Photovoice: Understanding How Engineering Students Engage, Reflect, and Grow Through a Learning Abroad Program in Brazil

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He began his higher education pursuits at Morehouse College and North Carolina Agricultural & Technical State University, where he earned degrees in both Chemistry and Chemical Engineering as a part of the Atlanta University Center's Dual Degree in Engineering Program. While in college, he was a Ronald E. McNair Scholar, which afforded him the opportunity to intern at NASA's Langley Research Center. He also earned distinction as a Phi Beta Kappa member and an American Chemical Society Scholar. Dr. Henderson completed his Ph.D. in Chemical & Biomolecular Engineering at the University of Illinois at Urbana-Champaign. During his time as a graduate student, he was a NASA Harriet G. Jenkins Graduate Fellow.

Dr. Henderson has dedicated his career to increasing the number of students who are on pathways to pursue STEM careers. He believes that exposing students to STEM early will have a lasting impact on their lives and academic pursuits. He is the co-founder of the St. Elmo Brady STEM Academy (SEBA). SEBA is an educational intervention aimed at exposing fourth and fifth-grade students and their families to hands-on STEM experiences.

His research group aims to understand student engineering identity trajectories and success mechanisms, using interpretive qualitative, and action-based participatory research methods.

He was most recently recognized by INSIGHT Into Diversity Magazine as an Inspiring STEM Leader, by the University of Illinois at Urbana-Champaign with the College of Liberal Arts & Sciences (LAS) Outstanding Young Alumni Award, and with a National Science Foundation CAREER Award in 2023 to advance his work that centers engineering identities of Black men in engineering.

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Abstract

Study abroad programs are recognized as a mechanism for fostering global competence, as high-quality experiences can cultivate the insight, skills, and motivation needed to thrive in international settings. However, significant barriers persist, including financial constraints, racism, lack of information, limited program options, and discomfort with unfamiliar environments. Students of color, in particular, often perceive study abroad processes as unwelcoming or inattentive to their needs. Furthermore, limited participation among faculty and staff of color may further deter student engagement. Simultaneously, while existing research has emphasized pre- and post-assessment of intercultural competence, emerging scholarship highlights the importance of understanding students' lived experiences. Scholars argue that unplanned, spontaneous intercultural interactions often yield the most meaningful learning, suggesting that program design should intentionally create space for such experiences. To more fully understand the range of experiences students encounter abroad, this project is two-fold: (1) we designed an equity-centered learning abroad program that assembled an interdisciplinary, diverse cohort of students from a large public research university for a 10-day National Academy of Engineering (NAE) Grand Challenges–focused experience in Rio de Janeiro and Salvador, Brazil, and (2) we used Photovoice, a participatory action research method, to elicit images and rich experiential descriptions to answer our research question, *using photovoice, how do participants describe their engineering abroad experience?* Four engineering students completed two photo prompts focused on global engineering identity and key takeaways, and a post-program focus group to describe their images. Using thematic analysis, we inductively developed two themes: Dispelling Myths and Reframing Cultural Identity on a Global Stage, which describe how students dispelled myths, deepened cross-cultural understanding, and strengthened their self-concept as engineers. Findings highlight the value of intentionally designed learning abroad experiences that foreground reciprocal engagement and structured reflection, and they support the use of visual, dialogic methods to examine how engineering students develop global competence in context.

Keywords: learning abroad; study abroad; global competence; engineering identity; photovoice; qualitative methods

Introduction/Background

Contemporary engineering challenges increasingly demand recognition that expertise and innovation are not centralized within the United States of America (USA) but are produced through globally distributed, culturally situated knowledge systems. As such, America is increasingly globally connected and therefore requires its citizens to be globally competent [1]. In fact, employer surveys consistently indicate that entry-level and early-career roles value, and even prioritize, skills such as collaboration, communication, problem-solving, and the ability to work across cultural, linguistic, and intellectual differences. For example, the National

Association of Colleges and Employers (NACE) reports that more than 80% of employers seek candidates with strong teamwork, communication, and problem-solving skills, while more than three-quarters emphasize the importance of working effectively within diverse and global teams [2]. Similar trends are reflected in broader workforce projections, which highlight intercultural competence and emotional intelligence as essential capabilities for the future of work [3]. However, employers have reported a lack of these skills among new hires and among candidates interested in positions requiring them [4]. As such, for most undergraduate students, degree programs offer few opportunities to develop global competence.

Nonetheless, study abroad programs are widely recognized as a mechanism for fostering global competencies [5] as high-quality experiences can cultivate the insights, skills, and motivation needed to thrive in international settings and early careers. Despite the promise of study abroad, significant barriers persist. For example, programs have often been either explicitly or implicitly exclusive, as indicated by their target audiences as reflected in advertisements and program descriptions, and by limited location options [6]. Students of color and those from lower socioeconomic backgrounds may be disproportionately excluded due to program costs, limited access to information about funding, and perceptions that study abroad structures are unwelcoming or inattentive to their needs [7], [8]. Furthermore, limited participation among faculty and staff of color may further deter student engagement [9]. Secondly, beyond access, research suggests that participation in some programs does not consistently involve intentionally structured experiences that support students' development of highly sought-after global intellectual skills [10], [11]. However, this deficiency in understanding the intellectual skills outcomes of students is likely due to poorly designed post-experience assessments. For example, Carlson et al. [12] used survey responses to compare 358 study abroad students with non-study abroad students across four institutions. They reported no statistically significant differences in growth between the two groups in academic, cultural, attitudinal, and personal development. On the surface, this can support the notion that there is a lack of well-structured study abroad programs capable of eliciting measurable change. However, these findings may indicate that shortcomings lie in post-program assessment approaches that inadequately elicit deeper reflection and sensemaking of students' lived experiences [13]. Though students may recognize the significance of their learning abroad experiences, they may struggle to articulate the complexity of these experiences when evaluation relies primarily on constricting self-report measures, such as surveys, which can overlook the breadth and detail of the whole experience abroad [12].

Simultaneously, while existing research has emphasized pre- and post-assessment of intercultural competence [12], [14], emerging scholarship highlights the importance of understanding students' lived experiences [15], [16], [17]. There have been student reports and reflections that summarize their time abroad in a seemingly superficial manner, with some even being descriptive but lacking deeper insight or takeaways from their time learning in a foreign country [17]. Nevertheless, Rodman and Merrill [18] argue that unplanned, spontaneous intercultural interactions often yield the most meaningful learning, suggesting that program design should intentionally create space for such experiences [17], [19], [20]. Therefore, to more fully capture the range of experiences students encounter during this learning abroad program, we used photovoice as our research method [21]. This participatory action research method uses

participant-generated photographs to elicit rich experiential descriptions to answer our research question (RQ):

Using Photovoice, how do participants describe their engineering-abroad experience?

Literature

The case for studying abroad

There are very few identity-shaping experiences during college that offer such a wealth of transformative knowledge and real-world benefits as study abroad [17]. As a result, studying abroad can serve as a unique and pivotal experience for students and emerging professionals, as it also equips participants with a distinct set of skills necessary for global competence and the ability to work with others from diverse backgrounds, upbringings, values, and even patterns of thinking shaped by their culture [22].

Large-scale studies have consistently documented the perceived impact of study abroad experiences. For example, the Study Abroad for Global Engagement (SAGE) project surveyed and interviewed more than 6,400 study-abroad alums across 22 universities and program providers. More than half of the participants identified study abroad as influential in their lives, and 83% reported that it was the most influential experience of their undergraduate education [23]. This influence is often attributed to the distinctive structure of study abroad programs, which are intentionally designed to place students in new cultural contexts alongside peers, providing access to encounters and experiences that support learning and personal development [13], [23].

Student outcomes during study abroad

As study abroad programs have evolved, so have the methods used to examine their influence, with researchers increasingly employing mixed-method and outcome-oriented approaches to assess student learning and development [13], [24]. Collectively, these studies suggest that studying abroad contributes to the development of intercultural awareness, shifts in students' perspectives on identity and difference, and growth in communication skills, adaptability, and global engagement. Prior studies further indicate that these outcomes are largely shaped by students' interactions with unfamiliar cultural contexts, peers, and everyday situations encountered abroad, rather than solely by the program's formal instructional components [16], [17], [20]. Accordingly, analyzing student outcomes based on formal instruction alone tells only part of the story, underscoring the need for methodological approaches that account for students' informal encounters and experiences.

While studies that rely on pre-defined constructs (i.e., preselected categories of learning or development) provide valuable insights, they often offer a limited account of learning outcomes. Constructs such as intercultural competence, cross-cultural communication, global awareness, professional readiness, and cultural sensitivity may therefore capture only a partial representation of students' experiences abroad ([11], [13], [24]. For example, Jaiswal and Sapkota [14] conducted an assessment study to examine the impact of studying abroad on the development of

intercultural competence, using this lens to evaluate whether programs were successful in this context. Specific assessments were in place to measure the extent of growth relative to the predefined goal of intercultural competence. In this approach, program success was evaluated based on measured changes relative to the specified competency outcomes, thereby enabling systematic comparisons across participants. The results revealed decreases in the lack of awareness and defensive reactions to cultural diversity, while revealing increases in the acknowledgement of commonalities and values across cultures, appreciation and respect for cultural complexity and variance, and the ability to adapt. While such methods offer clarity and comparability, they also emphasize particular definitions of learning and growth; while narrowing attention to aspects of students' experiences that align with the selected constructs, leaving less structured, emergent, or personally salient learning outside the scope of analysis. Furthermore, despite careful program planning, many of the most formative aspects of study abroad unfold through moments that cannot be fully anticipated or controlled [16], [17], [20]. For example, prior studies have highlighted such moments in students' accounts of navigating everyday interactions, managing uncertainty or discomfort, responding to ethical tensions, and interpreting emotionally charged encounters within unfamiliar cultural contexts [17], [25], [26].

Predefined categories of learning or growth are a helpful way to visualize data on study abroad program outcomes. However, these strategies may diminish the individual meanings, unexpected accounts of learning, and emotionally salient experiences that can often foster the most memorable, hence impactful, moments [27]. Wong [17] further states that outcome-based framings do not cover the complexity of learning abroad experiences. Although outcome-focused approaches are valuable and appropriate for certain purposes, the conclusions drawn from them may be inherently bounded by the assumptions fixed in the measures themselves. This does not suggest that such approaches are misguided. Instead, it highlights how the scope of findings can be shaped and constrained by the methodological choices made. These limitations inform our own methodological choice to use photovoice.

Photovoice

Visual and participatory methods such as photovoice are well-suited for examining experiences that are characterized by complex thoughts, emotions, insights, and transformative experiences because "the parts of the brain that process visual information are evolutionarily older than the parts that process verbal information" [28], p. 13. Consequently, images can induce greater depths of human consciousness than words because interactions centered on words alone use a smaller percentage of the brain's capacity than interactions requiring the brain to process images as well as words [28].

Photovoice is a participatory methodology intended to empower individuals within a community by amplifying their voices and perspectives [21]. For example, Wang and Burris [21] demonstrated how visual images and documentary photography can draw attention to social issues while promoting critical reflection through participants' engagement with their environments. In photovoice studies, power dynamics between researchers and participants are reduced, thereby empowering participants to co-create knowledge about topics relevant to their communities [29], [30], [31], [32], [33]. Through photography, participants capture images that describe their lived experiences and participate in focus groups or interviews aimed at "Voicing

Our Individual and Collective Experiences" (VOICE) [29], [30]. The three main objects of photovoice include: (1) documentation and reflection; (2) collaborative group discussion; and (3) change promotion by reaching out to leaders and decision-makers [31], [32]. In photovoice, rather than simply responding to interview prompts, participants actively document moments, spaces, encounters, and events that capture their attention. This shift from purely verbal explanation to visual exchange encourages participants to reflect more deeply on their experiences, often prompting layered meanings, connections, and insights that may be difficult to access through traditional interview-based approaches alone.

In addition to its methodological strengths, photovoice has shown to offer pedagogical value by aligning with modes of communication that many students already navigate with ease [33]. Students are often more proficient at interpreting and expressing meaning through visual and narrative media than through traditional written texts [34]. Visual artifacts such as photographs and films can serve as accessible entry points for reflection, enabling students to recognize symbolism, emotion, and significance in ways that may be more challenging to articulate through writing alone [35].

Importantly, photovoice has been used across a wide range of contexts, demonstrating its value beyond a mere data-collection technique. In healthcare education, photovoice has been employed to illuminate structural challenges and inspire action. For example, Leipert and Anderson [36] used photovoice with nursing students to explore perceptions of rural healthcare work in Canada. Through photo sharing and facilitated discussions, students identified challenges in rural nursing practice, providing insights that informed strategies to address workforce shortages. In this case, photovoice functioned as both a reflective and generative process, revealing issues that may not have emerged through traditional survey-based methods, ultimately providing a platform for reconstruction and change.

In engineering education and higher education research, photovoice has also been used to better understand identity development, professional meaning-making, and emotionally significant learning experiences. For example, Anderson et al. [37] used photovoice to study students' perceptions of "good teaching," revealing that students viewed effective instruction not only through pedagogical competence, but through care, relational engagement, and personal connection. Parnell et al. [38] also used photovoice to examine Black engineering students' experiences at a predominantly White institution, where students often contended with racially unwelcoming environments. By integrating participant-generated images with reflective narratives and critical dialogue, researchers uncovered themes related to belonging, community, imposter syndrome, mentorship, and persistence that are often overlooked in traditional assessment approaches. This literature establishes photovoice as a robust and effective methodology for accessing the complex, affective, and interpretive dimensions of learning and development that can be masked by outcome-driven approaches.

With respect to engineering students' learning abroad, the closest related work was conducted by Burleson and colleagues [26]. Using photovoice, students captured a single photograph before and after a study-abroad program in Ghana to represent their identities as global citizens and engineers. They demonstrated that studying abroad strengthened students' sense of belonging through cross-cultural connections and the development of teamwork skills. While Burleson and

colleagues offer important insights into engineering students' identity development through learning abroad, their photovoice design was intentionally bounded by a single pre- and post-program image and identity-focused prompts. The present study builds on this work by broadening both the temporal scope and the openness of the photovoice task to capture a broader range of learning experiences.

Research Design & Methods

In this study, we employed a general qualitative inquiry approach [39]. This approach provided the research team with flexibility to "simply seek to discover and understand a phenomenon, and the perspectives and worldviews" ([40] p. 11) of study participants.

Learning Abroad Setting

We (authors one and three) designed a 10-day faculty-led experience in Brazil (our fourth such program) because of its unique global challenges that require innovative solutions and its alignment with the National Academy of Engineering (NAE) Grand Challenges. These grand challenges were developed by a panel of accomplished engineers and scientists from around the world. They proposed 14 grand challenges for engineering that are both achievable and sustainable, to help people and the planet thrive [41]. Brazil was selected for its opportunities for student cultural exchange. We designed an experience to give students a first-hand understanding of the Grand Challenges in the context of Brazilian culture, STEM advances, sustainability, and workforce development. This was achieved through hands-on experience in research laboratories, visits to local engineering companies, cultural excursions, and conversations with faculty and students at universities in Rio de Janeiro and Salvador. We assigned students to teams of three or four to investigate how their respective Grand Challenges were being addressed in the United States and Brazil. Based on their research and our visit to Brazil, they proposed innovative solutions to their specific grand challenge.

Before traveling abroad, students collaborated to conduct research and prepare a 15-minute presentation addressing their assigned Grand Challenge. With support from faculty mentors from our institution and individuals they met in Brazil, students were guided and challenged to be creative in developing presentations and communicating what they learned.

Participant Recruitment

All study abroad participants were invited to participate in this post-experience study. We distributed our Institutional Review Board (IRB) approved recruitment email to each of the 14 students. As a requirement of the study abroad experiences, students provided a pre-departure and post-return reflection. The analysis and presentation of pre- and post-reflections are outside the scope and purpose of this work. Table 1 outlines selected demographics for participants, along with their self-selected pseudonyms.

Table 1. Participants and Selected Demographics

Participant Pseudonym	Engineering Major	Year in Major	Self-Described Race/Ethnicity
Forever Young	Chemical	Second	Black & Latino
Toff	Chemical	Second	Black
Jupiter	Chemical	Second	Hispanic
K-Dot	Chemical	Third	Afro Latino

Data Collection

Before participating in the focus group, participants completed a demographic questionnaire that collected their race/ethnicity, engineering major, classification, and gender identity. During the program orientation, we also provided students with an opportunity to learn more about the aims of the photovoice study, including an introduction to photovoice methods, goals, and outcomes. We also introduced our predetermined prompts and encouraged participants to take photos that highlighted their experiences. We shared the following prompts with participants: *(1) Please capture and share 1-2 photographs that represent your identity as a global engineer. (2) Please capture and share 1-2 photographs that represent your most important takeaway from your learning abroad experience.*

Participants were asked to select and submit their photographs on the last day of the learning abroad trip and to provide 1-2 sentences describing each submitted photograph. Lastly, upon returning to the USA (i.e., 3 months later), four participants joined a face-to-face focus group session lasting 110 minutes with two members of the research team, namely authors one and three.

For the focus group, we created a PowerPoint presentation featuring photographs submitted by participants. Once a participant's picture appeared on the PowerPoint, we used the "SHOWeD" Method [42] to elicit descriptions of the submitted photographs. The acronym "SHOWeD" summarizes the questions we used to solicit feedback. Those questions include: What do you **See** here? What is really **Happening** here? How does this relate to **Our** lives? Why does this strength or challenge **exist**? What can we **Do** about it? After participants discussed their photographs, we invited their peers to provide feedback on the similarities and differences in their experiences. Participants received a $25 electronic gift card upon completion of the focus group. We audio-recorded the focus group session for future transcription.

Data Analysis

Primarily, as photovoice researchers, our analysis relied on participants' interpretations of their photographs, as interpretation lies in the "domain of the participants" ([43], p. 74). Below, we provide a brief description of how our team conducted the analysis. Focus group audio files were

transcribed by an external transcription service and then analyzed by the project team. As a first step in reliability, author one reviewed and updated the transcripts to correct transcription errors [44]. We then used thematic analysis to guide our analysis procedures [45], [46]. Specifically, we followed the six phases of thematic analysis, which include (1) data familiarization, (2) generating codes, (3) constructing themes, (4) reviewing themes, (5) defining themes, and (6) writing up findings. Author one led the data analysis procedure.

First, authors one and three listened to the focus group audio files before proceeding with further analysis. The transcripts were then read and re-read, followed by the development of hand-written descriptive and linguistic notes [47], [48]. This stage of data familiarization (Phase 1) enabled the team to attend to two levels of annotation simultaneously: examining the descriptions of participants' experiences and exploring their language choices [49].

Our individual annotations/notes served as sources of code during the code generation phase. To organize the analysis, the team created matrices to illustrate the codes, pairing them with excerpts from the focus group transcript to provide an additional layer of credibility. These matrices served two purposes: first, as an audit trail of code generation; and second, as a means to track the progression of code after team peer debriefings. After reviewing the transcript, led by author five, the team convened for a debriefing, which we call "time[s] of calibration" [50].

In addition, the lead author developed the themes, but additional authors, including one of the authors who participated in the focus group as a participant, served as a checker to ensure that the data were anchored in participants' descriptions, as achieved through our calibration sessions. During this meeting, author one presented emergent findings to the team, and the team interrogated the analysis procedures and findings by asking questions. We then proceeded to Phase 3, *constructing themes*. In this phase, diagrams of possible themes were constructed to illuminate and contemplate various thematic connections. Author one presented this information to the team to elicit feedback. In Phase 4 of the analysis, *reviewing themes,* the team routinely returned to the transcripts to ensure that the themes aligned with participants' experiences [51], [52]. In Phase 5 of the process, *defining themes,* we developed concise descriptions (i.e., one or two sentences) to anchor themes in the findings. Lastly, during Phase 6, all team members contributed to the writing up of the findings.

Limitations

As with other studies, some aspects of our study's design may be limited and require further investigation. First, although we attempted to reduce participant burden, submitting photographs and attending a face-to-face focus group months after the abroad program may have still been perceived as a burden. This resulted in our recruiting 4 of the 14 study-abroad participants. While recognizing that the experiences of these four participants do not reflect the broad range of learning abroad experiences, rather than focusing on the number of participants, we sought to elicit rich, detailed responses [53]. We did this in two ways. First, participants were eager to talk, which allowed researchers to build on the rapport we had established during the learning abroad experience. Second, the use of photovoice itself helped illuminate the richness of participants' experiences abroad. For example, because a picture can elicit a thousand meanings [54], this method not only enabled researchers to understand engineering learning and development

qualitatively but also provided a catalog of photographs that illustrate how learning abroad experiences are described from students' perspectives. In addition, as lived experience researchers, our approach to the study is to lean into the small sample size, which allows us to maintain a commitment to interpreting phenomena through the perspectives of the participants without the need for nomothetic generalization (i.e., a concern with what is broadly applicable). The analytical work required for lived experience research is extensive and not innately a limitation; thus, using a small sample size, as we have in previous photovoice studies [55], [56], [57], [58], is a methodological move that allowed focus on transferable insights gained through contextual depth [59]. Last, of note, one woman participated in this study (25% of the sample). Although we did not specifically target gender balance in this study, we acknowledge that this proportion aligns with the broader underrepresentation of women in engineering (approximately 20%; [60]), and therefore, readers should appraise the transferability of findings to other contexts.

Quality

To establish quality in the process of "making" and "handling data," the team was guided by Walther et al.'s [61] Qualifying Qualitative Research Quality (Q3). We use this framework because it offers practical ways for the team to focus on procedural, communicative, pragmatic, and ethical validation, as well as process reliability [62], [63]. For example, we assembled a team of varying levels of experience and positionalities throughout all phases of the project (e.g., data collection, analysis, and dissemination).

In "making data," we implemented several steps. As described above, we focused on building rapport with participants to enhance relational validity [64]. The photovoice focus group, because of its participatory nature, is a methodological move with a form of real-time member checking. Therefore, at the end of the focus group, we asked, "What has resonated with you and what themes did you hear?" This helped further anchor interpretation in participants meaning making. We also included two researchers in each focus group to balance participant comfort with adequate research support. For example, during the focus group, one team member focused on logistics, such as ensuring that participants' images were displayed and tracking who was taking notes during group discussions. Having two team members also enabled the team to engage in a dynamic process of asking follow-up questions to participants as needed, without relying on a single team member to manage logistics and lead the data collection session. During the focus group, we reminded participants to use their own language and communication styles and not to struggle to use "fancy" or formal language [65]. When participants requested additional time to reflect before responding or to seek clarification we provided that time and space. Our procedures for "handling data" involved thorough engagement with the data, multiple rounds of analysis prior to final theme development, and incorporation of peer feedback from an earlier conference presentation. Finally, we situated ourselves in this research through a positionality statement to ensure awareness of aspects of our experiences that might influence the research process, both positively and negatively [66].

Positionality

As researchers, our identities and positionalities are important considerations [66]. Each of us possesses multiple identities that shape our approach to all aspects of the project. We promote transparency by providing insight into the intersection of our research and personal identities without creating an exhaustive biography. The first author is an assistant professor of chemical engineering and identifies as a Black man. His research focuses on the experiences of Black men in engineering, with the aim of improving their experiences, trajectories toward degree completion, and representation. His approach to research study design centers on humanizing participants and lessening power dynamics. The second author is a postdoctoral research fellow in Engineering Education and identifies as a Christian Black male. His research interests lie at the intersection of neuroscience and education, constructing effective methodologies for training the cognitive capabilities of students to positively influence their academic performance. The third author currently serves as the Research Professor in the College of Engineering at the project host institution. His participation in the Brazil program was his first time participating in a study abroad program, as well as his first experience leading a program. The fourth author is an undergraduate engineering student and identifies as a Christian Afro-Latino man. So far, his research focuses on using the early experiences of Black male undergraduates in engineering to inform strategies to increase the number of Black male undergraduates in engineering and to better support them. His experiences as a research assistant and an engineering mentor shaped his engagement in this study. He is both a study participant and a member of the research team. He leveraged these positionalities as an asset in data analysis. Lastly, as a team of all-Black researchers, we subscribe to research suggesting that who we are shapes the questions we ask and how we answer them [67]. Collectively, we view our positionality as an asset, as it has led us to grapple with the data and to ensure that findings are grounded in participants' experiences rather than in pre-established understandings of the social reality under investigation [54] or in the team's relationships with participants [68].

Findings

In this study, we examined how students describe their learning-abroad experiences. Photovoice invited participants to reflect on their journeys abroad and those of their peers. We inductively developed several themes; however, for the purposes of this conference proceeding, we present two. The themes are summarized in Table 2, which includes a brief description of each, and the participants' collective story is presented in this section.

Table 2. Study themes with descriptions

Theme	**Description**
Dispelling Myths	Transformative experiences that reshaped students' perceptions of the places they visited
Reframing Cultural Identity on a Global Stage	The ways students reinterpreted, affirmed, and deepened their understanding of their cultural identities through global engagement

Dispelling Myths

First, participants described their learning abroad experience as reshaping their preconceived notions about Brazil, its people, and its technological advancements. Interestingly, their travel to Brazil facilitated and served as the seed for these myth-busting experiences. For example, in Figure 1, submitted by *Jupiter*. When asked, "What do we see here?" They said:

> This was at an institution in Salvador… The students had different divisions or different sections where they were innovating today's - or trying to solve today's problems with the help of different sponsors, and also their professors, and their mentors. So, in one side of the picture on the bottom left is a robot dog that they had rebuilt, repurposed, and optimized as well to kind of show - to kind of learn their circuitry and design skills and learn how to manipulate different materials. On the top of the picture, yellow and red, is an underwater automatic submarine. So, it would be a camera. So, it was to do deep-dive camera work and learn about deep water and ocean, and spaces that we haven't discovered yet.

When asked "why they chose this image." *Jupiter* said, "I chose this picture [because] it shows innovative projects that students my age and my degree in the same field, building and innovating."

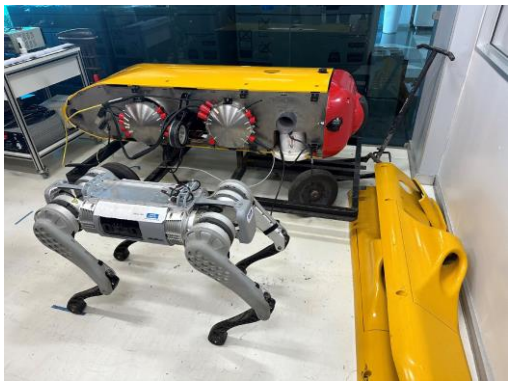

Figure 1. *Jupiter*'s Image from a University in Salvador.

Jupiter was impressed by the innovation they observed in Brazil. In addition, we begin to gain insights into how this was myth-busting for them, as the technology was not even something they could fathom: "projects that no one could even dream of doing." In describing how seeing these technological advances initiated myth-busting. *Jupiter* said:

> So, going here and seeing the robots that we see sometimes, our day-to-day life or our social media, and thinking like, "Oh, they might not have the same thing." They have maybe the same or more.

They went on to say:

> I'd say like US is very much of like trying to be the first in everything. The racing, we're the best. We're number one, but I think taking the time to pause and look at countries that we might think I guess, stereotypically, I guess, stereotypically, wouldn't have the same resources as us, having resources that we want to achieve, and we want to have, just because we're in the US, we think, Oh, we have everything."

Jupiter notes that social media may have influenced their expectations for what they would see in Brazil. Yet, their visit required pause as they began to consider that those in the United States are not the only people in the world who possess knowledge and technological innovation. This realization prompted them to share, "there're people all around the world trying to solve these problems that we think that we're only trying to solve them." *Jupiter* begins to push back against their own notion that Americans are the only problem-solvers.

For participant *Forever Young*, myths about Brazil as underdeveloped were also broken down as a result. They shared with researchers:

> So, it kind of gave me an idea of the false narrative. They're not so not so undeveloped, because they have this institutional technology…It kind of makes me think that they're actually advanced more than we think they are… It's changing insights of engineers of Brazil and engineers from the United States.

For *Forever Young*, understanding that the mainstream narrative is not always accurate served as the catalyst for dismantling the "false narratives." Both he and *Jupiter* demonstrate that their time in Brazil challenged their very ways of thinking (e.g., "we think"). This indicates their active processing of all that they were experiencing, and technology, in fact, facilitated this thought-changing experience.

Forever Young also describes how visiting was an important part of their realization. During the focus group, they stated, "So, yes, we shouldn't take for granted saying that 'Oh, they're [under]developed country,' and think that They lack certain technology,' when we actually don't know." Observing technological advances, such as those depicted in *Jupiter*'s image, prompted *Forever Young* to refine his understanding of what "underdeveloped" means. *Jupiter* also addresses the issue of underdevelopment. They shared:

> Underdeveloped doesn't mean they're struggling. Underdeveloped means they still have room to grow. So, I thought that was a really big experience that we had. Even talking about it after the trip like telling people now, I was just like, "They're not the underdeveloped that you think. [Laughter] Actually, they're doing a lot of cool things and they're working on issues that we're also working on." So, they're a lot more relatable than what we thought they would be.

In this, *Jupiter* left Brazil as a global ambassador, sharing what they learned about what it means to be underdeveloped. *Jupiter*'s laughter also reveals in some way how silly their perception of Brazil being underdeveloped in the deficit sense of the word.

Furthermore, for *Forever Young*, seeing was believing. They described this experience as changing their insights. Traveling enabled the "knowing" global engineers to see with open eyes. *Forever Young* ends by saying, "So, as a global engineer, I think it will make you open your eyes and see that they're actually stepping up to the game. So, that's what I see in the picture. I don't know if that's too overwhelming."

In this example, *Forever Young* demonstrates critical reflection on what it means to be a global engineer, as evidenced by explicit engagement with dispelling persistent myths. This reflection

also signals the development of emotional intelligence through the participant's willingness to confront complexity, discomfort, and uncertainty. The question about whether this realization is "too overwhelming" is coupled with their ability to raise the question, demonstrating growth and a willingness to engage in potentially difficult conversations.

Jupiter also described how the experience was eye-opening. "It was really eye-opening and it really broke our idea of what other countries are doing, especially like South America what they're doing. So, I think it really broke our stereotype of what idea we had." *Jupiter* proclaimed that the learning abroad experience "broke our stereotype." Interestingly, they used the collective "we." As expected, photovoice gave participants permission to both describe their own experience and "voice our individual and collective experiences (VOICE). *Jupiter*'s comment was a powerful expression of engineering as a facilitator of breaking stereotypes through the commonalities they shared with the students they met.

Similarly, *K-Dot* described seeing the engineering and technological advances as a catalyst for myth-busting. They shared, "There's a lot that I saw in what they were doing that impressed me deeply, and just their work motivation, their ethic, their passion about what they were doing, it was all very clearly there." *K-Dot*'s transformation was also initiated by seeing and being "deeply impressed," which helped challenge preconceived notions.

When asked by researchers, "What can be done about it [the preconceived notions, myths, and false narratives]?" *Toff* offered:

> Through collaboration, I think that we can get rid of some of these stigmas that, like a less developed country, can't be doing engineering on the level that the US is, because a lot of the things we are seeing at their institutions were beyond what I had seen or done

Toff suggests the power of collaboration in transforming and breaking stigmas and stereotypes.

This spirit of collaboration was captured in *Forever Young's* image (**Figure 2)**. For which they simply described as "We see a group of engineers gathered after interacting and exchanging knowledge about what we know and love to work on." Again, being engineering problem-solvers and having a love for engineering facilitated this myth-busting interaction and exchange. In this, *Forever Young,* describes the connections they inevitably experienced.

> The way I said fascinating is because anywhere I go, I try to be able to build connections. I try to build a possible relationship that can enhance me or enhance the other person or whatever project or whatever anything that I'm working on.

Forever Young highlights the depth of the connections as a mutually beneficial experience for both them (the study abroad student) and the others (the Brazilian students).

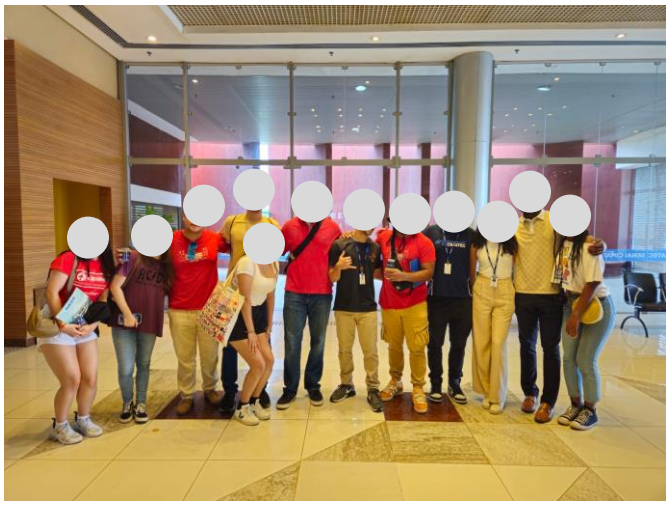

Figure 2. Photograph submitted by *Forever Young*.

Participant *Toff* also points to learning abroad as a powerful mechanism for hopeful collaboration. They shared, "It makes me hopeful for the future, where I'm able to connect more with groups who are working in collaboration with other countries… there's a lot to learn from them, and there's a lot that we can do together." In this way, learning abroad inspired *Toff* to believe that true collaboration involves a bidirectional exchange. This type of thinking is consistent with asset-based thinking.

In summary, providing students with opportunities to travel abroad empowered them to envision themselves as collaborators in the global world. It also helped to dismantle myths and preconceived notions about engineering around the world. Participants recognized that underdevelopment does not equate to struggle or lack, and found the innovation they observed in Brazil inspiring. Myths about whose ways of knowing and values were also interrogated and destroyed. Students experienced changes in how they recognized their Brazilian peers as engineers and what knowledge they could glean from them.

Reframing Cultural Identity on a Global Stage

The next theme focuses on the identities students encountered through learning abroad and how they reckoned with and deepened their understanding of those identities. First, we zoom in on *K-Dot*'s pictures and the conversation surrounding them (**Figures 3 and 4**).

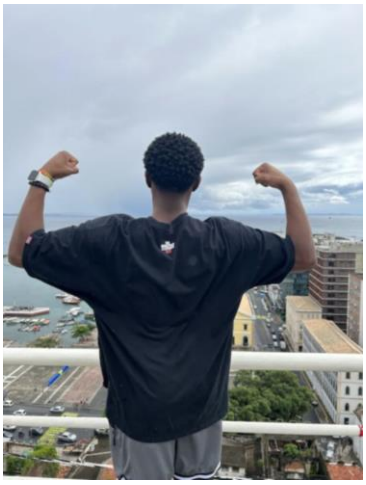

Figure 3. *K-Dot*'s Image- Looking at Salvador

When asked why they selected this image, *K-Dot* described it as a representation of their identity as both a global engineer and a global citizen. Here they explained:

> I selected this photo because I want to learn things about my identity… I associate that with my identity as a global engineer, because a lot of times, especially like I made that my degree, and I work on projects, whether that be inside [the] office or in the field, somebody has to lead the team. Somebody has to be brave enough to go headfirst and not be afraid to mess up, anything like that.

Here, *K-Dot* describes their identity as one who is willing to lead without fear, in a sense, a type of trailblazer, as being one to step out and travel to Brazil, which is likened to an "in the field experience." One that requires courage, adaptability, and presence. *K-Dot* also demonstrates their commitment to the learning-abroad experience and to the process of discovery. K-Dot calls it "go[ing] headfirst" or all in.

In addition, when asked to elaborate on this image, *K-Dot* (an Afro-Latino) emphasizes their African American identity. They said:

> As a global citizen, of course, because I'm African-American, and with all the things we've gone through in this country [United States], both from an inside perspective and my outside perspective, I want to represent for African-Americans as I have the strength, the strength to be able to do anything.

K-Dot's experiences in Brazil helped connect with their African American identity, both as they looked inward toward personal identity and outward toward collective representation. *K-Dot* wants this image to serve as an illustration and a source of support, demonstrating that others can be strong as well. Upon further describing the image, the following was shared: "Just on top of everything to signify that nothing is too big for me to get, if that makes sense. I'm here to show my strength, no matter where I am." As the image shows, they gaze at Salvador, flexing muscles, conveying the powerful imagery of strength even in uncomfortable or unfamiliar settings.

K-Dot's image also resonated with *Toff*'s own experiences as a Black engineering student. They said:

> I would say within this picture, for me, I see – I get like a feeling of what it's like to be like traveling to a different - a new city where like there're different challenges and things that they have to overcome that are reflected in things that are experienced by Black - African-American, things, challenges that I believe our community have to overcome and looking at *K-Dot* and his picture surrounded by the City of Salvador.

The emotions that *K-Dot* hoped to evoke rang true for *Toff* as they leaned into the victory and the overcoming. *Toff* expounded:

> I just think that there's a lot of potential for positive change, and like through engineering, through community activism, through traveling, and seeing and experiencing different people and cultures, that there's a lot of strength to be gained through that. I believe that picture is very, very evoking of that sense of resiliency.

Interestingly, *Toff* emphasized that this strength and resilience, which emerged specifically through the act of "seeing and experiencing," were the facilitators of this strength and this identity of resilience that were salient enough for them to comment on.

Similarly, *K-Dot*'s second photograph (**Figure 4**) evoked similar feelings in *Toff* and prompted further discussion around cultural identities and belonging.

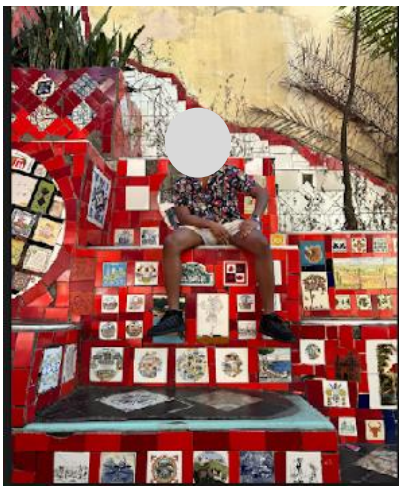

Figure 4. *K-Dot* in a Cultural landmark

In response to **Figure 4**, *Toff* described how traveling to Brazil invited an appreciation for diversity. Concerning the image location, the following was offered:

> So, it's an environment that you can be comfortable and chill because you know that there're going to be these places where people are able to come together and expressing their culture, while also amongst others who are just there to admire the beauty behind those other cultures.

In this way, *Toff* emphasizes that Salvador was a place for appreciating diversity and the beauty it can evoke. This sense of comfort was unexpected and became a point of realization for *Toff*. In reflecting on how racialized assumptions often dictate where Black students are perceived to belong, they offered:

> There are many people who would say and who think based on our skin color or backgrounds that we shouldn't be here, or that you don't have the ability to do things on the level that you're able to do the set learning a broad experience, and how far we've come up until that point. It was really like amazing to see that and be able to like feel a sense of accomplishment,

This intentionally designed study abroad experience provided *Toff* with a sense of accomplishment despite the noise they grappled with regarding limitations others may place on them because of skin color or background. For *Toff*, the accomplishment was not tied to a technical deliverable or academic milestone, but rather to presence itself. Traveling to Brazil and occupying space freely. Like *K-Dot*, *Toff* experienced a sense of achievement simply in being in Brazil. One may ask what accomplishment? *Toff* indicates simply traveling to Brazil, or as described, "how far we've come."

Simultaneously, the ability to exist in a space that celebrated Blackness was shocking for *Toff* - "I was shocked to see how much I related to the African culture and the culture of Salvador, being very diverse and very familiar to me. It felt like an extension of my family and my roots." For *Toff*, this experience in Brazil affirmed their racial identity as they felt connected like an extension of home, a homeplace of sorts [69], [70]. In fact, *Toff* went on to say, "I was expecting to be more out of place. Like they [another participant] was the one speaking Portuguese, [they] were able to connect in that way, and I thought that was really great." *Toff*'s connection transcended language as they described the experience as "it was for me a very nurturing environment." It should be noted that *Toff* did not describe this experience as merely fun or exciting; rather, the word "nurturing" connotes a more deeply rooted source, analogous to food as a source of nourishment for the body.

One final comment on how students make sense of their study abroad experiences emerge in the discussion of *Toff*'s photograph (**Figure 5**). *Toff* explained that the image prompted him to reflect on global history and their identity as an African American.

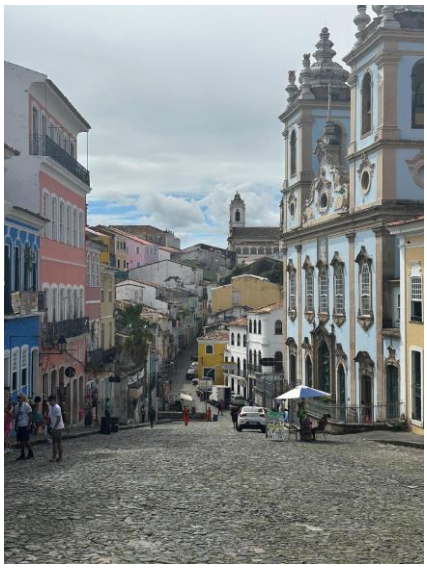

Figure 5. *Toff*'s photograph taken in Salvador

In describing this picture, *Toff* shared:

> This picture is of an area in the historical center of Salvador, located in the upper city, where there are many beautifully designed buildings, churches, and houses. This portrayed the role that global expansion played in the development of countries outside of the USA, as well as from a different perspective that I experience it from as an African American.

Toff described how they were able to step back and reflect on the experience of these buildings through the lens of their identity as an African American. It caused them to grapple a bit as seen in this excerpt:

> I also relate to the picture from the location being featured in Michael Jackson's music video "They Don't Care About Us", which accurately describes how the natives and Africans were viewed by the European colonizers at the time the areas were settled, as well as how it has continued and led to the current state for those of African and Native American descent in communities all over the world.

Toff's ability to connect the site to Michael Jackson's "They Don't Care About Us," filmed in Salvador, using the location as an entry point to grapple with colonial histories and their ongoing impact:

This selected quote represents a transformative experience for *Toff*:

> "Something I was thinking about throughout the entire trip was just how people from all over the world can come together to build and do great things, but if they're not I guess pursuing it collaboratively, it can seem one person's being excluded or isolated... Because a lot of the history of many of these places, there are groups that were basically marginalized groups and then there were the other, the people that would gain, like would, the right words are not coming through but like try to just reap benefits that could've been shared. [Pause] It's something that just hit really close to home for me"

This reflection extended beyond historical awareness toward a critique of exclusion and missed opportunities for collective progress. *Toff* articulated a longing for collaborative approaches to global development, noting that marginalized communities have often been excluded from benefits that could have been shared. These realizations "hit really close to home," underscoring how study abroad facilitated critical consciousness alongside cultural affirmation.

Collectively, this section demonstrates that learning abroad served as a powerful site for the development of cultural identity. Through place-based experiences, visual reflection, and dialogue, students not only affirmed their identities but also reinterpreted strength, accomplishment, and belonging on a global scale.

Discussion

This study examines how learning abroad can function as a catalyst for knowledge, relational, and identity-based development among students. Participants not only reported "growth" in global competence but also described shifts in how they recognized expertise, positioned themselves in relation to place, history, and racialized global systems. In doing so, the findings extend prior work documenting gains in intercultural awareness and professional readiness ([13], [24] by illuminating the mechanisms through which these shifts occur, namely, through physical, visual, and relational encounters during their time in Brazil.

First, a recurring theme across participants involved the reexamination of prior assumptions about Brazil as technologically underdeveloped. Analysis of photovoice focus group discussions indicated that students articulated surprise and reassessment after encountering engineering projects, innovation spaces, and student-led technological problem-solving within Brazilian institutions. Participants consistently emphasized that these shifts emerged through firsthand, visual encounters rather than through conventional information dissemination, describing "seeing" innovation as central to confronting assumptions shaped by social media and dominant American-centered narratives.

These encounters positioned engineering as a form of cross-cultural common ground between U.S. and Brazilian students. Participants identified shared problem-solving practices, design processes, and professional commitments as mechanisms through which Brazilian students were recognized as equals rather than as beneficiaries of U.S. work. In doing so, students began to question who is positioned as a true producer of knowledge. Students openly challenged assumptions that innovation and problem-solving are centralized in the United States.

Consistent with prior work, these findings suggest that global competence is constructed through interpersonal engagement, collaboration, and proximity rather than through abstract knowledge acquisition alone [22], [26]. Students' accounts further illustrate how belief and knowledge shifts can be surfaced through visual and narrative data, extending beyond outcome-based measures of intercultural awareness that rely on predefined competency frameworks [13], [24].

Holding myths as beliefs can be very easy, and sometimes even unconscious, when only being exposed to pre-selected news stories, social media posts, and social rhetoric that place South America, namely Brazil, in a specific light. Learning abroad experiences fostered humility in

global knowledge, as students begin to recognize the limits of their understanding beyond their own national context. This shift was evident as students moved from confidence in their assumptions to a more reflective acknowledgment of the boundaries of their global engineering knowledge. Though participants were not initially aware of the myths they held, the act of visually documenting global engineering enhances the quality and depth of reflection, as photovoice enables access to transformative learning moments that are often missed by survey-based or outcome-focused assessments [33], [71].

Finally, the theme of myth-dispelling was accompanied by a shift from competitive comparison toward collaboration. This experience seemed to prompt students to position themselves as future collaborators rather than external observers. Participants express increased openness to international collaboration and collective innovation as aspiring outcomes of their experience abroad. This shift in thinking is vital for continuing efforts to build global competence within the engineering workforce. It reflects a move away from competitive framings towards more collaborative, globally oriented approaches to engineering.

Next, learning abroad afforded students the space to reflect on and affirm their identities not only as global engineers but also as global citizens. When completing the photovoice tasks, participants used photographs to articulate their understandings of leadership, courage, and identity associated with being physically present in unfamiliar environments. Interestingly, cross-cultural comparisons were primarily technologically based; identity-related reflections were consistently anchored in physical presence. Essentially, the physical spaces students encountered at different points in the trip served as vehicles that sparked greater reflection and perspective on their own identities. *K-Dot* mentions this when they state, "This mindset signals not only commitment to the technical dimensions of engineering but also a deeper engagement with self-discovery and identity development through travel." Specifically, in Brazil, their presence there enabled them to connect with their African American identity, both inwardly and with its collective significance. This is an example of the power an environment can have over one's self-perspective. Being physically immersed in a particular environment can lead to deeper self-understanding, as it allows students like *Toff* to affirm their racial identity. They recall specific parts of Brazil that helped them feel connected, as if they were an extension of their family, their roots, and their home. Experiences of cultural affirmation, such as *Toff*'s description of Salvador as a "nurturing" space, coincide with literature on homeplace, identity validation, and belonging, suggesting that study abroad can serve not only as a site of disruption of mainstream narratives and ideologies, but also as one of affirmation and grounding for minority students [70]. Participants' reflections on race, identity, and representation align with scholarship demonstrating that study abroad can prompt identity reevaluation, particularly for students from historically marginalized backgrounds, through encounters with new cultural mirrors and contexts of belonging [16], [17]. Narratives such as *K-Dot*'s and *Toff*'s exemplify how learning abroad can foster critical consciousness, echoing research showing that transformative learning often involves grappling with history, power, and positionality rather than acquiring discrete, measurable skills [25], [26]. Such processes align with conceptions of critical consciousness as involving critical reflection on inequality, sociopolitical awareness, and emerging commitments to change, and they echo findings that transformative learning is often rooted in meaning-making rather than in outcome attainment [25], [26].

Racial and cultural identity proved significant for Black and Afro-Latino students, as their reflections on strength, resilience, and visibility in a global context link their experiences to broader racial histories and lived realities. This touches on the sense of belonging that transcends the present moment, helping one feel connected to a network of individuals larger than themselves. Researchers have found that Black students experience growth in personal, psychological, and ethnoracial identity development, including knowledge and appreciation of their Black identity and its global intersections, which directly ties to experiences of strength, resilience, and broader connection [72]. Consequently, we see that identity development can occur through resonance, not assimilation, as students described Salvador as a familiar, nurturing, and connected to themselves, even when the language, food, and way of life had foreign aspects.

Importantly, students' perceptions of accomplishment were closely tied to presence and participation rather than to the completion of academic or professional tasks. They described achievement as rooted in simply being in Brazil, navigating new environments, and freely occupying cultural spaces. This sentiment challenges outcome-driven notions of program success as identity formation and belonging can develop outside of measurable competencies or predefined learning goals. Such findings extend prior work by demonstrating that learning abroad outcomes may be intrinsically meaningful and crucial to students' self-understanding, even when not captured by traditional assessment measures [17], [27].

Furthermore, participants used their physical presence in the landmarks and historical sites as avenues for wrestling with generations of marginalization and inequality. Being abroad helped facilitate these meaningful reflections on global history, colonialism, and exclusion. Students expressed that the implementation of cultural collaboration in the past could have shifted historical trajectories and the outcomes we live with today. Again, we revisit the power of collaboration rather than competition. This is evident both in the students' reflections on global engineering and in their thoughts on their experience in general.

Lastly, photovoice provided researchers with access to the affective and developing dimensions of learning among participating students. Photovoice allowed us to capture scopes of learning and meaning-making that could have been overlooked with outcome-based assessments or predefined labels that measured the level of a program's success. In this study, participants used images to help articulate emotions, resonance, and identity shifts that may be difficult to express solely in a verbal or written form. Within the photovoice focus group, conversations unfold rather than a simple question-and-answer dynamic. This further serves as a catalyst for deeper reflection among students on this new experience abroad. Photovoice focus groups also aided participants in collective meaning-making. We see how important this aspect of data collection can be, as participants respond to their peers' images, extending meaning and reflection beyond personal experience into a shared understanding. The dialog-based interpretation of photos within the focus groups strengthens prior findings that photovoice enables collective reflection, allowing participants to co-construct meaning around identity, belonging, and global citizenship [37], [73]. Participants' use of collective language, such as "we," reflects shared understanding and contemplation facilitated by visually influenced dialogue.

Recommendations for Practice

For those designing study abroad programs, this work, as well as prior research, emphasizes the importance of proximity and interpersonal engagement as a mechanism for global competence development [22], [26]. Engineering learning abroad programs should therefore intentionally incorporate structured opportunities for students to engage with local engineers, faculty, and students as collaborators, co-problem solvers, and knowledge producers. In addition, given the power of photovoice or other photo-elicitation methods, we recommend that program designers integrate reflective, visual, and dialogic opportunities into study abroad programs. Incorporating visual methods such as photovoice alongside facilitated group dialogue can create space for students to articulate their experiences.

Conclusions

We inductively developed two themes: B*reaking Stereotypes* and *Reframing Cultural Identity on a Global Stage.* This study demonstrates that learning abroad can function as a powerful context for reshaping engineering students' understandings of global knowledge, collaboration, and identity through firsthand, visual, and relational encounters. By using photovoice, this work extends prior outcome-focused research by illuminating the mechanisms through which students reexamined deficit-based assumptions, affirmed their racial and professional identities, and oriented themselves toward collaborative global engineering practice. The findings highlight the value of methodologies that capture the affective, embodied, and collective dimensions of learning, which are often obscured in conventional assessments. This study also highlights the importance of intentionally designed learning abroad experiences and methodological approaches that foreground meaning-making, belonging, and identity in engineering education.

Acknowledgements

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