

Developing Global Competency Skills Among Preservice Childhood Educators Using Diverse Children's Storybooks

Peter Kalenda 
SUNY Geneseo

Sumreen Asim 
Indiana University Southeast

ABSTRACT

The cultural and linguistic diversity of PreK-6 students in the regional school districts surrounding our universities has been increasing over the years, yet existing teacher education programs often address global competency in elementary STEM contexts only at surface levels or as isolated add-ons. This action research study targets the development of global competency skills among undergraduate preservice teachers through redesigned STEM education methods courses. Global competency skills encompass the knowledge, skills, attitudes, and values needed to understand and engage with a diverse and interconnected world, fostering critical thinking, empathy, and effective communication across cultures. Preservice teachers (N=111) participated in modeled inquiry-based STEM lessons integrating children's storybooks with diverse ethnic, cultural, linguistic, or ability-diverse representation. These storybooks served as vehicles for exploring science concepts while broadening teachers' understanding of global diversity. Each lesson aligned with the United Nations Sustainable Development Goals, encouraging consideration of values, beliefs, resources, and practices from different cultural contexts. Data were collected through pre- and post-surveys across two semesters. Quantitative analysis revealed significant findings for four of five questions, showing growth in self-analysis of global competency skills. Qualitative analysis revealed shifts from surface-level cultural awareness to deeper pedagogical understanding, increased family and community engagement considerations, and movement toward lifelong learning orientations. The findings suggest that integrating global competency development within undergraduate STEM methods courses using accessible tools like diverse children's storybooks can effectively inform global dispositions and competencies among future teachers.

Keywords: Culturally responsive pedagogy, teacher education, children's literature, inquiry-based learning, sustainable development goals, diversity and inclusion

Introduction

The cultural and linguistic diversity of PreK-6 students in the regional school districts surrounding our universities has been increasing over recent years, yet existing teacher education programs often address global competency in elementary STEM contexts only at surface levels or as isolated add-ons (Thomas, 2021; Witt, 2023). We redesigned the elementary STEM (Science, Technology, Engineering, Mathematics) education methods courses for our preservice teachers (PSTs) to better prepare them for the students they will serve by enhancing the curriculum with intentionally introduced concepts and practices that would help educators communicate across cultures, recognize their own perceptions, think critically about global issues, and develop efficacy as global citizens. Our hope is that this integration would move beyond superficial cultural awareness toward authentic pedagogical transformation.

Specifically, this action research study examines the development of global competency skills among undergraduate PSTs. Global competency skills encompass the knowledge, skills, attitudes, and

values needed to understand and engage with a diverse and interconnected world, fostering critical thinking, empathy, and effective communication across cultures (Kopish, 2017; Longview Foundation & Learn NC, 2014; UNESCO, 2015).

Developing stronger global competencies helps to prepare teachers to have instructional practices that recognize the interconnectedness of the world (Thomas, 2021; UNESCO, 2015). Students were engaged in an internationalization of science education (ISE) intervention that aimed at increasing their global competency knowledge, skills, and dispositions throughout the semester. The ISE intervention included:

1. Several modeled inquiry-based STEM lessons to develop a classroom culture of wonder, curiosity, learning through questioning,
2. The use of storybooks with diverse representation of cultures and different geographical locations around the world,
3. Deliberate conversations throughout the modeled STEM lessons about cultures to build awareness and empathy.

Research Questions

How does participation in the ISE intervention influence elementary preservice teachers'?

- a. Global competencies (knowledge, skills, and dispositions),
- b. Future classroom environment design, and
- c. Instructional design choices.

Conceptual Anchoring and Literature Review

Global Competencies have emerged as essential elements in preparing individuals to navigate and contribute to an increasingly interconnected world. Global competence is defined as having the dispositions and capacity to understand and take action on issues of global significance (Kopish, 2017). The PISA framework (OECD, 2019) expands this definition to:

A multidimensional capacity that encompasses the ability to: 1) examine issues of local, global, and cultural significance; 2) understand and appreciate the perspectives and worldviews of other; 3) engage in open, appropriate, and effective interactions across cultures, and 4) take action for collective well-being and sustainable development.” (Boix-Mansilla & Schleicher, 2022, p. 11)

Teaching global competencies is also often referred to as teaching global citizenship, which is broadly defined as the education and cultivation of civic-minded individuals within a global context, emphasizing inclusivity, peace, and sustainability (Thomas, 2021; Byker, 2018). The United Nations Educational, Scientific, and Cultural Organization (UNESCO, 2015) offers a framework for global citizenship that is multifaceted, integrating cognitive, socioemotional, and behavioral dimensions to foster critical thinking about inequities, empathy, communication skills, and collective action for the global good. Furthermore, UNESCO helped to frame the 2030 Agenda for Sustainable Development and led to the creation of 17 sustainable development goals (SDGs), which are an urgent call for all countries in a global partnership (United Nations, 2018). These SDGS include ideas such as global solidarity, inclusion, climate action, anti-discrimination, gender equality and accountability. However, while there is a growing demand for global competencies and these achieving SDGs, particularly in response to global crises such as COVID-19, the teaching of these concepts remains inconsistent, with many college courses addressing them only at a surface level (Thomas, 2021). A significant

challenge lies in ensuring that teaching global competencies promotes justice-oriented citizenship rather than serving a privileged international agenda (Thomas, 2021).

The Globally Competent Teaching Continuum (Longview Foundation & Learn NC, 2014), or GCTC, breaks down these global competencies into three categories: Dispositions, Knowledge, and Skills. Teacher Dispositions include empathy and valuing multiple perspectives, and commitment to promoting equity worldwide. Teacher Knowledge includes understanding global current events, understanding interconnectedness, experiential understanding of cultures, and understanding of intercultural communication. Teacher Skills include communication in multiple languages, creating a classroom environment that values diversity and global engagement, creating learning experiences that promote content-aligned explorations worldwide, facilitate international dialogue that promotes active listening, develop partnerships that have real-world contexts for global learning, and develop and use methods of inquiry to assess students' global competence. This GCTC tool can aid us in reflecting on our global competency abilities as educators and can also assist us with developing and reviewing educational programs designed to achieve growth in global competencies among stakeholders.

Efforts to develop global competencies in education have taken many forms. Study abroad programs have shown to be an exceptionally strong tool for developing global competency skills among preservice teachers (Byker, 2018). This immersive process has also aided in developing intercultural awareness and cultural responsiveness by experiencing a shared common humanity. Study abroad programs, aligned with UNESCO's framework, focus on inclusiveness, peace, and sustainability by supporting three dimensions in our preservice teacher's development: cognitive, socioemotional, and behavioral. The cognitive dimension allows for the critical examination of inequities, the socioemotional dimension focuses on the development of communication skills, respect for diversity, and empathy. Lastly, the behavioral dimension focuses on action, supporting the collective good through collaboration. The challenge with relying on study abroad experiences to develop these skills in our preservice teachers lies in access. These experiences are often expensive and can limit the audience who can participate. We can "no longer relegate global competency education to an add-on or luxury only for those who can afford it but instead must train all future teachers with this essential knowledge" (Witt, 2023, p. 300).

Slapac (2021) used a Global Teaching Model (GTM) to increase the global competency skills of grade 5-12 students in language classes. GTM uses authentic resources to investigate local-global issues (immigration, pollution) to go beyond the usual cultural connections of holidays and foods. Although students did reach their language goals, they were unable to approach global issues at a transformational level. A different approach was taken by Kopish (2017) to successfully teach global competencies that involved leveraging campus and community assets. The author notes that we are often "stuck within our own disciplinary borders and rarely seek or create opportunities to collaborate" (p. 44). Kopish attended events and networked with allies, partners, international students, and colleagues to develop a series of workshops. This led to impressive student reflections that showed the strength of cross-cultural experiential learning that depended on campus and community partnerships.

Research on Storybooks & STEM Education

Research on storybooks has demonstrated their effectiveness in fostering cultural literacy and understanding of diversity, particularly in early education. Storybooks have a way of holding attention, engaging readers visually, and emotionally connecting with readers, therefore, leading to an experience that is both intellectual and emotional (Ansberry, & Morgan, 2010; Yigit-Genten & Uyar, 2025). Specifically, having students engage in the creation of storybooks about their own culture has shown to lead to increased cultural competency and patriotism (Ursa, 2018; Wuryandani, 2020). This

approach has led to positive outcomes in multiple contexts; however, both studies focused solely on better understanding and having positive feelings about the dominant culture of their *own region*. Research conducted by Prasetya (2023) found similar results when using already published children's storybooks that focused on their own culture. Children showed an increased cultural diversity understanding of their own regional cultures.

Educating children at a young age about complex global STEM topics, like climate change, can help to foster awareness at an early age (Adam & Barratt-Pugh, 2020; Salmon et. al., 2024). Children can learn about the connected nature of preserving the planet in different cultures while learning about global competencies. Learning about climate change, a wicked problem, can often seem challenging and grim for young learners. The use of children's literature can create a playful learning setting where analysis of this issue is possible (Yigit-Genten & Uyar, 2025). Educators can foster a safe space for social and emotional learning while also posing critical questions that tap into STEM learning standards and cultural and geological characteristics explored in children's literature. Specifically, "children often identify with the main characters when stories capture their attention, thus opening scenarios to develop empathy" (p. 22). Adding the layer of selecting stories from different cultures allows for reduced othering by presenting relatable characters that are also different from us.

Focusing on the "M" in STEM education, similar research on global competencies and storybooks has also occurred in childhood mathematics classrooms. Harding et al. (2017) found that infusing multicultural mathematics storybooks placed cultural diversity in the forefront of preservice teachers' minds when they were planning mathematics lessons. Specifically, this approach led to purposeful integration of cultural diversity - making it an authentic part of the teaching cycle instead of an add-on piece. This research notes that it is crucial that educators ensure content learning goals are still achieved when attempting to integrate multicultural learning through storybooks.

Using diverse "storybooks as a medium for promoting global diversity among fourth-grade students demonstrated a significant impact on students' ability to recognize and appreciate different cultural identities" (Kuswendi et al., 2024, p. 91). However, selecting diverse children's storybooks to embed in STEM instruction is a challenging task. Grady (2019) completed a survey of children's storybooks and found that Asian and Latinx characters were often portrayed as being more emotional than characters of European descent. This presents our first challenge, many storybooks may represent different cultures in ways that can often generalize cultures and language backgrounds in stereotypical ways (Salmon et al., 2024). Given possible biases and misrepresentations, it is simply not enough to find a storybook that represents a culture. Educators need to consider how the choice of storybook could affect their students' perceptions of other cultures. The second challenge when selecting storybooks with diverse representation is an imbalance of STEM topics with accurate STEM information. Educators who are trying to find storybooks accurately representing all different STEM topics in their curriculum will already face a challenge. Attempting to find diverse cultural and geographical representation among characters in these books adds an even more taxing feat. To complicate matters further, Yoon (2022) found that even when diverse characters were present in these books, the storybooks rarely discussed how these characters were world citizens connected to other people around the world.

Collectively, these studies highlight the need for intentional, reflective, and justice-oriented approaches in teaching the knowledge, skills, and dispositions related to global competencies. As Witt (2023) reminds us, we "must radically reimagine the practice and possibilities of GCE for responding to the generation of students and teachers who know they live in a deeply connected, unjust world and need an immediate, coherent strategy for how to navigate and thrive in it" (p. 299). Yet missing from the existing literature is an empirically examined, replicable model for embedding global competency development directly within required elementary STEM methods courses. Specifically, a model that is accessible to all preservice teachers regardless of institutional resources or financial means. This study addresses that gap by demonstrating how intentionally curated diverse children's

storybooks, paired with inquiry-based instruction, can move preservice teachers beyond the surface-level cultural awareness that Thomas (2021) and Yoon (2022) identify as pervasive, toward the deeper pedagogical transformation and justice-oriented citizenship that the field demands.

Methods

Context Description

Researchers of this study included two professors who were instructors for the courses. The study included undergraduate elementary PSTs attending two institutions and were mostly from rural areas. SUNY Geneseo is a public college located in a rural area of the Northeastern United States with a student population that is 80% white, coming from mostly rural and suburban areas. Students in childhood certification programs enroll in a 4-credit STEM course, the course used for this study, where they learn about how to teach science and math to meet the needs of all learners. These students were sophomores or juniors near the beginning of their education course sequence. Indiana University Southeast is a public university with both undergraduate and graduate programs. This regional teaching focused campus is situated in the Midwestern United States. Students in the elementary and special education undergraduate programs take this methods course that also has a practicum tethered to it in their senior year. All students engaged in the ISE intervention as part of their course but had the ability to opt-in or opt-out of the data collection process anonymously.

The state contexts and undergraduate teacher preparation programs varied widely in terms of science education standards, the extent to which STEM integration was emphasized, the number of STEM methods courses required, the size of the teacher preparation program, and the geographic region.

We, the two authors and course instructors, held meetings online prior to implementation of the intervention to discuss features of the science methods course that served as the context of the study. During the meetings, we discussed curriculum needs and the philosophical and methodological approaches at our respective institutions. There were some differences in course topics however given the mission and vision the ISE was made an essential component of the course.

Description of Teaching Interventions

Positive experiences gained during science methods courses help support the self-efficacy of future science teachers (Palmer, 2006; Menon & Sadler, 2018). Teachers' science teaching beliefs influence their (a) instructional decisions (Rubie-Davies et al., 2012), (b) implementation of content in a classroom (Luft, 1999; Roehrig et al., 2007), and (c) reasons for engaging in certain types of science instructional practices, such as inquiry (Subramaniam et al., 2018). One way to promote the acquisition of information and new understandings is through the inquiry-based learning cycle model (Bybee, 2014). Additionally, we chose to implement the learning cycle inquiry-based model to "develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world" (National Research Council, 1996, p. 23). This was an essential part for us since the intervention was based in a STEM methods course and layers onto the scientists highlighted in the intervention. Scientists and STEM professionals engage in complex tasks that include STEM process skills (See Table 1 below, Ponniers & Asim, 2016) and sense-making around the world. When preparing PSTs to teach science in PreK-12 schools, teacher educators embody the practices of STEM skills and model best practices for future teachers (Gess-Newsome, 2002).

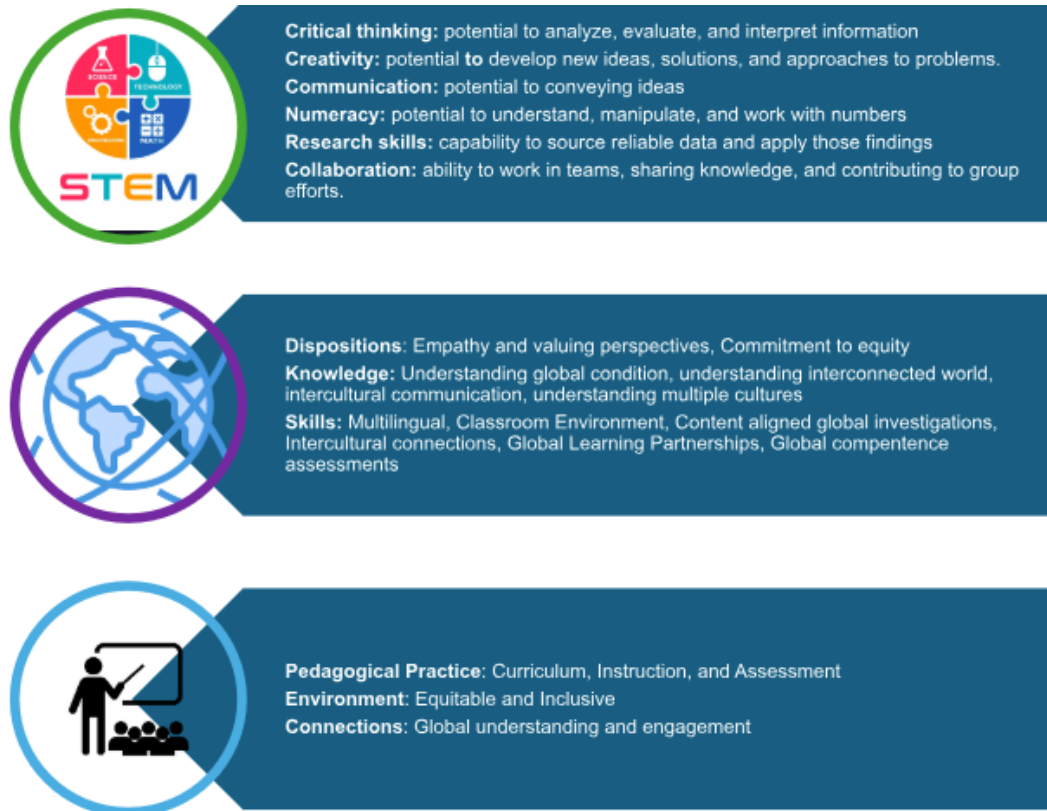
Table 1*STEM Process Skills Comparison Across Content Areas (Ponners & Asim, 2016)*

Science	Technology	Engineering	Mathematics
Observe	Define the problem	Identify the need	Problem Solving
Define the problem	Brainstorm	Define the problem	Mathematical communication
Infer	Research and generate ideas	Search for solution	Reasoning and Proof
Formulate Hypothesis	Identify criteria	Identify constraints	Communication
Predict	Specify constraint	Specify evaluation criteria	Connections
Measure	Explore possibilities	Generate alternate solutions	Representation
Control Variable	Select an approach	Engineer analysis	Appropriate Tools
Experiment	Develop a design proposal	Optimization	Precision
Analyze data	Build a prototype or model	Decision	
Evaluate hypothesis	Test and evaluate design	Design specification	
Communicate results	Refine the design	Communication	
Formulate theory	Make it and create it		
	Communicate results		

The methods courses at both institutions focused on supporting PSTs in developing knowledge, skills, and dispositions in global competencies along with research-based science instructional practices. Carefully chosen fiction and nonfiction books can allow students to practice their critical thinking and comprehension skills while providing science content knowledge (Mahzoon-Hagheghi et al., 2018; McGinnis, 2020). Elementary school teachers use books almost every day in their classroom (Sackes et al., 2009). Therefore, using children's literature to engage students in thinking about countries and people across the globe (Yoon, 2022) seemed like an accessible and

synergistic tool. Many science educators may refer to and try the National Science Teaching Association's (NSTA) Outstanding Science Trade Books for Students K-12 listing, which was an inspiration for us, and we believe that a curated book list with a global focus may be useful for teacher preparation programs as well as K12 educators. Like NSTA's Picture Perfect curriculum guides, the storybooks help engage students in learning STEM content. The selected storybooks helped generate conversations related to various cultures, practices, processes, vernacular, and resources. Connecting elementary classrooms to different geographical locations and cultures can also help build a foundation for empathy and embracing differences.

PSTs were engaged in modeled inquiry-based STEM lessons that integrated storybooks with diverse ethnic, cultural, linguistic, or ability diverse representation. These books served as a vehicle for exploring science concepts while simultaneously broadening the PSTs' understanding of global STEM education. Each lesson was carefully designed to align with the United Nations Sustainable Development Goals (UNSDG), encouraging PSTs to consider values, beliefs, resources, and practices from different cultural contexts. Common model lessons anchored by storybooks and assignments were implemented in both universities. The courses included concurrent participation in a practicum, allowing PSTs firsthand observation and interaction with elementary students. Our intervention, named the internationalization of science education (ISE), includes three elements: 1) inquiry-based model STEM lessons, 2) a children's book that highlights a different region of the world, and 3) engaging learners in meaningful discussions of culture to build awareness and empathy (see Figure 1). The inquiry-based-model STEM lesson helps to build the process skills mentioned in Table 1 and overlaps with the development of 21st Century Skills. 21st Century skills include creativity, critical thinking, communication, collaboration, digital literacy, problem solving and productivity (Voogt, et al., 2013). While the focus of this study centers on global competencies, 21st Century Skills and global competency frameworks share significant overlaps, particularly the shared emphasis on critical thinking, communication, and collaboration. Developing 21st Century Skills through inquiry-based STEM instruction provides a complementary foundation upon which global competency dispositions, such as cross-cultural communication and collective problem-solving, can be built.

Figure 1*Internationalization of Science Education Intervention*

Note. The ISE intervention integrates three interconnected domains: STEM (creativity, communication, numeracy, research skills, and collaboration), global competency (dispositions, knowledge, and skills from the GCTC framework), and pedagogical practice (equitable curriculum, instruction, assessment, and global engagement).

We, as teacher educators, wanted to use books to engage students in a broader connection of science content and expand the perspectives of our PSTs. Regions of the globe such as the Middle East and Asia were purposefully on our radar as we collected a selection of books for this study (Table 2).

Table 2*Inquiry-based STEM Lessons with Aligned Diverse Storybooks*

<i>Inquiry-Based Science Lesson</i>	<i>Children's Storybook with Diverse Representation</i>	<i>Country Represented</i>
Building Up (Ansberry & Morgan, 2023)	The World is not a Rectangle: A Portrait of Architect Zaha Hadid by Jeanette Winter (2017)	Iraq
Let's Drum (Ansberry & Morgan, 2022)	Drum Dream Girl: How One Girl's Courage Changed Music by Margarita Engle (2015)	Cuba
Glo-Germ Lab (Educational Innovations, 2015)	Tu Youyou's Discovery: Finding a Cure for Malaria by Songju Ma Daemickle (2021)	China
Pollution in the Well Lab (Seneca Park Zoo, 2016)	Saving Salila's Turtle: An Environmental Engineering Story by Martin, J., & Boston Museum of Science (2006)	India

Data Collection

The study included enrolled PSTs in an elementary science or STEM methods course that incorporated the ISE intervention. All PSTs engaged in the ISE intervention as part of their coursework, however participation in the research component was voluntary. Only responses from the PSTs who consented to research use were included in the final analysis. No other exclusion criteria were applied. Data was collected across two semesters in 2024. Data was collected at the beginning and end of the semester to determine the ways in which our interventions impacted our preservice teachers. SUNY Geneseo had 84 students participating in four class sections, and there were 27 students from Indiana University Southeast in two class sections.

Quantitative Survey Instrumentation

A 5-item Global Learning Survey was used to assess changes in preservice teachers' global perspectives before and after an instructional intervention in a science methods course within education preparation programs. The instrument was introduced to the second author through participation in the professional learning community for teacher educators from multiple institutions during 2022-2023 Globalizing Rural Science Teacher Education. The survey was shared by one of the facilitators and was originally adapted from the Global Competence Matrix developed by the Asia Society, EdSteps, and the Council of Chief State School Officers (CCSSO) (Dimitrieska, 2017). ACE's (2018) Comprehensive Internationalization Framework provides clear definitions of *globalization* (i.e., movement of ideas, people, good, services across the globe; uncontrollable by individual people) and *internationalization* (the higher ed institutions' response to globalization by intentionally incorporating global content, global perspectives, etc. in their programs, lessons, and teaching). Results from the pre- and post-surveys were analyzed to determine shifts in participants' perceived global competence following the intervention.

The Global Learning Survey tool was ultimately selected over more rigorous tools, such as the GCTC, in order to increase student response rates. Similarly, survey data was also gathered

anonymously and not viewed until after the closing of the semester to appease any student concerns about the results or their choice to opt-in or opt-out of study affecting their course grade.

Our survey included the following questions with a four-point Likert scale:

1. I can communicate and collaborate across national and cultural boundaries.
2. I can make choices and design solutions informed by multiple frames of reference including international, global, and cultural contexts.
3. I can demonstrate openness, recognition, and acceptance of differences.
4. I can demonstrate willingness to adapt my own practices, values, and behaviors.
5. I am willing to act upon acquired knowledge, skills, and attitudes in global and local contexts.

Qualitative Survey Instrumentation

In addition to Likert-scale questions, written reflections were also solicited. The following questions were asked at the beginning and close of the semester:

1. How can you demonstrate openness, recognition, and acceptance of diverse populations in your future classroom?
2. What skills do you have to communicate and collaborate across national and cultural boundaries?
3. What choices and instructional design ideas do you have to address international, global, and cultural contexts?

Mixed Methods Approach

Following the mixed-methods principle, the two methods we used measured the same concept (Creswell, 2014). While the qualitative and quantitative data were collected simultaneously at the same two timepoints — pre- and post-survey — and analyzed separately using appropriate analytic techniques, the interpretation phase employed a convergent mixed-methods approach (Creswell & Plano-Clark, 2018).

Data Analysis

Quantitative Analysis

To measure the impact of the ISE intervention, PSTs participated in pre- and post-surveys, utilizing a combination of quantitative and qualitative measures to evaluate their global competencies. Data were collected in Spring 2024 and Fall 2024 semesters. These assessments focused on the educators' ability to incorporate global competency skills into their teaching strategies and their evolving understanding of the importance of preparing young students for a globally interconnected world. Quantitative data was analyzed independently using a 2-tailed independent samples t-test (Privitera, 2024) because we had no identifiers to pair pre- and post- assessments among the anonymously collected data.

Qualitative Analysis

Each of us independently coded the participant reflection responses. Following this process, we met to identify discrepancies and reach a consensus on code development, ensuring consistent interpretation of participant responses (Creswell & Plano Clark, 2018). A second round of coding resulted in refinement of the codes through a constant comparative method (Clandinin & Rosiek, 2007). We also reflected on preliminary codes that were associated with global competency skills, knowledge, and dispositions. We then conducted a thematic analysis (Saldana, 2021) collaboratively. Initial themes were identified and codes were compared across all qualitative data sources to identify patterns and contradictions. At the conclusion of this process six major themes were identified without reference to the quantitative findings, preserving the independence of each analytical strand.

Data Triangulation

Once quantitative and qualitative data were analyzed independently in the same phase of research, they were compared with a goal of assessing whether the datasets contained similar or diverging findings (Creswell & Plano-Clark, 2018). We collaborated throughout this process to increase interrater reliability of the connections identified. Themes from the written reflection responses were compared with the patterns in the survey results to triangulate findings and to better understand how PSTs experienced changes in their dispositions and instructional practice. Convergence across strands was substantial, with Themes 1 and 6 aligning with significant growth in Q4 and Q5, Themes 3 and 5 with Q1, and Themes 2 and 4 with Q2. The one area of divergence — Q3's ceiling effect — was clarified by qualitative data showing PSTs already held strong dispositional openness but lacked the skills to enact it, illustrating the added explanatory value of the concurrent design.

Results

The findings indicate that the iterative nature of the ISE intervention was well received, with quantitative and qualitative data analysis revealing student growth regarding several variables. Both course professors also noted during informal observations that their students were highly engaged in the ISE lessons and embraced many of the newly introduced children's storybooks with diverse representation.

Quantitative analysis revealed significant changes for four of the five questions posed to participants. Data showed growth in their self-analysis of global competency skills in each of these four categories (see Table 3). Question 3 was the only prompt that did not have a significant p value, but it did have a very high self-assessment rate on the post-assessment. Due to Question 3 also having the highest self-analysis on the pre-assessment (3.764) it did not lead to a significant finding when compared to the post-assessment scores.

Table 3*Pre- & Post- Quantitative Data Summary*

Question	N _{pre}	M _{pre}	SD _{pre}	N _{post}	M _{post}	SD _{pos} t	p
1. I can communicate and collaborate across national and cultural boundaries.	111	2.955	0.477	108	3.178	0.563	0.002
2. I can make choices and design solutions informed by multiple frames of reference including international, global, and cultural contexts.	111	2.790	0.560	108	3.206	0.562	< 0.001
3. I can demonstrate openness, recognition, and acceptance of differences.	111	3.764	0.448	108	3.748	0.551	0.815
4. I can demonstrate willingness to adapt my own practices, values, and behaviors.	111	3.563	0.498	108	3.710	0.567	0.044
5. I am willing to act upon acquired knowledge, skills, and attitudes in global and local contexts.	109	3.398	0.546	108	3.598	0.597	0.011

Qualitative Themes

Qualitative analysis of pre- and post-survey responses revealed variation in themes among student data (summarized in Table 4). Both the pre- and post-survey responses led to the identification of six major themes. Although these themes are categorically similar, such as classroom environments being the first theme for both, the nuances in student language choice help us see a shift in their thinking.

Table 4

Qualitative Themes for Pre- vs. Post Data

Pre-Survey Qualitative Themes		Post-Survey Qualitative Themes
1 Classroom Environment	Cultural Inclusion Through Classroom Environment Visual Cultural Representation, Creating Welcoming Spaces, Fostering Acceptance and Belonging, Building Relationships	Creating Safe and Welcoming Environments Establishing Welcoming Spaces, Ensuring Psychological Safety, Promoting Open Expression
2 Teaching Materials with Diverse Representation	Diverse Representation in Curriculum Diverse Learning Materials, Inclusive Character Representation, Cultural Content Integration, Expanding Diversity Resources	Diverse and Inclusive Learning Materials Diverse Book Collections, Representational Materials, Inclusive Resource Variety
3 Supporting Linguistic and Cultural Diversity	Language Accommodation & Communication Language Support, Translation Tools, Multilingual Abilities, Non- verbal Communication	Culturally Responsive Teaching Approaches Culturally Responsive Pedagogy, Cultural Knowledge Integration, Equitable Teaching Practices, Adaptive Teaching
4 Specific Cultural Teaching Approaches	Active Cultural Learning Strategies Cultural Holiday Exploration, Student Recognition, Cultural Education Approaches, Cultural Curriculum Development	Cultural Representation and Celebration Cultural Visibility, Student Recognition, Cultural Celebration, Cultural Awareness and Sharing
5 Students Discussing Cultures	Student-Centered Cultural Exchange Student Voice and Sharing, Facilitated Cultural Dialogue, Community Building	Communication Across Boundaries Multilingual Communication, Translation Resources, Family Engagement, Collaborative Communication
6 Teacher Growth Regarding Cultures	Personal Cultural Awareness & Growth Bias Recognition, Professional Development, Cultural Curiosity and Openness, Active Cultural Learning	Teacher Growth and Self- Education Professional Modeling, Open- mindedness, Active Listening and Learning, Cultural Understanding

Categories with the largest shifts in language use appear to be Category 1: Classroom Environments, Category 3: Supporting Linguistic and Cultural Diversity, Category 4: Specific Cultural

Learning Approaches, Category 5: Discussion Cultures, Category 6: Teacher Growth Regarding Cultures. Student word choice in each of these categories became more specific, citing teaching practice and specific examples, instead of generalized approaches or surface-level concepts. Category 2: Teaching Materials with Diverse Representation does not show a major difference among codes.

Findings for Research Question a: Global Competencies

Student Self-Assessment of Global Competency Skills. The survey functioned as a metacognitive tool contributing to improvements as seen in the results obtained in Table 3. Student quantitative data shows significant growth regarding student self-analysis of their global competency skills.

Question 3 showed high scores in both pre- and post-surveys, but no significant findings (no major shift in data). PSTs entered with strong dispositions toward openness (3.764/4.0) but they lacked the skills and knowledge to enact this disposition—which the intervention then developed (as shown in Q1, Q2, Q4, Q5). This pattern is consistent with the GCTC framework's distinction between dispositions (which many PSTs already held) and the knowledge and skills required to act on those dispositions (Longview Foundation & Learn NC, 2014).

Pedagogical Transformation. PSTs demonstrated a clear progression from surface-level understanding to intentional pedagogical integration. Pre-survey responses reflected limited conceptions often framed as "cultural holiday exploration" and visual classroom decorations. In contrast, post-survey responses demonstrated a more sophisticated understanding, with PSTs articulating approaches grounded in "culturally responsive pedagogy" and intentional instructional design that embedded cultural perspectives throughout their teaching practice.

This shift signifies a deeper understanding between culture and content instruction. One PST reflected: "When I was writing my lesson plan and teaching my STEM lesson I learned to value cultures other than my own. I knew students would finish building their tent a lot earlier than some of the other students, so I printed off coloring pages. I thought about where some of my students were from in my classroom. One of the coloring pages showed the sun in Mexico, and the other ones had the sun by the ocean, and one was in the mountains" (Indiana University, Fall, Post-Survey). This response illustrates movement beyond superficial representation to authentic integration of cultural context in science content.

The inquiry-based pedagogy in the ISE catalyzed global competency development. By engaging PSTs in active questioning, investigations, and meaning-making around STEM phenomena embedded within culturally diverse contexts, the inquiry-based lessons created natural opportunities for examining how scientific practices and knowledge are influenced by cultural perspectives and resources. This pedagogical integration addresses concerns raised by Harding et al. (2017) about maintaining content learning goals with multicultural perspectives—our findings suggest that embedding cultural contexts within inquiry-based STEM lessons enhances both content mastery and cultural awareness.

Storybooks served as authentic contexts for STEM learning that naturally incorporated cultural perspectives, values, and practices. For instance, using Tu Youyou's *Discovery: Finding the Cure for Malaria* not only introduced PSTs to scientific inquiry but also highlighted how cultural contexts shape scientific work. This approach aligned well with Kuswendi et al. (2024) and addressed the challenge identified by Yoon (2022) that many diverse storybooks fail to discuss global citizenship and interconnectedness.

Post-survey responses show PSTs articulating specific instructional strategies, such as: "My ideas to address these topics in my classroom include selecting culturally relevant content, materials

and resources. I will also include global perspectives like current events, global challenges, etc." (Indiana University, Spring 2024, Post-Survey). This move toward specific strategies, rather than vague comments on inclusivity, indicate that the ISE intervention successfully developed not just dispositions but also pedagogical knowledge and skills necessary to enact culturally responsive STEM instruction.

Lifelong Learning Orientations. Qualitative data revealed a significant shift in how PSTs conceptualized their relationship to cultural knowledge and global competency development. Pre-survey responses frequently included phrases like "I would need to research more" or "I need to learn about," positioning PSTs as passive recipients awaiting cultural information. Post-survey responses demonstrated a fundamental transformation in teacher identity, with PSTs using language such as "open-minded," "active listening," and "engaging in life-long learning" to describe their ongoing commitment to understanding diverse cultures and meeting learners' needs.

The conceptual shift represents more than acquiring new knowledge—it reflects a reconceptualization of global competency as an evolving professional responsibility rather than a finite skill set. One PST articulated this transformed perspective: "My ideas to address these topics in my classroom include selecting culturally relevant content, materials and resources. I will also include global perspectives like current events, global challenges, etc. I will also make sure I am always educating myself" (UN2 SPG 24 POST, GC). The phrase "I will also make sure I am always educating myself" signals a commitment to continuous learning that extends beyond the methods course.

This conceptual shift toward lifelong learning orientations also appeared in PSTs' recognition of students themselves as cultural knowledge sources. Post-survey responses increasingly referenced "letting students teach us as well" (UN2 SPG 24 POST, KS), positioning learners as co-constructors of cultural understanding rather than passive recipients.

Research Question b: Future Classroom Environment Design

Classroom Environment. One of the most significant transformations revealed among our qualitative data was the shift in PSTs' language about classroom environments. Pre-survey responses emphasized surface-level accommodations, such as visual representations, welcoming decor, and general acceptance. Post-survey responses demonstrated a much deeper understanding of creating safe spaces that promote student expression and agency.

Examples of pre-survey reflections:

- A. "[e]xposing students to manageable amounts of foreign language vocabulary" (SUNY Geneseo, Pre-Survey, Fall 2024),
- B. "[e]xpanding on my DEI materials such as posters, books, toys/classroom materials. Also, make it a point to make a statement to my students on acceptance and how hate won't be accepted" (SUNY Geneseo, Pre-Survey, Fall 2024), and
- C. "you can use read-alouds that respect not only the diverse population in your classroom but also in the world. Treating anyone like a human and human experiences goes a long way. Having diverse classroom decor and guests can cultivate a learning environment that welcomes differences and diversity" (Indiana University, Pre-Survey, Spring 2024).

In contrast, a post reflection stated:

I always try to get to know my students on a personal level to better understand their background and culture. I talk to my students in the morning, at recess, when waiting for dismissal, and at odd times throughout the day. I also try to be flexible when it comes to

how a student does an activity. If they want to be more hands-on, only writing, or speaking, it is up to them. I also try to make what I am teaching connected to real world situations or problems. Having students learn about the world around them can make them more culturally aware too (Indiana University, Post-Survey, Fall 2024).

Responses illustrate a shift in our teachers' understanding of a classroom environment from a static, decorated space to a dynamic, socially-mediated learning community. The ISE intervention placed an emphasis on discussing many of these topics with students following model lessons, which may have aided our PSTs in making their view of the classroom environment inseparable from student relationships and pedagogical choices. This aligns well with our own observations as professors and researchers, as we saw our students evolve as they brought substantially more depth to creating classroom communities, with many of their responses overlapping heavily with Theme 6: Teacher Growth Regarding Cultures.

Research Question c: Instructional Design Choices

Family and Community Engagement. By the end of the semester, PSTs' reflections increasingly emphasized the importance of family and community engagement. In Table 4, Category 4: Specific Cultural Teaching Approaches and Category 5: Students Discussing Cultures show the appearance of new approaches to engaging families and celebrating cultures that were not considered among the pre-survey data. PSTs used terms such as "family engagement," "cultural collaboration," and "multilingual communication," whereas at the start of semester they used terms like "student voice" and "facilitated cultural dialogue."

This shift represents a reconceptualization of the classroom as a broader community ecosystem rather than an isolated instructional space. Post-survey responses demonstrated PSTs had developed an expanded understanding that authentic cultural learning requires connecting with families and communities beyond the school building. This aligns with research on culturally responsive pedagogies which emphasize the importance of building bridges between school and home cultures (Gay, 2000). One PST articulated this expanded perspective:

First I would describe the meaning of family and how family looks different for all of us. Having posters of leaders of every kind hanging around the room, because we need to see, not just hear about diversity. Music is important for everyone (Indiana University, Post-Survey, Spring 2024).

The appearance of "multilingual communication" in post-survey responses suggests PSTs moved beyond viewing language diversity as a barrier to overcome and instead began seeing it as an asset to embrace. One PST specifically noted:

They loved the coloring pages and got to finish them later that day. Then for one of my extensions activities I linked a website that had a science game that was all about the sun. On this website you can switch the languages. I thought this was very helpful because half of my class was ELL students, so I knew this would be beneficial for them, and they would understand because the instructions were read to them in their language (Indiana University, Post Survey, Fall 2024).

This example demonstrates proactive efforts to use multilingual tools for equitable engagement, signaling a move from accommodation to integration of family-engaged pedagogy. The qualitative data also revealed PSTs increasingly considered how cultural celebrations could extend beyond the classroom to include family participation, representing a significant development in global competency understanding consistent with Thomas's (2021) justice-oriented approach to diversity.

Specific Cultural Teaching Approaches. PSTs increasingly discussed designing learning experiences that focused on cultures represented in their classrooms. Post-survey responses revealed intentional strategies from general cultural awareness to systematic instructional planning. One PST noted:

Choices and instructional ideas I have to address [international], global and cultural context include incorporating diverse perspectives in the curriculum I teach, global awareness projects, representing diverse cultures in my classroom, having guest speakers and even show-n-tell where students share about their background (Indiana University, Post-Survey, Spring 2024).

This movement demonstrates how the ISE scaffolded PSTs' understanding of culturally responsive STEM instruction as a fundamental lens through which all instructional decisions should be filtered. Another PST reflected:

Even now, I'm still studying the Korean culture as it will be the culture I'm immersed into in a year or so. I truly do believe that when you're creating lesson plans or activities, that you are aware of your students' cultures, especially if they are not born and raised here in the US. You never want your students to feel left out due to not implementing things about their culture that they miss (Indiana University, Post-Survey, Fall 2024).

This response highlights the personal investment PSTs developed in understanding their students' cultural contexts and surfaces a productive tension inherent in global competency work: while the ISE intervention was designed to broaden PSTs' perspectives outward toward global interconnectedness, moments like this illustrate how that orientation simultaneously drew PSTs inward toward the specific local and cultural identities of their own students. This duality is consistent with the PISA framework's vision of global competence as encompassing both issues of local and global significance (Boix-Mansilla & Schleicher, 2022), and with Slapac's (2021) finding that meaningful global competency development depends on connecting local realities to broader global issues.

The intentionality expressed by PSTs in their post-surveys marks a critical shift from reactive to proactive cultural integration. Pre-survey responses often positioned culture as something to respond to when diverse students were present. Post-survey responses revealed PSTs planning for cultural diversity as a default assumption, recognizing that even seemingly homogeneous classrooms benefit from global perspectives (Byker, 2018). The alignment with UN Sustainable Development Goals provided PSTs with a practical curricular organizing framework that elevated cultural teaching approaches beyond surface-level celebrations, making cultural diversity integral to STEM learning objectives rather than separate from them.

Discussion

The ISE methods course intervention created opportunities where PSTs were able to encounter not only new perspectives but also engage with tools, tasks, and academic terminology to articulate their identities as a STEM educator and global citizen. Global competence encompasses knowledge, skills, and dispositions. Through ISE, PSTs strengthened their global competencies, fostering career readiness and collective responsibility as global citizens.

The Role of Diverse Storybooks as an Accessible Tool

The ISE intervention's reliance on diverse storybooks as the primary vehicle for global competency development addresses a critical equity challenge in teacher preparation. While study abroad programs have demonstrated exceptional strength in developing global competency skills among preservice teachers (Byker, 2018), yet these experiences remain inaccessible to many students

due to cost, time constraints, family obligations, and other barriers. Our study demonstrates that carefully selected storybooks paired with inquiry-based STEM instruction can provide an accessible, cost-effective alternative within required methods courses.

Storybooks offer several advantages for democratizing access to global competency development. First, storybooks are already familiar pedagogical tools that elementary teachers use regularly in their classrooms. PSTs expanded their existing literacy practices to encompass global dimensions, likely contributing to the high engagement levels observed. Second, diverse storybooks provide windows in dimensions, and contexts that might otherwise remain abstract. The narratives demonstrated how scientific knowledge is culturally situated and how different communities approach shared global challenges using varied resources, values, and knowledge systems. Third, this approach is adaptable across institutional contexts. Our study included PSTs from two different locations with varying course structures, geographic locations, and student populations, yet both successfully implemented the ISE intervention using the same curated storybooks. The curated list of recent storybooks in Table 5 offers other teacher educators a ready-to-use resource for incorporating global perspectives into STEM methods courses without requiring extensive curriculum redesign, specialized training, or additional funding. This accessibility is very different from study abroad programs, which require substantial institutional infrastructure, partnerships, and financial investment.

However, storybooks alone are not sufficient enough for developing global competencies—the pedagogical approach matters significantly. Our pairing of storybooks with inquiry-based instruction and facilitating classroom discussions about culture and global interconnectedness also played a large role.

Implications for STEM Methods Courses and Teacher Preparation

This study makes several specific contributions to the existing literature on global competency development in teacher preparation. Most directly, it provides an empirically examined, replicable model for embedding global competency development within required elementary STEM methods courses, which is a gap that Thomas (2021) and Witt (2023) explicitly identified as needing to be filled. Where prior efforts have addressed global competencies either as standalone diversity courses, costly study abroad experiences (Byker, 2018), or surface-level cultural add-ons (Thomas, 2021; Yoon, 2022), this study demonstrates a viable, low-cost, institutionally accessible alternative that produced measurable growth in PST dispositions, knowledge, and skills. In doing so, it directly answers Witt's (2023) call to stop relegating global competency education to a "luxury only for those who can afford it" and instead train all future teachers with this knowledge as a standard component of their professional preparation.

A second contribution lies in demonstrating that rigorous STEM content learning and global competency development are not competing priorities. Harding et al. (2017) flagged a critical concern that integrating multicultural perspectives through storybooks risks subordinating content learning goals. Our findings challenge this framing: PSTs showed growth both in their articulation of inquiry-based STEM instructional strategies and in their global competency dispositions and skills, suggesting that the two reinforce rather than undermine each other when pedagogical integration is intentional. This is consistent with Ansberry and Morgan's (2010) argument that children's literature can anchor rigorous science inquiry and extends that argument by demonstrating the same is true when the books carry explicit global and cultural dimensions.

A third contribution addresses a specific critique raised by Yoon (2022), who found that even when diverse characters appeared in children's storybooks, those books rarely positioned characters as world citizens connected to broader global systems. Our curated selection and inquiry-based pedagogical framing were designed precisely to counteract this tendency by pairing each book with deliberate discussion of global interconnectedness and alignment with the UN Sustainable

Development Goals (United Nations, 2018; UNESCO, 2015). The qualitative data showing PSTs' post-survey language shifting from "cultural holiday exploration" toward "global awareness projects" and "interconnected global challenges" suggests this pairing was effective at moving beyond the kind of surface-level cultural representation Yoon (2022) critiqued.

These contributions have several implications for how STEM methods courses are designed. First, the inquiry-based approach appears essential for connecting cultural learning to disciplinary practices. The GCTC framework (Longview Foundation & Learn NC, 2014) identifies inquiry as a core teacher skill for global competency. Specifically, developing and using methods of inquiry to assess students' global competence, and our findings suggest that modeling this approach in methods courses creates natural opportunities for PSTs to experience it from the learner's perspective before enacting it in their own classrooms. Methods courses that primarily emphasize direct instruction or procedural teaching skills may miss these opportunities.

Second, the deliberate selection and integration of diverse children's storybooks provide an accessible entry point for methods course redesign. The socioemotional power of narrative, the way stories open readers to empathy by allowing identification with characters unlike themselves (Yigit-Genten & Uyar, 2025), appears to operate effectively for adult PSTs as well as for the elementary students they will eventually teach. Methods instructors could begin by replacing one or two existing lessons with storybook-anchored investigations like those described in Table 2, gradually expanding as they develop confidence facilitating cultural discussions alongside STEM content. Critically, unlike the GTM approach used by Slapac (2021), which also drew on authentic resources to investigate global issues but was unable to move students to a transformational level, our pairing of storybooks with structured inquiry and reflection appeared to support deeper dispositional change. This likely occurred because it was embedded within the professional identity-forming context of a methods course rather than a language class.

Third, our findings highlight the importance of explicitly naming and discussing global competencies throughout methods courses, rather than assuming these dispositions will develop organically. The self-assessment surveys functioned as metacognitive tools that prompted PSTs to articulate their developing competencies in terms aligned with the GCTC's Dispositions, Knowledge, and Skills categories (Longview Foundation & Learn NC, 2014), likely contributing to the growth we document. Methods courses should incorporate structured reflection opportunities where PSTs consider how their instructional choices connect to culturally responsive STEM teaching (Gay, 2000) and global citizenship development (UNESCO, 2015).

Fourth, this study reinforces that global competency development requires sustained, integrated engagement rather than isolated experiences. Kopish (2017) demonstrated the power of cross-cultural experiential learning sustained across a semester through campus and community partnerships; our findings suggest that a parallel kind of sustained engagement built not through external partnerships but through the iterative layering of storybooks, inquiry, discussion, and reflection across a full semester can produce comparable dispositional growth within the more accessible context of a single required course. Teacher preparation programs should consider how global competency learning can function as a continuous thread woven through the entire preparation sequence, rather than a unit confined to one course.

Finally, our findings point to the value of aligning STEM instruction with the UN Sustainable Development Goals as an explicit organizing framework. The SDGs helped surface how different cultures approach shared global challenges using varied resources, values, and knowledge systems, which makes cultural diversity integral to STEM learning rather than supplementary to it. However, our particular implementation did not yet make the SDG framework fully visible to PSTs as a planning tool. A future iteration in which PSTs explicitly use the SDGs to design their own lessons would likely deepen both global competency development and the transferability of that learning to their own practice.

Limitations

We acknowledge that our study has some limitations as to its transferability. It was conducted in two rural contexts with relatively small class sizes (12-25 PSTs). The implementation approaches of the ISE intervention and data collection also slightly varied slightly between our two courses. One of us taught a 4-credit STEM methods course (including math and science instruction) with field-based teaching, and the other taught a 3-credit science-specific methods course. This shift in course design led to students experiencing some additional math-specific ISE intervention experiences in the 4-credit course, and students also then taught a model lesson in the field using a storybook with diverse representation. Regarding data collection, at SUNY Geneseo, students participated in only the pre- and post-assessment and the conversations regarding global competencies that occurred during the ISE intervention. However, at Indiana University Southeast, students regularly engaged in reflections using a journaling approach. This journaling approach led to much more robust responses to our qualitative questions in the post-survey.

Students also grew and were influenced by factors outside of the ISE intervention. During this four-month window, students carried a full semester schedule of additional courses and their own lived experiences. These lived experiences outside of the science/STEM methods courses may have contributed to any shift in the PSTs' global competencies.

Future Work

We concur with and borrow related terminology and categories from the review of literature that state that PSTs need to develop instructional practices that will meet the needs of being a global citizen. We are in no way pioneering the concept of global competencies; however, we believe that transformative practices such as the ISE and methods courses can increase the quality of science & STEM instruction. Throughout the process of this research project, we strove to advance the understanding about preparing students to have conversation between inquiry-based teaching and emphasizing the development of professional dispositions that integrated a global lens. Reflection is a powerful tool to allow PSTs to reflect on their own teaching beliefs, skills and dispositions. Our attempt at designing the interventions was overtly to provide a space to explore ways to better align instruction to the needs of being a global citizen and scaffold global competencies. Teacher education preparation programs, and the teacher educators, have a responsibility to prepare PSTs with several sets of skills that will help them in their future classrooms to meet the needs of various backgrounds and cultures. Being cognizant of teachable moments and showing awareness of different teaching approaches, assessment strategies, classroom management, classroom learning environments and science/STEM content knowledge must be part of science & STEM methods courses. Science methods courses need to gain experiences with addressing broader cultures. When PSTs read aloud storybooks they invite student listeners to engage with culture and STEM content; therefore, allowing them to stimulate scientifically literate discussions. Since choosing appropriate storybooks to teach STEM content is not a simple task, we have curated a longer list of storybooks from the past six years to share that we believe would be helpful for other methods instructors (Table 5). This study has indicated that books are not just tools for teaching rather they allow readers to construct their own dispositions about the surrounding world.

Table 5

Curated Global Storybooks List for Elementary STEM Courses

Book Title	Author(s)	Geographic Location or Cultural Focus
Tu Youyou's Discovery: Finding a Cure for Malaria (2021)	Songju Ma Daemicke	China
Save Our Forest (2024)	Nora Dåsnes	Norway
Forest Fighter: The Story of Chico Mendes (2022)	Anita Ganeri	Brazil
Secrets of the Sea: The Story of Jeanne Power, Revolutionary Marine Scientist (2021)	Evan Griffith	Italy
Santiago Saw Things Differently: Santiago Ramón y Cajal, Artist, Doctor, Father of Neuroscience (2023)	Christine Iverson	Spain
Autumn Peltier, Water Warrior (2023)	Carole Lindstrom	Indigenous Communities in Ontario, Canada
Flipflop!: How a Boat Made from Flip-Flops is Helping to Save the Ocean (2023)	Linda Ravin Lodding and Dipesh Pabari	Kenya
Dinosaur Lady: The Daring Discoveries of Mary Anning, the First Paleontologist (2020)	Linda Skeers	England
Building Zaha: The Story of Architect Zaha Hadid (2020)	Victoria Tentler-Krylov	Iraq
Fly, Girl, Fly (2020)	Nancy Roe Pimm	Refugee from Afghanistan
June Almeida, Virus Detective (2021)	Suzanne Slade	Scotland
Mother of Sharks (2023)	Melissa Cristina Márquez and Devin Elle Jurtz	Puerto Rico
Beatrix Potter, Scientist (2020)	Lindsay Metcalf	Scotland

The Tree of Hope (2022)	Anna Orenstein-Cardona and Juan Manuel Moreno	Puerto Rico
River of Mariposas (2023)	Michelle Ortega	Mexico
When the Ocean Came to Town (2023)	Sal Sawler	Canada
The Forest Keeper: The True Story of Jadav Payeng (2023)	Rina Singh	India
Sona Sharma, Looking After Planet Earth (2024)	Chitra Soundar	India
Rats to the Rescue (2024)	Scott Riley and Sambat Meas	Cambodia
Ganesha Goes Green (2023)	Lakshmi Thamizhmani	India
When the Storks Came Home (2022)	Isabella Tree	United Kingdom
Joan Procter, Dragon Doctor: The Woman Who Loved Reptiles (2023)	Patricia Valdez	England
Eco Girl (2023)	Ken Wilson-Max	Africa
Up, Up, Ever Up! Junko Tabei: A Life in the Mountains (2024)	Anita Yasuda	Nepal

Overall, this study provides additional evidence that we need to further strengthen teacher preparation by using strategies that can make meaning, connect science practices, and with intentionality help our future elementary teachers develop as globally competent educators. We as science educators are aware that science/STEM instruction is not a priority in many of our partnering elementary schools as strategically using literacy block with children's books has great potential. The ISE intervention demonstrates that global competency development need not compete with rigorous STEM content learning—rather, when thoughtfully integrated, these goals can reinforce one another. As our world grows increasingly interconnected and our classrooms more diverse, preparing teachers who can navigate cultural boundaries, design culturally informed instruction, and foster global citizenship becomes essential rather than optional. The shifts we document—from surface-level awareness to pedagogical integration, from reactive accommodation to proactive planning, from passive learning to lifelong inquiry—suggest that methods courses can serve as powerful sites for dispositional transformation when we deliberately design them with this purpose. If we are to prepare teachers capable of educating the next generation of global citizens, we must ensure that global competencies are found throughout our teacher education preparation programs rather than treated as enrichment.

The authors received no financial support for the research, authorship, and/or publication of this manuscript.

Peter Kalenda (pkalenda@geneseo.edu) is an assistant professor of Childhood STEM Education at SUNY Geneseo. His areas of research include technology integration in STEM methods courses and program evaluation of informal science education programs.

Sumreen Asim (sasim@iu.edu) is a Professor of Science and Technology Education at Indiana University Southeast, where she teaches both undergraduate and graduate courses. With over two decades of experiences, she is dedicated to fostering meaningful connections with educators through collaboration, mentorship, and a shared passion for learning.

References

- Adam, H., & Barratt-Pugh, C. (2020). "The challenge of monoculturalism: What books are educators sharing with children, and what messages do they send?," *Australian Educational Researcher*, 47(5), 815–836. <https://doi.org/10.1007/s13384-019-00375-7>
- American Council on Education. (2018). *Comprehensive internationalization: A model for colleges and universities*. American Council on Education.
- Ansberry, K., & Morgan, E. (2010). *Picture-perfect science lesson, expanded 2nd edition: Using children's books to guide inquiry*, 3–6. Arlington, VA: NSTA Press.
- Ansberry, K., & Morgan, E. (2022). *Picture-perfect STEM lessons, grade 1: Using children's books for three-dimensional learning*. Arlington, VA: NSTA Press.
- Ansberry, K., & Morgan, E. (2023). *Picture-perfect STEM lessons, grade 2: Using children's books for three-dimensional learning*. Arlington, VA: NSTA Press.
- Asim, S., & McDonald, J. (2023). Reframing elementary science methods courses using literature to bring in a global perspective. In G. A. Buck, V. Dimitrieska, & V. L. Akerson, (Eds.) *Internationalizing rural science teacher preparation* (Contemporary Trends and Issues in Science Education, Vol 58. Springer. https://doi.org/10.1007/978-3-031-46073-9_5
- Boix-Mansilla, V., & Schleicher, A. (2022). *Big picture thinking: Educating for global competence—principles and practice* (1st ed.). OECD.
- Bybee, R. (2014). The BSCS 5E instructional model: Personal reflections and contemporary implications. *Science and Children*, 51(8), 10–13. https://doi.org/10.2505/4/sc14_051_08_10
- Byker, E. J. & Putman, S. M. (2019). Catalyzing cultural and global competencies: Engaging preservice teachers in study abroad to expand the agency of citizenship. *Journal of Studies in International Education*, 23(1), 84–105. <https://doi.org/10.1177/1028315318814559>
- Clandinin, D. J., & Rosiek, J. (2007). Mapping a landscape of narrative inquiry: Borderland spaces and tensions. In D. J. Clandinin (Ed.), *Handbook of narrative inquiry: Mapping a methodology* (pp. 35–75). SAGE. <https://doi.org/10.4135/9781452226552.n2>
- Creswell, J. W. (2014). *Research design qualitative, quantitative and mixed methods approaches* (4th ed.). SAGE.
- Creswell, J. W., & Plano Clark, V. L. (2018). *Designing and conducting mixed methods research* (3rd ed.). SAGE.

- Daemickle, S. M. (2021). *Tu Youyou's discovery: Finding a cure for malaria*. Lee & Low Books.
- Dašnes, N. (2024). *Save our forest!* (L. L. Bryn, Trans.; First American edition). Hippo Park.
- Dimitrieska, V. (2017). [Adapted survey based on *Global Competence Matrix by Asia Society, EdSteps and CCSSO*] [Unpublished raw data]. Indiana University.
- Educational Innovations, Inc. (2015). *Glo-Germ Classroom Kit* [Lesson plan]. Educational Innovations, Inc. https://cdn.commercev3.net/cdn.teachersource.com/downloads/lesson_pdf/GLO-210.pdf
- Engle, M. (2015). *Drum dream girl: How one girl's courage changed music*. Houghton Mifflin Harcourt.
- Freeman, L. (2007). An overview of dispositions in teacher education. In Diez, M. E., & Rath, J. (Eds.), *Dispositions in teacher education*, (pp. 3–29). Information Age Publishing.
- Ganeri, A. (2022). *Forest fighter: The story of Chico Mendes*. Crocodile Books, and Imprint of Interlink Publishing Group, Inc.
- Gay, G. (2000). *Culturally responsive teaching: Theory, research, and practice*. Teachers College Press.
- Gess-Newsome, J. (2002). Pedagogical content knowledge: An introduction and orientation. InJ. Gess-Newsome & N. Lederman (Eds.), *PCK and science education* (pp. 3–17). Kluwer Academic. <https://doi.org/10.1007/0-306-47217-1>
- Grady, J. S. (2019). Emotions in storybooks: A comparison of storybooks that represent ethnic and racial groups in the United States. *Psychology of Popular Media Culture*, 8(3), 282–295. <https://doi.org/10.1037/ppm0000185>
- Griffith, E. (2021). *Secrets of the sea: The story of Jeanne Power, revolutionary marine scientist*. Clarion Books is an imprint of Houghton Mifflin Harcourt Publishing Company.
- Harding, J., Hbaci, I., Loyd, S., & Hamilton, B. (2017). Integrating multicultural children's math books into kindergarten through sixth-grade classrooms: Preservice teachers' reflections. *The Teacher Educator*, 52(4), 386–407. <https://doi.org/10.1080/08878730.2017.1358784>
- Iverson, C. (2023). *Santiago saw things differently: Santiago Ramón y Cajal, artist, doctor, father of neuroscience* (L. Lozano, Illus.). Creston Books.
- Kopish, M. (2017). Global citizenship education and the development of globally competent teacher candidates. *Journal of International Social Studies*, 7, 20–59.
- Kuswendi, U., Wulandari, M. A., Ariawan, V. A. N., & Firdaus, A. R. (2024). The effect of ICT digital picture storybook learning on the global diversity dimension of fourth-grade elementary students. *PrimaryEdu: Journal of Primary Education*, 8(2), 84–95. <https://doi.org/10.22460/pej.v8i2.5214>
- Lindstrom, C., & Peltier, A. (2023). *Autumn Peltier, water warrior* (First edition). Roaring Brook Press.
- Longview Foundation & LEARN NC. (2014). The globally competent teaching continuum. NAFSA. https://www.nafsa.org/sites/default/files/ektron/files/underscore/2016colloquia/2016_teachered_GCTC.pdf

- Luft, J. (1999). Rubrics: Design and use in science teacher education. *Journal of Science Teacher Education*, 10(2), 107–121. <https://doi.org/10.1023/A:1009471931127>
- Mahzoon-Hagheghi, M., Yebra, R., Johnson, R. D., & Sohn, L. N. (2018). Fostering a greater understanding of science in the classroom through children's literature. *Texas Journal of Literacy Education*, 6(1), 41–50.
- Márquez, M. C. (2023). *Mother of sharks*. Penguin Workshop, an imprint of Penguin Random House LLC.
- Martin, J., & Boston Museum of Science: Engineering is Elementary Team. (2006). Saving Salila's turtle: An environmental engineering story. Boston Museum of Science.
- McGinnis, P. (2020). From the editor's desk: Using literature in the science classroom. *Science Scope*, 44(2), 1.
- Menon, D., & Sadler, T. D. (2018). Sources of science self-efficacy beliefs for preservice elementary teachers in science content courses. *International Journal of Science and Mathematics Education*, 16(5), 835–855. <https://doi.org/10.1007/s10763-017-9813-7>
- Metcalf, L. H. (2020). *Beatrix Potter, scientist*. Albert Whitman & Company.
- National Research Council. (1996). National science education standards. National Academies Press. <https://doi.org/10.17226/4962>
- Orenstein-Cardona, A. (2022). *The tree of hope: the miraculous rescue of Puerto Rico's beloved banyan*. Beaming Books.
- Organisation for Economic Co-operation and Development. (2019). *PISA 2018 assessment and analytical framework* (PISA). OECD Publishing. <https://doi.org/10.1787/b25efab8-en>
- Ortega, M. (2023). *River of mariposas*. Cameron Kids.
- Palmer, D. (2006). Sources of self-efficacy in a science methods course for primary teacher education students. *Research in Science Education*, 36(4), 337–353. <https://doi.org/10.1007/s11165-005-9007-0>
- Pimm, N. R. (2020). *Fly, girl, fly!: Shaesta Waiz soars around the world*. Beaming Books.
- Ponners, P., & Asim, S. (2016). Beyond the classroom walls: Technology infusion changing STEM literacy. *Delta Kappa Gamma Bulletin*, 83(1), 61–67.
- Prasetia, I. (2023). The effectiveness of picture story book application towards understanding cultural diversity in elementary school level. *International Journal of Elementary Education*, 7(2), 234–241. <https://doi.org/10.32934/jmie.v7i1.508>
- Privitera, G. J. (2024). *Statistics for the Behavioral Sciences* (Fourth edition). SAGE.
- Riley, S., & Meas, S. (2024). *Rats to the rescue: the unlikely heroes making Cambodia safe*. Millbrook Press, an imprint of Lerner Publishing Group, Inc.

- Roehrig, G. H., Kruse, R. A., & Kern, A. (2007). Teacher and school characteristics and their influence on curriculum implementation. *Journal of Research in Science Teaching*, 44(7), 883–907. <https://doi.org/10.1002/tea.20180>
- Rubie-Davies, C. M., Flint, A., & McDonald, L. G. (2012). Teacher beliefs, teacher characteristics, and school contextual factors: What are the relationships? *British Journal of Educational Psychology*, 82(2), 270–288. <https://doi.org/10.1111/j.2044-8279.2011.02025.x>
- Sackes, M., Trundle, K. C., & Flevares, L. M. (2009). Using children’s literature to teach standard-based science concepts in early years. *Early Childhood Education Journal*, 36(5), 415–422. <https://doi.org/10.1007/s10643-009-0304-5>
- Saldaña, J. (2021). *The coding manual for qualitative researchers* (4th ed.). Sage Publications.
- Salmon, A. K., Perez-Prado, A., Morrison, K., & Iuspa, F. (2024). Children’s literature aligned with SDGs to promote global competencies: A practical resource for early childhood education. Springer. <https://doi.org/10.1007/978-3-031-57128-2>
- Sawler, S. (2023). *When the ocean came to town*. Nimbus Publishing.
- Seneca Park Zoo (2016). *Grade 3 waters around the world expedition: Pollution in the well lab experience* [Lesson Plan]. Seneca Park Zoo.
- Singh, R. (2023). *The forest keeper: The true story of Jadav Payeng*. NorthSouth Books, Inc.
- Skeers, L. (2020). *Dinosaur lady: The daring discoveries of Mary Anning, the first paleontologist*. Sourcebooks Explore.
- Slade, S. (2021). *June Almeida, virus detective!: The woman who discovered the first human coronavirus*. Sleeping Bear Press.
- Slapac, A. (2021). Advancing students' global competency through English language learning in Romania: An exploratory qualitative case study of four English language teachers. *Journal of Research in Childhood Education*, 35, 231–247. <https://doi.org/10.1080/02568543.2021.1880993>
- Soundar, C. (2021). *Sona Sharma, looking after planet Earth* (First U.S. edition). Candlewick Press.
- Subramaniam, K., Asim, S., Lee, E.Y., & Koo, Y. (2018). Student teachers’ images of science instruction in informal setting: Focus on field trip pedagogy, *Journal of Science Teacher Education*, 29(4), 307–325. <https://doi.org/10.1080/1046560x.2018.1452531>
- Tentler-Krylov, V. (2020). *Building Zaha: The story of architect Zaha Hadid* (First edition). Orchard Books, Scholastic Inc.
- Thamizhmani, L. (2023). *Ganesha goes green*. Barefoot Books.
- Thomas, M. (2021). Toward a framework for assessing the 'global' and 'citizen' in global citizenship education in Australia and beyond. *Globalisation, Societies and Education*, 19(4), 496–509. <https://doi.org/10.1080/01596306.2020.1843113>
- Tree, I. (2022). *When the storks came home*. Ivy Kids.

- UNESCO. (2015). Global citizenship education: Topics and learning objectives. UNESCO.
- United Nations. (2018). The 2030 agenda and the sustainable development goals: An opportunity for Latin America and the Caribbean (LC/G. 2681-P/Rev. 3). <https://sdgs.un.org/goals>
- Ursa, M. (2018). Storybooks as a way to improve language and cultural literacy. *Philologica Jassyensia*, XIV(1), pp. 255–265.
- Valdez, P. (2023). *Joan Procter, dragon doctor: The woman who loved reptiles* (First Dragonfly Books edition). Dragonfly Books, an imprint of Random House Children's Books, a division of Penguin Random House, LLC.
- Voogt, J., Erstad, O., Dede, C., & Mishra, P. (2013). Challenges to learning and schooling in the digital networked world of the 21st century. *Journal of Computer Assisted Learning*, 29(5), 403–413. <https://doi.org/10.1111/jcal.12029>
- Wilson-Max, K. (2022). *Eco Girl* (First US edition). Candlewick Press.
- Winter, J. (2017). *The world is not a rectangle: A portrait of architect Zaha Hadid*. Beach Lane Books.
- Witt, A. (2023). Postpandemic futures of global citizenship education for preservice teachers: Challenges and possibilities. *Prospects*, 53(3), 299–312. <https://doi.org/10.1007/s11125-022-09599-5>
- Wuryandani, W. (2020). Development of picture storybook about cultural diversity and patriotism characters in elementary schools. *Universal Journal of Educational Research*, 8(11), 5157–5167. <https://doi.org/10.2991/assehr.k.201221.053>
- Yasuda, A. (2024). *Up, up, ever up!: Junko Tabei: A life in the mountains* (First edition). Clarion Books, an imprint of Harper Collins Publishers.
- Yigit-Gencten, V., & Uyar, R. O. (2025). Exploring children's voices on picture books through the lens of joy. *The Reading Teacher*, 79(4), 1–14. <https://doi.org/10.1002/trtr.70031>
- Yoon, B. (2022). How does children's literature portray global perspectives? *Journal of Global Education and Research*, 6(2), 206–222. <https://doi.org/10.5038/2577-509X.6.2.1090>