build with. They were really **friendly**… They were **nice** to us.
Helpful *[sub-types identified after each statement]*	… they helped us when we raised our hands and asked for a question, and they **came right to us**. *[attentiveness/willingness]* They have to find different times to help us all **because there's other people in the class too**… t**hey eventually find [time] to help everybody**. *[everyone gets help]* She [EOE] knew that we were in the middle [of project], and that **she didn't need to explain every single little detail**. But she also didn't need to be super vague. And it just fit the project really well. *[tailor help]*
Relatability of EOE	[EOE 1] is funny and **likes to dance**. **That's what I like to do**. And [EOE 2] **likes to play video games**. **That's what sometimes I like to do**. They…**talk to us like we were their friends** and it was mostly like you were hanging out as a group of friends. It wasn't…like they were teachers or anything. They're like good engineers...**If we want to become engineers, we can remember back from what they teached us**.

Note. Keywords appear in **bold text.**

Instructional Moves – the "How." Students perceived two types of instructional moves made by engineering outreach educators: technical practices and supportive moves. In other words, EOEs provided technical help and affective support while working with students to complete design challenges. Table 4 presents sample student statements for the instructional moves. EOEs used a variety of technical practices to help students during design challenges. These practices included providing tips or suggestions (e.g., specific tip, multiple options to choose from, hints, general information, etc.), showing/telling students what to do, supplying materials or physical help, giving instructions, or offering explanations (e.g., steps, concepts, etc.). Students described instances where they struggled and were unable to move forward with their designs, noting that EOEs often would provide tips that helped them to get unstuck. In other examples, students described not understanding a concept or how to move forward on an activity, recounting EOEs providing additional explanation or showing them how to do specific parts of activities so that they could proceed on their own.

In addition to technical practices, students perceived supportive moves made by EOEs. The nature of the design challenges meant that students engaged in an iterative process of designing, testing, and re-designing. These steps in the engineering design process were introduced and emphasized by EOEs. However, to many students, this process was new and unfamiliar, especially the moments of struggle when designs failed. During these moments of failure, students mentioned interactions with EOEs, describing how they provided support and encouragement to persist. Specifically, students noted that EOEs demonstrated a positive mindset, often reaffirming students of their capability to complete a project and encouraging them to keep trying, noting that failed attempts were simply a part of the process.

Table 4. Sample Student Statements by Instructional Moves

Instructional Move	**Student Statements**
Technical Practices *[sub-types identified after each statement]*	Because she [EOE] wasn't very pushy about it, she just **gave multiple ideas** and let us choose from the couple she gave us. *[Tips – multiple]* When our group rocket wasn't very successful, [EOE] told us that **maybe if we took off the top part it** would work and it worked much better afterwards. *[Tips – specific]* I liked [it] because she [EOE] didn't just tell us what to do, **she actually showed us** so that we could do it again if she wasn't there. *[Show/Told]* Yeah, they [EOEs] would like **hold the things** that I needed to attach together and I would tape it. *[Physical Help]* They [EOEs] just told me, "**Put this piece here, and then there, and then there**." They just [kept] telling me where to put every single piece. *[Instructions]*

	Well, they [EOEs] explained how to do it. They **explained how to make it**, but they didn't really make it for us, they just explained how to. *[Explanation]*
Supportive Moves	I like…how they **helped us feel like** we were doing really, really good even if we weren't feeling that way about ourselves. What I like most about it is that **they kept encouraging us** to keep going and not give up on doing our creative experiments and doing the project. … they would just **congratulate us** when we made our design work, and when we didn't they would just say, "Oh, **try again**, maybe you could try doing this."

Note. Keywords appear in **bold text.**

Children Focus on the "Why" of Outreach

As described above, students notice multiple aspects of the outreach space, including design/content, relational components, and instructional moves, with greater attention paid to the latter two. However, beyond simply noticing the interplay of these aspects within the context of outreach, students also notice the reason (or "why"). Namely, irrespective of the design/content ("what"), EOEs leverage relational components and instructional moves in service of supporting students' agency and ultimate success or understanding of engineering concepts and activities. For example, students mentioned that EOEs noticed they were struggling and tailored the help provided ("who") using various instructional moves ("how") because they wanted to enable the students to figure it out on their own and arrive at a successful solution/design (the "why"). Students perceived that EOEs wanted them to be successful, resulting in a positive experience and reinforcing their ability to do the design challenges. Table 5 presents sample student statements related to fostering student agency, project success, and understanding of engineering concepts and activities.

Support of Student Agency. Students often commented that EOEs did not explicitly provide the answer. Students recognized and appreciated that their EOEs intentionally refrained from providing answers or doing the activity for them. Rather, EOEs guided students to discover the answer or solution on their own by providing suggestions, tips, or ideas, thus fostering student agency. Students indicated that they liked not being told the answer or how to do the design challenge, preferring to be supported while maintaining agency in completing the activity. This suggests students are aware of their personal learning preferences (e.g., they want to figure activities out on their own) and that the support provided by the EOEs aligns with these preferences. Students' perceived agency also seemed to reaffirm their capability to complete design challenges.

Fostering Understanding and Success. In addition to noticing EOEs support of their individual agency, students also perceived that EOEs wanted them to be successful and to

understand concepts and techniques underlying the design challenges. Recounting instances where they had struggled or not understood a concept or how to proceed, students reflected that EOEs stepped in to help them figure out how to move forward, providing encouragement and support throughout. Their comments suggested that the goal of the EOEs was to ensure that students were successful on a project, even if they had failed attempts along the way. Students felt supported by EOEs throughout the design challenges and perceived that EOEs worked to make the experience as positive as possible for them.

Table 5. Sample Student Statements Related to Fostering Student Agency, Understanding, and Project Success

Sub-theme	**Student Statements**
Student Agency	T**hey [EOE] didn't do it for me.** They gave me some directions so **then I could figure it out**... not every time someone's going to tell you what to do in life, so **it's good that they help you but don't tell you what to do**. They'll **help you try to figure it out**. And then if you need to, they'll give you a little push. They'll give you a little hint and you're like, "**Yeah, I get it now**." They just didn't do everything for us. They just **gave us a little nudge** to push us in the right direction. I liked that some teachers just give you the answer, but the [EOEs] actually **help you understand it** instead of just giving you the answer for the project. Our only problem [with the activity] was we didn't know how to design a hole at the bottom. **[EOE] came up with the idea** of doing out the math, and seeing where the cup, where it should be put off the desk so the ball would fall down. So, **we made** an arena, and then **we put the cup** like that and it would just roll in…I like the way he [EOE] helped me because it was, it felt like he was really trying to help and **he wasn't just trying to do it**. They didn't tell us exactly what to do…**They gave us … a good amount of freedom** on what we're supposed to do. And they wouldn't just be, 'This is what's wrong"… They said, 'This is what might be wrong or just try again and see what's wrong and try to **figure it out yourself**.' … I think that's better than them just telling us what is wrong and instead letting us figure it out by ourselves… **Because then you can figure out how it feels just to solve problems.** And to find out by yourself.

Foster Student Understanding	Yeah, so they [EOE] helped me in coding and when we were building bridges. We **hadn't done that before** so they **helped me understand** the vocabulary about suspension bridges and other bridges. But all the computer stuff **we were really confused** about…**They would show us, they would make a model** of [EOE 1] and [EOE 2], or [Teacher] doing it, and then **they would try to help**.
Project Success/Completion	So, we had a tub full of water, and they put some olive oil in it, and you had to find a way to take out the olive oil without taking out any water. **We were really struggling, but then [EOE] pointed us in the direction** of maybe trying to use yarn and wrapping it up and bringing it out…That kind of help really **helped us because that project was one of the hardest ones**. We weren't sure what to do [on project], and we were starting to give up….. She [EOE] told us that one of the legs, just the legs aren't stiff enough for the flamingo to hold up, and that the body is actually really heavy on the flimsy legs. And that helped us a lot **because we could actually finish the whole project** then. Before they helped us, they told us to explain why we did something in our project so then we could see what we did right or wrong. … **It helped me make the project work better**. We tried to put Play-Doh on two little spiky things that the light bulb had and then put the wire, but that always failed. **We thought we never could do it** but then [EOE] came. He said why since the Play-Doh and wire is our conductor, why don't you put them together and then put the light bulb in there. And we didn't think that would work, but once when we tried it, it actually worked…**if he hadn't told us like those parts like what we could do, we would never got the light bulb to light up**.

Note. Keywords appear in **bold text.**

Our findings suggest that students not only notice the instructional moves and actions of EOEs but that they value these moves and find them helpful to their learning and overall success. Students demonstrate that they are aware of and reflective about their own learning preferences and appreciate when educators employ these approaches to support their learning.

Limitations

The current study focuses on students' reflections of positive aspects of interactions with their EOEs. We intentionally asked students what they liked about working with and the help received from their EOEs in order to focus on the assets and affordances of outreach spaces rather than ways in which they were lacking. Our choice was deliberate as we did not want to put

elementary students in an awkward position such that they felt pressures to negatively evaluate (e.g., say anything bad about) the EOEs who came into their classrooms, who are themselves students and novice educators. We recognize that focusing only on what students liked potentially biases our analyses and findings to positive experiences. However, during the interviews we did provide students an opportunity to provide a counter-narrative and share negative perceptions of the program. Namely, we asked students what they did and did not like about doing engineering, what could be done to make them feel more successful in engineering, and to provide any other feedback they had about the program. These questions were worded to focus on the program more broadly and did not specifically prompt students to critique the EOEs. Responses to these questions were not presented as part of the current study.

We sought to understand what students perceived about working with EOEs during outreach. However, we did not directly ask students what they noticed. Instead, we asked students what they liked about working with EOEs and how EOEs helped them during the outreach program. While these questions did prompt students to reflect on interactions with their EOEs, these prompts might have triggered students to notice instructional factors and relational components more often than if we had simply asked them to indicate what they noticed more generally.

A single researcher conducted open coding of the data and created an initial codebook. The study would benefit from having the data coded by a second researcher and establishing inter-rater reliability for the codes and revising the codebook accordingly.

Discussion

People believe that including role models in outreach is one way to inspire interest in and attract students into STEM with outreach educators often positioned as role models. Previous research has focused on the impact of role models on student outcomes (e.g., self-efficacy and career aspirations) or identifying components of role models (e.g., characteristics of role models) rather than the mechanisms that lead students to take individuals up as role models. We sought to better understand students' perceptions about working with outreach educators in order to identify possible factors that contribute to students seeing them as role models. Our findings contribute to what we know about what students experience and notice about outreach programs in which they participate.

Students noticed what was provided, who provided it, and how it was provided during outreach. While we expected students to mention generic features and surface-level characteristics of the design/content of the activities, we did not anticipate that they would equally notice more specific aspects of the activities. For example, students went beyond simply identifying the activity (e.g., egg drop) or saying an activity was "fun", but they mentioned specific skills used while engaging in the activities, such as building and testing. This indicated to us that students enjoy both the content and the actions or skills characteristic of engineering. More than the "what", students also noticed whom they interacted with during outreach, namely the engineering outreach educators. Again, while we expected students to notice characteristics about the EOEs (e.g., kind, knowledgeable, attentive), we did not anticipate the extent to which students would mention deeper relational aspects of interactions with EOEs. Finally, students noticed the instructional moves used by EOEs to support them while engaging in the design challenges. Consistent with our expectations, students described a variety of generic instructional

strategies (e.g., providing tips, explanations), but they also described the meaningful encouragement provided by EOEs as being particularly supportive.

Of greater interest, however, was that students noticed how the relational components and instructional moves together worked in service to the purpose of outreach (the "why"). Students perceived that EOEs were attentive to their needs and tailored instruction to best support them in completing the activity on their own. In short, EOEs supported agency of students while engaging in the design challenges. What is more, students indicated that they preferred having agency and noticed that EOEs intentionally provided space for them to have it. Finally, students also noticed that EOEs wanted them to complete the design challenges, even if this meant working through multiple failed attempts on the way to a successful design. These findings suggest that students notice not only the characteristics of EOEs (i.e., the "what") but also how EOEs teach and why they teach in those ways. This suggests the value of utilizing EOEs as more than just potential role models who generate enthusiasm or interest in engineering, as EOEs may serve to support students in a variety of ways, including fostering their sense of belonging, agency, and self-efficacy.

Conclusions and Implication

Given the increased use of role models to inspire students' interest in STEM, and more specifically engineering, we began by questioning the assumption that students perceive outreach educators as role models. We sought to understand whether students identified engineering outreach educators as role models and, if so, what factors led to their uptake as such. To do this, we had to step back and first discover what students notice about outreach and about interacting with engineering outreach educators. This study suggested that students in our sample noticed aspects related to design/content, relational components, and instructional moves, all of which supported students' feelings of agency, competence, and success.

Students perceived that EOEs wanted them to have agency over their projects and to feel capable of completing design challenges, many of which required applying new concepts and skills and resulted in failed attempts along the way. Students liked having agency and recognized that EOEs could have given them the answer but that they intentionally did not, allowing students to direct their own progress. The preference for agency expressed by students has implications for how we approach fostering student agency in engineering outreach. Positioning youth as agentive and capable not only is something that youth notice and prefer, but it also has the potential to foster greater feelings of competence that could lead to increased motivation or affinity towards engineering. Due to the open-ended nature of design challenges (e.g., no one correct design), engineering outreach may be particularly well-suited to support students' agency and competence as they engage in the iterative process of completing the challenges. As such, engineering outreach educators should attend to supporting agency and capability in these settings. Additionally, we should consider providing professional development for outreach educators that specifically trains them to support students' sense of agency and competence.

Providing students with opportunities to engage with the technical content of engineering is an important part of outreach. Our study suggests that relationship building in these spaces may be equally important. Students noticed efforts made by EOEs to support them both technically and emotionally. EOEs provided a space in which students felt capable and successful while

engaging in hands-on engineering design challenges. Interactions with EOEs are consequential to students and may influence both their initial and lasting impressions of engineering such that they welcome students and make them feel like they belong in engineering. Training and professional development of EOEs typically focuses on technical content and pedagogical approaches. However, our findings suggest that providing training specifically related to building relationships with and providing emotional support to students in these spaces, especially during moments of design failure or frustration, would be beneficial.

Finally, this work may inform how we think about and conceptualize outreach educators as potential role models. While often positioned as such, our findings suggest that EOEs might not be taken up as role models in ways that are typically associated with these settings (e.g., inspiring interest, showing possible future selves, dispelling and/or inoculating against stereotypes, etc.). Rather, our work suggests that EOEs might provide affective or emotional support to youth, serving to welcome youth into these engineering spaces by supporting and reinforcing that students are capable and belong in this space. Outreach programs may want to consider positioning EOEs less as career role models and focus more on leveraging these other benefits that students gain from interacting with EOEs. Most importantly, we should be deliberate in how we utilize EOEs, ensuring alignment with the specific purpose of outreach, whether it be to inspire or simply to welcome students into the space.

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