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Exploring Lake Endor: Elementary preservice teachers' environmental literacy in a science methods course

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ABSTRACT

This qualitative case study explored how elementary preservice teachers engaged in environmental education (EE) during a science methods course. Interviews with the preservice teachers and an analysis of their written responses revealed that they both demonstrated environmental knowledge and concern about a community-based environmental issue they learned about in the course. However, they engaged in action and advocacy about the issue differently within the community. Suggestions for future instruction in science methods courses include additional instructional approaches that integrate action and advocacy-oriented EE coursework, which can strengthen elementary preservice teachers' funds of knowledge, critical consciousness, and an understanding of systemic factors that contribute to community-based environmental issues.

Keywords: elementary, environmental education, preservice teachers, community issues, science methods

INTRODUCTION

According to the North American Association for Environmental Education (NAAEE, 2011), the goal of environmental literacy is a society that demonstrates knowledge of environmental issues, an understanding of the impact of human activity on our communities, and engagement in actions that may mitigate these challenges. Furthermore, the NAAEE (2011) notes that a way to achieve these goals is environmental education (EE) at all levels (Hollweg et al., 2011). As such, universities play a significant role in supporting an environmentally literate society (Álvarez-García et al., 2015; Fakhriyah et al., 2024), and the inclusion of EE in teacher education programs has been recognized as a global priority (United Nations Educational, Scientific and Cultural Organization, 2021). Echoing this call, scholars around the world have advocated for more widely implemented EE within elementary teacher education (Campigotto & Barrett, 2017; Fakhriyah et al., 2024; Green et al., 2016; Gwekwerere, 2019; Orbanić & Nataša, 2021; Wakefield et al., 2022), mainly through science methods courses (Álvarez-García et al., 2015).

However, despite these recommendations, EE and research about this instruction with elementary preservice teachers remains limited (Álvarez-García et al., 2015; Fakhriyah et al., 2024). Regarding the studies that have previously explored EE in this context, elementary preservice teachers have consistently demonstrated limited environmental literacy, particularly regarding the relationship between human activity and natural systems (Garcia et al., 2022; Saribas et al., 2017; Teksöz et al., 2014). Furthermore, there has been a notable reluctance among them to act within communities to address these challenges (Campigotto & Barrett, 2017; Fakhriyah et al., 2024; Green et al., 2016; Gwekwerere, 2019; Orbanić & Nataša, 2021; Wakefield et al., 2022). This trend is unsurprising given the frequent oversight of K-12 science standards that address EE and the impact of human activity on the environment (Morales-Doyle et al., 2019). As such, this holds significant importance; without exposure to EE during teacher education programs, elementary preservice teachers are unlikely to act and implement this instruction in their classrooms with our youngest learners (Álvarez-García et al., 2015; Fakhriyah et al., 2024; Green et al., 2016).

Over time, scholars have reiterated the need for EE in elementary teacher education to support knowledge of environmental issues, as well as actions that elementary preservice teachers can take to address them within their own communities (Campigotto & Barrett, 2017; Fakhriyah et al., 2024; Green et al., 2016; Gwekwerere, 2019; Orbanić & Nataša, 2021; Wakefield et al., 2022). Thus, the initiative lies with teacher educators to design and cultivate these environmental learning experiences for elementary preservice teachers (Álvarez-García et al., 2015; Fakhriyah et al., 2024).

As such, my study investigates the following research question: *In what ways do elementary preservice teachers*

demonstrate environmental literacy after EE in a science methods course?

LITERATURE REVIEW

According to the NAAEE (2011) and Hollweg et al. (2011), EE aims to support knowledge and understanding of the environment, address relationships between humans and the world, and empower environmentally responsible behavior and actions within communities. Previous research demonstrates that EE has historically been underrepresented in elementary preservice teacher education (Álvarez-García et al., 2015; Fakhriyah et al., 2024). However, when reviewing the limited scholarship about EE and elementary preservice teachers, it is evident that research focuses on two themes about their environmental literacy:

(1) their knowledge and attitudes about environmental issues and

(2) their actions regarding these challenges.

Elementary Preservice Teachers' Environmental Knowledge & Attitudes

While the NAAEE (2011) notes that environmental knowledge pertains to the information and understanding of issues, attitudes involve feelings or concern about them (Hollweg et al., 2011). Overall, elementary preservice teachers held limited knowledge about environmental issues throughout science methods courses but demonstrated high concern about addressing them (Álvarez-García et al., 2015; Fakhriyah et al., 2024; Garcia et al., 2022; Saribas et al., 2017; Teksöz et al., 2014). For instance, preservice teachers primarily worry about specific problems that could affect their daily lives, such as climate change, recycling, pollution, animal rights, poor water quality, and loss of green spaces. However, while they identify these issues as important, they struggle to understand the complex, underlying causes of these environmental issues. This gap hinders their ability to see how such problems extend beyond individual experiences and affect broader communities (Teksöz et al., 2014).

Furthermore, when completing presentations on climate change, many preservice teachers struggle to link specific environmental processes, such as the origins of CO_2 emissions from industrial activities and fossil fuel consumption, with broader impacts, like the threat of rising global temperatures that disproportionately affect certain geographic areas. Similarly, preservice teachers show limited awareness of how the environmental effects of climate change–such as melting glaciers and flooding–can disrupt aquatic ecosystems, compounding the effects of warming waters on marine biodiversity and communities (Saribas et al., 2017). As such, it is significant to note that preservice teachers may be aware of environmental issues and express intent toward mitigating these challenges. However, a consistent need remains to enhance their understanding of *why* these issues exist, as well as the relationship between human actions and their impacts on communities (Álvarez-García et al., 2015; Fakhriyah et al., 2024; Garcia et al., 2022; Saribas et al., 2017; Teksöz et al., 2014).

Elementary Preservice Teachers' Environmental Actions

It is also essential to turn to scholarship exploring elementary preservice teachers' actions as part of their overall environmental literacy. According to the NAAEE (2011), actions can be defined as forms of participation to solve problems and mitigate environmental issues (Hollweg et al., 2011). Previous studies highlight how elementary preservice teachers struggle to translate environmental knowledge into community-based action (Campigotto & Barrett, 2017; Fakhriyah et al., 2024; Green et al., 2016; Gwekwerere, 2019; Orbanić & Nataša, 2021; Wakefield et al., 2022). However, action-oriented EE coursework and projects hold the potential to shape preservice teachers' behavior.

For example, Green et al. (2016) implemented a project to investigate elementary preservice teachers' environmental actions within their school community. Through this experience, they were required to collect data and conduct research on campus about energy conservation strategies. Ultimately, the project led preservice teachers to adopt more energy-saving practices individually. Similarly, Wakefield et al. (2022) conducted a study with elementary preservice teachers, where they created digital narrative projects to highlight social and economic factors impacting community-based environmental issues, such as water pollution, energy conservation, and microplastics. At the course's end, preservice teachers designed a unit plan for elementary students about these issues. Analysis of the preservice teachers' plans revealed that consistent with prior research, most focused on individual behaviors such as recycling and turning off lights, rather than broader, systemic community solutions.

Furthermore, research indicates that elementary preservice teachers' environmental knowledge and engagement with environmental issues is influenced significantly by personal experiences, prior involvement, and media exposure rather than formal education (Orbanić & Nataša, 2021). For preservice teachers, environmental knowledge often stems more from community activism and local engagement than from science coursework (Gwekwerere, 2019). These findings suggest an effective EE curriculum should emphasize authentic, experiential learning experiences in teacher education to foster preservice teachers' environmental action and advocacy within communities. One approach to achieve this involves integrating preservice teachers' community-based volunteer experiences with classroom assignments, helping to strengthen their overall environmental literacy (Campigotto & Barrett, 2017).

In conclusion, previous scholarship demonstrates the importance of EE in supporting elementary preservice teachers' environmental literacy through science methods courses, which encompasses their environmental knowledge, attitudes, and actions within communities. Specifically, the authors propose that preservice teachers should have more opportunities to analyze systemic environmental issues that impact communities (Saribas et al., 2017; Teksöz et al., 2014) and help identify EE instructional approaches that can effectively translate preservice teachers' environmental knowledge into community-based action (Campigotto & Barrett, 2017; Fakhriyah et al., 2024; Green et al., 2016;

Table 1. Example codes based on environmental literacy framework & AST

Example code	Description
Systems & issues	Demonstrates knowledge of environmental issues, systems, human impacts, and the relationships between them (AST & NAAEE)
Community	Identifies a sense of place, environmental issues, and is able to question how specific communities are connected to environmental issues or impacted by events (AST & NAAEE)
Changes in thinking	Change in ideas in revising explanations for environmental issues, including a shift in beliefs in terms of importance, impact, or causes (AST)
Affect	Demonstrates sensitivity, appreciation, or responsible views towards the environment (NAAEE)
Value	Has ideas about and/or recognizes the importance of behaviors that respect, restore, protect, or change communities and environmental systems (NAAEE)
Change	Engages in behaviors that respect, restore, protect, or change communities and environmental systems (NAAEE)

Table 2. Preservice teacher participants

Preservice teacher	Lived experiences
Katie	Girl Scout, VP of Future Educator Association in high school and college, climate change, women's and LBGTQ rights, beach clean ups, racial justice advocacy
Jessica	Raised in local urban area, family gardening experiences, traveled abroad, Youth Group, concerned about CO^2 emissions and pollution

Gwekwerere, 2019; Orbanić & Nataša, 2021; Wakefield et al., 2022).

Theoretical Framework

Environmental literacy involves the knowledge of issues, which includes beliefs that humans and the environment have a relationship within natural systems and continually impact each other. Furthermore, environmental literacy determines the extent to which individuals are predisposed to take action to address these issues within communities (United Nations Economic and Social Commission [UNESC], 2013). Similarly, according to the *framework for environmental literacy & learning* developed by the NAAEE (2011), environmental literacy evolves with changes in personal knowledge, attitudes, and actions based on lived experiences from the world around us (Hollweg et al., 2011). Thus, drawing on this framework, I conceptualized constructs of environmental literacy that preservice teachers could potentially demonstrate as they engage in EE and how they align with the knowledge, attitudes, and actions (see **Table 1**).

Additionally, I developed the EE for the science methods course based on ambitious science teaching (Windschitl et al., 2018) and drew on the critical and cultural approaches to ambitious science teaching (C^2AST) principles by Thompson et al. (2021) that aim to anchor learning in authentic issues that impact communities.

METHODOLOGY

The current study is part of a larger research project involving qualitative methodology and a comparative case study design (Stake, 1995) to explore the environmental literacy of elementary preservice teachers. During the Spring of 2023, EE was implemented for elementary preservice teachers during the second of three science methods courses within the university's BA/MS teacher education program. The course is 16 weeks duration, focusing on the life & earth/space science disciplines. As the instructor of records, I taught both sections of the methods course and developed the curriculum for EE based on the NAAEE (2011) *environmental literacy and learning framework* (Hollweg et al., 2011). Although all of the elementary preservice teachers engaged in EE throughout the semester, the learning experience I highlight in this paper centers two of the preservice teachers and the community-based phenomena of Lake Endor they investigated during week 8 and week 9 of the course. I chose this specific area of the Theed community for preservice teachers to explore in class as it has been previously identified as an area of concern in our county by State University students (Jordan, 2021).

Participants

The participants of this study are a sample of two elementary preservice teachers across two sections of a science methods course during the Spring 2023 semester. The preservice teachers were purposefully sampled after the conclusion of the semester to represent a range of lived experiences and funds of knowledge brought to EE within the class, based on the community they were originally from, as well as the breadth and depth across their course reflections and assignments. While the population of my study and the preservice teachers in state university's BA/MT Elementary Education program is overwhelmingly white and female, these demographics are reflective of the overall profession of elementary teachers and those about to enter the field (Rimm-Kaufman & Thomas, 2021). More information about the two preservice teacher participants is included below (see **Table 2**).

Environmental Learning Experience for Preservice Teachers

Lake Endor

Lake Endor Park is near the State University campus in Theed. Long before the park existed, a neighborhood stood for more than 60 years as the home to several hundred Black families (Jordan, 2021). In the late 1950s, an unprotected water ditch and railroad ran through the segregated area with a gasification plant nearby. Also, it housed industries, such as the Endor Crate Company, that released additional toxins and pollutants into the local air and soil (American Society of Landscape Architects [ASLA], 2014). Today, near Lake Endor,

another neighborhood has developed, encompassing subsidized apartments, fast casual restaurants, and streets full of college students. As part of the city stormwater system, the lake is an area of continuing environmental concern as the water and soil are currently not tested or regulated by the City of Theed as it is not a natural body of water. As such, these pollutants affect the nearby residents and the water, air, and wildlife that call Lake Endor and connecting watersheds home (Jordan, 2021).

Class activities

During class, preservice teachers tested authentic water samples from Lake Endor, compared data sets from the county public works regarding phosphorus, ammonia, and pH levels, and concluded future actions they could take to mitigate pollution in the area. While learning about Lake Endor in class as an environmental issue within the Theed community, preservice teachers first had the opportunity to explore watershed maps and identify other local bodies of water they were familiar with. Afterward, they simulated how water travels through our local watershed and developed 2D models of how pollution could travel throughout Theed. Furthermore, preservice teachers analyzed primary sources such as historical documents from the civil rights era, current city zoning maps, and pictures of industrial fires in the area.

Data Collection & Analysis

Data sources

During the semester, preservice teachers completed weekly written reflections based on EE learning experiences in class. These prompts were presented through Canvas, an online learning management tool preservice teachers were familiar with and have continuously used throughout the teacher education program. For example, after learning about Lake Endor and local watersheds in Theed in week 9, preservice teachers responded to prompts on Canvas such as: *What can we conclude about the water from Lake Endor? Why do you think this is happening? How do you think the local community is impacted? What is something today's class made you think more deeply about?* In addition to collecting the preservice teachers' written Canvas reflections, after the last week of the semester, I asked them to reflect on the takeaways they gained throughout EE. Preservice teachers addressed several questions in a short online Flip video, which was limited to a maximum of five minutes. First, they discussed the significant insights they acquired during the course. Second, they shared how their thinking about environmental issues had evolved ("I used to think _____") to their current perspectives ("Now I think _____"). This assignment allowed the preservice teachers to share concerns about community-based environmental issues. Furthermore, I conducted interviews over Zoom with them to form a more robust case study after the conclusion of the Spring 2023 semester, as I was no longer positioned as their instructor. To prompt preservice teachers throughout the interviews, I used their Canvas reflections from class to help develop interview questions and support their responses.

Initial Coding

Once my data sources were collected, I reviewed each preservice teacher's Canvas reflections and transcripts from their interviews and Flip videos, which I organized in a Google Sheet. As I read, I performed my first coding cycle by moving line-by-line through each data source (Yin, 2017). Reviewing all three data sources, I found that the initial codes from the preservice teachers' Canvas reflections and broader ideas were further supported by the experiences they shared during the Flip reflections and interviews. For example, preservice teachers not only wrote about the impacts of the water pollution in Lake Endor on the community of Theed, but at the end of the semester, they specifically mentioned this in their Flip videos as a way they learned more about the environmental issue. Next, using these initial codes, I could extract specific quotes and passages from the Google Sheet to create a smaller, more manageable data set, or profile, for each preservice teacher in individual Google Documents. Building these profiles with my data allowed each preservice teacher to become a bounded case. As a result, I could holistically capture their perspectives and prepare for my second coding cycle.

Thematic Analysis

My second coding cycle focused on a comparative method, which allowed me to identify similarities and differences across the preservice teachers' data profiles and look for patterns (Creswell & Poth, 2018). For instance, each preservice teacher demonstrated varying levels of environmental knowledge regarding the impacts of issues on various communities and drew from a range of their own lived experiences and funds of knowledge. As such, the pattern of *impacts on communities* was evident for both preservice teachers as it aligned with my initial codes as well as the example codes in the *environmental literacy and learning framework*, including community, knowledge, and action. Following this, I could take the next step and analyze these patterns across the profiles of the preservice teachers to develop overarching themes and produce a narrative addressing my research question. As a result, I was able to determine how preservice teachers demonstrated environmental literacy during EE.

Overall, it was evident that Jessica and Katie leveraged their own funds of knowledge in different ways, shaping how they demonstrated environmental literacy. They both recognized the impacts of the pollution of Lake Endor on the community of Theed. However, Jessica held more individualistic thinking about these challenges and solutions that may help mitigate them, and Katie demonstrated more critical consciousness and environmental actions.

FINDINGS

Jessica: A Case of Individualistic Thinking About Causes and Mitigation Strategies

Jessica is a 22-year-old preservice teacher in her second year of the BA/MT elementary education program at a state university. Originally from the eastern area of the state, she later moved to the northern part of Theed with her family

when she was 13 and attended local public schools. Throughout her undergraduate journey, Jessica first studied at Theed Community College before transferring to a state university's elementary education program to pursue her goal of becoming a first-grade teacher. She has lived with her parents during this time in Theed, appreciating a strong sense of family support throughout her academic pursuits. In addition, Jessica's interests extend beyond the classroom, as she is curious and dedicated to learning about other cultures and life abroad.

Environmental literacy: Beliefs & attitudes

In her Canvas reflections about the community of Theed after week 9 of the semester, Jessica demonstrated environmental knowledge and an attitude of concern about pollution in Lake Endor. For example, she noted,

> We learned today in class that the county doesn't even routinely test this water. This likely shows that restoring the water quality at Lake Endor is not going to happen because it's not a priority. This impacts the local community because of how connected Theed's bodies and sources of water are. Our activity today showed us how far a single water droplet can travel–polluted water can be transported into healthy bodies and sources of water and end up polluting it too. This is dangerous if we want to keep having clean drinking water and preserve the ecosystems in Theed.

However, during her interview, when asked to elaborate on her reflection and why she thought this environmental issue existed and persisted in and around Lake Endor, Jessica was perplexed about why pollution was located in a low-income area of the Theed community and what actions would mitigate the issue. She explained,

> I think if you don't test [the water], or if you don't monitor, it must not be high up on your concern list, and I don't know why that is. Maybe the county doesn't think it's an issue. Maybe they don't have the manpower to do it, which I doubt–I'm sure that they do. I don't know why the county would just conveniently skip over an entire body of water, and just choose not to test it, especially when it's so central to [our university] and families. It's not like it's just in the middle of nowhere, it's right in our town!

Overall, Jessica demonstrated knowledge and concern about Lake Endor's pollution, recognized that these impacts extended beyond the local environment, and questioned why the city government and policies within the Theed community did not do more to address it.

Environmental literacy: Actions

After learning about Lake Endor in week 8 and week 9 of the semester, Jessica felt frustrated that such a body of water, situated in the heart of Theed, appeared to be ignored. Despite this concern, in her interview, Jessica expressed skepticism towards environmental cleanups as a solution, doubting the impact of individual actions, "I kind of roll my eyes because I do not know how much those [clean ups] make a change, but if I were convinced my impact as a single individual would help, I would be a lot more inclined to participate." Additionally, Jessica elaborated on how she feels overwhelmed by the scale of environmental issues and actions needed to make a difference. In her interview, she explained,

> It's overwhelming because I know that it takes hundreds and thousands of people to contribute to enormous environmental issues over time, so trying to fix a problem that many of us created as an individuals seems impossible. Unless many people bonded together to attempt to fix a problem over several months and years, one person's efforts wouldn't mean too much.

As such, while Jessica understands the importance of addressing pollution and environmental issues, she is unsure about taking concrete actions to mitigate these issues within her community.

Katie: A Case of Critical Consciousness About Causes and Mitigation Strategies

Katie is a 21-year-old preservice teacher from the southwest area of the state, enrolled in her second year of the BA/MT elementary education program at a state university. Katie is passionate about becoming a teacher and has developed a profound interest in educational policy. While at state university, Katie joined the Future Educator Association organization for preservice teachers and served as the vice president for the organization from the college of education. She attended the annual conference in February of 2023, meeting with other preservice teachers from across her home state, honoring her commitment to social justice and educational advocacy. Embracing this opportunity to engage in action through a professional organization before beginning her career as an educator, Katie hopes to continue to serve the needs of the most vulnerable students and ensure that teachers have the resources they need within the public education system.

Environmental literacy: Beliefs & attitudes

As Katie reflected on our local community and our study of Lake Endor after week 9, she explained that she initially thought water pollution was mainly related to littering. However, her perspective shifted as she learned about other factors influencing pollution, such as the land surrounding individual bodies of water. Katie noted, "Due to Lake Endor's proximity to student living, it has become very polluted as it is located at a lower elevation than other bodies of water; trash rolls down to these areas. The wind and other natural elements also move pollutants toward it." Furthermore, Katie also shared that communities such as those in the Lake Endor area often bear the brunt of past environmental issues. She elaborated,

> The community around Lake Endor is like a scapegoat as they continually feel the more negative impacts of environmental issues. I definitely remember a map and chart that we looked at in class that had all of the old districts in Theed, where the industries were, where the commercial area was, and where most of the housing was - and then we compared it to pollution levels now in the watersheds.

When reflecting on Lake Endor, Katie's concern about biases held by community members based on pollution levels in certain areas of Theed eventually went beyond acknowledging humans' impact. During her interview, she recognized the impacts on the people in Theed's lower-income community near Lake Endor, who may not have had attention from legislation or organizations to help address the pollution issue. This realization also prompted Katie to consider the broader implications of how local policies play a pivotal role in protecting the environment. In her interview after the conclusion of the semester, she explained, "[Lake Endor] makes me think more about how much power the government has over protecting the environment and how much they do nothing." Another aspect of Katie's interview touched on the issue of prejudice and assumptions regarding the local community around Lake Endor. She explained,

> Some might have an assumption that people in a localized area are the ones that are contributing to the pollution and that's an incorrect assumption to have. They might assume that those that live in that area are lazy, don't care, or aren't educated enough to care about the environment. This can lead to holding prejudices against others. So, it's important to know that's not the case, it's not the people that live there, there's so many factors in an area that can contribute to pollution. In fact, it's very rarely, if ever, the case. Also, it's important for me to address my own biases and understanding of the world around me, to make sure that I'm providing my students with accurate information in a holistic way.

In addition, Katie explained how EE and developing a better understanding of Lake Endor's water pollution impacted her thinking and the ways she hopes to act within the Theed community. She reflected, "When there is pollution, especially this much, the natural environment and communities will suffer. This class made me think more about finding volunteer opportunities to combat the excess pollution in our lakes and rivers." Katie explained,

> I really wonder about Lake Endor and what kind of animals live here, as well as the surrounding forests. I wonder why it is more slippery the closer I get to the water. I wonder why it is more polluted than other areas of Theed. I wonder how often people come and clean it up. I wonder what the city is doing to help keep this park clean. I wonder what more I could do to help.

Furthermore, as an advocate for a range of social issues and her future students, Katie was the only preservice teacher on the science methods course who demonstrated actions regarding environmental issues within the Theed community, both as a community member and teacher.

Environmental literacy: Actions as a community member

As a preservice teacher, Katie actively sought opportunities to contribute to Theed's community. For instance, she was the only undergraduate student to dedicate a Saturday morning to assisting the state university graduate student association and local families in cleaning up Lake Endor. Katie explained that she had previous experience participating in community projects involving recycling and clean-ups through girl scouts as she was growing up. Furthermore, Katie explained that she participated in a book drive project in a low-income neighborhood in Theed, which is very close to the Lake Endor area. Katie is also passionate about social issues such as LGBTQ+ advocacy, women's rights, and climate change. For example, she has participated in organizing walkouts during both high school and college to raise awareness for racial justice. Recognizing the need to stay aware of social issues, Katie acknowledges the importance of making a more concerted effort to learn more about social issues when she begins teaching, particularly to support her future students.

Environmental literacy: Actions as a teacher

During the Spring 2023 semester, Katie also took action to teach her students about environmental issues. In her instructional approach for the culturally responsive teaching class she was taking in addition to the science methods course, she designed a lesson much like the EE learning experience she participated in about Lake Endor. Katie explained that third-grade students created a 3D model of a local lake and its surroundings in her lesson to challenge their perceptions of pollution and its ties to communities. Katie demonstrated the correlation between pollution and elevation, intending to dispel preconceived notions for her students related to socioeconomic factors of the community near the lake. Furthermore, she is committed to teaching her students about environmental issues beyond their own communities, recognizing their diverse backgrounds. Katie explained how she wants to encourage them to explore problems outside their immediate experiences–whether through discussions with classmates or lessons about global challenges–to enhance her students' thinking. By encouraging them to consider issues they may not yet face, Katie aims to prepare them to engage thoughtfully with broader environmental issues.

Taken together, Jessica and Katie demonstrated an understanding of the environmental issue of watershed pollution at Lake Endor, as well as concern about the impacts on the community of Theed. However, it was evident that while both Jessica and Katie felt the Lake Endor area should have more resources from organizations or support from policies and local legislation in place to help address the environmental issue, they were unable to link this concern to broader systemic factors that existed and now persist within the lower-income community.

DISCUSSION

Overall, the findings of this case study echo previous scholars' conclusions regarding elementary preservice teachers' environmental literacy (Campigotto & Barrett, 2017; Fakhriyah et al., 2024; Green et al., 2016; Gwekwerere, 2019; Orbanić & Nataša, 2021; Wakefield et al., 2022). Katie and Jessica showed concern about how environmental issues, such as water quality, air pollution, and recycling efforts, affected individuals. They both supported the idea of government initiatives to address environmental issues, such as policies requiring regulations to protect Lake Endor's water. However, the preservice teachers struggled with the complexity of the

relationship between humans and natural systems in the environment.

In alignment with previous studies that explored preservice teachers' actions and advocacy regarding environmental issues (Campigotto & Barrett, 2017; Fakhriyah et al., 2024; Green et al., 2016; Gwekwerere, 2019; Orbanić & Nataša, 2021; Wakefield et al., 2022), my research highlighted that Katie and Jessica's ideas focused mainly on individual actions that address issues within the community. For example, when prompted to reflect on ways to mitigate challenges in Theed, Jessica referenced activities such as recycling, picking up trash, and protecting our water. While all of these actions are commendable, they center on ideas about individual efforts. In addition, this study highlighted how Jessica expressed only ideas about actions as part of her environmental literacy while Katie was empowered to take specific actions within the community. As such, the case of Katie is distinctive and deserves more attention to examine why and how she demonstrated action as part of her environmental literacy. This begs the question, *What was different in the case of Katie?*

Why Katie? Examining Critical Consciousness

First, I believe it is significant to reiterate that throughout EE, Katie held more funds of knowledge relevant to environmental issues than other preservice teachers, including her experiences participating in past community projects, teaching experiences, educational advocacy efforts, and leadership positions within organizations at State University. However, I argue that Katie not only held these funds of knowledge but also was aware of them. Furthermore, she used this awareness and her lived experiences as a tool to help her better understand and connect to factors that impact community-based issues and demonstrate environmental literacy. This deeper knowledge bolstered feelings of concern and confidence, ultimately supporting Katie to act within the community. Thus, I argue to answer the question: What *was different in the case of Katie?* It was evident she held a unique asset supporting this knowledge translation to action: she engaged in self-reflection and held *critical consciousness* about her own funds of knowledge. As such, this afforded her an awareness of the tools she had to draw on to support taking action to demonstrate her environmental literacy.

To conceptualize critical consciousness for preservice teachers, I drew on the C^{2}AST principles by Thompson et al. (2021) that aim to anchor learning in authentic issues that impact communities. Developing critical consciousness is outlined in the first C^{2}AST principle to help shape a lens for preservice teachers to "recognize our own and other's worlds," which emphasizes the need for them to think critically about environmental issues to develop new perspectives, or funds of knowledge, to support taking action to address these problems.

However, the critical consciousness and action seen in the case of Katie were not evident in Jessica's overall environmental literacy. For example, Jessica demonstrated an understanding of and concern for Lake Endor's pollution level. In addition, she also expressed frustration and confusion over why the city of Theed and the local government were not addressing the environmental issue. However, Jessica was missing funds of knowledge about historical redlining policies, generational poverty, zoning ordinances, and lack of resources in Theed. Since these funds of knowledge were missing from her, she could not self-reflect or draw on them to help her understand why the area surrounding Lake Endor continually caused so much pollution. Overall, with limited critical consciousness and, therefore, less environmental literacy, it was less imperative for Jessica to take action to address the problem within the Theed community. As such, this helps to explain evident gaps in preservice teachers' demonstration of action as part of their environmental literacy (see **Figure 1**).

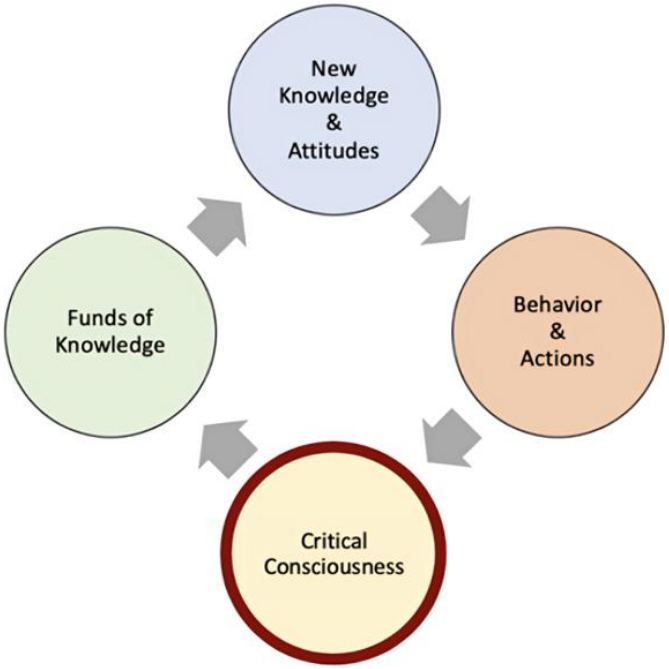

Figure 1. A potential cycle to strengthen preservice teachers' environmental literacy (Source: Author's own elaboration)

In sum, these findings highlight the importance of EE in science methods courses that connect to authentic community-based issues and strengthen their lived experiences. In turn, this can help develop preservice teachers' critical consciousness about their own funds of knowledge. Finally, this can help preservice teachers better understand systemic factors involved in environmental challenges that impact the world around them, empower them to act, and support their overall demonstration of environmental literacy.

Action-Oriented Coursework

It is critical to return to previous research about EE, as an instructional approach that can potentially support preservice teachers' critical consciousness of funds of knowledge is embedding action -oriented projects in EE (Campigotto & Barrett, 2017; Fakhriyah et al., 2024; Green et al., 2016; Gwekwerere, 2019; Orbanić & Nataša, 2021; Wakefield et al., 2022). In the context of these studies, this refers to an assignment for preservice teachers embedded in EE coursework that requires them to engage in research or a specific, structured activity within the community to investigate and develop solutions for environmental issues. As such, these learning experiences can facilitate the development of preservice teachers' funds of knowledge about issues, allowing them to draw upon this new understanding of

these challenges to act within their communities. In the current study, it was evident that Katie had previous volunteer experience before engaging in EE that involved holding leadership positions, participating in advocacy regarding social and environmental issues, as well as volunteering in communities that differed from her own.

CONCLUSION

Overall, this research adds to the literature about EE in teacher education programs, specifically through science methods courses. In this study, engaging in EE about a community-based environmental issue supported elementary preservice teachers' demonstration of environmental literacy. However, moving forward, additional instructional approaches that integrate action-oriented EE coursework can strengthen preservice teachers' funds of knowledge and critical consciousness about environmental issues, as well as an understanding of systemic factors concerning these challenges. In turn, this can support actions regarding community issues as part of environmental literacy. As environmental issues grow more pressing and harmful, preservice teachers must demonstrate the environmental literacy needed to teach our youngest students about the impacts of these challenges on the world around us, especially in the communities they live and teach in.

Limitations

Overall, this research has several limitations. First, the case study focuses on a small sample of elementary preservice elementary teachers to provide in-depth descriptions of their experiences during EE in a science methods course. While there may be comparisons made across preservice teachers within this study, the results are not generalizable to all preservice teachers, methods courses, or university elementary teacher education programs. Also, it is significant to note that there was no control group to contrast the instruction, as both sections of the science methods course received the same EE. In addition, I only studied the preservice teachers during the Spring of 2023. As such, this research does not aim to make claims about the long-term effects of preservice teachers' engagement in EE; instead, it can only address emerging findings from the recent science methods course. Additionally, I have acknowledged the biases that may exist as I hold dual roles as a teacher educator and researcher in the current study. Also, as a researcher involved in a small academic community and a transplant to Theed, I am an outsider to the preservice teachers and most other groups and spaces in the area. As such, my perspective on issues that impact the community may be limited.

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