Received: 30 March 2022 | Revised: 22 August 2023 | Accepted: 28 August 2023

DOI: 10.1002/jee.20555

JEE Journal of Engineering Education

RESEARCH ARTICLE

Photovoice: Visualizing the engineering identity experiences of sophomore students

Jerrod A. Henderson[1] | **Brian L. McGowan**[2] | **Joan Wawire**[3] | **Le Shorn S. Benjamin**[1] | **Kristin L. Schaefer**[4] | **Jeannette D. Alarcón**[5]

[1]William A. Brookshire Department of Chemical & Biomolecular Engineering, University of Houston, Houston, Texas, USA

[2]School of Education, American University, Washington, DC, USA

[3]Department of Petroleum Engineering, University of Houston, Houston, Texas, USA

[4]Department of Mechanical Engineering, University of Houston, Houston, Texas, USA

[5]Department of Curriculum and Instruction, University of Houston, Houston, Texas, USA

Correspondence
Jerrod A. Henderson, William A. Brookshire Department of Chemical & Biomolecular Engineering, University of Houston, 4226 Martin Luther King Jr., Boulevard Room S222, Houston, TX 77204, USA.
Email: jahenderson5@uh.edu

Abstract

Background: Researchers have shown that students leave undergraduate engineering programs during the first 2 years. Justifiably, many studies have tried to tackle engineering student persistence and attrition, especially during the first year, and then developed interventions to address the challenges. Although those interventions have improved freshmen retention in some institutions, less has been published on the impacts of these interventions on the sophomore student experience.

Purpose: To contribute to the knowledge base about all engineering students, we examined the experiences of sophomore engineering students and explored how these experiences might be related to their identities as engineers.

Design/Method: We conducted this study using photovoice, a methodology in which participants submit photographs to describe their experiences and give recommendations on improving their experiences and resolving their concerns. Participants submitted three sets of pictures (at the beginning, middle, and end of the semester) and participated in focus groups to aid in illuminating their experiences. We analyzed data using thematic analysis.

Results: We inductively determined three themes: on the frame, out of focus, and prefigures. These themes illustrate the experiences of sophomore engineering students, enabling us to see what interest, competence, and recognition as engineers looked like from their perspectives.

Conclusions: Participants grappled with the tension between their personal, social, and engineering identities. Photovoice empowered them to author and illustrate that they could exist beyond the murky middle.

KEYWORDS

engineering identity, Hispanic-Serving Institution, photovoice, sophomore year, thematic analysis

1 | INTRODUCTION

The scholarly literature exploring college students in science, technology, engineering, and mathematics (STEM) fields has grown substantially over the past two decades (Morelock, 2017; Rodriguez et al., 2018). This has occurred alongside growing attention to coordinating retention efforts beyond the initial college year (Schaller, 2018; Schreiner, 2018; Sterling, 2018). Although much has been written about the persistence and matriculation of first-year college students, less attention has been given to the sophomore-year experience. We selected sophomore students in this inquiry because approximately half of the students who enroll in engineering programs either drop out or switch to other majors (Flynn, 2016; Olson & Riordan, 2012), and a significant part of that leaving happens during the sophomore year (Graunke & Woosley, 2005; Ohland et al., 2008). Moreover, although some literature has described the challenges of sophomore-year students (Peacock, 2016; Yoon et al., 2019), what is less clear from the literature are ways to support students during their sophomore year (Godwin & Boudouris, 2020), especially with their engineering identity development; so we seek to add to the knowledge base around studies that specifically include sophomore students within the study. We choose to use the term "sophomore year" over "second year" to honor those students who may not take a traditional 4-year pathway to obtain their engineering degrees (Anderson-Rowland & Rodriguez, 2015; Kelly, 2020).

Because of the link between engineering identity development and persistence (Capobianco et al., 2012; Matusovich et al., 2011; Tonso, 2006), especially for women and students of color (Pierrakos et al., 2009; Ross & Godwin, 2016), we read literature on engineering identity to "hone our [and our participants'] sensitivity" (Huff et al., 2021) to aspects of the sophomore experience that might influence students' decisions to remain in or leave their engineering program. Our research question was as follows: *Using photovoice, how do sophomore-level engineering students describe their experiences related to their identity development as they progress through their sophomore-level courses?* In the next section, we discuss literature that influenced our study's inception, design, and analysis.

2 | VISUAL METHODS TO UNDERSTAND EXPERIENCES OF ENGINEERING COLLEGE STUDENTS

Scholars have recently embraced visual representations to understand better college student experiences (Kelly & Kortegast, 2018; Kortegast et al., 2019; McGowan, 2017; Metcalfe, 2012). Within the context of college students majoring in engineering, newer studies have primarily used photo-elicitation (Berdanier et al., 2018; Herrera et al., 2023; Maitra & Coley, 2022) to illuminate their trajectories. Photo-elicitation is "a qualitative interview technique where participants are asked to take photographs relating to the concept under study, which are then used as triggers for underlying memories and feelings during a subsequent interview" (Tonge et al., 2013, p. 41). For instance, using photo-elicitation, Maitra and Coley described how you could build rapport with participants as they discuss their identity-related obstacles. Similarly, Berdanier et al. (2018) found photo-elicitation as a method where participants were more comfortable discussing topics as the photograph helped to anchor their talking points. Furthermore, this article dovetails with the importance of exploring ethics and sustainability through an intersectional perspective, particularly in a global context. Despite emergent research in engineering on visual representations, there lies a significant gap in the literature about what happens to students in their sophomore year, and we used photovoice methodology to situate this study as described below.

Photovoice is a participatory action research methodology designed to empower individuals within a community and give voice to their challenges and community-driven solutions (Baker & Wang, 2006; Wang & Burris, 1997). Photovoice offers individuals who are often disadvantaged and marginalized an opportunity to reflect on their experiences through photography (Wang & Pies, 2008). This process involves more than simply taking a photo and telling a story about the image (Wang, 2022). The goal of photovoice is to empower participants to plan, interact, and collaborate with researchers (Kindon et al., 2007; Morrell, 2021; Wawire et al., 2022), essentially becoming co-creators of the knowledge about important topics that are relevant within their community (Amon, 2017; Hatten et al., 2013). An essential aspect of photovoice is the ongoing and cumulative process and its emancipatory aims. By breaking past language and traditional communication barriers and power dynamics between researchers and participants, photovoice allows participants to share an authentic and different perspective than the mainstream narrative (Aboulkacem et al., 2021). Photovoice has three main objectives: (i) documenting and critically reflecting on strengths and weaknesses in one's community; (ii) engaging in collaborative group discussions; and (iii) promoting change by reaching out to leaders and decision makers within that community (Aboulkacem et al., 2021; Wang, 2022).

Photovoice has been applied across multiple research settings within health care, community development, and education. In healthcare education, photovoice has been used in nursing research to improve rural health care and communities' health. For example, Leipert and Anderson (2012) used photovoice to inspire nursing students to pursue rural nursing job opportunities in Canada because of a continuing labor shortage. Through photo-sharing and discussions facilitated by photovoice, nursing students exposed researchers to rural nursing challenges that needed to be addressed to improve the labor shortage issue (Leipert & Anderson, 2012). In addition to the health and empowerment of vulnerable populations, photovoice has also been used in education research. For example, Shah (2015) used photovoice to study the traditional gender-role perceptions and experiences of Indian adolescent girls. The photographs in this study were ultimately shared with their community, igniting an atmosphere for social change and empowerment for the participants (Shah, 2015). In another example, Anderson and others used photovoice to understand students' perceptions of "good teaching." The photographs collected in their study illustrated how students conceptualized good teaching as both professors who demonstrated care in delivering course content and those who attempted to make personal connections with students (Anderson et al., 2020).

Most closely related to our work, Amon (2017) conducted a photovoice study to understand how 46 women fared in pursuing leadership positions in male-stereotyped STEM fields. The participants were graduate students or postdoctoral fellows and, through photography, were able to share their STEM career strategies and barriers to achieving their career goals. The study found that the participants' career strategies (e.g., professional development, collaboration, and social impact), although effective, were tempered by a lack of reward for those activities. To overcome apparent barriers, they found resiliency in feelings of competence and recognition. Social support from mentors and finding a work–life balance also helped participants overcome workplace barriers (Amon, 2017).

Although the above-mentioned studies provide guidance for the implementation of photovoice across different disciplines, there is a dearth of research studies adopting this approach in STEM. We used photovoice in this inquiry to both understand and illuminate the experiences of engineering students to better support their persistence during the sophomore year, a time described in education literature as the sophomore slump (Miao & Li, 2021). We also designed this photovoice study to empower students as knowledge constructors throughout the process. More specifically, when introducing the study's aims to the students, we shared the three dimensions of engineering role identity (interest, recognition, and competence) and encouraged them to use these constructs to guide and sharpen the focus of their active explorations. We describe this process in more detail in the Methods section.

3 | ENGINEERING IDENTITY

Engineering identity, which gleans perspectives from engineering, education, psychology, and sociology (Rodriguez et al., 2018), is an important indicator of engineering persistence, or the lack thereof (Capobianco et al., 2012; Godwin & Potvin, 2017; Matusovich et al., 2011; Tonso, 2006), especially for women and students of color (Pierrakos et al., 2009; Ross & Godwin, 2016; Tonso, 1999). We define engineering role identity as how students position themselves and are positioned by others to be the kind of people who engage in engineering (Godwin et al., 2016; Godwin & Lee, 2017; Matusovich et al., 2011; Tonso, 2006). Role identity builds on prior qualitative work around STEM identity (Carlone & Johnson, 2007; Gee, 2000; Hazari et al., 2010). Engineering role identity is comprised of three dimensions: interest, recognition, and competence beliefs (Carlone & Johnson, 2007; Godwin et al., 2016; Hazari et al., 2010).

3.1 | Interest

Interest can be described as the personal desire to pursue and engage with engineering or other STEM disciplines (Godwin et al., 2013; Hazari et al., 2010; Potvin et al., 2009). Interest has also been described as a willingness to reengage with material (Ainley et al., 2002; Hidi & Renninger, 2006; Verdín, 2021). Researchers have demonstrated a connection between persistence and interest in engineering. For example, Hidi and Renninger (2006) found that interest positively impacted persistence, motivation, and classroom learning. Furthermore, Patrick and colleagues demonstrated the importance of interest in predicting students' persistence. When controlling for major, year in school, mother's level of education, and gender, they showed that students who reported higher interest in engineering subjects were more likely to persist by remaining in the major and obtaining a degree (Patrick et al., 2018).

3.2 | Recognition

Recognition refers to how others (e.g., parents, teachers, peers, or instructors) view students and how this recognition is internalized by students (Carlone & Johnson, 2007; Gee, 2000; Godwin, 2016; Tonso, 1999, 2006). Researchers have shown that recognition is the most important predictor of student career choice (Godwin et al., 2016). In a study investigating "surviving and thriving" among Hispanic engineering students, Garriott and colleagues highlighted sources of recognition. They revealed that students felt recognized by their families and others when they were acknowledged as majoring in a respected field (Garriott et al., 2019). Participants also indicated that recognition by their peers greatly enhanced their sense of belonging. Last, Hughes and colleagues investigated engineering identity using focus group interviews with 62 students across 15 engineering majors and 3 universities in the United States. Participants associated their engineering identity and success with recognition by peers through their willingness to collaborate. Competence was also enhanced when students could participate in engineering industry experiences (Hughes et al., 2021).

3.3 | Competence

Competence is defined as students' internalized beliefs about their ability to perform well and understand engineering material (Godwin, 2016; Verdín, 2021). Competence has been shown to be important in declaring engineering as a major and for identity development (Marra et al., 2009; Mau, 2003). For example, a mixed-methods study by Fleming and others in which 76 students participated in interviews concluded that students demonstrated their engineering identity through competence beliefs as early as the second year. Students leaned into experiences and supports that validated their competence beliefs but shied away from those that did not (Fleming et al., 2013).

Although multiple studies have advanced our knowledge of the significance of role identity to persistence among engineering students (Carlone & Johnson, 2007; Godwin et al., 2013; Godwin et al., 2016; Hazari et al., 2010; Prybutok et al., 2016), given the "high stakes" nature of the sophomore year, more must be done to understand the experiences of sophomore-level students (Godwin & Lee, 2017; Matusovich et al., 2011) so that we can develop supports to aid in their success. Through photovoice, this study contributes to the engineering identity body of knowledge by enabling us to visualize how students conceptualize the dimensions of engineering identity as they construct their professional identities during the sophomore year.

4 | METHODS

4.1 | Research setting

This study occurred at Eunice College (pseudonym), a large public Southwestern doctoral university with very high research activity (Carnegie Classification of Institutions of Higher Education, 2021). Eunice College is also designated as a Hispanic-Serving Institution and an Asian American and Native American Pacific Islander-Serving Institution (AANAPISI). In addition to being racially and ethnically diverse, Eunice College is economically diverse, with 40% of its students qualifying for Pell Grants. The undergraduate population is composed of 10.2% Black students, 23.0% Asian students, 36.5% Hispanic students, 3.8% International students, 21.2% White students, and 5.3% other. In terms of gender, although women outnumber men on the broader campus, the College of Engineering is comprised of 27.4% women and 72.6% men. Table 1 shows representation by ethnicity/race for the College of Engineering students and the First Time in College (FTIC) freshmen to sophomore (university-level) retention versus sophomore to junior year retention. Specifically, the sophomore to junior year retention by race/ethnicity is lowest for Black (67%) and Hispanic students (73%) and highest for Asian American (89%) and International students (89%).

Because of previous approaches designed to increase the retention of freshmen engineering students at Eunice, such as an enhanced "first-year engineering program" (Hamlin et al., 2020) and common "gateway" (Yoon et al., 2019) curriculum, retention of freshmen students has improved, yet sophomore-year retention remains a challenge.

TABLE 1 Eunice university enrollment and engineering retention.

	Campus enrollment (percentage)	Engineering college enrollment (percentage)	Freshmen → sophomore engineering retention (percentage)	Sophomore → junior engineering retention (percentage)
Asian American	23.0	20.93	96	89
Black	10.2	4.87	73	67
Hispanic	36.5	27.64	84	73
International	3.8	20.44	95	89
Other	5.3	5.56	86	77
White	21.2	20.58	83	75
Overall retention	–	–	89	80

TABLE 2 Participants and selected demographics.

Pseudonym	Phonetic spelling	Engineering major	Gender	Race/ethnicity
Anjali	ahn-JUL-lee	Chemical	Woman	Asian American
Chagatai	chah-guh-TAHY	Chemical	Man	Asian American
Frances	FRAHN-sess	Chemical	Woman	Other (biracial)
Tuvok	TWO-vok	Electrical	Man	Latino

4.2 | Participants

This study's four participants were undergraduate sophomore engineering students at Eunice College. They were recruited in three ways. First, we sent an Institutional Review Board (IRB)-approved recruitment email to the Engineering Communications Office of Eunice College for broad distribution. We also sent our recruitment email to an institutional gatekeeper who had extensive contact with engineering students to aid in sharing with students. Last, we requested that students share the recruitment email with others they thought might be interested in the study. To be included in the study, participants had to be enrolled in sophomore-level engineering courses at Eunice College at the time of the investigation. Recruitment yielded four traditionally aged (i.e., 18–22 years old) student participants who each selected a pseudonym, as shown in Table 2.

Three participants majored in chemical engineering and one in electrical engineering. Two students self-identified as Asian, one as Latino, and one as biracial, who selected "Other."

4.3 | Data sources

We collected data via four methods: pre-survey, post-survey, photograph submissions with hashtags, and photovoice focus group interviews (Creswell, 2018). We introduced participants to the study via an orientation meeting. In the pre-survey, we asked participants to share their race/ethnic identity, major, specific engineering program, current courses, and grade point average. During the participant orientation, we gave students an opportunity to learn more about the study's aims, which included introducing them to the engineering identity constructs of interest, recognition, and competence. Interest was described as students' desire to think about and do well in engineering; recognition was described as students' feelings that others view them as good engineering students; and competence was defined as students' belief that they could understand engineering content and perform engineering tasks (Godwin, 2016). These terms were selected because they are commonly used and "experience near" (Geertz, 1974). In addition to being easily understood and digestible, we wanted to see how participants would construct meaning of these terms through photography. At the end of the orientation, participants received the initial prompt for the study (Table 3). After each focus group, they received the prompt for the next focus group.

TABLE 3 Data collection prompts.

Data collection point	Prompt
1	In preparation for focus group 1: Capture photographs that explain why you decided to major in engineering and that describe your engineering identity and understanding of the terms of recognition, interest, and feelings of competence.
2	In preparation for focus group 2: Capture photographs that describe at this moment in time your engineering identity in terms of recognition, interest, and feelings of competence.
3	In preparation for focus group 3: Capture photographs that describe your engineering identity in terms of recognition, interest, and feelings of competence.

We also asked participants to assign hashtags to their submitted photographs. We suggested three hashtags, #interest, #recognition, and #competence, to anchor students' active explorations in the co-constructed understandings of the study's theoretical framing. To not limit the students' reflections exclusively to identity development, we encouraged them to offer additional hashtags of their choosing. Participants had approximately 3 weeks before each of the three focus group interviews to take up to four photographs and submit them to the lead researcher. Before each photovoice focus group, we combined the submitted pictures of each participant into a PowerPoint presentation for that respective session. A complete list of prompts is listed in Table 3.

During the photovoice focus groups, we used a script to ensure clear communication of the study objectives and the discussion topics (Jacob & Furgerson, 2012). Given the conversational nature of the focus groups, each lasted longer than we initially expected, resulting in even richer data. We tried in earnest to schedule the photovoice focus groups for 60 min, but the participants desired to engage with one another beyond the scheduled time. These sessions lasted between 75 and 90 min. When presenting the findings, we searched for and included varying and competing perspectives to illustrate the complex dimensions of participants' experiences and perspectives (Creswell, 2012, 2018; Jacob & Furgerson, 2012; Maxwell, 2013; Weiss, 1994).

In each photovoice focus group, once their respective pictures appeared in the PowerPoint, we used a modified version of the "SHOWeD" Method (Wang, 2022) to elicit descriptions of the submitted photographs. "SHOWeD" is an acronym developed to summarize the questions involved in soliciting feedback related to participant-submitted images. Those questions include: What do you *S*ee here? What is really *H*appening here? How does this relate to *O*ur lives? *W*hy does this condition *e*xist? What can we *D*o about it? Rather than have them write a reflection as the traditional SHOWeD method advocates for, we asked participants to discuss their pictures in the focus groups. After the participants discussed each of their photographs, we invited their peers to provide feedback on similarities and differences in experiences. The 36 submitted pictures included images of coursework assignments, physical buildings, peers, family members, social media applications, emails of professional opportunities, residence hall rooms, nature, and outdoors. In addition to #interest ($n = 11$), #recognition ($n = 10$), and #competence ($n = 8$), participants also added a total of 13 other hashtags to their photographs, such as #worktime, #well-rounded, #entrancing, #achievement, #confusing, and #comfort. Note that the total is greater than 36 because participants were allowed to add multiple hashtags to their images. The frequent and productive use of the suggested hashtags indicates their usefulness and applicability to students' explorations. This outcome suggests both pragmatic validation of the theoretical concepts (Walther et al., 2013) and communicative validation of their co-construction between the researchers and the participants (Walther et al., 2013). At the same time, the use of other hashtags suggests that the theoretical framing of the study did not confine the students' explorations. Lastly, after the semester ended, students completed a post-survey to self-report their grade point average as a way to understand their performance throughout the semester.

4.4 | Data analysis

The words participants used in the photovoice focus groups were transcribed, analyzed, and incorporated into the dataset for analysis. As a first stage of attending to the reliability, we reviewed the transcripts and updated them to eliminate transcription errors (Creswell, 2018). We used a thematic approach to guide our data analysis process (Braun &

Clarke, 2019). Specifically, we followed the six phases of thematic analysis outlined by Braun and Clarke (2006), which include the following:

1. Data familiarization.
2. Generating codes.
3. Constructing themes.
4. Reviewing themes.
5. Defining themes.
6. Writing-up the results.

Thematic analysis of focus group transcripts was triangulated with our interpretations of submitted photographs and participant-ascribed hashtags. After reading each transcript, we discussed our reflections and instances of disagreement until all the codes aligned. We created a matrix in Excel to illustrate our themes with excerpts from the focus group transcripts. We routinely returned to the transcripts during the analysis process to ensure that the emerging themes aligned with the participants' experiences (Creswell, 2012; Maxwell, 2013).

4.5 | Limitations

We made some experimental design and analysis decisions that could have limited the study. For example, since the goal of the study was not to obtain generalizable results, the sample size was small. Focusing on four students allowed for consideration of their unique contextual (institutional, college, classification) experiences, which might have been lost or overlooked in a larger sample. Three of the four participants were chemical engineering majors, so we do not know to what extent these findings apply to other engineering majors at Eunice College or beyond. Readers should appraise the transferability of findings to other contexts. Furthermore, although we requested that students expound on their racial identity noted in the pre-survey, one student selected the option "other" without explaining, and we did not probe further. Last, with theoretical considerations in mind, we could have spent more time (beyond the orientation meeting) sensitizing participants to the engineering identity dimensions, namely interest, recognition, and competence. Allowing their own meaning-making of these dimensions may or may not completely align with currently accepted research interpretations of these dimensions.

4.6 | Trustworthiness

To enhance the trustworthiness of the findings, we implemented several steps. For instance, we deliberately decided to only have one person collect data in this study. This researcher was nearly of the same age as the study participants and was able to build rapport and trust with them throughout the research process (Weiss, 1994). Doing so also allowed us to reduce variations in participant reactivity (e.g., the degree to which they were influenced by the interviewer) in this inquiry (Maxwell, 2013, p. 124). Additionally, the lead researcher consulted more senior colleagues throughout the study, from research design to data collection and analysis (Creswell, 2018; Merriam & Tisdell, 2015). Three authors of this paper served as peer debriefers to the lead researcher, while one author reviewed our data analysis process and served as an auditor. The auditor created a report with superordinate themes. We met shortly after receiving this report and worked to resolve any potential disagreements. We also used conference presentations of our emerging findings as an opportunity for peer debriefing (Lincoln & Guba, 1985; Marshall & Rossman, 2006) and received verification of the credibility and transferability of our findings. Finally, we collectively situated ourselves in this research via a positionality statement and epistemological underpinnings influencing the research process (Jones et al., 2014).

4.7 | Positionality

Despite having some shared characteristics, we each have unique identities, which we believe are strengths that helped in the experimental design and data analysis process as we approached the study from different lenses. To highlight these aspects, we share some insight into our identities.

Jerrod, the corresponding author, is an assistant professor in engineering and identifies as a Black man. He initiated the study because he is concerned about low levels of persistence in STEM fields. In his own teaching, he seeks to understand the experiences of his students with empathy. He participated in data analysis and peer debriefings and spearheaded manuscript preparation. Brian is an associate professor, education researcher, and a Black man with extensive experience using qualitative methods and incorporating visual methods into the research process. He served as the expert in photovoice for this study. His work focuses on the experiences of Black college men, including those in post-secondary STEM contexts. Joan identifies as a Black woman of African descent who, at the time of the study, was living through her own experiences as an engineering student. Joan was the only author involved in the data collection process. Her own experiences as a current engineering student helped her to establish a strong rapport with the study participants (Prosek & Gibson, 2021). Le Shorn is a higher education researcher who identifies as an Afro-Caribbean immigrant woman. Her research focuses on exploring minoritized learner experiences in various contexts. She also assisted with data analysis and debriefing meetings. The fifth author, Kristin, identifies as a White woman. She served as the independent auditor of the data analysis and editor of the paper (Creswell, 2018). She is a licensed engineer, certified K–12 STEM teacher, lecturer, and engineering doctoral candidate researching persistence and engineering identity among women in engineering. Jeannette identifies as a Chicana. She employs critical qualitative research to engage in community-based projects aimed at improving educational experiences for learners in a variety of contexts. She assisted with data analysis and participated in peer debriefings. She engaged the team in reflections on how we were "doing justice" (Sochacka et al., 2018, p. 371) to participants.

As authors, we approached this study from various standpoints and social locations that position us in and out of similar proximities as our study participants. Throughout the research process, we were reflexive about our positionalities in this research (Jones et al., 2014) and accounted for potential biases or assumptions that may have influenced our interpretations of the data (Warren & Vincent, 2001). We view our collective positionalities as STEM faculty, current and former STEM students, and individuals who are committed to college student success as strengths in this inquiry because we were able to understand participants' experiences, which led to more nuanced interpretations of the interview data and enabled us to contextualize the themes within broader engineering identity constructs.

5 | FINDINGS

Incorporating photovoice not only allowed us to learn about the experiences of participants but also empowered the participants within the photovoice focus groups as they supported and encouraged one another. The findings are summarized in Table 4, and their collective story is described in this section. In naming themes, we used metaphors. Our use of metaphors during theme development was twofold: (i) to highlight an interconnection between the methodology and findings, and (ii) to provide an anchor for supporting readers' retention of the findings. In line with Boers (2000), who acknowledged how metaphors allow individuals to make connections between new information and past knowledge, we envisioned that these metaphors would structure how users of this research understand, recall, and share.

5.1 | On the frame

This theme illustrates how participants grappled with balancing their lives, living at the boundary (i.e., on the frame) of their personal and social lives, and engineering interests. Figure 1 presents the photographic experiences of three participants and their chosen hashtags in response to the first prompt.

In Figure 1, we start with Tuvok's narration from focus group 1. Tuvok said, "On the frame, there are just a ton of clothes. It's just laying everywhere on there." Tuvok's photograph and hashtag highlight his struggles to find order during his freshman year, both on the inside, as indicated by the hashtag (#feelingsofincompetence), and on the outside, as illustrated by the "ton of clothes ... laying everywhere." The layering of clothing items might be likened to the layers of challenges Tuvok expressed feeling, as he went on to explain:

> The reason why I took that picture was that any time I'm doing like really good in school or just like doing really good in one particular part of my life, I have to like drop the ball on a lot of other parts, and so because I've been busy with work and school and stuff, that leaves my personal stuff messy.

TABLE 4 Table of themes.

Theme	Description
On the frame	Illustrates how students sought balance, living at the boundary of their personal and social lives and engineering interests
Out of focus	Describes how participants calibrated the experiences of being seen and not seen as engineers
Prefigures	Outlines how students are figuring out who they are becoming as engineers and what they need to do to get there

FIGURE 1 #feelingofcompetence (Tuvok, focus group 1).

In this excerpt, Tuvok describes his difficulty in balancing school with other aspects of their life, such as work and "personal stuff." When he put effort into one area, the others suffer, and he is left feeling incompetent. Here we might also infer that it is not a lack of interest in engineering that might cause Tuvok's school work to suffer but rather a need to attend to other responsibilities. This discussion in focus group 1 resonated with another participant, Anjali, who responded to Tuvok by saying:

> I also feel that, but for me, it's less of a physical thing but mental clutter. It's just like, Oh, I have to do this. Oh, I have to do this later, and just all of these things that I know I have to do in the limited time that I have, it just piles on, and I can't get anything done.

Here Anjali builds on Tuvok's theme of layered and messy challenges by describing how when her mental list of tasks "just piles on," she "can't get anything done." Again, here we see that Anjali's challenges lie not in a lack of interest in engineering but in the number of tasks and responsibilities she has to juggle.

Figure 2, submitted by Anjali for focus group 1, similarly illustrates how challenges are "blurr[ing]" her experiences of being an engineering student. She said:

> This is a blurry picture of the moon that I took with some branches in the way. This is more towards the interest hashtag because the moon it's gorgeous, it's stunning, but the branches get in the way making the moon blurry. That's kind of how I feel about engineering and my prospects in the future, yes, this seems very interesting. It's that there are all these other things that get in the way that kind of stop me from enjoying it now and maybe in the future as well ... it's hard to see past it to see the prospects, the good future, and a very interesting career.

In this quote, Anjali clearly describes that while she desires to pursue engineering and "all these other things," we might infer that academic and life challenges make achieving her goal difficult to see. However, her hashtag reiterates her interest and commitment to the field, which she finds #entrancing.

FIGURE 2 #entrancing (Anjali, focus group 1).

FIGURE 3 #wellrounded (Chagatai, focus group 1).

Last, in focus group 1, Chagatai introduced a photograph (Figure 3) that led to an interesting exchange about relaxation. Chagatai said:

> This is me going out to play golf with my buddies. A big part of my life is relaxing. I love relaxing, whether it's going out fishing with my friends or just chilling at a golf range. I feel like at the end of the day, like you said, it really just makes you take a step back, like when you saw that picture of the trees. You just step back and think about it's all going to be good at the end of the day. After being out with my friends and relaxing, that's what regrounds me after I feel anxious about anything.

This excerpt illustrates the importance that Chagatai places on taking time to enjoy non-school-related activities. We might say he has found a way to live healthily on the frame. He has figured out that taking a step back from work, enjoying sports, and the company of friends help him find stability during challenges he might face.

Although discussing this photograph made an important addition to the conversation, finding balance as an engineering student caused other participants to describe competing experiences. For example, Tuvok responded by saying:

> I don't know about you guys, but I find that because school is sometimes on my mind so much that whenever I try to relax, I'm not actually relaxing. It's like I'm acting like I'm relaxing, but in the back of my mind, I'm stressed the entire time until I --started doing work again and stuff like that. So, I think it's really hard to find good actual rest.

During this same exchange, Chagatai added:

> There's always that little bit of guilt in the back of your mind ... I could be using this time for doing X homework or working ... I always [feel a] little guilty when I'm enjoying myself. It's really toxic.

All three of the photographs, corresponding hashtags, and discussions illustrated some of the struggles in balancing multiple responsibilities—how to live "on the frame." These struggles included having to navigate a range of challenging emotions, feeling overwhelmed, being distracted, and even feeling guilty during attempts at relaxation. The students' willingness to discuss these challenges suggests that the photovoice approach empowered them to push back against identities of shame (Secules et al., 2021) and engineering stress culture (Jensen & Cross, 2021).

5.2 | Out of focus

The second theme describes the varied ways participants negotiated what it means to be recognized as engineers.

First, Figure 4, submitted by Chagatai for focus group 2, illustrates the power of recognition by family members. When describing the picture, Chagatai said:

> So sometimes, if I need a change of my environment, I'll go study in my sister's room when she's not home. This is me. I went to my sister's room to study, and I fell asleep. I was studying for my thermo exam. Then she came home and took a picture of me. So, I related it to recognition because she recognized my hard work, my grind in a way.

Though Chagatai was not seeking recognition in this instance, his sister's gesture of taking a photograph was perceived as a powerful recognition of his "grind." The impact was so profound that Chagatai felt compelled to submit the picture and assign the hashtag #recognition. This photo, and Chagatai's description of it, demonstrates how studying, an act of enhancing competence and a demonstration of his commitment to his interest, caused him to feel recognized by his sister.

The salience of family support was not necessarily the case for all participants. Anjali and Tuvok both discussed how they grappled with the duality of being seen and unseen. In response to Chagatai's photo in Figure 4, Anjali said:

> My parents are a great support system. It's just that sometimes they're not really the ones I need to prop me up. It's other places and other people that sometimes are necessary, and I can't really get it because all of my friends don't understand how hard it can be sometimes.

In this excerpt, Anjali described feeling recognized, likely through expressive social capital (Martin et al., 2020), by her parents and friends, but that her engineering identity might need to be "propped up" by those who understand what it means to be an engineer. Perhaps recognition by her engineering peers, professors, or industry professionals would bring her identity into clearer focus.

Frances also described how recognition by friends played a role in her engineering identity development. She said:

> When I hang out with my friends that I've known for a whole bunch of years, since middle school or high school or something, and they see how my life has changed or how things are going right now, it's always really nice to get that recognition of just like, "Oh, good job." It does not have to be this big thing or whatever. They're just like, "We're proud of you. Keep going."

Other participants shared the metaphoric experience of feeling "out of focus" as well. For example, in Figure 5, Tuvok explained his disappointment at not being recognized by his professors:

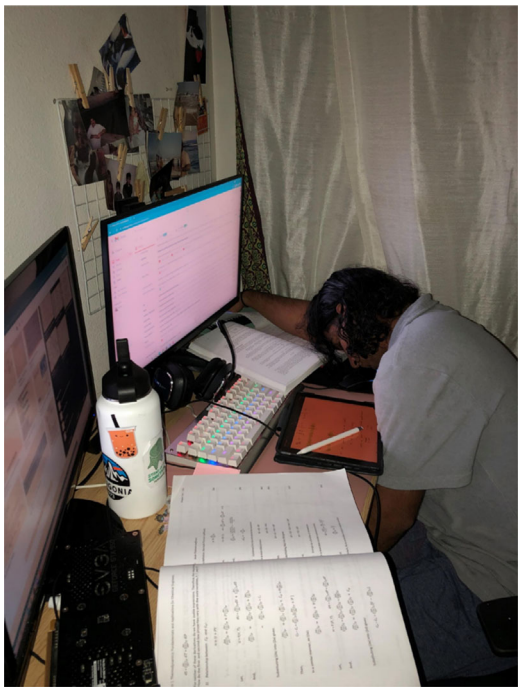

FIGURE 4 #recognition (Chagatai, focus group 2).

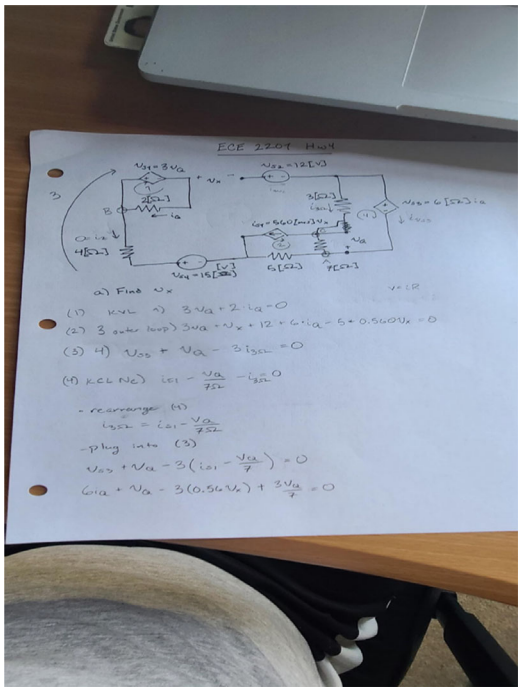

FIGURE 5 #recognition (Tuvok, focus group 1).

a picture of one of my homework, and I said that relates to recognition. The reason why I took that picture was that I was having a really hard time with this homework, and it took me three to four hours just to get this one page out. The reason why I put that underneath recognition was that a lot of times, you are working by yourself, or you are working with a couple of friends, and the only feedback that you get is your grade. It's like three or four hours that you have worked, and you end up just getting your grade back,

FIGURE 6 #recognition#blurry (Anjali, focus group 2).

> and you are like, "Well, cool," and then you stash it away, and you move on, but you never feel recognition for the three or four hours that you put into doing each piece of homework.

In this quote, Tuvok describes a desire to be recognized by his professors for the significant amount of effort that is required to complete assignments. He said, "There really doesn't seem to be any feedback on the type of work that you do every single day."

In addition, when talking about her photograph in Figure 6, Anjali compared her struggle to be recognized with the "#blurry" moon in her picture.

> my hashtags are "recognition" and "blurry" because, as you can see, the image is of the moon, and it's very blurry ... you can tell that it's the moon, but the details aren't completely there, and that's how I've been feeling ... it's like it's not quite—the details aren't quite there yet ....

Here, Anjali referenced how her understanding of non-engineering second-year course material, "that's how I've been feeling about specifically organic chemistry and physics," was "not quite there yet." We also interpreted this as demonstrating how she might feel out of focus (unrecognized) as an engineer-in-the-making. All three photographs and associated focus group discussions point to the importance of recognition for students as they work on sophomore-level courses. At this point in their development as engineers, it seems especially important for others—whether those others be family members, friends, engineering peers, instructors, or industry professionals—to convey that while the students might be struggling, their struggles are being seen and have value.

5.3 | Prefigures

The last theme highlights how students made connections to engineering that helped them to build beliefs about their competence.

Frances used Figure 7 to demonstrate her use of resources to advance her engineering competence. Frances said:

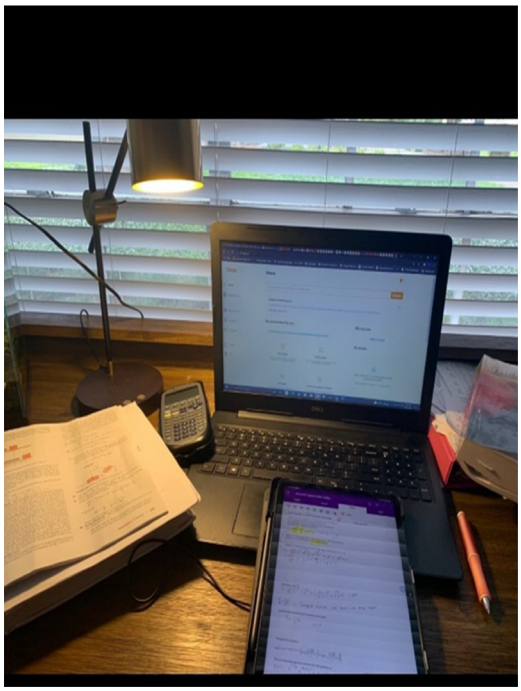

FIGURE 7 #competence (Frances, focus group 1).

> I'm showing that I had multiple resource materials out. I'm currently using Chegg, probably not the best, but I have the book that actually shows you how to do it, and I have the notes from a professor in another notebook.

Frances went on to elaborate on how drawing on multiple resources made her feel competent:

> I feel that represents competence because sometimes, just the notes from a professor, even if the problem is similar enough to the professor's notes, you still don't know 100% that you're doing it the right way. It's good to have all the different resources, and you can't rely on really even the professional people's answers that solve it step by step because sometimes they're really wrong or these are wrong processes compared to what we're being taught. So, it's good to have all the materials available, and that represents competence.

During the data analysis, we found it interesting that the image of Frances' resources formed what looked like a triangle—a visual representation of Frances' process of checking her content knowledge by triangulating data sources. Though some students may not even be aware of it, Frances exhibits what some researchers have framed as "accidental competencies" (Walther et al., 2011). These kinds of skills are transferable to engineering practice.

During this same focus group, Chagatai also pointed out the need for more resources for additional courses and how this might help students to build competence. He said:

> but in the course, I'm taking right now, there's nothing really like that ... [there's no] online resource [to] use as a supplement to what I'm learning in class. So, that makes it that much harder.

Next, in Figure 8, we show a photograph of Tuvok's workspace, which he submitted in preparation for focus group 2. At first glance, this workspace might not appear tidy. But as Tuvok explained:

> This is my desk and my workplace. Even though it's a little bit messy, I put it under "feelings of competence" because it's taken me a long time to find a place that I'm really comfortable in.

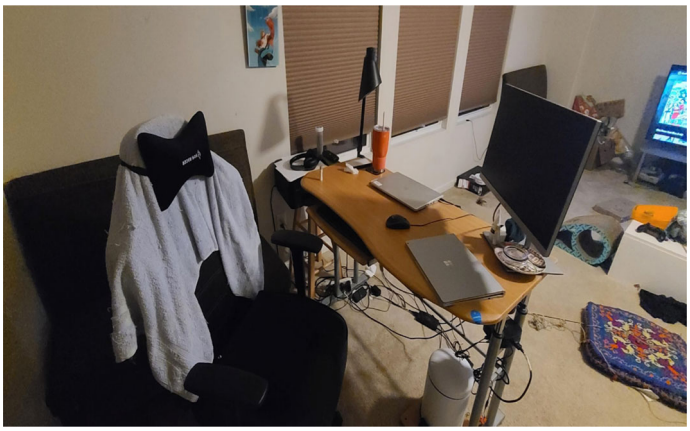

FIGURE 8 #feelingsofcompetence (Tuvok, focus group 2).

FIGURE 9 #makinganimpact (Chagatai, focus group 1).

Tuvok highlights the necessity of finding what works for him as an individual. He went on to elaborate on the individuality of competence in his experience when he said:

> I don't like to study in public places because I feel like I can get distracted between—maybe even looking at the table and being like, "Oh, look at this pretty table or whatever," but just setting up an area where I know I'm going to focus and just be calm and centered, I guess, it makes a really big difference, but it took me a while to get there.

It is interesting that Tuvok describes the desk as a "workplace" and that he has worked hard to find somewhere where he can "focus and just be calm and centered." Again, these are markers of competence that prefigure his future as an engineer. The beauty in this is that competence looks like figuring out what works.

Lastly, in focus group 1, Chagatai shared about Figure 9:

> I'm with the Engineers Without Borders organization, and we went last week to save the turtles with a little beach cleanup. This is my sort of interest, I guess, again. I'm really interested in sustainability, so I feel like going to the beach and having an impact on such a small scale, like picking up trash on the beach ... I've probably saved one or two turtles [Laughter], but maybe in the future, I could save a lot more. Just me trying to make an impact ....

When the moderator asked, "Can you reiterate how this relates to your engineering journey?" Chagatai said:

> Yes, so I feel one thing that drove me towards engineering was sustainability because there are a lot of issues with sustainability right now, economically and just theoretically, and how we approach our lives. I feel being part of an organization that makes an impact on a small scale makes me hopeful for the future, where I could be doing things on a much larger scale. I could fix this entire beach one day.

In these excerpts, Chagatai explained how his beach cleanup experience allowed him to make a connection between sustainability and a career in engineering. Chagatai was particularly drawn to #makinganimpact and described how he felt that becoming an engineer might enable him to do that on a broader scale—"I could fix this entire beach one day." This prefiguring of the future seemed to reinforce both his interest in engineering and also his perceptions of future competence—"I've probably saved one or two turtles [Laughter], but maybe in the future, I could save a lot more." At this point in their engineering journeys, participants seemed to value having the space to self-author what competence individually looks like for them.

6 | DISCUSSION AND RECOMMENDATIONS

In this study, understanding the experiences of sophomore-level engineering students at Eunice College enabled us to develop three themes. The themes were "on the frame," "out of focus," and "prefigures." Although much of what we learn seems true for all students, we add to the knowledge base by explicitly selecting sophomore engineering students. We learned that their experiences and identity negotiations were murky and at the boundaries. However, participants persisted in their engineering programs by negotiating the boundaries between their engineering and other interests, recognizing themselves and being recognized by others as engineers, and building belief in their engineering competence. Using photovoice, we captured nuances of the participants' complex experiences while working toward the goal of obtaining their engineering degrees. Each participant noted challenges such as feeling overwhelmed by course material, feeling unsettled as they adjusted to their program of study and university, and figuring out how to create a healthy balance.

Consistent with previous studies, we observed that participants leveraged a deep interest in engineering against the challenges they faced (Ainley et al., 2002; Hidi & Renninger, 2006; Verdín, 2021). For example, despite the obstacles illustrated as "branches" in Anjali's photograph from Figure 2, students could still see their goal to become an engineer and found it "#entrancing." Participants expressed not only their willingness to re-engage with engineering despite challenges but also the reasons why they found engineers' work important. The students also authored their interests and fought for their existence "on the frame" of multiple priorities/identities (Matusovich et al., 2011). These sophomore students' conceptualizations of interest included a more holistic visualization of what interest should include. For instance, interest in both engineering and spending time with friends to relax proved to be important. Further, they suggested that their interest in engineering should not compromise their well-being.

As we envision how to support sophomore-level students, engineering educators could develop structures that help students to explore their purpose for desiring to become engineers while also balancing their engineering interests with their outside interests. Finding the time to recharge physically, mentally, and emotionally was deemed critical and essential in the focus groups and subsequently represented in the submitted images as participants worked to resist engineering stress culture (Jensen & Cross, 2021). Student support around well-being could include spaces for faculty to share strategies for how they live "on the frame" or balance their lives. Additionally, efforts could be made to promote students' engagement in outside interests and rest periods to recharge and retain the stamina needed for obtaining a degree in engineering (Wilson et al., 2022). In addition, for students who desire more formalized support around balancing priorities, proactive advising strategies (Allen et al., 2013), which often attend to issues related to time

management, school/life balance, and mentoring, might also be a strategy for augmenting the sophomore student experience.

When considering how participants understand being recognized as engineers, the images illustrate the power of recognition by family and social networks, as seen in previous studies (Garriott et al., 2019; Henderson et al., 2023; Herndon & Moore III, 2002; Hughes et al., 2021; Veenstra et al., 2009). While this type of recognition was important, participants demonstrated the complexity of recognition as they brought into focus the types of recognition they would prefer. For example, although family support was welcomed and generally a positive aspect of identity development, participants also revealed that families may not know how to support their engineering interests. This disconnect often produced additional stress that may negatively impact their developing engineering identity.

Institutions should consider programming or opportunities to bridge family-based support and engineering experiences to help sophomore-level students gain competence by sharing new knowledge. An example of such programming is the Meyerhoff Scholars program, which provides successful models for how to bring family engagement (Maton et al., 2000) into focus. Participants also highlighted how recognition beyond grades from professors enhanced their engineering identities. This calls for faculty to broaden criteria for praise to include recognizing students' dedication, persistence, and interest in engineering.

The participants in our study also related their engineering competence to evidence of their ability to complete engineering tasks (Fleming et al., 2013). This study, through focus groups and images, uniquely illustrates how students understood the competent connections (e.g., what competence looks like to a novice engineer). We were able to identify whether students believed they were competent and how developing such competence was negotiated. Competence seemed to be connected to authentic engineering extracurricular learning experiences. These competent connections enabled participants to envision themselves as future engineers. Participants also described competence as self-authored. For example, one participant found competence in connecting resources, while another found competence in a "disorganized" space that worked for him.

Finally, we encourage students to use alternative practices to support their success. For instance, during the photovoice focus group discussions, participants expressed their appreciation for the reflective elements of the research design and the corresponding benefits derived from their participation. Photovoice also has important implications as a didactic tool for college teaching and pedagogy. Building upon Hidi and Renninger's (2006) work, where they discovered interest impacting participants' classroom learning experiences, we advocate for the use of photovoice in the classroom. Past studies using visual methods in engineering and other disciplines have illuminated how participants felt comfortable using photographs as a proxy for conveying information, facilitating dialogue, and learning. Incorporating photographs in the classroom offers new pedagogical possibilities for teaching, as it promotes active learning where students can investigate and interrogate social problems while developing self-efficacy skills (Hershberg et al., 2019).

6.1 | Implications for future research

Although the findings from this study offer new understandings of the varied ways sophomore engineering students conceptualize their engineering identity, given the challenges facing sophomore students in engineering, additional studies that move us toward better understanding and improving their experiences are highly needed. This study has visually illustrated students' sophomore-level engineering identity experiences. For example, it is complex and changes over time (Patrick & Borrego, 2016). While our findings contribute to the conversation around engineering identity formation, more work is needed to understand the scope of this identity formation among engineering students. For example, additional longitudinal studies spanning multiple academic years could provide more in-depth knowledge of engineering identity (i.e., what it looks like and how it is negotiated). We need to see how students at different levels capture their engineering identity so that we have a basis for comparisons. Most of the study participants were within a single engineering discipline. We postulate that the perspectives from various engineering disciplines may yield nuanced discipline-specific findings (Murzi & Shapiro, 2015). Similarly, more studies that look at additional and complex intersectional identity perspectives (e.g., race/ethnicity/gender/disability/sexuality) will make for a more comprehensive catalog of engineering identity photo-elicitation work (Capobianco et al., 2012; Dancy & Brown, 2012; Ross & Godwin, 2016).

Using visuals as data sources has not been a common focus in engineering studies, and we found that doing so has immense benefits to the study participants. Visual methods in research studies are powerful, as they help study participants to feel more comfortable as they can describe what is taking place in the photographs on their own terms

(McGowan, 2017; Wawire et al., 2022). We also propose coupling photovoice with newer theoretical lenses like "Advancing from Outsider to Insider" (McCall et al., 2021) to understand how students navigate their engineering identity.

In honor of the tenets of photovoice and its emphasis on communal impact, we collaborated with institutional stakeholders to present preliminary findings at a campus-level conference. We hosted an art exhibit to promote critical conversations about engineering student success and identity (Blaffer Art Museum, 2023). We advocate for these types of activities, as they offer rich learning opportunities for multiple stakeholders to better understand the experiences of engineering students.

Additionally, the team proposes pushing the boundaries of bringing together photovoice with data science analysis techniques to create an engineering "frame" for the pictorial analysis. For example, using photo-hashtag combinations to determine what we might glean through artificial intelligence (AI) perspectives when a study has hundreds of photographs can be helpful.

7 | CONCLUSION

Despite the challenges associated with the sophomore year, we were struck by the resilience of the study participants. We saw that sophomore engineering identity negotiations were murky, that is, "on the frame," but students did not want to exist in the murky middle. They fought for balance and against identities of shame (Secules et al., 2021) and engineering stress culture (Jensen & Cross, 2021). Photovoice empowered them to share their real-time experiences on their own terms. We not only learnt that participants sought and fought for a balance at the boundary of their personal and social lives and engineering interests but also saw images of how they did so. Participants' identity negotiations were also regulated by their experiences with their peers, family, and other social networks. Participants also authored what competence looks like for themselves. Our work contributes to the knowledge base around the experiences of sophomore-level engineering students and is a springboard. Additional studies that move us toward better understanding and improving their experiences are needed.

ACKNOWLEDGMENTS

Sincere thank you to our study participants. Thank you for allowing us the opportunity to learn from your experiences. We also acknowledge Dr. Nicola Sochacka, who read and provided feedback on early iterations of this manuscript and coached and mentored the research team while we were developing this work and grappling with our claims. Dr. Sochacka's insights helped significantly transform the first author's conceptualization, confidence, and dissemination of this work.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID

Jerrod A. Henderson https://orcid.org/0000-0002-0501-5805
Brian L. McGowan https://orcid.org/0000-0003-2730-9705
Joan Wawire https://orcid.org/0000-0003-1846-6493
Le Shorn S. Benjamin https://orcid.org/0000-0002-6753-968X
Kristin L. Schaefer https://orcid.org/0000-0002-5945-1485
Jeannette D. Alarcón https://orcid.org/0000-0002-4142-9968

REFERENCES

Aboulkacem, A. R., Aboulkacem, S., & Haas, L. E. (2021). Photovoice 2.0: A comprehensive research framework for the digital generation. *TechTrends: Linking Research & Practice to Improve Learning*, *65*(5), 874–883. https://doi.org/10.1007/s11528-021-00642-4

Ainley, M., Hidi, S., & Berndorff, D. (2002). Interest, learning, and the psychological processes that mediate their relationship. *Journal of Educational Psychology*, *94*(3), 545–561. https://doi.org/10.1037/0022-0663.94.3.545

Allen, E. L., Castillo, F., & Schiorring, E. (2013). *The reflective engineering advisor: A paradigm for learning-centered student advising*. Paper presented at the ASEE Annual Conference and Exposition, Atlanta, GA. https://doi.org/10.18260/1-2–22613

Amon, M. J. (2017). Looking through the glass ceiling: A qualitative study of STEM women's career narratives. *Frontiers in Psychology*, *8*, 236. https://doi.org/10.3389/fpsyg.2017.00236

Anderson, V., Rabello, R., Wass, R., Golding, C., Rangi, A., Eteuati, E., Bristowe, Z., & Waller, A. (2020). Good teaching as care in higher education. *Higher Education*, *79*(1), 1–19. https://doi.org/10.1007/s10734-019-00392-6

Anderson-Rowland, M. R., & Rodriguez, A. A. (2015). *Sophomore transfers: Who are they and what support do they need?* American Society for Engineering Education. https://peer.asee.org/24721

Baker, T. A., & Wang, C. C. (2006). Photovoice: Use of a participatory action research method to explore the chronic pain experience in older adults. *Qualitative Health Research*, *16*(10), 1405–1413. https://doi.org/10.1177/104973230629

Berdanier, C. G., Tang, X., & Cox, M. F. (2018). Ethics and sustainability in global contexts: Studying engineering student perspectives through photo elicitation. *Journal of Engineering Education*, *107*(2), 238–262. https://doi.org/10.1002/jee.20198

Blaffer Art Museum. (2023). *1 UH school of art annual student exhibition*. https://blafferartmuseum.org/2023-student-show/#engineering_adversity

Boers, F. (2000). Metaphor awareness and vocabulary retention. *Applied Linguistics*, *21*(4), 553–571. https://doi.org/10.1093/applin/21.4.553

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health*, *11*(4), 589–597. https://doi.org/10.1080/2159676X.2019.1628806

Capobianco, B. M., French, B. F., & Diefes-Dux, H. A. (2012). Engineering identity development among pre-adolescent learners. *Journal of Engineering Education*, *101*(4), 698–716. https://doi.org/10.1002/j.2168-9830.2012.tb01125.x

Carlone, H. B., & Johnson, A. (2007). Understanding the science experiences of successful women of color: Science identity as an analytic lens. *Journal of Research in Science Teaching*, *44*(8), 1187–1218. https://doi.org/10.1002/tea.20237

Carnegie Classification of Institutions of Higher Education. (2021). *Basic classification description*. American Council on Education. https://carnegieclassifications.iu.edu/classification_descriptions/basic.php

Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Pearson.

Creswell, J. W. (2018). *Qualitative inquiry & Research design: Choosing among five approaches* (4th ed.). Sage.

Dancy, T. E., II, & Brown, M. C. (2012). *African American males and education: Researching the convergence of race and identity*. IAP.

Fleming, L. N., Smith, K. C., Williams, D. G., & Bliss, L. B. (2013). Engineering identity of black and Hispanic undergraduates: The impact of minority serving. *Institutions*, *18*, 23.510.1–23.510.18. https://doi.org/10.18260/1-2–19524

Flynn, D. T. (2016). STEM field persistence: The impact of engagement on postsecondary STEM persistence for underrepresented minority students. *Journal of Educational Issues*, *2*(1), 185–214. https://doi.org/10.5296/jei.v2i1.9245

Garriott, P. O., Navarro, R. L., Flores, L. Y., Lee, H.-S., Carrero Pinedo, A., Slivensky, D., Muñoz, M., Atilano, R., Lin, C.-L., Gonzalez, R., Luna, L., & Lee, B. H. (2019). Surviving and thriving: Voices of Latina/o engineering students at a Hispanic serving institution. *Journal of Counseling Psychology*, *66*, 437–448. https://doi.org/10.1037/cou0000351

Gee, J. P. (2000). Chapter 3: Identity as an analytic lens for research in education. *Review of Research in Education*, *25*(1), 99–125. https://doi.org/10.3102/0091732X025001099

Geertz, C. (1974). "From the Native's point of view": On the nature of anthropological understanding. *Bulletin of the American Academy of Arts and Sciences*, *28*(1), 26–45. https://doi.org/10.2307/3822971

Godwin, A. (2016). *The development of a measure of engineering identity*. American Society for Engineering Education. https://doi.org/10.18260/p.26122

Godwin, A., & Boudouris, B. W. (2020). Fostering motivation for chemical engineering Students' academic success: An example from a sophomore materials and energy balances course. *Chemical Engineering Education*, *54*(3), 3. https://journals.flvc.org/cee/article/view/116780

Godwin, A., & Lee, W. C. (2017). *A cross-sectional study of engineering identity during undergraduate education*. American Society for Engineering Education. https://doi.org/10.18260/1-2–27460

Godwin, A., & Potvin, G. (2017). Pushing and pulling Sara: A case study of the contrasting influences of high school and university experiences on engineering agency, identity, and participation. *Journal of Research in Science Teaching*, *54*(4), 439–462. https://doi.org/10.1002/tea.21372

Godwin, A., Potvin, G., Hazari, Z., & Lock, R. (2013). *Understanding engineering identity through structural equation modeling*. IEEE Frontiers in Education Conference. Oklahoma City, OK, USA. https://doi.org/10.1109/FIE.2013.6684787

Godwin, A., Potvin, G., Hazari, Z., & Lock, R. (2016). Identity, critical agency, and engineering: An affective model for predicting engineering as a career choice. *Journal of Engineering Education*, *105*(2), 312–340. https://doi.org/10.1002/jee.20118

Graunke, S. S., & Woosley, S. A. (2005). An exploration of the factors that affect the academic success of college sophomores. *College Student Journal*, *39*(2), 367. https://link.gale.com/apps/doc/A133606107/AONE?u=aust49034&sid=googleScholar&xid=aa067c61

Hamlin, A. J., Kemppainen, A., Hamlin, B., Veurink, N. L., & Sticklen, J. (2020). *Three years after rollout: A report on systemic changes in a first-year engineering program*. Association for Engineering Education—Engineering Library Division Papers. https://peer.asee.org/35780

Hatten, K., Forin, T. R., & Adams, R. (2013). *A picture elicits a thousand meanings: Photo elicitation as a method for investigating cross-disciplinary identity development*. American Society for Engineering Education. https://doi.org/10.18260/1-2–19103

Hazari, Z., Sonnert, G., Sadler, P. M., & Shanahan, M.-C. (2010). Connecting high school physics experiences, outcome expectations, physics identity, and physics career choice: A gender study. *Journal of Research in Science Teaching*, *47*(8), 978–1003. https://doi.org/10.1002/tea.20363

Henderson, J. A., Junqueira, W., Benjamin, L. S. S., Hines, E. M., Alarcón, J. D., Davis, J. L., & Cavazos, S. (2023). Circle of success—An interpretative phenomenological analysis of how Black engineering students experience success. *Journal of Engineering Education.*, *112*, 403–417. https://doi.org/10.1002/jee.20509

Herndon, M. K., & Moore, J. L., III. (2002). African-American factors for student success: Implications for families and counselors. *The Family Journal*, *10*(3), 322–327. https://doi.org/10.1177/10680702010003009

Herrera, L., Schaefer, K. L., Benjamin, L. S. S., & Henderson, J. A. (2023). Flash on: Capturing minoritized engineering students' persistence through photovoice research. *Sustainability*, *15*(6), 5311. https://doi.org/10.3390/su15065311

Hershberg, R. M., Andringa, O., Camm, K., Hill, H., Little, J., Smith, R., & Wilkinson, S. (2019). Learning through doing: Reflections on the use of photovoice in an undergraduate community psychology classroom. *Global Journal of Community Psychology Practice*, *10*(2), 1–38. https://digitalcommons.tacoma.uw.edu/ias_pub/1075

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

Huff, J. L., Okai, B., Shanachilubwa, K., Sochacka, N. W., & Walther, J. (2021). Unpacking professional shame: Patterns of White male engineering students living in and out of threats to their identities. *Journal of Engineering Education*, *110*(2), 414–436. https://doi.org/10.1002/jee.20381

Hughes, B. E., Schell, W. J., Tallman, B., Sybesma, T., Kwapisz, M. B., Annand, E., Ranch, S., Krejci, C., Bozic, C., & Kotys-Schwartz, D. (2021). Entering the community of practice: Changes in engineering students' engineering identities and perceptions of the field. *European Journal of Engineering Education*, *46*(6), 968–986. https://doi.org/10.1080/03043797.2021.1947197

Jacob, S., & Furgerson, S. (2012). Writing interview protocols and conducting interviews: Tips for students new to the field of qualitative research. *The Qualitative Report*, *17*(42), 1–10. https://doi.org/10.46743/2160-3715/2012.1718

Jensen, K. J., & Cross, K. J. (2021). Engineering stress culture: Relationships among mental health, engineering identity, and sense of inclusion. *Journal of Engineering Education*, *110*(2), 371–392. https://doi.org/10.1002/jee.20391

Jones, S. R., Torres, V., & Arminio, J. (2014). *Negotiating the complexities of qualitative research in higher education: Fundamental elements and issues* (2nd ed.). Routledge.

Kelly, B. T., & Kortegast, C. A. (2018). *Engaging images for research, pedagogy, and practice: Utilizing visual methods to understand and promote*. Stylus Publishing.

Kelly, C. (2020). Pathway to STEM. *Mechanical Engineering*, *142*(9), 42–47. https://doi.org/10.1115/1.2020-SEP3

Kindon, S., Pain, R., & Kesby, M. (Eds.). (2007). *Participatory action research approaches and methods: Connecting people, participation and place*. Routledge. https://doi.org/10.4324/9780203933671

Kortegast, C., McCann, K., Branch, K., Latz, A. O., Kelly, B. T., & Linder, C. (2019). Enhancing ways of knowing: The case for utilizing participant-generated visual methods in higher education research. *Review of Higher Education*, *42*(2), 485–510. https://muse.jhu.edu/article/712605

Leipert, B., & Anderson, E. (2012). Rural nursing education: A photovoice perspective. *Rural and Remote Health*, *12*(2), 2061. https://doi.org/10.22605/RRH2061

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage.

Maitra, D., & Coley, B. (2022). Marginalized engineering students' narrative construction through photo elicitation. *Qualitative Research Journal*, *22*(4), 448–463. https://doi.org/10.1108/QRJ-10-2021-0110

Marra, R. M., Rodgers, K. A., Shen, D., & Bogue, B. (2009). Women engineering students and self-efficacy: A multi-year, multi-institution study of women engineering student self-efficacy. *Journal of Engineering Education*, *98*(1), 27–38. https://doi.org/10.1002/j.2168-9830.2009.tb01003.x

Marshall, C., & Rossman, G. B. (2006). *Designing qualitative research* (4th ed.). Sage.

Martin, J. P., Stefl, S. K., Cain, L. W., & Pfirman, A. L. (2020). Understanding first-generation undergraduate engineering students' entry and persistence through social capital theory. *International Journal of STEM Education*, *7*(1), 1–22. https://doi.org/10.1186/s40594-020-00237-0

Maton, K. I., Hrabowski, F. A. I., & Schmitt, C. L. (2000). African American college students excelling in the sciences: College and postcollege outcomes in the Meyerhoff scholars program. *Journal of Research in Science Teaching*, *37*(7), 629–654. https://doi.org/10.1002/1098-2736(200009)37:7<629::AID-TEA2>3.0.CO;2-8

Matusovich, H. M., Barry, B. E., Meyers, K., & Louis, R. (2011). *A multi-institution comparison of students' development of an identity as an engineer*. Paper presented at the ASEE Annual Conference and Exposition, Vancouver, BC. https://doi.org/10.18260/1-2–17351

Mau, W.-C. (2003). Factors that influence persistence in science and engineering career aspirations. *Career Development Quarterly*, *51*(3), 234–243. https://doi.org/10.1002/j.2161-0045.2003.tb00604.x

Maxwell, J. A. (2013). *Qualitative research design: An interactive approach* (3rd ed.). Sage.

McCall, C., McNair, L. D., & Simmons, D. R. (2021). Advancing from outsider to insider: A grounded theory of professional identity negotiation in undergraduate engineering. *Journal of Engineering Education*, *110*(2), 393–413. https://doi.org/10.1002/jee.20383

McGowan, B. L. (2017). Visualizing peer connections: The gendered realities of African American college men's interpersonal relationships. *Journal of College Student Development*, *58*(7), 983–1000. https://doi.org/10.1353/csd.2017.0079

Merriam, S. B., & Tisdell, E. J. (2015). *Qualitative research: A guide to design and implementation* (4th ed.). John Wiley & Sons.

Metcalfe, A. S. (2012). Imag(in)ing the university: Visual sociology and higher education. *Review of Higher Education*, *35*, 517–534. https://doi.org/10.1353/rhe.2012.0028

Miao, L., & Li, C. (2021). *Engaging minority and underrepresented engineering students to fight "sophomore slump" through a summer research and enrichment program* (Research). American Society for Engineering Education. https://peer.asee.org/37046

Morelock, J. R. (2017). A systematic literature review of engineering identity: Definitions, factors, and interventions affecting development, and means of measurement. *European Journal of Engineering Education*, *42*(6), 1240–1262. https://doi.org/10.1080/03043797.2017.1287664

Morrell, E. (2021). *Becoming critical researchers: Literacy and empowerment for urban youth*. Peter Lang Group. https://www.peterlang.com/document/1098489

Murzi, J., & Shapiro, L. (2015). Validity and truth-preservation. In T. Achourioti, H. Galinon, J. Martínez Fernández, & K. Fujimoto (Eds.), *Unifying the philosophy of truth* (pp. 431–459). Springer. https://doi.org/10.1007/978-94-017-9673-6_22

Ohland, M. W., Sheppard, S. D., Lichtenstein, G., Eris, O., Chachra, D., & Layton, R. A. (2008). Persistence, engagement, and migration in engineering programs. *Journal of Engineering Education*, *97*(3), 259–278. https://doi.org/10.1002/j.2168-9830.2008.tb00978.x

Olson, S., & Riordan, D. G. (2012). *Engage to excel: Producing one million additional college graduates with degrees in science, technology, engineering, and mathematics* [President's Council of Advisors on Science and Technology, PCAST; Report to the President]. Executive Office of the President. https://eric.ed.gov/?id=ED541511

Patrick, A. D., & Borrego, M. J. (2016). *A review of the literature relevant to engineering identity*. Paper presented at the ASEE Annual Conference and Exposition, New Orleans, LA. https://doi.org/10.18260/p.26428

Patrick, A. D., Borrego, M. J., & Prybutok, A. N. (2018). Predicting persistence in engineering through an engineering identity scale. *International Journal of Engineering Education*, *34*, 351–363. https://par.nsf.gov/servlets/purl/10066205

Peacock, P. H. (2016). *The second year slump in engineering students at James Cook University*. Paper presented at the Australian Conference on Science and Mathematics Education. Sydney Australia. https://openjournals.library.sydney.edu.au/IISME/article/view/10810

Pierrakos, O., Beam, T. K., Constantz, J., Johri, A., & Anderson, R. D. (2009). *On the development of a professional identity: engineering persisters vs. engineering switchers*. Paper presented at the 39th IEEE Frontiers in Education Conference, San Antonio, TX. https://doi.org/10.1109/FIE.2009.5350571

Potvin, G., Tai, R., & Sadler, P. (2009). *The difference between engineering and science students: Comparing backgrounds and high school experiences*. American Society for Engineering Education. https://doi.org/10.18260/1-2–4606

Prosek, E. A., & Gibson, D. M. (2021). Promoting rigorous research by examining lived experiences: A review of four qualitative traditions. *Journal of Counseling & Development*, *99*(2), 167–177. https://doi.org/10.1002/jcad.12364

Prybutok, A. N., Patrick, A. D., Borrego, M. J., Seepersad, C. C., & Kirisits, M. J. (2016). *Cross-sectional survey study of undergraduate engineering identity*. American Society for Engineering Education. https://doi.org/10.18260/p.26610

Rodriguez, S. L., Lu, C., & Bartlett, M. (2018). Engineering identity development: A review of the higher education literature. *International Journal of Education in Mathematics, Science and Technology*, *6*(3), 3. https://doi.org/10.18404/ijemst.428182

Ross, M. S., & Godwin, A. (2016). *Engineering identity implications on the retention of Black women in the engineering industry*. Paper presented at the ASEE Annual Conference and Exposition, New Orleans, LA. https://doi.org/10.18260/p.26652

Schaller, M. A. (2018). Intentional design of the college sophomore year. *New Directions for Higher Education*, *183*, 23–34. https://doi.org/10.1002/he.20290

Schreiner, L. A. (2018). Thriving in the second year of college: Pathways to success. *New Directions for Higher Education*, *2018*(183), 9–21. https://doi.org/10.1002/he.20289

Secules, S., Sochacka, N. W., Huff, J. L., & Walther, J. (2021). The social construction of professional shame for undergraduate engineering students. *Journal of Engineering Education*, *110*(4), 861–884. https://doi.org/10.1002/jee.20419

Shah, P. (2015). Spaces to speak: Photovoice and the reimagination of girls' education in India. *Comparative Education Review*, *59*(1), 50–74. https://doi.org/10.1086/678699

Sochacka, N. W., Walther, J., & Pawley, A. L. (2018). Ethical validation: Reframing research ethics in engineering education research to improve research quality. *Journal of Engineering Education*, *107*(3), 362–379. https://doi.org/10.1002/jee.20222

Sterling, A. J. (2018). Student experience in the second year: Advancing strategies for success, student experiences in the second year: Advancing strategies for success beyond the first year of college beyond the first year of college. *Strategic Enrollment Management Quarterly*, *5*(4), 136–149. https://doi.org/10.1002/sem3.20113

Tonso, K. L. (1999). Engineering gender-gendering engineering: A cultural model for belonging. *Journal of Women and Minorities in Science and Engineering*, *5*(4), 365–405. https://doi.org/10.1615/JWomenMinorScienEng.v5.i4.60

Tonso, K. L. (2006). Student engineers and engineer identity: Campus engineer identities as figured world. *Cultural Studies of Science Education*, *1*(2), 273–307. https://doi.org/10.1007/s11422-005-9009-2

Veenstra, C. P., Dey, E. L., & Herrin, G. D. (2009). A model for freshman engineering retention. *Advances in Engineering Education*, *1*(3), 33. https://files.eric.ed.gov/fulltext/EJ1076050.pdf

Verdín, D. (2021). The power of interest: Minoritized women's interest in engineering fosters persistence beliefs beyond belongingness and engineering identity. *International Journal of STEM Education*, *8*(1), 33. https://doi.org/10.1186/s40594-021-00292-1

Walther, J., Kellam, N., Sochacka, N., & Radcliffe, D. (2011). Engineering competence? An interpretive investigation of engineering students' professional formation. *Journal of Engineering Education*, *100*(4), 703–740. https://doi.org/10.1002/j.2168-9830.2011.tb00033.x

Walther, J., Sochacka, N. W., & Kellam, N. N. (2013). Quality in interpretive engineering education research: Reflections on an example study. *Journal of Engineering Education*, *102*(4), 626–659. https://doi.org/10.1002/jee.20029

Wang, C. C. (2022). The Tai Qi of photovoice. *Health Promotion Practice*, *23*(2), 205–210. https://doi.org/10.1177/15248399211069905

Wang, C. C., & Burris, M. A. (1997). Photovoice: Concept, methodology, and use for participatory needs assessment. *Health Education & Behavior*, *24*(3), 369–387. https://doi.org/10.1177/109019819702400309

Wang, C. C., & Pies, C. A. (2008). Using photovoice for participatory assessment and issue selection: Lessons from a family, maternal, and childhealth department. In M. Minkler & N. Wallerstein (Eds.), *Community-based participatory research for health: From process to outcomes* (pp. 183–197). Jossey-Bass.

Warren, S., & Vincent, C. (2001). "This won't take long ...": Interviewing, ethics and diversity. *International Journal of Qualitative Studies in Education*, *14*(1), 39–53. https://doi.org/10.1080/09518390010007674

Wawire, J., McGowan, B., Benjamin, L. S., Schaefer, K., & Henderson, J. (2022). *Work-in-progress: Balancing it all: Using photovoice to visualize second-year engineering student experiences*. Paper presented at the ASEE Annual Conference and Exposition, Minneapolis, MN. https://peer.asee.org/41135

Weiss, R. S. (1994). *Learning from strangers: The art and method of qualitative interview studies*. Free Press.

Wilson, S., Wright, C., Miller, M., Hargis, L., Usher, E., Hammer, J., Ban, N., & Shannon, H. (2022). *Identifying common perceived stressors and stress-relief strategies among undergraduate engineering students*. American Society for Engineering Education. https://peer.asee.org/41009

Yoon, S. Y., Imbrie, P. K., Reed, T. K., & Shryock, K. J. (2019). Identification of the engineering gateway subjects in the second-year engineering common curriculum. *International Journal of Engineering Education*, *35*, 232–251. https://dialnet.unirioja.es/servlet/articulo?codigo=6861559

AUTHOR BIOGRAPHIES

Jerrod A. Henderson, William A. Brookshire Department of Chemical & Biomolecular Engineering, University of Houston, 4226 Martin Luther King Jr., Boulevard Room S222, Houston, TX 77204, USA; jahenderson5@uh.edu.

Brian L. McGowan, School of Education, American University, 4400 Massachusetts Avenue, Northwest, Washington, DC, 20016, USA; bmcgowan@american.edu.

Joan Wawire, Department of Petroleum Engineering, University of Houston, 4226 Martin Luther King Jr., Boulevard, Houston, TX 77204, USA; jaywronz@gmail.com.

Le Shorn S. Benjamin, William A. Brookshire Department of Chemical & Biomolecular Engineering, University of Houston, 4226 Martin Luther King Jr., Boulevard Room S222, Houston, TX 77204, USA; lbenjami@central.uh.edu.

Kristin L. Schaefer, Department of Mechanical Engineering, University of Houston, 4226 Martin Luther King Jr., Boulevard, Houston, TX 77204, USA; klschae3@central.uh.edu.

Jeannette D. Alarcón, Department of Curriculum and Instruction, University of Houston, 3657 Cullen Boulevard #214, Houston, TX 77004, USA; jdalarco@central.uh.edu.

How to cite this article: Henderson, J. A., McGowan, B. L., Wawire, J., Benjamin, L. S. S., Schaefer, K. L., & Alarcón, J. D. (2023). Photovoice: Visualizing the engineering identity experiences of sophomore students. *Journal of Engineering Education*, *112*(4), 1145–1166. https://doi.org/10.1002/jee.20555