

Why Not Me? A Photovoice Study of Belonging and Identity Formation Among Gender Minorities in STEM

Dori Harcharik, University of Southern Mississippi

Dori Harcharik is a first year PhD student in Polymer Science and Engineering at the University of Southern Mississippi. She graduated in 2020 with a B.A. in Psychology from the University of North Carolina at Asheville and earned a second bachelor's degree in 2025 in Polymer Materials Engineering from Western Washington University, where she developed a strong interest in research and opportunities related to the enhancement of community, equity, and belonging in STEM programs. She is dedicated to connecting skills in material science with her background in psychology, aiming to enhance STEM education initiatives in her community to amplify student voice and well-being through a variety of leadership initiatives and research endeavors. She will be completing a STEM Education master's degree at the University of Southern Mississippi, concurrent with her PhD in Polymer Science and Engineering.

Ms. Jill Davishahl, Western Washington University

Jill Davishahl is Associate Professor and First Year Programs Director in the Engineering + Design department at Western Washington University. Jill's teaching, service, and research activities focus on enhancing the first year student experience by providing the foundational technical skills, student engagement opportunities, and professional skill development necessary to improve success in the major. Her current research focuses on creating inclusive and equitable learning environments through the development and implementation of strategies geared towards increasing student sense of belonging.

Liz Stuart Liz Stuart, Western Washington University

Liz Stuart, M.Ed., is the Assistant Director of Outreach and Health Promotion at Western Washington University in Bellingham, Washington. She is also a part-time adjunct faculty member in the Department of Public Health and has taught courses on health education as well as seminars focused on retaining students who are transitioning to college. She has implemented structural changes within Academic and Student Affairs that promote embedding health and wellbeing access into the students daily lives, including adding resource applications into canvas, increasing the distribution of free health supplies to enrolled students, and centering art and cultural connection within health promoting initiatives. She believes in student leadership and self-efficacy as solutions to the community-wide public health issues that impact undergraduate student communities. She enjoys designing learning experiences like the one in this paper, that encourage users to be part of brainstorming and implementing creative solutions to the problems we experience, study and observe.

Why Not Me? A Photovoice Study of Belonging and Identity Formation Among Gender Minorities in STEM

Abstract

Research demonstrates that belonging is essential for student success and retention, yet gender minorities in STEM fields still face significant isolation and barriers to inclusion. Studies have found that students of underrepresented groups in STEM majors are less likely to feel a sense of belonging in their program, illustrating a need for opportunities and initiatives to foster community and connection for these populations on college campuses. This paper details the process of a student-centered photography project, Through Our Lens, and explores participants' reported experiences of belonging in STEM majors on a college campus before and after engagement with the project. Through Our Lens is an arts-based participatory research methodology, following the photovoice model wherein students combine storytelling with photography. Disposable cameras were provided for participants from various STEM programs across the campus of Western Washington University. In a two-part workshop series, the participants collaboratively designed two prompts to explore via photography: "Why not me?" and "How do you create your own space at Western?" Participants captured their photographs over the winter quarter, then attended a second workshop where they received their printed photos and captioned them for a gallery exhibition. The project was evaluated using a mixed-methods pre-/post-survey design with Likert-scale items and open-ended responses. Motivations for participation in Through Our Lens included the desire to learn about gender equity, seek community, and make a difference in STEM. Post-participation responses showed statistically significant increases in participants' reported sense of belonging on campus, belonging within their major, and feeling that their perspectives were valued in STEM, though the small sample and absence of a comparison group preclude causal attribution. Qualitatively, participants described experiencing voice and validation through the project, articulating gender barriers in STEM and building community with peers. The findings suggest that creative mediums of student expression may be associated with community, inclusivity, and validation of lived experiences for gender groups statistically underrepresented in STEM fields.

Introduction

Despite efforts to spur interest in STEM fields among gender minorities, representation of minority groups remains limited in STEM careers and advanced positions [1]. In 2023, there was a 34% increase in women earning science and engineering bachelor's degrees, yet only 24% of the United States STEM workforce the same year was comprised of women [2] [3]. Common efforts to close the gender gap in STEM programs include instrumental modes of support, such as STEM programs, increased training for underrepresented groups, providing academic tutoring and accessible resources, or improved institutional policy [4]. Equally important are initiatives that focus on modes of support that encourage underrepresented groups to develop a deeper sense of self-efficacy and confidence in STEM and to explore personal experiences that influence this sense of belonging [4] [5] [6]. Studies have illustrated that female students are less likely to feel a sense of belonging in STEM, which is compounded when considering other intersecting facets of identity such as race [7]. The connection between feelings of belonging and

academic success is well documented, highlighting the importance for further examination of methods that reinforce a sense of belonging for underrepresented populations in STEM programs [8] [9] [10].

While many studies for improving the sense of community amongst minorities in STEM have been assessed, few focus on arts-based interventions [11]. Arts-based initiatives could serve as an additional mechanism to help close the gap between the need for belonging initiatives and available approaches. We believe artistic, creative methods for student engagement can provide unique opportunities for underrepresented groups in STEM to engage in introspection and assess their personal experiences, motivations, and needs. Assessing these more personal experiences as they relate to feelings of belonging and inclusion could help provide a more well-rounded understanding of factors that influence attrition of minority groups in STEM programs. One unique approach to gather these perspectives while encouraging belonging and creating community is photovoice, a participatory research methodology that uses visual data to understand human perceptions [12]. The photovoice structure uses images and corresponding narratives to capture and reflect community strengths and needs, encourage critical dialogue about pertinent issues, and inspire stakeholders to act [13].

In 2023-24, a photovoice initiative, Through Our Lens, was piloted at Western Washington University (WWU) through the campus Counseling and Wellness Center. The pilot initiative engaged an upper level research methodology course and 35-student sample who opted into this photography project focused on wellbeing and health promotion. After the initial success of this project and an intention to refine and adapt the project based on what was gleaned from the initial attempt, student affairs staff involved in the project sought other collaborators to implement a second iteration of the project in the 2024-25 academic year. Following nationwide changes in STEM program funding and language around equity in STEM spaces, collaborators in the WWU Counseling and Wellness Center, Engineering and Design Department, and student group for gender equity in STEM, the Pink Moon Society, felt it pertinent to unite and find ways to support underrepresented groups heavily affected by these changes. The desire to provide an enriching experience wherein underrepresented groups in STEM spaces could call for action in their community while exploring their individual narratives and perspectives fit perfectly with the intent of photovoice research. The unique combination of arts-based methods and belonging research in the context of minority groups in STEM programs provided an interdisciplinary intervention that has the potential to contribute to public health equity frameworks where a sense of belonging protects against negative health outcomes. The 2024-25 iteration of Through Our Lens was thus initiated, with a focus on promoting gender inclusivity in STEM spaces at WWU.

The purpose of this research is to explore approaches to addressing belonging issues among underrepresented students, particularly gender minorities, in STEM programs at WWU through an arts-based photovoice intervention. The project is rooted in community-based participatory research and employs photovoice methodology, which puts cameras in the hands of community members to gain insight from their firsthand experiences. By providing students with disposable cameras and facilitating a collaborative process where students develop their own reflective

prompts during workshops, the project empowers them to visually document their perspectives on belonging and gender equity in STEM spaces, giving them agency over their own narratives rather than having their experiences interpreted by others.

The project aims to inspire community engagement and student participation in the development, planning, and implementation of a belonging intervention that gives students both individual and communal space to reflect on connection and belonging at WWU. Through collaborative workshops and shared storytelling, the project seeks to build community among STEM students, help them develop their social and personal identities, and foster critical consciousness about their experiences. Ultimately, the project seeks to amplify student voices through public gallery exhibitions to acknowledge gender inequality, raise institutional awareness of STEM student experiences, and potentially influence WWU policies and strategies around equity. Additionally, this research aims to contribute methodologically by demonstrating the effectiveness of photovoice approaches in STEM contexts, where such arts-based participatory research methods are relatively uncommon.

Research Question

The following research questions have guided this work:

How does participation in a photovoice intervention affect sense of belonging, institutional trust, and self-efficacy among students in STEM programs? How do these effects vary among underrepresented students in STEM?

Quantitative Research Sub-Question:

RQ1: Does photovoice participation lead to changes in students' sense of belonging, perceptions of institutional inclusivity, STEM self-efficacy, and resource awareness?

Qualitative Research Sub-Questions:

RQ2: How do students describe barriers they experience in STEM education, and does their ability to articulate these barriers change through photovoice participation?

RQ3: What aspects of the photovoice experience do students identify as most meaningful?

Theoretical Frameworks

Our research is grounded in 4 theoretical frameworks:

1. Community-Based Participatory Research (CBPR)

Community-based participatory research is an approach that emphasizes collaboration with community members throughout the research process, ensuring that outcomes are representative of the community's needs and perspectives [14]. CBPR prioritizes conducting research *with* rather than *on* communities, positioning community members as co-creators of knowledge [15]. In this study, CBPR principles guided the collaborative development of the photovoice

intervention, with students participating in prompt development, workshop design, and the creation of the public exhibition.

2. Photovoice Methodology

Photovoice is an arts-based participatory method that provides participants with cameras to document and reflect on their lived experiences [13]. The methodology is grounded in critical pedagogy and serves multiple purposes: enabling people to record and reflect on community strengths and concerns, promoting critical dialogue about personal and community issues, and reaching policymakers [13]. Research has demonstrated photovoice's effectiveness in giving participants opportunities to develop social and personal identities, build reflective skills, and become positive agents within their communities [16]. Photovoice has been successfully applied in various educational and community health contexts to promote voice development and agency [17] [18].

3. Sense of Belonging Theory

Sense of belonging is defined as students' perceived social support on campus, feelings of connectedness, and sense that they matter and are cared about as individuals [10]. Belonging has been identified as a fundamental human need and a critical protective factor against mental health challenges, particularly for college students [19] [20]. Research demonstrates strong correlations between belonging and student well-being, retention, and academic success [21]. For underrepresented students in STEM, belonging is particularly salient, as experiences of marginalization can undermine a sense of fit and persistence in STEM fields [9]. This study examines belonging at multiple levels—institutional and departmental—recognizing that students may experience belonging differently across contexts.

4. Feminist Methodology

Feminist research methods center the experiences and voices of marginalized individuals, challenge traditional power structures in research, and validate lived experience as a legitimate form of knowledge [22]. Photovoice itself is recognized as a feminist research method that places tools of representation directly in the hands of those whose experiences are being documented [13]. This study's partnership with the Pink Moon Society, a campus student-led movement for gender equity in STEM, and its focus on underrepresented students reflects feminist commitments to addressing structural inequities and amplifying marginalized voices in STEM education.

These frameworks work synergistically in this research. CBPR and feminist methodology provide the ethical and epistemological foundation for centering student voice and experience. Photovoice methodology offers the practical mechanism through which students document and reflect on their experiences. Sense of belonging theory provides the conceptual lens for understanding the outcomes we seek to measure and the importance of these outcomes for student success and well-being in STEM.

The Photovoice Intervention

Grounded in community-based participatory research and feminist methodology, the photovoice intervention was designed to center student voice and experience. While photovoice has been widely used in health and community-based research, it remains underutilized in higher education generally and has only recently gained traction in engineering and STEM contexts, where limited examples exist to guide implementation [12] [23]. The sample size of 12 participants aligns with established norms for photovoice research, which has a median project size of 13 participants due to the intensive, dialogic nature of the methodology [24]. The intervention occurred over two academic quarters (5 months) and consisted of five components:

Recruitment

Participants for the 2025 Through Our Lens project were recruited by each hosting entity in various modes. The Pink Moon Society Instagram page was used as a primary marketing platform to inform potential participants of the project, share sign up information, and post about project milestones. Flyers with information pertaining to the project and initial workshop were distributed in all campus buildings housing STEM programs in addition to the project details and sign up sheet being shared on the WWU Counseling and Wellness Center website. The Director of First Year Programs in the WWU Engineering and Design Department announced the event to first-year engineering students enrolled in ENGR 101 and ENGR 115 courses, and the initial workshop details were posted to this department's shared event calendar.

Introductory Workshop

The purpose of the initial workshop was for participants to interact with peers in STEM programs at WWU and learn about photovoice methodology, visual storytelling techniques, and the Through Our Lens project. To encourage community and incentivize attendance, a meal was provided. A shared meal helped break the ice between participants and set the stage for a welcoming atmosphere wherein conversation between students could continue throughout the course of the intervention. The workshop participants were split into small groups, each equipped with a packet containing compiled data and statistics pertaining to gender minorities in STEM programs and careers. At this time, the groups were encouraged to peruse the data and subsequently engage in a discussion about their thoughts, connections, and personal experiences, as they felt comfortable, in relation to the data presented. The discussion was connected to the greater goal of Through Our Lens, and each group was then tasked with designing potential focus questions related to belonging, connection, and experiences in STEM spaces to guide the photography period of the project (Figure 1). All questions were compiled, after which participants voted on the two questions of most interest to explore, which were "Why not me?" and "How do you create your own space at Western?". It is during this initial workshop that a pre-survey was administered to gather data on motivations for participation and demographic information. The workshop concluded with details about the next phase of the project, which would be the independent photography period. This included assigning participants a disposable camera along with a training in photography ethics and the importance of consent when

capturing photos with human subjects. The participants were given resources for properly gaining consent, including a QR code for subjects to scan and give written consent for photo release.

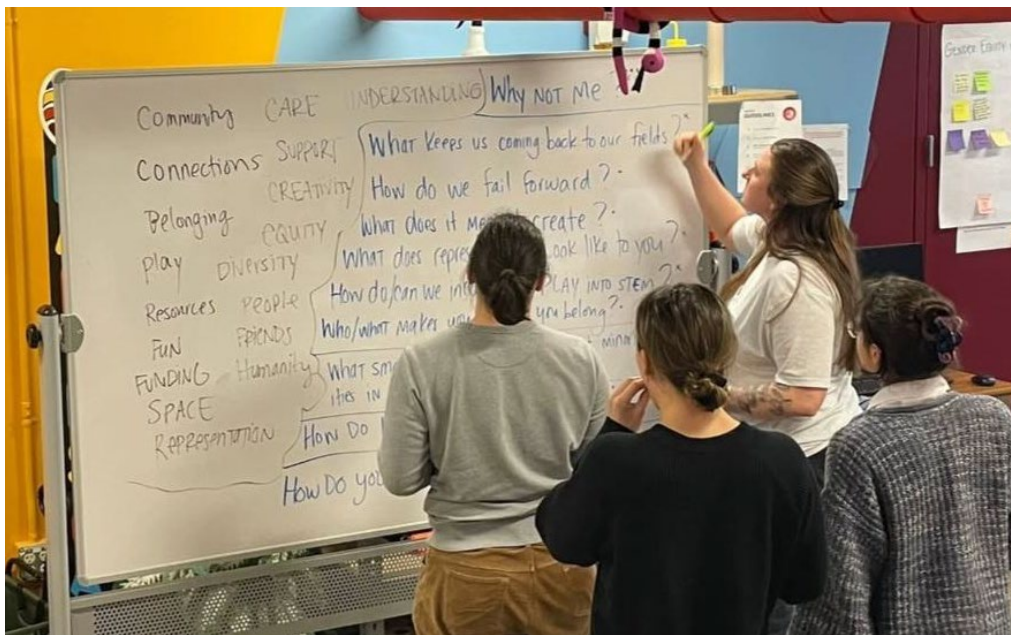


Figure 1. Participants record questions to explore via photography.

Photography Period

Following the introductory workshop, participants had four weeks to document their experiences responding to the project prompts using their disposable cameras. A Through Our Lens Microsoft Teams group was created as a means to foster communication between participants, check in on the photography progress, and provide reminders about impending dates for the next stages of the project. Additionally, two optional drop-in workshops were offered for participants wanting to talk through their photography process or brainstorm ideas for potential photos to capture. A drop-off box situated at the location of the initial workshop was made available for participants to drop off their cameras. The drop-off deadline was three weeks before the second workshop, during which the developed photos would be available.

Photo & Narrative Workshop

After film development, a second workshop was held, during which participants were given back their photos. Each participant was tasked with selecting two or three of their favorite images to share within a small group. This served as an opportunity to further connect with peers in STEM who participated in the project and to engage with the content of each other's photos as it related to the prompt questions. During this time, some participants sought help from their peers to choose which photos they wanted to showcase during the gallery exhibit. The participants then created captions and narratives connecting their chosen photographs to their STEM experiences and the project prompts. These captions could be a story, poem, narrative, or any other method

the participant desired to connect the photograph to their own interpretation of the prompts. Participants were sent a link to a shared document that contained digital files of the developed photos so the captions could be typed next to each participant's corresponding chosen photographs. After the workshop, the photos selected by the participants were printed and mounted along with their narrative captions for exhibition.

Gallery Exhibition

The mounted photographs and captions were displayed for two weeks in a public campus gallery, allowing participants to share their perspectives with the broader university community. The exhibit featured a description of Through Our Lens and its hosting entities to provide context for the project. Several stations were set up to give attendees the opportunity to engage in and interact with the exhibition. Post cards with the displayed photographs were printed and placed around the gallery as keepsakes, and heart stickers were provided for patrons to place on the wall next to their favorite photographs as an in person "like" feature. A disposable camera and logbook station was available for those attending to take their own photographs at the exhibit, which were later emailed to them once the film was developed. The two questions, "Why not me?" and "How do you create your own space at Western?" were placed on a bulletin board in the back wall along with cards and writing utensils for attendees to answer the questions themselves and then post to become part of the exhibit. At the conclusion of the exhibit, the participants were able to collect their mounted photographs to keep and were asked to complete a post-survey.

Research Methodology

We used a mixed-methods quasi-experimental approach with a pre-test/post structure to examine the impact of a photovoice intervention on STEM students' sense of belonging, institutional trust, and self-efficacy among STEM students [25] [26]. The study examined the research question: *How does participation in a photovoice intervention affect sense of belonging, institutional trust, and self-efficacy among students in STEM programs, and how do these effects vary among underrepresented students in STEM?* This design integrates quantitative measures of change with qualitative understanding of participant experiences to provide insight into the effects of the photovoice project. The pre and post survey questions are included in Appendices A and B, respectively.

The study was conducted at WWU, a public comprehensive university in the Pacific Northwest. Participants were recruited through campus-wide marketing including social media, email newsletters, classroom visits, and partnerships with campus organizations serving underrepresented students in STEM. The study was conducted in partnership with the Pink Moon Society, a campus movement for gender equity in STEM.

Twenty-seven students completed the pre- survey, with twelve completing the post- survey (44% completion rate). Completion rate could be attributed to a variety of factors, including post survey collection at a busy time of the school year, inability to continue with the project, or

challenges with camera collection. The sample consisted primarily of underrepresented students in STEM, particularly gender minorities, reflecting both the recruitment focus and the partnership with the Pink Moon Society. The pre-survey was administered during the first workshop (mid-January) and the post survey was administered after the gallery event (late May).

Data Collection

Participants completed pre- and post-surveys measuring sense of belonging and institutional trust using items adapted from validated instruments [9] [27] [28] and modified for the WWU STEM context. Given the small sample size (N=27 pre, N=12 post) and exploratory nature of this work, survey results provide preliminary quantitative context to complement the photovoice findings. The primary contribution of this paper is to share the photovoice methodology as an innovative approach for surfacing STEM student experiences around gender equity and belonging, and to demonstrate preliminary impact on this small group of participants. All procedures received WWU IRB approval.

Participants completed pre- and post-intervention surveys containing 10 Likert-scale items (5-point scale from Strongly Disagree to Strongly Agree) measuring:

- Sense of belonging at the institution and in major
- Perceptions of institutional inclusivity and commitment to fostering inclusive environments
- Belief that one's perspective is valued in STEM spaces
- STEM career self-efficacy
- Social integration (connections with peers, identification of faculty mentors)
- Awareness of campus support resources

Both pre- and post-intervention surveys included two open-ended questions: "What barriers, if any, have you experienced in your STEM education at Western?" and "What changes would you like to see in STEM education at WWU to promote greater equity and inclusion?"

The post-intervention survey included additional open-ended questions about the photovoice experience, including what aspects participants found most valuable, what they learned from participation, what they enjoyed most, and what they found most challenging.

Data Analysis

Quantitative data were analyzed using independent samples t-tests to compare pre (n=27) and post (n=12) group means on each Likert-scale item. Open-ended survey responses were analyzed using systematic thematic analysis with AI assistance [29] [30] [31] [32]. Claude (Anthropic) was selected as the AI tool in part due to its default data privacy protections, including its policy of not using conversation data for model training, which aligned with research ethics obligations to protect participant data. Following the approach outlined by Naeem et al. (2025) for integrating generative AI into systematic thematic analysis, the AI was familiarized with the study's research questions, theoretical context, and participant background prior to analysis. AI assistance was employed across Steps 1 through 5: (1) familiarization and selection of 45

substantive quotations, (2) identification of theory-driven keywords organized into 12 categories aligned with Sense of Belonging Theory, (3) development of 8 analytical codes, (4) organization of codes into 3 themes, and (5) conceptualization of patterns to understand barrier types and articulation changes. AI outputs functioned as analytical prompts and preliminary suggestions; all codes, themes, and interpretations were verified and refined by the researcher to ensure alignment with the study's constructivist, exploratory orientation. Throughout the analysis, AI served as an organizational and pattern-identification assistant while researchers maintained control over theoretical framing, code definitions, and interpretations. For example, when identifying keywords in Step 2, the AI proposed initial terms drawn from participant language; the researcher then evaluated each suggestion against Sense of Belonging Theory, retaining, rejecting, or reframing terms to ensure theoretical alignment. Similarly, proposed codes in Step 3 were reviewed and refined by the researcher before being accepted into the analytical framework. Step 6 (conceptual framework development) was not pursued given the exploratory nature and small scale of this study.

Participant Demographics

Table 1 summarizes the demographic characteristics of participants. Demographic data suggest that Through Our Lens largely reached its intended population of marginalized students in STEM. The majority of pre-survey respondents ($n = 27$) identified as women or gender minorities (93%), with only a small number of men participating (7%). Over half of participants identified as BIPOC (52%), and nearly three-quarters identified as LGBTQ+ (74%). These patterns are consistent with the project's community-based recruitment approach — centered through the Pink Moon Society and the WWU Counseling and Wellness Center — which appears to have resonated with students holding multiple marginalized identities within STEM, the population the intervention was designed to serve.

Table 1: Participant demographic characteristics.

	Characteristic	Pre-Survey (n=27)	Post-Survey (n=12)
<i>Gender Identity</i>	Woman or gender minority	25 (93%)	11 (92%)
	Man	2 (7%)	1 (8%)
<i>Race/Ethnicity</i>	BIPOC	14 (52%)	4 (33%)
	White	12 (44%)	7 (58%)
<i>Sexual Identity</i>	LGBTQ+	20 (74%)	7 (58%)
	Heterosexual/Straight	3 (11%)	3 (25%)

Note. Gender minority includes participants identifying as nonbinary, trans, genderqueer/fluid, or another gender not listed. BIPOC includes all participants identifying as Asian, Black or African American, Hispanic/Latino/Spanish origin, Native Hawaiian or Pacific Islander, or multiracial. LGBTQ+ includes participants identifying as bisexual, gay/lesbian, asexual, or another non-heterosexual identity. All demographic questions used select-all-that-apply formats. Participants who selected "prefer not to answer" are not shown; percentages may not sum to 100%.

Findings

Quantitative

Quantitative data were analyzed using independent samples t-tests to compare pre-intervention (n=27) and post-intervention (n=12) group means on each Likert-scale item. Means (M) and standard deviations (SD) computed from raw pre-/post-survey data; p-values from independent-samples t-tests. Statistical significance was set at $\alpha = 0.05$. The summary of the statistical analysis findings can be seen in Tables 2-4.

Table 2. Statistical analysis results for Likert-scale questions pertaining to perceptions of belonging.

Item	Pre-Survey M (SD)	Post-Survey M (SD)	p-Value
I feel that I belong in my major	3.52 (1.25)	4.50 (0.52)	< .01**
I feel that I belong at WWU	3.33 (1.04)	4.08 (1.00)	< .05*
I can see myself having a successful STEM career	3.70 (1.20)	4.33 (0.65)	< .05*
I have made connections with other students	3.96 (1.02)	3.75 (0.87)	n.s.

** $p < .01$. * $p < .05$. n.s. = not significant. Pre-survey $n = 27$; post-survey $n = 12$.

Table 3. Statistical analysis results for Likert-scale questions pertaining to perceptions of institutional support of gender inclusivity in STEM programs and spaces.

Item	Pre-Survey M (SD)	Post-Survey M (SD)	p-Value
I feel my perspective is valued in STEM spaces	3.22 (1.09)	4.08 (0.51)	< .01**
I believe WWU is committed to fostering an inclusive environment	3.33 (1.07)	4.17 (0.39)	< .01**
I am aware of resources available to support my success	3.89 (1.12)	4.50 (0.90)	n.s.

** $p < .01$. * $p < .05$. n.s. = not significant. Pre-survey $n = 27$; post-survey $n = 12$.

Table 4. Statistical analysis results for Likert-scale questions pertaining to perceptions of self-efficacy and connection in the context of STEM program participation.

Item	Pre-Survey M (SD)	Post-Survey M (SD)	p-Value
I feel comfortable asking questions or seeking help from professors	3.93 (1.14)	4.42 (0.51)	n.s.
I can name at least one faculty/staff member I could go to for advice	4.30 (0.95)	4.75 (0.62)	n.s.
I am actively involved in clubs or activities on campus	4.19 (1.04)	4.00 (1.13)	n.s.

** $p < .01$. * $p < .05$. n.s. = not significant. Pre-survey $n = 27$; post-survey $n = 12$.

Qualitative

Finding 1: Barriers are multilayered and compounding.

Students experience barriers at three interconnected levels:

Identity-Based Marginalization

- Gender discrimination and sexism
- Social exclusion (feeling "I don't belong")
- Lack of representation and role models

Relational Dynamics

- Dismissal from peers ("dismiss my input during group projects")
- Lack of faculty support and allyship
- Competitive rather than collaborative climate

Institutional Structures

- Resource gaps (financial, informational)
- Physical barriers (facilities, spaces)
- Systemic policies (weed-out classes)

Finding 2: Articulation was substantially more sophisticated post-intervention.

Post-survey responses averaged 52-74% more words and were qualitatively different across multiple dimensions. Examples of language evolution are presented in Table 5.

Table 5. Examples of language used in pre-survey responses compared to post-survey responses.

What Changed	Pre-Survey Example	Post-Survey Example
Specificity	"Sexism" (1 word)	"Male professors not being allies or wanting to better the STEM experience for gender minorities" (16 words)
Actor Identification	"professors," "students"	"white male peers," "some (not all) of the male professors"
Contextual Detail	"in classes"	"during group projects," "in [computer science] major"
Behavioral Description	"not supporting"	"dismiss my input," "disregarded"
Nuanced Understanding	Absolute statements	Qualifications: "often," "some (not all)"
Solutions	"bathrooms," "scholarships"	"warmth in STEM spaces," "professors build a toolbox," "foster sense of belonging"

Finding 3: Students are telling us climate matters more than structure.

The most striking pattern was that structural barrier mentions dropped 82% post-intervention while community/climate focus remained stable or increased.

What decreased dramatically post-intervention:

- Mentions of bathrooms, scholarships, physical resources
- Focus on "adding programs" or "providing opportunities"
- Requests for structural fixes

What stayed consistent or increased post-intervention:

- Desire for "warmth in STEM spaces"
- Need for community-building and support networks
- Faculty development and consciousness-raising
- Climate transformation over structural additions

Discussion

Quantitative Data

Analysis of quantitative survey items revealed several statistically significant differences between pre- and post- survey responses pertaining to sense of belonging and perception of

institutional support. Specifically, there was a significant increase in agreement with the following statements:

- “I feel that I belong in my major”
- “I feel that I belong at WWU”
- “I can see myself having a successful STEM career”
- “I feel my perspective is valued in STEM spaces”
- “I believe WWU is committed to fostering an inclusive environment”

No statistically significant evaluations were found for the questions relating to self-efficacy and connection, potentially due to the nature of the survey questions corresponding to these research question topics. The questions in this section were heavily related to self-efficacy and connection in the context of student-professor or student-faculty relationships rather than student-student connections, the latter of which were more relevant to the Through Our Lens process.

The quantitative data suggest that participants reported notable shifts in perceptions of personal belonging in STEM and the institution’s greater commitment to inclusivity. Although discussions with peers in STEM were prominent during the workshops, the nature of the project being about the students’ personal experiences and interpretation of the project prompts via photography lends itself to more prominent impacts at the scale of the individual. This pattern is reflected in the significant differences observed for statements involving the individual’s STEM specific identities, such as major and career interest. Shifts in perceptions of institutional support may be related to the intervention being an action-oriented collaborative project between a university STEM-based program, campus student group, and the campus Counseling and Wellness Center. Additionally, the project was made possible with the assistance of a university fund, and the photography exhibit was hosted in a campus gallery maintained by the WWU Fine Arts Department. We suspect that this interdisciplinary approach and support from multiple entities illustrates an institutional interest in the intervention, as this support emphasizes collective encouragement of the intervention’s purpose and call to action.

Qualitative Data

Three interconnected barriers were expressed in open-ended questions probing the STEM student experience. These were found to be marginalization based on identity, relationship dynamics, and impacts imposed by institutional structures. Barriers pertaining to identity included feelings of social exclusion, a lack of role models and representation in programs, and instances of gender discrimination. Relational barriers included feeling dismissed by peers such as during group assignments or projects, feeling a general lack of allyship, and the promotion of a competitive environment where collaboration is of secondary concern. Institutional structures were deemed to have gaps in resources and support, as well as systemic and physical barriers to inclusivity, such as a lack of inclusive restroom access or use of “weed out” classes that might deter underrepresented groups from enrollment or continuation in STEM majors. Feelings of marginalization are strongly connected to subsequent interactions between the student and other groups or individuals in STEM spaces, which compound with perceived flaws in the structure of

the program and institution at large as they relate to the advancement of inclusivity and minority student success.

Notable advancement in the language used between pre and post survey responses was observed, with post-survey responses having up to 74% more words. One-word answers such as “sexism,” or generalized identification such as “professors” and “students” included in pre-survey answers evolved to include more specific, contextualized, and nuanced examples and explanations on the post-survey. For example, answers such as “during group projects” and “in the [computer science] major,” provide more contextual detail than “in classes,” while “Male professors not being allies or wanting to better the STEM experience for gender minorities,” details behavior that is recognized as “sexism.” Additionally, there was a reduction in absolute statements and emergence of qualifications such as “often,” or “some (not all).” These changes in responses cannot be attributed solely to participation in Through Our Lens, as the project spanned five months, during which participants could have been exposed to other experiences, projects, coursework, and opportunities that could have contributed to the development of thought articulation. While the improvement in writing detail and nuance cannot be attributed solely to the photovoice intervention, it appears that the project had an influential role, as language discussed during the project workshops pertaining to identity and belonging was integrated into responses, in addition to direct mentions of Through Our Lens, such as “projects like this one.”

In addition to a shift in articulation, an increase in climate-focused feedback was observed on the post-survey, with an 82% decrease in the mention of structural specific barriers. Physical resources such as gender-neutral bathrooms, scholarships for gender minorities, or specific program additions that were highlighted in pre-survey responses did not show up as often in post-survey responses. Instead, post-survey responses primarily called for a greater transformation in the overall climate of STEM spaces, such as raising consciousness, development of understanding in faculty, greater warmth in interactions, and support in building community. In relation to ideas pertaining to program improvement one student wrote, “Helping STEM professors build a toolbox for improving their own interactions, thoughts, etc. surrounding gender equity,” another added “Dedicated spaces and support networks for students of color, gender minorities, and other underrepresented groups...foster a stronger sense of belonging and community.” The latter quote provides a key takeaway—that structural changes are still deemed important but should be developed in tandem with more holistic culture change initiatives that promote a greater sense of belonging and inclusion. This highlights participants’ desire to feel a positive shift in interpersonal dynamics within STEM programs and spaces rather than just see structural additions as a response to the requests of minority groups in these spaces.

The three aspects of Through Our Lens that were identified as being the most meaningful to students were the photograph gallery exhibit, the sense of community and connection the intervention provided, and perspective illustration. The gallery exhibition was central to feelings of pride and excitement as the conclusion to the photovoice intervention. One participant expressed, “How exciting it is to have my photos in a gallery! I was super proud.” The public display of the photographs provided an opportunity for participants to show their work to friends,

family, peers, faculty, and staff. To be recognized by a variety of community members and stakeholders encouraged the celebration of the participants' work and vulnerability in sharing their personal expressions of STEM experiences as they related to the project prompts. While written feedback from attendees was not captured during the gallery exhibit, conversations with participants, families, friends, faculty, and campus members in attendance indicated that the project was greatly appreciated and enjoyed. When reflecting on the impact of sharing the gallery opening experience with mentors, one participant shared,

"Seeing my professor and mentor who I had invited to the exhibit opening walk through the door made me feel so seen, supported, and validated. He talked to me about my photographs and took a postcard of one of my photos, which included two of my fellow female classmates, to hang in his office. I felt like that was exactly what I needed in a male ally—to see an effort to show up, engage, and support students like me who are underrepresented in my major."

In relation to a question about meaningful aspects of the photovoice project, some of the responses included, "you're not alone," "connecting with others," "[I] felt recognition for my voice," and "engaging with others about their work." These responses suggest that though the photography was an individual task, the process of talking to fellow participants about their work, stories, and prompt interpretation created a sense of feeling part of a greater collective with similar desires for improving the experiences of gender minorities in STEM spaces. Creative expression and freedom was also mentioned as a valuable outcome of the intervention. One participant shared, "I was reminded of how much I enjoy being creative." This might suggest that there's a desire for acts of creative expression to be more consistently integrated into STEM initiatives where the content might feel less conducive to freedom of expression.

Considering the results, there are several factors we believe were pertinent to the success of this arts-based approach and the unique experience it offered for exploring belonging in ways that traditional STEM interventions might not allow. The Through Our Lens project was a creative experience that differs from skill-focused extracurricular events that are typically hosted by STEM departments or student organizations, such as resume workshops, interview preparation, or even panels featuring minority figures in STEM. The purpose of this intervention was to provide a pause from these types of content-related events and instead allow students to reflect on lived and felt experiences and how this has impacted them as a student and human in the context of personal belonging. We suspect that the initiative provided a more inventive avenue for STEM student involvement that provided a break from content-heavy initiatives that are more traditional.

The entirety of the intervention was action oriented, with students creating their own meaning from the experience rather than being presented with specific expectations of outcomes or takeaways. Students were given the tools and creative freedom to collect snapshots of their life that resonated with the questions *they* designed: "Why not me," and "How do you create your own space at Western?" The photographs captured across participants highlight the variability in interpretation of the questions, showing how these prompts were used as reflection points to

create individual meaning and inspiration (Figures 2-5). Ultimately, we feel this intervention provided a means to fulfill needs of STEM students that are not usually met via traditional offerings, specifically, a creative longing to engage in a discussion about human experience rather than student skill management alone.

A safe space was provided for participants to tell their story via a medium that could capture and evoke details that words sometimes fail to fully provide, and to share these stories in an approachable, tangible, visually enriching modality. The finale of Through Our Lens offered participants an exciting way to conclude their experience, by presenting their work in a way that honors their voice and perspective and allows for it to be shared with an invested audience. This differs greatly from many content-focused extracurricular offerings, for which incentives to participate typically don't include the ability to reach a greater community audience of stakeholders wanting and willing to act. The stories and narratives presented via Through Our Lens transcend STEM related content and focus on larger ideas surrounding being—concepts audience members can connect with regardless of their professional interests. This differs greatly from many content-focused interventions, where stakeholders might be limited to those invested in the STEM content itself.

The setting of Through Our Lens and its placement as a reflective opportunity within the STEM student experience also provides the potential for influence of andragogical practices. Andragogy, which defines methodologies for maximization of learning in adults, sets a standard of active learning and inquiry driven by the student. The students are active stakeholders in deciding what is to be learned, what needs to be learned, and why, with these questions being developed in the context of individual experiences and situations. In this approach, the learning process caters to the individual needs and starting position of understanding and thought [33]. The Through Our Lens intervention essentially follows this exact andragogical approach of learning and questioning centered in the students' individual ideas, inputs, and needs, with gender equity in STEM being the topic of exploration. The intervention met students at their respective starting points relative to the discussion of experiences in STEM spaces, providing a framework for guided personal reflection. The andragogical facet of the project could be further explored in future iterations of the project to assess the impact of photovoice on the learning experience.

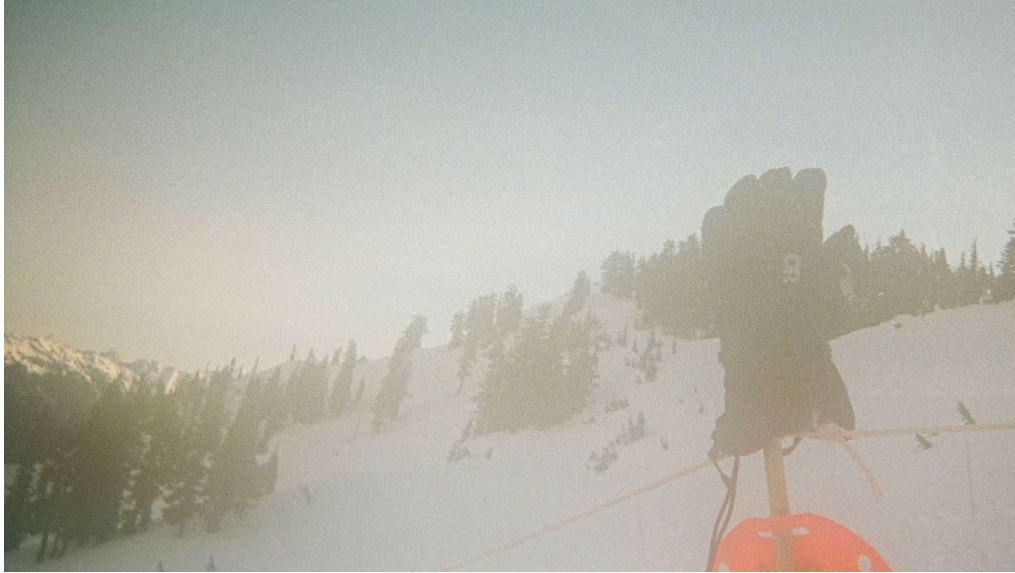


Figure 2. *“In the serene embrace of the mountains, where the vastness of nature highlights our insignificance. I sit and wonder why not me? I’m longing for connection and the desire to belong. We are surrounded by the beauty of the world yet so scared of the people in it.”-Student participant*



Figure 3. *“Why not me? there is nothing like the joy you will find while spending time with yourself. the days spent making jokes in your head, once in a while, a line so fire you laugh out loud attracting some side eyes. the solo camping trips and flights booked across the world. there is so much strength in connection, but there is also so much strength in solitude. If you are looking for companionship, perhaps ask yourself Why Not Me?”-Student participant*



Figure 4. *“This is my family, not my born family, but my given family here at Western. The kitchen can be a place for nourishment, connection, or artistry. February 12, 2025 this kitchen was a place of professional celebration with steak and Oreo cheesecake.” -Student participant*



Figure 5. *“Two people work together at a station to create sculptures out of metal utensils. They are working separately, but with close proximity, gives an air of community. A safe space to learn new things is paramount.” -Student participant*

Limitations and Considerations

Several limitations to the study accompanying the Through Our Lens intervention should be addressed. Firstly, the study that accompanied Through Our Lens was not the primary focus of the process, but rather exposing students to an original arts-based participatory project that is action-oriented to inspire meaningful conversations about gender identity and experiences in STEM spaces was the main goal. Due to the research study being developed secondary to the project itself, some questions included in the surveys could benefit from further development to better highlight data more pertinent to the project goals and purpose. Generalizability of the findings is limited by the small survey sample size of 12, which is a 44% attrition rate from pre to post survey completion. This limiting factor to statistical power could be influenced by individual student limitations which caused several participants to be unable to continue with the project after completing the pre survey. Considering students self-select to participate in the project, it is expected that circumstances might arise which would result in some participants not being able to continue with the project, which spanned several months. Additionally, Through Our Lens was implemented at a single institution, WWU, and with participants self-selecting to complete the pre and post surveys, with no control group included. It should be noted that potential differences in students who completed the post survey versus those who did not might have influenced the overall findings. The collected data might be disproportionally reflecting the experiences, perspectives, and feedback of participants who were more motivated to contribute to the project's study and/or found the intervention particularly helpful and engaging.

Future Directions

We believe given the data presented in this paper, along with the knowledge gained from project implementation, will better serve future iterations of Through Our Lens which are more intentionally designed as a robust research project. Given the success of Through Our Lens, we would like to see iterations of the project adapt to include additional STEM populations and programs outside of WWU. A future direction of interest is implementing the project at another institution with participants from both undergraduate and graduate STEM programs. It is a short-term goal to pilot Through Our Lens with a mixed undergraduate and graduate participant pool at the University of Southern Mississippi (USM), hosted by this institution's chapter of Women in Science & Engineering. There is also motivation to facilitate Through Our Lens as part of an undergraduate course offered through the STEM education program at USM. Additionally, we are interested in exploring how the Through Our Lens project could be adapted for administration in a high school or middle school setting to capture the perspectives of younger gender minorities interested in STEM fields but not yet enrolled in a STEM program. We believe that implementing this initiative with different populations and ages of students either enrolled in or interested in STEM programs could corroborate the initial findings and provide insight into the following questions:

- Does participation in a photovoice project help young students develop a more robust understanding of their personal interests in STEM fields?
- What aspects of STEM experiences do different age populations desire to explore via photography?

- What aspects of the photovoice intervention do students in different age/program groups (graduate, undergraduate, high school, middle school) identify as being the most meaningful?
- Can photovoice interventions relay patterns regarding perceived sense of belonging between age/program groups?
- What are the motivations behind self-selection for participation between age/program groups?

Considerations for Practice

Participants were able to provide feedback regarding the intervention, which serve as areas for consideration during future iterations of Through Our Lens or for STEM educators wishing to implement this initiative. Time management and remembering to take photographs were noted as challenges. It is recommended that the project host(s) employ some system in which they can check on participants, gauge progress, and provide reminders of deadlines. Figuring out what to photograph was also mentioned as challenging to participants. While optional drop-in sessions were provided for participants to discuss their ideas for photographs, hosting an additional workshop with a focus on cultivating inspiration and forming ideas might be beneficial to provide soon after cameras are dispersed. Potential activities for the workshop include featuring examples of photographs from members of the hosting entities as inspiration, having participants respond to prompts that help form ideas about photograph subjects, or encouraging small group sharing sessions between participants about photographs that have already been captured. Additionally, sharing a list with participants of potential community or campus events that might provide opportunities for photograph inspiration could be helpful.

An additional recommendation for future iterations is ensuring a secure means by which cameras can be dropped off for film development. We had placed a labeled box for camera drop off outside of the room where the initial workshop took place so participants could submit cameras at any time while the building was unlocked, but, unfortunately, some of the cameras that were dropped off later went missing. Participants whose cameras were taken were given the option to submit photos captured via other means, such as their phone or personal cameras.

Understandably, some of these participants chose not to continue with the project after this incident. We recommend providing a more secure means through which cameras could be dropped off or checked back in, such as a departmental office where the process can be monitored and or cameras can be accounted for as they're turned in.

Conclusion

We know that for students in STEM programs, a strong sense of belonging can affect program attrition and academic success. Modes to help improve this sense of belonging for underrepresented groups in STEM could aid in achieving greater gender parity within STEM programs and encourage further involvement of minority groups. While many initiatives to connect underrepresented groups and cultivate belonging have been assessed, few studies specifically assess the impact of arts-based participatory research as a means to develop a sense of belonging. Photovoice intervention Through Our Lens was implemented with a group of

minority students in STEM programs at Western Washington University as a health equity intervention to encourage expression of experience and impacts of gender inequality in STEM spaces, call community to action, and generate a sense of belonging. This intervention provided participants with a camera to capture photographs that resonate with their interpretation of the questions “Why not me?” and “How do you create your own space at Western?” Data collected from pre- and post-surveys showed statistically significant differences, with post-survey responses indicating higher participant-reported feelings of belonging within their STEM major, spaces, and institution, as well as higher perceptions of institutional support. The most valuable aspects of the experience according to participants included the photography gallery exhibit, cultivating community and connection, and getting to illustrate perspective. Our findings suggest that interventions like Through Our Lens have the potential to shed light on factors that influence minorities’ experiences of connection and perceptions of belonging in STEM while offering an enjoyable creative experience with tangible deliverables to encourage community engagement and action.

Acknowledgements

We would like to acknowledge the WWU Sustainability, Equity, and Justice Fund for providing funding for the 2024-25 Through Our Lens project. Additionally, we would like to thank Madison Wiese and Maggie Feeney of the WWU Counseling and Wellness Center for their support in preparation and maintenance of Through Our Lens promotional and exhibition materials, as well as the WWU Fine Arts Department for providing the space for the Through Our Lens gallery exhibit.

The authors acknowledge the use of Claude (Anthropic) to support systematic thematic analysis, specifically to assist with quotation selection, keyword identification, code generation, and theme development across Steps 1–5 of the Naeem et al. (2023; 2025) process. Claude was selected in part for its data privacy protections, consistent with ethical obligations to research participants. All analytical interpretations and final decisions were made by the researcher. The authors take full responsibility for the content presented.

References

- [1] The STEM Labor Force: Scientists, Engineers, and Skilled Technical Workers | NSF - National Science Foundation, *ncses.nsf.gov*, May 30, 2024.
<https://ncses.nsf.gov/pubs/nsb20245/representation-of-demographic-groups-in-stem>
- [2] C. Piloto, The Gender Gap in STEM: Still Gaping in 2023, *MIT Professional Education*, Mar. 13, 2023. <https://professionalprograms.mit.edu/blog/leadership/the-gender-gap-in-stem/>
- [3] K. Kwon, US STEM Diversity Growing, but Inequality Persists, *Optica*, Feb. 28, 2023.
https://www.optica-opn.org/home/career/2023/february/us_stem_diversity_growing_but_inequality_persists/
- [4] Meyer, J., Barnett, J., Corbett, E., Yeomans, L., and Blackwood, L., Increasing diversity in STEM academia: a scoping review of intervention evaluations, *Studies in Higher Education*, pp. 1–38, Jan. 2025, doi: <https://doi.org/10.1080/03075079.2024.2442052>.
- [5] Y. Zhang & K. Rios. “Exploring the Effects of Promoting Feminine Leaders on Women’s Interest in STEM.” *Social Psychological and Personality Science*, vol. 14, no. 1, p. 194855062110698, Feb. 2022, doi: <https://doi.org/10.1177/19485506211069808>.
- [6] K. Allen, N. Jamshidi, E. Berger, *et al.* “Impact of School-Based Interventions for Building School Belonging in Adolescence: a Systematic Review”. 2022. *Educ Psychol Rev* 34, 229–257.
<https://doi.org/10.1007/s10648-021-09621-w>
- [7] K. Rainey, M. Dancy, R. Mickelson, E. Stearns, & S. Moller, “Race and gender differences in how sense of belonging influences decisions to major in STEM.” *International Journal of STEM Education*, vol. 5, no. 1, Apr. 2018, doi: <https://doi.org/10.1186/s40594-018-0115-6>.
- [8] J. L. Smith, K. L. Lewis, L. Hawthorne, and S. D. Hodges, “When Trying Hard Isn’t Natural”. *Personality and Social Psychology Bulletin*, vol. 39, no. 2, pp. 131–143, Nov. 2012, doi: <https://doi.org/10.1177/0146167212468332>.
- [9] C. Good, A. Rattan, & C.S. Dweck. “Why do women opt out? Sense of belonging and women's representation in mathematics”. 2012. *Journal of Personality and Social Psychology*, 102(4), 700-717. <https://doi.org/10.1037/a0026659>
- [10] T.L. Strayhorn. *College students' sense of belonging: A key to educational success for all students* (2nd ed.). 2019. Routledge.
- [11] M. Sáinz, S. Fàbregues, M. J. Romano, and B.-S. López, “Interventions to increase young people’s interest in STEM. A scoping review,” *Frontiers in Psychology*, vol. 13, Oct. 2022, doi: <https://doi.org/10.3389/fpsyg.2022.954996>.
- [12] L. Bosman & B. Kolta. “Applications of Photovoice-Based Entrepreneurial-Minded Pedagogical Interventions in the Engineering Classroom”. 2024. *Trends in Higher Education*, 3(2), 308-323. <https://doi.org/10.3390/higheredu3020019>

- [13] C. Wang & M.A. Burris. "Photovoice: Concept, methodology, and use for participatory needs assessment". 1997. *Health Education & Behavior*, 24(3), 369-387. <https://doi.org/10.1177/109019819702400309>
- [14] N. Wallerstein, & B. Duran. "Using community-based participatory research to address health disparities". 2006. *Health Promotion Practice*, 7(3), 312-323. <https://doi.org/10.1177/1524839906289376>
- [15] B. A. Israel, A. J. Schulz, E. A. Parker, & A. B. Becker. "Review of community-based research: Assessing partnership approaches to improve public health". 1998. *Annual Review of Public Health*, 19, 173-202. <https://doi.org/10.1146/annurev.publhealth.19.1.173>
- [16] R. W. Strack, C. Magill, & K. McDonagh. "Engaging youth through photovoice". 2004. *Health Promotion Practice*, 5(1), 49-58. <https://doi.org/10.1177/1524839903258015>
- [17] R. W. Strack, K.A. Lovelace, T. D. Jordan, & A. P. Holmes. "Framing photovoice using a social-ecological logic model as a guide". 2010. *Health Promotion Practice*, 11(5), 629-636. <https://doi.org/10.1177/1524839909355519>
- [18] S. Switzer. "Working with photo installation and metaphor: Re-visioning photovoice research". 2019. *International Journal of Qualitative Methods*, 18, 1-11. <https://doi.org/10.1177/1609406919872395>
- [19] M. Gopalan, A. Linden-Carmichael, & S. Lanza. "College students' sense of belonging and mental health amidst the COVID-19 pandemic". 2022. *Journal of Adolescent Health*, 70(2), 228-233. <https://doi.org/10.1016/j.jadohealth.2021.10.010>
- [20] C. Zhou, M. Gao, X. Shi, & Z. Zhang. "Suicidal behavior, depression and loneliness among college students: the role of school belonging." *Psychology, Health & Medicine*, 28(6), 1520-1526. 2023. <https://doi.org/10.1080/13548506.2022.2113105>
- [21] Ö. Karaman & B. Tarim. "Investigation of the correlation between belonging needs of students attending university and well-being." 2018. *Universal Journal of Educational Research*, 6(4), 781-788. <https://doi.org/10.13189/ujer.2018.060422>
- [22] S. N. Hesse-Biber. *Feminist research practice: A primer* (2nd ed.). 2014. SAGE Publications.
- [23] R. Wass, V. Anderson, R. Rabello, C. Golding, A. Rangi, & E. Eteuati. "Photovoice as a research method for higher education research". 2020. *Higher Education Research & Development*, 39(4), 834-850. <https://doi.org/10.1080/07294360.2019.1692791>
- [24] C. Catalani & M. Minkler. "Photovoice: A review of the literature in health and public health". 2010. *Health Education & Behavior*, 37(3), 424-451. <https://doi.org/10.1177/1090198109342084>
- [25] J. W. Creswell & V. L. Plano Clark. *Designing and conducting mixed methods research* (3rd ed.). 2018. SAGE Publications.

- [26] C. S. Reichardt. Quasi-experimental design. In R. E. Millsap & A. Maydeu-Olivares (Eds.), *The Sage handbook of quantitative methods in psychology* (pp. 46–71). 2009. Sage Publications Ltd. <https://doi.org/10.4135/9780857020994.n3>
- [27] M. Hoffman , J. Richmond, J. Morrow, & K. Salomone. “Investigating "sense of belonging" in first-year college students”. 2002. *Journal of College Student Retention: Research, Theory & Practice*, 4(3), 227-256.
- [28] G.M. Walton, & G. L., Cohen. “A question of belonging: Race, social fit, and achievement”. 2007. *Journal of Personality and Social Psychology*, 92(1), 82-96.
- [29] V. Braun, & V. Clarke. Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101. 2006. <https://doi.org/10.1191/1478088706qp063oa>
- [30] J. Saldana. *The coding manual for qualitative researchers*. 2013. SAGE Publications.
- [31] M. Naeem, W. Ozuem, K. Howell, and S. Ranfagni, “A step-by-step Process of Thematic Analysis to Develop a Conceptual Model in Qualitative Research,” *International Journal of Qualitative Methods*, vol. 22, no. 1, pp. 1–18, 2023, doi: <https://doi.org/10.1177/16094069231205789>.
- [32] Naeem, T. Smith, and L. Thomas, "Thematic Analysis and Artificial Intelligence: A Step-by-Step Process for Using ChatGPT in Thematic Analysis," *International Journal of Qualitative Methods*, vol. 24, pp. 1–18, 2025, doi: <https://doi.org/10.1177/16094069251333886>.
- [33] R. Goodnight, D. O. Owen, and T. Zickel, “Understanding Andragogy: How Adults Learn,” American Society for Engineering Education, pp. 4.565.1–4.565.5, Jun. 1999, Available: <https://peer.asee.org/understanding-andragogy-how-adults-learn>

Appendix A: Through Our Lens Pre-Survey

Belonging & Identity Items (*Likert Scale*)

1. I feel that I belong at WWU
2. I feel that I belong in my major
3. I can see myself having a successful STEM career
4. I have made connections with other students in my department and/or program
5. I feel comfortable asking questions or seeking help from my professors
6. I feel my perspective is valued in STEM spaces

Institutional Trust & Resources (*Likert Scale*)

7. I am aware of resources available to support my success
8. I am actively involved in clubs or activities on campus
9. I can name at least one faculty member or staff who I could go to for advice
10. I believe that WWU is committed to fostering an inclusive environment

Open-Ended Questions:

- What barriers, if any, have you experienced in your STEM education at WWU?
- What changes would you like to see in STEM education at WWU to promote greater equity and inclusion?

Demographics: Gender identity, race/ethnicity, sexual identity, disability status

Appendix B: Through Our Lens Post-Survey

All pre-survey questions were asked again, in addition to the following questions:

Project Participation & Overall Experience:

- What aspects of the project did you participate in? (select all that apply)
- How would you rate your overall experience with the "Through Our Lens" project?
- What aspects of the project did you find most valuable? (select all that apply)
- Did participating in this project meet your expectations?
- Please explain your answer to the previous question

Component Ratings (*How would you rate:~*)

- Initial Workshop
- Support during photo-taking period
- Photo & Narrative Workshop
- Gallery Exhibition
- Project Communication

Reflection Questions:

- Would you recommend this project to another student?
- What did you learn from participating in this project?
- What did you enjoy most about this project?
- What aspects of the project did you find most challenging?