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Bridging Inquiry-Based Science Learning through Children's Literature: A Case Study of an Initial Teacher Certification Program

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ABSTRACT

This case study explores the integration of children's literature in science education, with a focus on engaging preservice teachers in a science methods course to select, locate, design, and implement the integration of children's literature in their instructional practices. Sixty-four elementary preservice teachers in an initial teacher certification program in the central US participated in this study. The comprehensive written and oral reflections captured in this study offer insights into preservice teachers' attitudes towards using children's literature to teach science and the challenges they encounter in book selection and pedagogical decision-making. Our findings highlight a significant contrast between preservice teachers' initial skepticism, marked by questions, concerns, and hesitance, and their positive feedback after engaging in the process of selecting, designing, and implementing science lesson plans incorporated with carefully selected children's literature pieces. Our study confirms the valuable role of children's literature in science teaching, particularly within the context of a science methods course for preservice teachers. It also aligns with Flick and Lederman's (2006) perspective on scientific inquiry as an instructional strategy. The identified gaps in preservice teachers' skills also emphasize the pressing need for professional development, such as workshops or training sessions, which specifically focus on developing their skills in selecting and locating children's literature pieces that could be incorporated in inquiry-based science lesson plans.

Keywords: Inquiry-based science, children's literature integration, preservice teachers' perspectives

Introduction

In the 21st century, what kind of competencies are needed for the new phase of globalization? As educators and teachers, we are facing a pressing problem: how can we better help students develop inquiring minds when they are learning different content knowledge, so that our students can become competent global citizens in the 21st century?

There is an urgent need for integrated STEM education (science, technology, engineering, and mathematics). Many reports issued by influential education, policy, and business groups have emphasized the importance of expanding or improving STEM education for globalization (Honey et al., 2014). In an era of technology development and innovation, a STEM-literate citizenry is not only the future workforce in the globalized market, but also the backbone of a nation's productivity and innovative capacity. In other words, a STEM-literate citizenry is closely linked with a nation's prosperity and competitiveness in the world (Carnegie Corporation Report, 2009; Gonzalez & Kuenzi, 2012; Kuenzi, 2008). However, there is also a growing concern in the US, due to the low math and science achievement of American students in the Program for International Student Assessment (PISA), and the lower proportion of STEM degrees in the US compared with other countries (Kuenzi, 2008).

To scaffold integrated STEM education, the use of children's literature emerges as an effective pedagogical practice. Children's literature, widely recognized for its effectiveness in teaching various content knowledge (Hanuscin et al., 2011; Larson & Rumsey, 2018; Saul & Dieckman, 2005; Spencer & Guillaume, 2011), aligns with the developmental stages of young learners (Heisey & Kucan, 2010; Stadler & Ward, 2005). It sparks interest and curiosity (Sackes et al., 2009; Salehjee, 2020),and plays a crucial role in reducing learning-related anxiety (Furner, 2018; Morrow et al., 1997), and thus cultivates a positive approach to education (Wadham & Young, 2015).

In addition, the value of children's literature in facilitating the understanding of inquiry-based content knowledge has long been emphasized by scholars (Howe, 1993; Zeece, 1999). Scholars and educational organizations, such as the National Council of Teacher of Mathematics (NCTM), National Science Teaching Association (NSTA), the National Council on the Teaching of Social Studies (NCSS), and others, support the integration of children's literature in various subjects (Tunks et al., 2015). For instance, in mathematics education, it not only meets instructional recommendations but also helps children achieve mathematics proficiency (Green et al., 2018). Additionally, quality children's literature in social studies provides students with a holistic perspective of historical events (Manak, 2012) and increases students' understanding of the importance of history (Palmer & Burroughs, 2002). Likewise, in science education, children's literature not only serves as an inquiry tool for active learning but also aids in developing inquiring minds and understanding the nature of science (Ford, 2004; Fredericks, 2008; Hanuscin et al., 2011; Lederman, 2014; May et al., 2020). It facilitates authentic scientific explorations by encouraging students to observe, pose questions, listen to different perspectives, and provide their understanding of phenomena (Hachey et al., 2022). The dynamic nature of science, as emphasized by the National Research Council (2000), necessitates a constructivist model (May et al., 2020), aligning with the 5E approach to science education (Bybee, 2019; Lederman, 2014).

To integrate children's literature in the content area study, teachers first must be familiar with a wide range of literature and be able to make selections suitable for the students (Tunks et al., 2015). Therefore, there is a pressing question: what kind of children's literature qualifies as quality literature and should be selected? Selecting appropriate literature poses a challenge even for experienced teachers because it involves many factors. In addition to genre and content, the physical property such as visual features are crucial elements for consideration (Crowther et al., 2005; Donovan & Smolkin, 2002; Sackes et al., 2009). The selection process could be even more daunting for preservice teachers due to their limited and developing content knowledge. Additionally, preservice teachers are often left

with few opportunities to explore the possibility of applying strategies outside their area of specialization (Krajcik & Sutherland, 2010). The selection process is also formidable because it involves considerations related to the accuracy of the scientific content, quality of the writing and organization, age appropriateness of subject matter and explanations, and the diversity of gender and ethnicity.

To explore the challenges which preservice teachers face in their attempts to integrate children's literature in inquiry-based science lessons, this article reports the findings of a qualitative study that examines preservice teachers' reasonings for literature choices. This study was guided by the following research questions:

1. How do elementary preservice teachers locate, select, and use children's literature within their inquiry-based lessons, and what rationales do they use in making their selections?
2. What are the convictions of preservice teachers after their experience with the use of children's literature in inquiry-based science lessons?

Literature Review

The Transformative Influence of Children's Literature on Learning, Motivation, and Futures

Over the years, there is a lasting recognition of the effectiveness of children's books in introducing abstract and challenging concepts, offering captivating storylines and colorful pictures, which is different from traditional textbooks (Butzow & Butzow, 2000; Ford, 2004, 2006; Rice, 2002).

Widely acknowledged for its role in teaching various content knowledge (Hanuscin et al., 2011; Larson & Rumsey, 2018; Morrow, Pressley, Smith, & Smith, 1997; Saul & Dieckman, 2005; Spencer & Guillaume, 2011), children's literature serves as a power tool for teachers to present challenging concepts and content knowledge in engaging narratives. Aligned with the development needs of young minds (Heisey & Kucan, 2010; Stadler & Ward, 2005), children's literature plays a pivotal role in alleviating anxiety about learning (Furner, 2018; Morrow et al., 1997) and consequently, cultivates a positive attitude towards learning (Wadham & Young, 2015). This significance lies in its impact on shaping students' perspectives on learning, closely related to their motivation (García et al., 2016), therefore influencing their academic achievements (Green et al., 2018). Such influence may endure in their higher-level studies and even extend to shaping their future career choices (Hackett & Betz, 1995).

Integration of Children's Literature across Inquiry-Based Content Areas

Enabling teachers to present challenging concepts in engaging narratives, children's literature has long been a powerful tool for enhancing inquiry across diverse content areas, promoting active exploration and understanding (Ansberry & Morgan, 2010; Ford, 2004; Fredericks, 2008; Howe, 1993; Lederman, 2014; Lynch-Brown et al., 2011; Mahzoon-Hagheghi et al., 2018; May et al., 2020).

Children's literature, including non-fiction science books, fiction, and poetry, can be used as a literacy tool to support the inquiry learning of content knowledge (Rice, 2002). This explains why integrating children's literature in inquiry-based content areas such as mathematics, social studies, and science is supported by literacy scholars and professional education organizations, including the NCTM, the National Council of Teachers of English (NCTE) (Tunks et al., 2015), the NCSS, and NSTA.

In mathematics education, children's literature not only meets current instruction recommendations by the National Association for the Education of Young Children (NAEYC) and the NCTM but also helps children achieve mathematics proficiency (Green et al., 2018). The NCTM

supports using children's literature to present mathematical concepts because such instruction helps students to see mathematics constructs from a different point of view (Tunks et al., 2015). Furthermore, the NCTM reports that the integration of children's literature within the mathematics class has helped students achieve five goals, including one: students understand the value of mathematics; two: students are confident in their mathematical abilities in their daily dealing with math; three: students develop mathematical problem-solving skills; four: students learn mathematical symbols and ideas to communicate with peers, and five: students acquire reasoning skills (Nesmith, 2008).

Likewise, integrating quality children's literature into the social studies class provides students with a more holistic perspective of historical events (Manak, 2012). Children's literature is a powerful and proven learning tool to stimulate the interest and imagination of young people and foster students' understanding of the importance of history (Palmer & Burroughs, 2002). Additionally, research shows that students' interest in history and their understanding and retention of information increase when literature is integrated as an instructional tool (Palmer & Burroughs, 2002).

Children's Literature as an Inquiry Tool for Science Education

When talking about science education in schools, scholars emphasize the importance of acquiring scientific literacy that is "developmentally appropriate and understandable" (Lederman & Lederman, 2019, p.1) for students at all levels. They assert that this acquisition equips students to make informed decisions regarding scientifically-based issues (Brunner & Abd-El-Khalick, 2020; Lederman et al., 2014; Lederman & Lederman, 2019). In essence, achieving scientific literacy involves more than just knowing the concepts, laws, and theories. Students must also understand the nature of science, recognizing that science is a "human enterprise" (Lederman et al., 2014, p. 288) shaped by human creativity, inference, beliefs, prior experiences, and social and cultural factors, which renders scientific knowledge tentative and evolving (Lederman et al., 2014).

In addition, to be scientifically literate, students also need to develop an understanding of how scientific knowledge is developed through scientific inquiry (Abd-El-Khalick, 2002; Brunner & Abd-El-Khalick, 2020; Lederman et al., 2014; Lederman & Lederman, 2019). Flick and Lederman (2006) explain that scientific inquiry, as mentioned in the National Science Education Standards (National Research Council [NRC], 1996) embodies several dimensions. First, it serves as a foundational principle guiding contemporary scientific practices. Furthermore, it refers to the processes and ways of thinking that facilitate the development of new knowledge. Additionally, scientific inquiry also pertains to an understanding of how to acquire knowledge about the characteristics of science, that is, the nature of science. By emulating, to a reasonable extent, the methods and procedures employed by scientists, students will acquire a deeper understanding of the nature of science and, consequently, a holistic understanding of science (Flick & Lederman, 2006). Beyond these aspects, scientific inquiry serves as an instructional strategy for teaching scientific disciplines. In this sense, scientific inquiry is expected to result in two student outcomes: the capacity to engage in scientific processes and the knowledge of the rationales behind (Flick & Lederman, 2006). This explains why "teaching science as inquiry" is a core principle for science education in the National Science Education Standards (Flick & Lederman, 2006, p.x).

In addition to the National Science Education Standards (NRC, 1996), inquiry-based teaching is also a prominent theme in national science education reform documents such as *Project 2061: Science for All Americans* (Rutherford & Alhgren, 1990), and the Next Generation Science Standards ([NGSS], NGSS Lead States, 2013). The NGSS aims to assure a strong foundation of scientific knowledge embedded in all K-12 curricula, achieved through an integrated focus on science content, practices, and crosscutting concepts. Moreover, the NGSS demonstrates a profound alignment with the English Language Arts (ELA) Common Core Standards, establishing explicit connections between the skills

of reading and analyzing texts and the science practices of obtaining, evaluating, and communicating information (Mcginnis, 2020).

Mahzoon-Hagheghi and colleagues (2018) emphasize the potential of trade books to align with science content and NGSS science and engineering practices. They claim that trade books used in inquiry-based science teaching can serve as an engaging supplement to science content, facilitating the integration of NGSS practices into students' learning experience. Carefully chosen trade books not only enhance scientific understanding but also promote the development of students' narrative and analytical skills, contributing to the creation of a cohesive and comprehensive learning experience for students.

Children's literature, as a literacy tool, can also activate a student-centered approach to inquiry-based science teaching, aligning with the national science standards (Ansberry & Morgan, 2010; Mahzoon-Hagheghi et al., 2018). This alignment is further underscored by the continued integration of children's picture books in science teaching. This trend is exemplified by the recommendation of the outstanding children's science trade books each year by the NSTA and The Children's Book Council (CBC) since 1973 (Children's Book Council [CBC], 2020). Specifically, series such as *Picture-Perfect Science* series have been designed to facilitate the creation of engaging and comprehensible science lessons through the integration of picture books (Ansberry & Morgan, 2010).

Children's literature proves particularly valuable in elementary inquiry-based science education, because it can effectively employ the storyline, narrative forms, or colorful illustrations (Feathers & Arya, 2012) to not only communicate scientific knowledge to children in an interesting way but also involve them in inquiry learning (Ansberry & Morgan, 2010). For example, children can be invited to identify the scientific problems that characters in the stories encounter, discuss the ways that characters used to solve the problems, and even take on the roles of the characters and provide their own solutions (Hachey et al., 2022). This approach is especially beneficial in elementary science education, allowing students to actively participate in "developing, researching, and investigating questions of significance that are not easily tested with empirical experiments" (Ford, 2004, p. 286).

In this sense, children's literature functions as an inquiry tool, enhancing students' understanding of science by engaging them in the scientific processes (Ford, 2004). Some scholars have noted that learning science in isolation denied children the opportunity to understand the nature of science and scientific inquiry (Ford, 2006; Lederman, 2014; May et al., 2020). Through the processes of scientific inquiry facilitated by children's literature, children not only learn the science concepts and laws but also develop an understanding of the nature of science and the way of thinking that underlies the scientific knowledge (Abd-El-Khalick, 2002; Flick & Lederman, 2006; Lederman, 2014).

The use of children's literature as an inquiry tool in science education is noteworthy also because it aligns with the active student-centered approach emphasized in the national science standards (Ansberry & Morgan, 2010; Mahzoon-Hagheghi et al., 2018). As previously mentioned, science is a "human endeavor" (National Research Council [NRC], 2000, p. xiii) to understand the natural and material world, characterized by its evolving and subjective nature. Scientific knowledge is crafted through scientists' creativity, inferences, and interpretations based on their observation of the empirical studies (Brunner & Abd-El-Khalick, 2020; Lederman et al., 2014). Therefore, from a pedagogical perspective, the "dynamic nature" of science (May et al., 2020, p. 399) calls for a constructivist model of science education. In a constructivist learning environment supported by children's literature, children actively engaged in the process of exploring and constructing their knowledge about science concepts, the nature of science, and the nature of scientific inquiry (Ford, 2004; Fredericks, 2008; Lederman, 2014; May et al., 2020).

In conclusion, the integration of children's literature as an inquiry tool in elementary science education aligns with the goal of cultivating scientific literacy and promoting the active student-centered approach advocated by national science standards. Through the use of carefully selected trade books, educators not only foster their literacy skills in reading and writing, but also enrich students'

scientific understanding. This approach creates a comprehensible and engaging learning experience, facilitating the exploration of science concepts and theories. Consequently, it contributes to the development of an understanding of the dynamic nature of science in the process of scientific inquiry.

Theoretical Framework

In this study, the 5E model (Engage, Explore, Explain, Elaborate, and Evaluate) serves as the guiding instructional framework for the integration of children's literature in science education. This model, rooted in constructivism, is widely acknowledged in the field of science education (Singh & Yaduvanshi, 2015; Taylor et al., 2015; van Garderen et al., 2020). Developed by the Biological Science Curriculum Study (BSCS) led by Rodger Bybee, the 5E model provides teachers with a structured approach to scaffold meaningful learning experiences for students (Bybee, 2014). Adopting a constructivist perspective (Duran & Duran, 2004), the 5E model encourages students to become active agents in their science learning, fostering an environment where they can generate scientific knowledge in an interactive environment, make their predictions, draw inferences, propose hypotheses, and develop their own solutions to scientific problems.

This constructivist pedagogy, centered around the 5E model, positions students as active participants in the process of scientific inquiry. Through engagement in the 5E phases, students move beyond the acquisition of dead facts, gaining a profound understanding of the dynamic nature and development of scientific knowledge (Bybee, 2019; Lederman, 2014). This approach promotes a deeper connection between scientific concepts and real-world applications, emphasizing critical thinking and problem-solving skills in the context of authentic learning experiences (Nesmith & Cooper, 2021; Weng et al., 2022).

Methodology

Research Context and Participants

This case study was conducted in an initial teacher certification program at a private university in the central United States. The principle of purposeful sampling was adopted because all sixty-four elementary preservice teachers in this program participated in this study and the purpose of the study was to examine preservice teachers' text selections (Creswell, 2012). All preservice teachers were in their junior year and were enrolled in their required mathematics and science methods courses: forty were first-semester juniors and twenty-four second-semester juniors who had completed their social studies/English language arts methods and practicum courses in the previous semester. Additionally, the preservice teachers were concurrently enrolled in a field experience course wherein they designed and taught mathematics and science lessons, based on methods course requirements, throughout the semester.

During the science methods course, the preservice teachers were exposed to lessons and strategies which aimed at establishing the connection between science and children's literature, including trade books, and other forms of literature such as poetry. Most trade books used in this course contained short passages, some being narratives while others were more didactic. All literature pieces shared throughout the semester-long course involved science content, either implicitly or explicitly (See Table 1). These trade books also contained a predominance of illustrations.

Table 1

Children's Literature Used, the Related Science Content, and Inquiry Activity Conducted

Preservice teacher	Children's Literature Used	Related Science Content	Inquiry Activity
1	Red Leaf, Yellow Leaf by Lois Ehler	Special characteristics of fall plants	Engage
2	Is your mama a Llama, by Deborah Guarino	Inherited Traits	Engage
3	Whose Feet Are These? By: Wayne Lynch	Animal Adaptations	Engage
4	The Tiny Seed by Eric Carle	The concept that not all plants come from seeds	Engage
6	The Windy Day by G. Brian Karas	Wind power & renewable resources	Engage
7	The Runaway Pumpkin by Kevin Lewis	Rolling	Engage
8	Light: Shadows, Mirrors, and Rainbows by Natalie M. Rosinsky	Light Energy	Engage
9	Gotcha! By Jennifer Dussling. The Remarkable Farkle McBride	Force of Magnetism	Engage
11	When Charlie McButton Lost Power by Suzane Collins	Electricity, more specifically battery voltage	Engage
12	Snowball by Shef Silverstein; Pancakes, Pancakes! By Eric Carle; Water is Water by Miranda Pa	Heat Energy; Water	Elaborate; Engage
13	Chicken Little by Steven Kellogg	Gravity	Engage
14	The Remarkable Farkle McBride by John Lithgow	Sound	Engage
15	If You Find a Rock by Peggy Christian; Let's Go Rock Collecting by Roma Gans	Rocks	Engage; Explain
16	Why Do I Have To Wear Glasses? By Greg Williamson	Refraction	Engage
17	One Bear Lost by Karen Hayles and Jenny Jones; Fiesta! By Katacha Diaz	Movement; How to describe the location of an object	Engage
18	Gotcha! By Jennifer Dussling; Nature's Treasures	Magnets; The Natural World	Engage; Elaborate; Explain

Table 1 (continued)

19	Move It! By Adrienne Mason	Motion and Force	Engage
20	One Bear Lost by Karen Hayles and Jenny Jones	Movement	Engage
21	Dirt, by Steve Tomecek and Spenser; Rocks, by Lawrence F. Lowery	The concept of soil and rocks	Engage
22	Who Sank the Boat; Sheep in a Jeep	Force (push/pull)	Engage
23	Move! By Steve Jenkins and Robin Page	Motion and Movement	Engage
24	Pancake, Pancakes! By Eric Carle as my piece of literature	Physical and Chemical Change	Engage
25	The Magic School Bus; Wet All over by Mike Guillory	The Water Cycle	Engage
26	The Snowflake: A Water Cycle Story by Neil Waldman	The Water Cycle	Engage
27	A Cornfield by Julia Ward; Modern Biomass by Joyce Hemsley	Biomass as an Alternative Source of Energy	Engage
28	Drop Goes Plop: First Look at the Water Cycle: Sam Godwin	Precipitation	Engage
29	The Tiny Seed by Eric Carle	The Four Seasons and how they affect plant life	Engage; Explore; Elaborate
30	Switch On, Switch Off by Melvin Berger	Electrical Circuits; Parallel and Series Circuits	Engage
31	The Giving Tree by Shel Silverstein	Renewable and Non-renewable Resources	Engage
32	Roller Coaster by Marla Frazee	Motion and how incline affects how fast something goes	Engage
33	The Lorax by Dr. Seuss	Recycling and Resources; Helping the environment	Engage
34	When Charlie McButton Lost Power by Suzanne Collins and Mike Lester	Electric Circuits specifically battery voltage	Engage
35	The Magic School Bus: Lost in the Solar System by Joanna Cole	Solar System and individual planets' characteristics	Engage

Table 1 (continued)

36	The Plop Goes Drop: A First Look at the Water Cycle, by Sam Godwin	Patterns in the natural world among objects in the sky; Water Cycle	Engage
37	Aunt Chip and the Triple Creek Dam Affair	Power of Water; Alternative Energy	Engage
38	When Charlie McButton Lost Power; Newton and Me	Battery Voltage and Energy; Push and Pull, Friction and Motion	Engage
39	The Wind Blew by Pat Hutchins	Energy	Engage
40	Wet All Over by Patrick Relf	Steps of the Water Cycle	Engage
41	Is Your Mama a llama by Deborah Guarino	Inherited Traits	Engage
42	What's For Dinner by Katherine Hauth	Producers, Consumers, and Decomposers	Engage
43	This Book just Ate My Dog! by Richard Byrne	Producers, Consumers, and Decomposers	Engage
45	Bear Snores by Karma Wilson	Adaptations	Engage
46	Who Eats What? Food Chains and Food Webs by Patricia Lauber, Illustrated by Holly Keller	Food Chain; Food webs	Elaborate
47	Turtle, Turtle, Watch Out! By April Pulley Sayre	Food Webs	Engage
48	Animals in Winter by Henrietta Bancroft; Louie the Leaf by Jeff VanGetson	Hibernation of animals during the wintertime	Engage; Explain
49	I Wanna Iguana by Karen Kaufman Orloff; Summer Coat, Winter Coat by Doe Boyle	Classification and Characteristics of Animals; Animal Adaptations	Elaborate; Explain
50	From Caterpillar to Butterfly by Deborah Heiligman	The Stages of Complete and Incomplete Metamorphosis of Insects	Engage
51	What Do You Do With a Tail Like This? by Steve Jenkins and Robin Page	Adaptations	Elaborate
52	Growing Frogs by Vivian French	Amphibians, and their life cycle	Explore
53	Is a Camel a Mammal? by Dr. Seuss	Amphibians, and their life cycle	Engage

Table 1 (continued)

54	The Reason For a Flower by Ruth Heller	Organisms and the environment; How pollinators work with their environment to pollinate plants and flowers	Explain
55	Wild & Wooly by Mary Jessie Parker	Organisms and Environments	Engage
56	Pass the Energy, Please. By Barbara Shaw McKinney	Organisms and Environments	Engage
58	Froggy Learns to Swim by Jonathon London	Amphibians, including frogs	Engage
59	Leaf Man by Lois Ehlert; Pumpkin Circle: The Story of a Garden by George Levenson	Amphibians, including frogs; Ecosystem and how humans have an impact and create consequences within the ecosystem	Engage
60	The Lorax, by Dr. Seuss	Ecosystem and how humans have an impact and create consequences within the ecosystem	Explain
61	The Lorax" by Dr. Seuss	Ecosystems	Explain
62	Animal Teachers by Janet Halfmann	Learned behaviors by different animals	Engage
63	Where in the Wild: Camouflage Creatures Concealed and Revealed by David M. Schwartz, Yeal Schy, and Dwight Kuhn	Adaptations of plants and animals	Engage
64	If I had Duck Feet by Dr. Seuss	Adaptations	Elaborate

At the beginning of each semester, there was a presentation that exemplified seven ways of integrating children's literature in science, as revised by Welchman-Tischler (1992) who focused on the use of children's literature in mathematics instruction. The aim of the presentation was to provide preservice teachers with a comprehensive framework for incorporating children's literature into elementary science teaching. These seven ways of integration that were introduced to preservice

teachers include: (a) provide a context, (b) introduce tools of science, (c) model a creative experience, (d) pose an interesting problem, (e) prepare for a concept or skill, (f) develop a concept or skill, and (g) provide a context for the review.

Throughout the semester, the methods course professor chose several pieces of children's literature and modeled to the preservice teachers the different ways of integrating them into elementary science instruction. One strategy the professor used was to engage the preservice teachers in science activities inspired by the children's literature so that they would have personal experiences connecting literature with science content. For example, after reading *Who Sank the Boat* (Allen, 1996), the preservice teachers were asked to build and launch aluminum foil boats of different shapes and sizes to build their understanding of the concepts of floating and sinking.

In their field experience course, preservice teachers were given the autonomy to choose whether to integrate children's literature into their lesson plans, and if they chose to do so, they would design the lesson plans accordingly. While the seven integration strategies were presented as valuable tools, preservice teachers were not mandated to use a specific strategy, allowing for flexibility and individualized approach in integrating children's literature into their teaching practices. An example lesson plan in which children's literature was integrated is provided in the Appendix.

Before implementing the teaching plans, a literacy-content specialist provided preservice teachers with resources on graphic organizers and ways to select appropriate literature based on the goals of the lesson. The integration of children's literature occurred in elementary school classrooms where students were enrolled in grades three-five and the time of the integration depended on the semester of the in-service teacher.

It should also be noted that the methods employed in this study are grounded in previous successful implementations of children's literature in similar science methods contexts (Nesmith et al., 2017).

Procedures

The most appropriate design for this investigation was the qualitative, naturalist paradigm because the research method allows for an investigation relative to how individuals react in and to the world around them as they construct a personalized meaning to that particular world. As posited by Lincoln and Guba (1985), only through holistic, contextually situated inquiry emphasizing processes, meanings, and the qualities of entities, can an understanding of those realities be determined with any degree of trustworthiness. The research design used for this article fits the characteristics and the process of naturalistic inquiry. Armstrong (2010) outlined eight basic processes of the naturalistic inquiry which include the following common sequence of steps:

1. Gaining access to and entering the field site
2. Gathering data
3. Ensuring accuracy and trustworthiness (verifying and cross-checking findings)
4. Analyzing data
5. Formulating interpretations
6. Writing up findings
7. Member checking (sharing conclusions and conferring with participants)
8. Leaving the field site (p. 881)

Additionally, we employed inductive analysis, a method characterized by the organic emergence of themes, categories, and patterns through the analysts' interactions with the data. This contrasts with deductive analysis, where data was analyzed based on a pre-existing framework (Patton, 2015).

Data Collection

Written Reflections

In this one-year study, the science methods course included a specific requirement for preservice teachers to incorporate children's literature into at least one science lesson during their elementary field experience. Preservice teachers were given autonomy in deciding whether they would integrate children's literature, and if they chose to do so, they would design their lesson plans accordingly. While the decisions regarding the content of the science lesson and the corresponding piece of children's literature were left to the preservice teachers, a collaborative process was established. The field-based classroom teacher participated by offering feedback and giving final approval to ensure the cohesion of the lesson with both course objectives and the practical requirements of the field experience.

Additionally, the preservice teachers were required to respond to a prescribed set of questions to guide their reflections of the literature integration experience. These questions involved various elements, including the planning and presentation of the literature-based science lesson. These questions were as follows: (a) What piece of literature did you use within the science lesson? (b) What science content did you address with the literature piece/lesson? (c) When did you integrate the literature piece and why was the timing a good choice? and (d) How and why did you choose the literature piece, and why was the literature piece a good choice?

Oral Presentations

At the end of each semester, during a scheduled science methods class, all preservice teachers were asked to discuss their literature experience with their course instructor and fellow preservice teachers. The discussions followed the same protocol for their writing reflections. In other words, the preservice teachers were required to respond to the prescribed four questions guiding their reflections on the literature integration experience. These discussions were facilitated with the same set of questions with the purpose of providing a consistent framework for preservice teachers to articulate their initial and evolving perspectives toward the strategy of literature integration.

The discussions were audio-recorded, transcribed, and verified. During the discussions, the preservice teachers responded to questions concerning their initial and ensuing perspectives toward the strategy of literature integration, possible reasons for changes in perspectives toward the strategy, and future plans for their pedagogical strategy.

Although class attendance was required of all preservice teachers, participation in the discussion was not a course requirement. A separate, distinct discussion occurred during each of two course sections each semester. During the discussions in the Fall semester, thirty three of the thirty-five preservice teachers provided oral reflections, and during the spring semester discussions, twenty one of the twenty-nine preservice teachers provided oral reflections. When examined in terms of first and second-semester juniors, thirty eight of the forty first-semester juniors provided oral reflections and sixteen of the twenty-four second-semester juniors provided oral reflections.

The researchers noted the discrepancy between the number of preservice teachers involved in the study and the number who participated in the discussions. However, the research described herein focused on the study and data components consistent for all sixty four of the preservice teacher participants: (a) all participants were required to plan and teach a science-focused lesson that incorporated a piece of children's literature; (b) all participants were required to reflect upon said lessons utilizing a prescribed set of questions; (c) all participants received instruction and support from

the same science methods course professor, and (e) all participants were invited to participate in a discussion that utilized a common protocol.

Additionally, the researchers considered the limited number of data sources and how the credibility of the study may have been strengthened through the triangulation of data with additional sources. However, in consideration of the nature of the participants' field teaching experience and concerning the time constraints of additional data collection points, the researchers felt the reflection data was strong in providing rich, thick descriptions of preservice teachers' thoughts, reflections, and experiences.

Data Analysis and Credibility

Researchers' Positionality

Each of the five researchers brought a unique perspective to the study: (a) elementary literacy methods course professor, (b) elementary science methods course professor, and (c) three curriculum and instruction doctoral students, each with unique experiences in English education. The five researchers are all in the teacher preparation program at the same university, but, as delineated above, only the science and literacy methods course professors had direct interactions with the preservice teacher participants, with the three doctoral students participating in data analysis following the intervention and data collection.

Triangulations and Intercoder Agreement

Data analysis is a process of reduction and condensation (Huberman & Miles, 2002). Numerous chunks of data are organized, coded, and categorized and then themes were generated after the pattern-matching process. The principle of triangulation was followed to ensure the credibility of the study (Stake, 1995; Creswell, 2005; Lincoln & Guba, 1985) because according to Lincoln and Guba (1985), "triangulation of data is crucially important in naturalistic studies" (p. 283). As Denzin (1978) recommended, we used two types of triangulations: method and investigator triangulation. First, in the data collection process, different methods were used, which involved gathering the participants' written reflections and oral presentations. The data collected through those methods were also verified with the participants. Second, there are five investigators for this research, two university professors and three doctoral students. All five investigators have unique perspectives about their academic specialty that enhanced the investigator triangulation during the research process.

Additionally, to mitigate researcher bias, data analysis was deferred until the conclusion of the spring semester. Each of the five researchers received word-processed copies of the oral reflection transcriptions and written reflections from the preservice teachers. To ensure the internal consistency, the researchers followed the procedures of intercoder agreement check recommended by Creswell and Poth (2017). They independently read several transcripts and reflections, individually conducted coding, and extracted verbal or written phrases consistent with the research questions.

Subsequently, the researchers came together to discuss the methodology for further analysis of the salient codes and developed a list of preliminary codes. After this, the researchers worked individually again, following the initial codebook to complete the coding for all data. After assessing the consistency of the codes done by the researchers independently to ensure that the intercoder agreement reached 85% as suggested by Miles, Huberman, and Saldana (2014), the researchers revised the codebook and abstracted codes into larger themes.

The generated themes were checked and matched until the researchers established themes and categories representing the entire data set. This method, incorporating constant comparison (Lincoln

& Guba,1985) and intercoder agreement check, significantly enhanced the reliability of this study (Creswell & Poth, 2017; Miles et al., 2014).

Findings

Driven by the interest in exploring the challenges that preservice teachers face when integrating children's literature into inquiry-based science lessons, the researchers aimed to address questions that could explain preservice teachers' perspectives and reasonings regarding the location, selection, and integration into science lessons. Additionally, the researchers sought to understand preservice teachers' convictions of their current and future application of integrating children's literature into inquiry-based science lessons. After collecting written reflections and oral presentations from the preservice teachers, we analyzed them using the principles of constant comparison (Lincoln & Guba,1985) and intercoder agreement check (Creswell & Poth, 2017; Miles et al., 2014), resulting in the identification of the following themes.

RQ1 Findings

The Impact of Personal Experience on Attitudes Towards Integrating Children's Literature

One of the themes that emerged from this study is the impact of prior learning experiences on preservice teachers' attitudes. The study revealed that the use of children's literature in the science methods course shaped preservice teachers' positive attitudes toward teaching, influencing their future decisions about instructional techniques.

When asked about their initial impressions of the use of children's literature in inquiry-based science lessons, most participants expressed excitement about their experience. Phrases such as "It's cool", "exciting", "interesting" or "a fun way of science" (e.g. in oral presentations of participant 31, 63, and more) were commonly used. The novel experience with the integration of children's literature in science lessons exceeded their expectations. Some participants even conveyed their surprise, saying "I had never thought about doing that before, so I thought that was really cool" (participant 25, oral presentation). Many preservice teachers were captivated by the creativity of this practice. They agreed that "it's a really fun, creative way to get students" and expressed their willingness, and even eagerness, to try using children's literature in their classroom instruction.

However, this study also revealed that, despite the professor's exemplary demonstration of integrating children's books into science teaching, there were still concerns and hesitance among the preservice teachers. The study involved sixty-four participants, all of whom had completed their social studies/English language arts methods and practicum courses in the previous semester. According to the participants' written reflections, five out of the 64 participants (7.81%) did not fulfill the requirement to integrate literature within their inquiry science lesson. However, the majority (92.19%) of participants used at least one piece of literature in their science classroom instruction.

These five preservice teachers either had an unintentional oversight or were possibly overwhelmed with lesson planning, not thinking to include literature within their lesson until reminded by the professor of the reflections being a part of their course requirements. It turns out that the textual content of the book was a primary concern. For example, some preservice teachers expressed concerns about the accuracy of the content. "Oh, fiction books aren't always correct" or questioning the effectiveness of the content knowledge, saying "You know if you think the *Magic School Bus,* they are kind of outdated information" (participant 24, oral presentation).

Concerns were also expressed regarding the pedagogical approach, even after the professor exemplified how to integrate children's literature into science lessons. One preservice teacher

admitted, "I was kind of confused." Despite the course instructor providing book suggestions, this preservice teacher still struggled to integrate literature appropriately. Additionally, a few preservice teachers, even if they used children's books in their lesson design, remained skeptical about the idea of integrating children's literature into science lessons. One preservice teacher shared, "I really was terrified and had no idea how to use literature in inquiry-based science because I didn't really think they went together at all, um, reading and inquiry."

However, this study also revealed how attitudes could be changed through personal experiences. Preservice teacher 41 shared how her experience with the use of children's literature changed her attitude toward science, saying, "That was something I was excited to bring into math and science because I think growing up, I didn't really like math and science as much." Preservice teacher 18 shared in the presentation how her initial reluctance was turned into a teachable moment, saying,

> Quite honestly, I thought putting literature in science and math was both kind of crazy, um, I thought it was unnecessary because like you already have learned doing so much hands-on, like I thought the hands-on was more useful than reading a book, but I found kind of an interactive book where the kids had to like look for the hidden animals that were camouflaged into the page and so they responded really well to it and wanted to read it again and it actually contributed a lot to their knowledge on the subject so then I kind of felt bad that I thought it was stupid at first because it worked really well so.

When discussing elementary children's experience in classroom science in the UK, Ward, Donna, and Mcnabb (2016) explored the impacts of children's attitudes on their experience and consequently on their study. They pointed out that affective learning involves feelings toward science, which might be positive, negative, or both. While positive feelings bring enjoyment to learners, negative feelings make them feel anxious and fearful about science. One reason for the popularity of using children's literature in various content knowledge learning is that books can ease anxiety and spark learners' interest and curiosity, not only aiding in the formation of positive attitudes toward learning but also potentially influencing their persistent interest in scientific study and even their future career choices (Furner, 2018; Hackett & Betz, 1995; Shapiro, 1995). Our study echoed these findings and confirmed that in affective learning, positive feelings and negative feelings can coexist (Ward et al., 2016).

Genre and Domain of the Books Selected by Preservice Teachers

Our findings confirmed Bandré's (2005) and Donovan and Smolkin's (2002) notion that genre is one important factor influencing preservice teachers' selection of children's literature. According to our data, a majority (68.12%) of participants used fictional texts, while some (26.09%) opted for non-fiction texts, and a few (5.80%) utilized the poetry genre. No major distinctions were noted between the decisions of the preservice teachers who had and had not previously completed the literacy methods course.

This study identified a disparity in the books selected by preservice teachers across the four domains of science. As presented in Table 2, more than two-thirds of the literature pieces chosen by the preservice teachers were related to Life Science (37%) and Physical Science (33.33%). A little bit less than one-third of the literature pieces chosen by the preservice teachers were related to Earth Science (26.09%), with a minimal proportion (2.90%) related to Space Science. While preservice teachers had considerable autonomy in making literature selections, the classroom teacher typically provided the specific content to be addressed in the lesson. Thus, some domain-specific literature choices were prescribed and outside of the preservice teachers' control.

The study also revealed that most literature pieces chosen by preservice teachers were implicitly related to the content taught in the classroom, except in the domain of Earth Science. In the domain of Life Science, 20.30% of the literature pieces chosen by the preservice teachers were implicitly related to the content taught, while 17.40% were explicitly (directly) related to the content taught. Regarding Physical Science, 26.09% of the literature pieces chosen by the preservice teachers were implicitly related to the content taught, while 7.25% were explicitly (directly) related to the content taught. Specific to Earth Science, the results revealed more direct relationships (17.40%) than implicit relationships (8.70%) between literature pieces chosen by preservice teachers and content taught.

Table 2

The Books in the Four Domains of Science Selected by Preservice Teachers (N=69)

Content Category	Number of Literature Pieces	Relation to Content taught	
		Explicit/Direct	Implicit
Life Science	26 (37.68%)	12 (17.40%)	14 (20.30%)
Earth Science	18 (26.09%)	12 (17.40%)	6 (8.70%)
Physical Science	23 (33.33%)	5 (7.25%)	18 (26.09%)
Space Science	2 (2.90%)	1 (1.45%)	1 (1.45%)

The Rationales Behind the Selection Choices

Entertaining and Engaging Contents

Our study revealed that preservice teachers prioritize the entertainment and engagement of the text when selecting literature for their instruction (See Table 3). Several preservice teachers explained their book selection, highlighting that the chosen literature was described as "very engaging," "a fun read,", and appropriate for their students' comprehension level. Preservice teacher 61 affirmed, "This book was a good choice, because my students were immediately drawn to the interesting pictures, and characters, and the interesting vocabulary of the story". Preservice teacher three shared, "[my students] were all excited, paying attention, and laughing and shocked when mystery animal was different than what they expected." Preservice teacher nine mentioned, "[the students] were able to interact with the story [in the book *Gotcha!*] as they made predictions." Preservice teacher 53 echoed this sentiment, stating, "the kids were actively engaged the whole time and loved looking at the cute illustrations." Additionally, preservice teacher three suggested, "Because it was very engaging, and I knew my students would like the guessing games aspect of the book."

Interesting stories from children's books not only stirred up students' interest but also encouraged their inquiry, as suggested by two preservice teachers. Preservice teacher 58 explained her reasoning:

> because the book definitely grabbed my students' attention and effectively engaged them. As soon as I got out the book, many of my kindergarteners immediately expressed excitement to begin reading and, thus, thinking about frogs. Since the book had a setting that included both water and land, it naturally led into the question of inquiry: Where do frogs and other amphibians live?

Preservice teacher one argued that her selection is a good one "because it would help spark the students' interest and would allow them to begin thinking about all of the different characteristics that each plant has."

Table 3

The Rationales Behind the Selection Choices

	Entertaining and Engaging Contents
Preservice teacher 61	This book was a good choice, because my students were immediately drawn to the interesting pictures, characters, and the interesting vocabulary of the story. Almost all of my students had seen the animated movie and they were familiar with [the] story. Since they had background knowledge of the book, it was interesting to see them engage with the story from a scientific perspective and learn and discuss about the true message of the book. After reading the story for a few minutes, they began to make connections from our discussion to the book and they did a really great job.
Preservice teacher 3	Using this book was a great choice because it got all of my students participating and engaged in my lesson. They were so excited to hear me read the next page of the book and get to guess what animal they thought it was based on the description of the feet. They were all excited, paying attention, and laughing/shocked when the mystery animal was different than what they expected.
Preservice teacher 9	I chose Gotcha! Because it was engaging for the students and also entertaining. They were able to interact with the story as they made predictions. It clearly explained magnetism and provided sidebars to break down difficult concepts.
Preservice teacher 53	This book was on their level and a fun read. The kids were actively engaged the whole time and loved looking at the cute illustrations. Like all Dr. Seuss books, some of the nonsense words went straight over their heads, but all in all they understood the concept and loved the different approach to science.
Preservice teacher 3	I chose this piece of literature after searching for different non-fiction books about adaptations, animal traits, and different animal feet. I ultimately chose this book because it was very engaging, and I knew my students would like the guessing game aspect of the book.
Preservice teacher 58	Because the book definitely grabbed my students' attention and effectively engaged them. As soon as I got out the book, many of my kindergarteners immediately expressed excitement to begin reading and, thus, thinking about frogs. Since the book had a setting that included both water and land, it naturally led into the question of inquiry: Where do frogs and other amphibians live?

Preservice teacher 1	For my science lesson, I would have used the book Red Leaf, Yellow Leaf by Lois Ehlert. This piece of literature would have been a good choice because not only is it a fun story about a little boy who planted a sugar maple tree, but it also allows the students to see the different stages that the tree goes through and the students could see the special characteristics that the tree had inherited and how they were even different from other types of trees. …because it would help spark the students' interest and would allow them to begin thinking about all of the different characteristics that each plant has.

Developmentally Appropriate and Easy-to-Understand Examples

Just as Zeece (1999) stated about choosing quality science-based books, the preservice teachers in this study considered factors such as whether the book provided clear and simple explanations of topics and at the same time made sure that the depth and breadth matched the developmental level of children. Preservice teacher 21 articulated, "there were colorful illustrations and vocabulary that the kids were able to comprehend. [The] books allowed for students' attention to be caught and stimulated their brains for the rest of the lesson." Preservice teacher 12, when discussing her choice of the book *Pancake, Pancake!*, expressed that it was "a good one" because "beautiful illustrations are relatable and entertaining." Similarly, preservice teacher nine elaborated on her selection of *Gotcha!* By stating it was "engaging for the students and also entertaining." Moreover, she detailed how her chosen book clearly explained magnetism and provided sidebars to break down difficult concepts.

The age appropriateness of the text and easy-to-understand examples were factors most often cited by the preservice teachers about their book choices. Some preservice teachers chose children's literature as part of their classroom instruction because they found the books were user-friendly with age-appropriate vocabularies, included interesting stories, and presented appealing and age-appropriate characters (See Table 4). Preservice teacher 23 asserted, "*Move!* was a great book to use because the vocabulary was simple for my second graders to understand, the pictures were easy to interpret, and it was concise." Preservice teacher 51 explained, "I chose this piece based upon the content we were studying as well as the age level appropriateness." Similarly, preservice teacher 15 stated in the written reflection about their book choice, saying "because it is developmentally appropriate for kindergarteners, and my students were able to relate to the story as they reflected on rocks that they have found in their own lives." Notably, preservice teacher 50, who didn't include children's literature in their instruction until they were reminded of the coursework requirement, imagined in her reflection that,

> This book would have been a good choice to use because this book had an interesting storyline with fun pictures and characters, and is filled with key vocabulary and a plot that would have made my students think about the science content.

Additionally, preservice teacher 58, who did use children's literature book, presented their reasons for such a choice, saying that "it was developmentally appropriate for my kindergarteners. The book has fairly simple vocabulary and syntax, and the length was short enough to match their attention spans."

Table 4

The Rationales Behind the Selection Choices

Easy-to-understand Examples and Developmentally Appropriate	
Preservice teacher 21	There were colorful illustrations and vocabulary that the kids were able to comprehend, but also both books allowed for students' attention to be caught and stimulate their brains for the rest of the lesson.
Preservice teacher 12	The book, Pancake, Pancake! was a good choice because the book was a big book, (so all the students could see the pictures), the illustrations were beautiful and engaging, and the book took you through the process of making pancakes. It shows how it is a batter and turns into a pancake. This shows how something can be a liquid and can change to a solid when heat is applied.
Preservice teacher 23	Move! Was a great book to use because the vocabulary was simple for my second graders to understand, the pictures were easy to interpret, and it was concise. The book had a lot of great "motion/action words' that we introduced to the students over the next two weeks of learning movement. There weren't a whole lot of words on every page, so students could easily read along and understand the purpose of the book during the lesson.
Preservice teacher 51	I chose this piece based upon the content we were studying as well as the age level appropriateness. This book was a great choice because it engaged my students and allowed them to really challenge themselves. The book would show a tail or a beak or a foot, etc. and ask who it belonged to. This gave the students an opportunity to take a guess and really think about what animals utilize the particular adaptation. They loved this. It was a game for them as well as a learning experience, and they were so proud of themselves when they would get it right.
Preservice teacher 15	This was a good choice because it is developmentally appropriate for kindergarteners, and my students were able to relate to the story as they reflected on rocks that they have found in their own lives.
Preservice teacher 58	I chose this particular book for a few different reasons. First, it was developmentally appropriate for my kindergarteners. The book has fairly simple vocabulary and syntax, and the length was short enough to match their attention spans. Also, the plot and illustrations would be interesting to them. Most importantly, though, I chose this book because it could lead into the concept I was teaching, which was the amphibian characteristic of living in water and on land. In this book, Froggy spends his time on dry land and in the water learning to swim.

Accurate and Relatable Content

Besides the age-appropriateness and user-friendly vocabularies and illustrations, the accuracy of the content was prioritized by preservice teachers. In this study, some of the preservice teachers picked their children's literature books because they discovered that those books represented accurate

information about the science content knowledge which they were to teach (See Table 5). The preservice teachers assessed the accuracy of the information based on their content knowledge.

Table 5

The Rationales Behind the Selection Choices

	Accurate and Relatable Content
Preservice teacher 17	This book was a good choice because the book was age-appropriate for my kindergarteners, and it provided a fun, colorful introduction to my lesson that got the students wondering how the bears were able to find the lost bear. Plus, I knew that my students loved talking about animals so I knew that this book would pique their interest. Fiesta! This book was a good choice because the books were colorful and very appealing to the students since it was huge and all about how the town was preparing for a party.
Preservice teacher 19	Force was the topic that I was covering that day and so this book was perfect for introducing the lesson. I was working with kindergarteners and I felt that this book was appropriate for their level, and it was also a fun book to read.
Preservice teacher 49	I also chose this book because I knew I would be able to tie in other animals and fully teach the concept of camouflage with this as a starting point for my students to draw from. Also, it was great for my ELL students because the illustrations show the process of camouflage so well.
Preservice teacher 8	I chose this book because I felt that it was a book that covered the topic of light very well. The reading level was at the perfect level for my students. The examples that were used throughout the book my students could relate to. It introduced vocabulary words that my students needed to know, and I liked how throughout the book there was an entire page of fun facts about light.
Preservice teacher 55	I read through it and found that not only are the illustrations cute, but the story is literally about the adaptations of two different sheep and I knew that it was the book I needed.
Preservice teacher 24	I used this particular piece of literature because it had examples of both physical and chemical changes throughout the book. The examples were relatable and a common experience for all students. They were able to connect our science subject to their own lives and apply it.
Preservice teacher 59	I found Leaf Man, with help from Analise, and thought it was perfect. The story was simple and age appropriate for my students, the character of Leaf Man was cute and lovable, and although the story was fictional, it accomplished the goal of my students looking at all types of real leaves (since there were drawings of many leaves in the book) and accessing their prior knowledge and their wonderings about leaves.

Preservice teacher 62 considered a book as a good choice for classroom reading "as it provided accurate information, sparking interest in the students, and a wide variety of content on this one particular topic". She continued to justify her choice of the book, indicating that,

> The book discusses many different examples of animals that have a variety of learned animal traits. The book accurately explains the behaviors these animals exhibit, and the information is communicated in an easily understood manner. The book also utilizes animals the students can relate with which gives room for students' interest to heighten.

The preservice teachers' attention to content accuracy may be specific to their utilization of the texts to build students' science content knowledge. For example, Tunks, Giles, and Rogers (2015) surveyed teachers' selections and uses of children's literature in reading classes. The criteria for the teachers' selections revealed an attention to ethical values and the opportunity for children to broaden their self-understanding and feelings, yet none of these criteria were not found in this study.

Aside from considering the books' developmental appropriateness and accuracy of the scientific content, the preservice teachers also stressed that the content or the topic they were able to teach was somewhat reflected in these literature books. For instance, preservice teacher 58 reasoned with her choice of the literature book,

> I chose this particular book for a few different reasons. First, it was developmentally appropriate for my kindergarteners. The book has fairly simple vocabulary and syntax, and the length was short enough to match their attention spans. Also, the plot and illustrations would be interesting to them. Most importantly, though, I chose this book because it could lead into the concept I was teaching.

Similar comments were made by two other preservice teachers. Preservice teacher 17 elucidated that "[this book] was a good choice because the book was age-appropriate for my kindergarteners, and it provided a colorful introduction to my lesson." Additionally, preservice teacher 19 remarked that "force was the topic that I was covering that day and so this book was perfect for introduction [to] the lesson. I felt that this book was appropriate for their level, and it was also a fun book to read."

After finding the literature whose content was related to the topics in the curriculum, four preservice teachers chose to use literature as a starting point to explain the very topics they were teaching. Preservice teacher 49 explained, "I ... chose this book because I knew I would be able to tie in other animals and fully teach the concept of camouflage with this as a starting point for my students to draw from. Also, it was great for my ELL students because the illustrations show the process of camouflage so well." Preservice teacher eight stated, "I chose this book because I felt that it was a book that covered the topic of light very well. The reading level was at the perfect level for my students."

Additionally, preservice teacher 55 shared, "I found not only are the illustrations cute, but the story is literally about the adaptations of two different sheep and I knew that it was the book I needed" and "like using the book to like move into the like question of inquiry was like super, super, super helpful because you don't just like jump into the inquiry like without any background information." This finding aligned with what Barker (2006) said about using purposeful, whole-class, interactive starters that can hook students' interest and engage them by incorporating the elements of mystery, curiosity, novelty, etc. Literature in our study was found to serve this purpose.

Preservice teachers also prioritized the books whose contents were related to students' prior knowledge or real-life experiences, as expressed by three participants. Preservice teacher 24 expressed,

"Because it had examples of both physical and chemical changes throughout the book. The examples were relatable and a common experience for all students. [The students] were able to connect our science subject to their own lives and apply it", stated preservice teacher 24. Additionally, preservice teacher 59 noted, "I found *Leaf Man*, and thought it was perfect. The story was simple and age appropriate for my students, the character of *Leaf Man* was cute and lovable, and although the story was fictional, it accomplished the goal of my students looking at all types of real leaves (since there were drawings of May leaves in the book) and accessing their prior knowledge and their wonderings about leaves." Similarly, preservice teacher 15 articulated, "This [book] was a good choice because it [is] developmentally appropriate for kindergarteners, and my students were able to relate to the story as they reflect on rocks that they have found in their own lives."

Visual Features

Our study confirmed the conclusions drawn by Donovan and Smolkin (2002) and Pringle and Lamme (2005) regarding the impact of visual features of trade books on preservice teachers' choices. Some preservice teachers included children's literature in their science classroom instruction due to the books' appealing design, which included features such as close-up pictures and book size. Preservice teacher 17 explained her choice of the book *One Bear Lost* is "very colorful and very appealing to the students since it was huge and all about how the town was preparing for a party." Preservice teacher 12 reasoned that the book *Pancake, Pancake!* as a good choice because the book [is] "a big book", "so all the students could see the pictures." She continued, "the illustrations were beautiful and engaging, and the book took you through the process of making pancakes." She concluded that the book "has beautiful illustrations and ... is relatable and entertaining. The students enjoyed predicting how water would be portrayed next." In essence, the visually appealing designs of children's literature not only attract students and stimulate their interest but also encourage exploration and reasoning. In this sense, visual features of children's literature contribute to the understanding of scientific knowledge in the inquiry process. Preservice teacher 48 echoed this sentiment in her choice of the book *Animals in Winter*, emphasizing that the book "had multiple animals from different places, which shows students [examples] that many animals hibernate and in different places" and "it also had great illustrations and was the perfect length for engagement purposes."

Other Factors that Influenced Preservice Teachers' Selections

As discussed in Bandré's (2005) study, teachers' selections are influenced by the original publication date of a book. In our study, whether the information in the literature was current was a concern raised by preservice teachers. For example, among the five preservice teachers who did not use literature in their instructions, one expressed this concern, saying, "you know if you think the *Magic School Bus,* they kind of outdated information."

Our study further substantiated Bandré's (2005) finding that in book selection, teachers may tend to choose books which are their personal favorite. In our study, several preservice teachers based their selection on their own experiences with particular books they had read previously. For example, preservice teacher 13 chose her book, stating, "I remember reading this book [*Chicken Little*] when I was in school."

Sources Where Teachers Got Information about the Books

Another theme generated from the data is how the preservice teachers obtained information about the literature they intended to use in the instruction. As discovered by Tunks, Giles, and Rogers (2015), word of mouth is one of the main sources where teachers acquire information about children's literature. In our study, there are two approaches that the participants utilized in choosing their

literature piece: seeking advice from others or conducting independent searches. For those seeking advice, the method course instructor was the primary source, followed by other elementary educators.

Some preservice teachers selected their literature based on the course instructor's recommendations or chose to use the same book previously used in the course. Preservice teacher 63 said that "I had trouble finding a good book to use about adaptations so I actually asked Dr. Nancy [pseudonym] for suggestions and she and [another fellow teacher] located this book for me out of some of the resources they had." Another participant observed the instructor using a specific book in a lesson and decided to use the same book, stating, "Dr. Nancy used this book [*When Charlie McButton Lost Power*] in a similar lesson, and I thought it was the most appropriate for the age group I would be teaching." Additionally, five participants explicitly mentioned choosing a particular book based on the course instructor's recommendation.

Preservice teachers also sought advice from other sources. Preservice teacher 36, influenced by her mother, a first-grade teacher. She explained, "I chose this particular piece of literature after doing some search of books that were available at the public liberty that had to do with precipitation, and it was a recommendation of my mother, a first-grade teacher." Another participant, preservice teacher 2, chose her literature piece based on the recommendation of a fellow teacher, stating, "I did a lot of researching on book ideas and it wasn't till I was talking to a fellow teacher that she told me about this book and how much her students loved it. I read through it and thought it was the perfect piece to open up the lesson."

Aside from recommendations by others, most of the preservice teachers chose and located their literature pieces through various means, including searching online, exploring the university's Learning Resource Center (LRC), checking the local library, or using a combination of these approaches. Some explicitly mentioned strategic searches through resources. Preservice teacher three shared that "I chose this piece of literature after searching for different non-fiction books about adaptations, animal traits, and different animal feet." Preservice teacher 16 stated, "I simply googled children's books on glasses and read summaries and chose a few to check out." Additionally, one preservice teacher mentioned that "I chose this piece of literature, because it was the only book I could find in the LRC that was about magnets, but didn't just give away everything I wanted them to discover on their own."

RQ2 Findings

Experience, Reflection, and Perspectives on the Future Plan

Regarding our second research question, this study uncovered that preservice teachers' experiences with literature integration played a vital role in reshaping their perspectives on using children's books for science teaching. These preservice teachers recognized the positive impact of children's books in science lessons, such as strengthening connections between students and content. Preservice teacher 43 shared an instance when using a familiar book not only sparked excitement but also increased engagement when her students found that they had watched a movie related to the book. This positive experience encouraged the preservice teacher to consider introducing more children's literature pieces in future teaching. In her presentation, she said,

> I used a book, obviously literature, in my science lesson and they loved it. They thought it was really exciting. And we used a book that they already knew, so they could, and it was a movie too, so they could have commented that they saw the movie and what's in the book. And I think it was really good to just to, like, get away from, just like, um, doing activities at their tables and becoming a group. And it's just something different than the regular teaching. So they liked...they liked the book, I liked the book and I'm definitely using more books in the

> future. It's just a different kind of engaging activity to use. And they enjoy it because it's not just a paper and pencil thing. It's fun.

Preservice teacher 36 mentioned how the book solidified students' knowledge on the topic, which brought changes to students as well as to the teacher, saying,

> After the use of the video, song, anchor chart, and hands-on learning engagement earlier in the instructional week, the reading of a piece of literature provided another input medium to stimulate students' working memory of prior knowledge and acted as a trigger of the inquiry process for the learning target of the day.

Preservice teacher 59 echoed this sentiment when explaining their choice of the literature book, saying, "my students were able to extend their knowledge of the plant life cycle to pumpkins, and by extension other vegetables, and because of the book I was able to correct some misunderstandings, like decomposition is part of the life cycle and it's important too." Three preservice teachers shared how this experience using children's literature in their instructional activities transformed their perspectives on teaching, inspiring them to adopt a more cross-curricular approach. One specifically emphasized the idea of integrating subjects to foster a more comprehensive exploration of both aspects, saying,

> Like we could only teach science or only teach math or only teach reading so that you could kind of...instead of doing an hour of science and an hour of reading, you could take the full two hours and combine both of them at the same time and you'd still be learning both aspects, but you'd have a longer time to explore instead of all these choppy little sections where it's not connected so. (preservice teacher 40; oral presentation).

Another preservice teacher echoed a similar viewpoint about how the experience using children's literature for science teaching made her recognize parallels between themes in math, science, and literature. This realization also led her to appreciate the engaging and creative attributes of books in presenting problems and fostering critical thinking:

> This semester has kind of taught me to, like, incorporate things in different ways that I just didn't think were possible. And like seeing the similarities between themes and incorporating math and science and literature and stuff like that. And books are just really helpful because they're engaging and, like, they can be really creative. There are so many ways to use them, which I used to think it would just be like direct instruction, like reading kind of, like, a textbook maybe with pictures, but there are so many ways to, like, see the problems within them and, um, So I think it has big impact on kids to, like, think more critically, like, not accept everything, but also get to be more creative in areas that are generally less creative, and then it had an impact on me, because I just see the, like, use of literature. (preservice teacher 2; oral presentation).

Integration Impact on Future Teaching Plans

There is one more preservice teacher who expressed her commitment to shaping future lessons with a cross-curricular approach centered around a selected book. Recognizing the transformative impact of enhancing learning through various connections, she advocated for linking content to other texts, to personal experiences, and to the broader world. This commitment reflects a holistic and integrated teaching strategy, which emphasizes connections beyond individual subjects.

By integrating cross-curricular connections, this preservice teacher aimed to provide students with a comprehensive understanding, aligning with the cross-curricular approach emphasized by her peers:

> I think for the future I want to plan more of my lesson directly around the book like not trying to make it fit if it doesn't fit, but like going through and when you're trying to determine different activities and things to implement into a lesson, picking a book first and maybe connecting some of those ideas directly to parts of the book. I think that would add just another aspect of like learning and a different way of looking at things and then for those like text-to-text connections or text-to-self or text-to-world like I think that would be really good to implement. So, I think I'm going to try to do that for the future. (preservice teacher 8; oral presentation).

Two more preservice teachers expressed in their presentations a shared commitment to implementing this strategy in the future. Preservice teacher 10 said, "I think it's going to be really exciting to get to see what all we can do whenever we get to integrate subjects hopefully next year, but if not when we have our own class two years from now." Preservice teacher 12 was eager to adopt the integration strategy because she recognizes the strategy as a valuable means of differentiation. She recognized. Its potential to cater to individual learning preferences, stating,

> My future plans would probably be to actually use these things because I think it's a great way to differentiate, uh, between your students because some students might do better with you reading them a book about the, uh, the topic that they're on or maybe watching a movie. So that's a great way to differentiate how you're going to teach your students and, um, help them make their learning more authentic to themselves.

Discussion

Villegas and Lucas (2002) assert that for preservice teachers to adopt constructivist views and strategies, they must be actively involved in the knowledge construction process as learners. Building upon the principles of scientific inquiry outlined in the National Research Council (NRC, 1996), our study frames preservice teachers' designing and implementing science lesson plans incorporating children's literature as an opportunity to foster questioning, exploring, experiencing, and understanding of the value of children's literature. The constructivist learning experience challenges the traditional way of teaching facts in direct instruction and shed light on the value of scientific inquiry as an instructional strategy, as emphasized by Flick and Lederman (2006).

Our findings reveal that few preservice teachers in our study have ever encountered using children's literature to teach science. When this teaching strategy was first introduced to them, it prompted initial skepticism, with questions, concerns, and hesitance. The sha contrast between the negative responses before trying this teaching strategy and the positive feedback, as well as the commitment to trying it in their future instructional practices suggests a significant transformation. This shift in attitudes and perspectives aligns with the purpose of cultivating scientific inquiry and reflective teaching practices, as discussed earlier.

In addition, our study showcases how experiential learning with the integration of children's literature allowed the preservice teachers to be open, listening to different perspectives on science teaching and responding to the new teaching strategy, and to display the positive attitudes and commitment to reshaping perspectives (Shephard, 2008). The value of learning through experience, to be exact, is also exemplified in this study. For example, inspired by *Who Sank the Boat* (Allen, 1996), the preservice teachers built foil boats of different sizes and shapes to test the concept of floating and sinking. Such experiences are opportunities to guide the preservice teachers to explore and build a

connection between theory and practice. In our study, the preservice teachers' prior experience with children's books constructed their knowledge in this field and after experiencing the use of children's books in science classes, the new knowledge was constructed through the new experience and in the dialogic reflection with the other people in the community. This way of constructing knowledge aligns with a constructive understanding of learning from practice. The importance of learning through experience and hands-on activities has long been emphasized by scholars such as Dewey (1902), Flybjerg (2004), Gutierrez, Rymes, and Larson (1995), Piaget (1970), Pinar, Reynolds, Slattery, and Taubman (1995), and Vygotsky (1978). Dewey's (1902) argument regarding the abstraction of eternal truth resonates with the idea that learning should be grounded in the real-world context of children, emphasizing the need for continuous, practical experiences to construct and reconstruct thinking and knowledge. The feedback given by the preservice teachers indicates that children's literature has the potential to build the connections between content and the broader world. This is especially important because children's children can engage elementary students in "developing, researching, and investigating questions of significance that are not easily tested with empirical experiments" (Ford, 2004, p. 286).

In addition, our study may suggest the potential impact of promoting affective learning in science classrooms through children's literature. As Shephard (2008) indicates, affective learning relates to values, attitudes, and behaviors, engaging learner emotionally. This emphasis on affective learning aligns with the broader goal of fostering positive attitudes toward science during the crucial elementary school years (Shapiro, 1995). Encouraging positive attitudes toward science is not only instrumental in shaping learners' perspectives but also aligns with the purpose of an integrated curriculum approach advocated by The National Science Foundation (NSF, 2000). Based on preservice teachers' feedback, our study affirms the engaging role of children's literature in sparking children's interest and curiosity. This observation suggests the possibility of encouraging a positive attitude toward learning and impacting their motivation and academic achievements, as identified by other scholars (García et al., 2016; Green et al., 2018; Wadham & Young, 2015).

The findings of our study may also add evidence to the existing literature about the value of children's literature in science education, as viewed from the perspective of preservice teachers. As demonstrated in our study, preservice teachers prioritize developmentally-appropriate children's literature pieces that align with curriculum topics. They find that that deliberately selected books can effectively facilitate meaningful discussions, serving as a starting point to explain specific science topics or providing a context that connects these topics to children's prior knowledge or real-life experiences. This recognition is exemplified by a preservice teacher who stated, "[The book] was a good choice because it not only made the children excited to discover how the boy played such crazy tricks but it also gave them an opportunity to see how magnets are not just a science thing they do at class, but how they can take what they learned home and use it."

Limitations

There were a few limitations in this study. First, the numbers of data sources are limited. As stated previously, the study may have been strengthened through additional data such as interview data, field notes, or observations of teaching. However, due to time constraints and impediments related to the participants' field-based teaching experiences, the researchers felt the two sources of reflection data were strong in providing the requisite rich, thick descriptions of preservice teachers' thoughts, reflections, and experiences regarding implementing children's literature within inquiry-based science.

Second, the source of information gathered about the children's literature that was used is limited. In consideration of future studies, a set of options that provide annotated bibliographies for each book could help discover prominent themes regarding the selection of literature and how it is

connected to science content. For example, since one goal of using children's literature in science lessons is to help students develop inquiring minds so that they can become socially competent and global citizens in the 21st century, global or multicultural aspects could be covered in the books selected for classroom instruction so that children's views could be broadened.

Implications

While using children's literature to teach science is not a new practice, this study provides valuable insights into understanding preservice teachers' perspectives and attitudes towards this teaching strategy. The participants in our study were not just preservice teachers; they were also new learners in the field of science education. Previous studies have identified that preservice teachers often lack confidence in integrating science into authentic inquiry opportunities (Mumba et al., 2019; Yoon et al., 2012). In addition, according to Kozoll (2020), even elementary teachers who value inquiry express varying levels of confidence and interest in implementing content-specific activities within the curriculum. In our study, to foster preservice teachers' confidence and alleviate their concerns, the course instructor modelled for the preservice teachers how to design and implement elementary science teaching, incorporating carefully selected children's literature pieces. This modelling served as a valuable guide. However, the transformative impact on preservice teachers became evident after they gained hands-on experience using children's literature in their teaching. This experience showcases the potential of inquiry opportunities during which personal experience and hands-on inquiry can effectively dispel misconceptions, addressing a gap noted by Sackes, Trundle, and Flevares (2009) that was not always addressed by teachers.

In addition, our study suggests an effective approach to broaden the pedagogical content knowledge of preservice teachers by providing them with affective experience in inquiry-oriented learning. However, as highlighted by Tunks, Giles, and Rogers (2015), the NGSS, Common Core, and other national science standards advocate for an integrated curriculum that emphasizes content, practices, and crosscutting concepts while maintaining a balanced use of various texts during instruction. This becomes particularly crucial when considering the racial and linguistic diversity in the public education system. Pappas (2006) suggests that the gender or ethnolinguistic background of children might influence their responses to children's literature integrated into science learning. For future studies, the issue of diversity should also be explored, such as, how the integration of children's literature can contribute to mitigating disparities, particularly among different ethnic groups. After all, advocating for multicultural science education becomes imperative (NSTA, 2000).

In conclusion, this study has implications for teachers seeking different methods for science teaching and developing cross-curricular perspective toward science learning. In addition, a nuanced understanding of preservice teachers' perspectives on using children's literature in inquiry-based science lessons may prove especially valuable for teacher educators in teacher preparation programs. The comprehensive reflections captured in this qualitative study offer insights into preservice teachers' attitudes towards using children's literature to teach science and the challenges they encounter in book selection and pedagogical decision-making. Teacher educators may find value in this study to enhance the preparation of preservice teachers, guiding them through and towards inquiry-based practices, fostering critical thinking, and developing cross-curricular perspective.

Conclusion

Building upon the transformative experiences of preservice teachers and the understanding of scientific inquiry suggested by Flick and Lederman (2006), our research views the design and implementation of inquiry-based science lesson plans incorporated with children's literature pieces as

an opportunity to engage preservice teachers in an inquiry process. During this process, preservice teachers explore, experience, and develop an appreciation for the significance of children's literature in science education.

Our findings reveal that preservice teachers' initial skepticism and concerns about the effectiveness of using children's literature to teach science were transformed after their exposure to this teaching strategy. Experiences in selecting and implementing strategies to integrate children's literature in the elementary classrooms not only encouraged preservice teachers to develop positive attitudes but also reshaped their perspectives. The study highlights the significance of affective learning through hands-on experience and the construction of knowledge during the inquiry process.

Moreover, our study reveals the notable gaps in preservice teachers' skills in selecting, locating, and effectively using children's literature in their instructional practices. The transformation of preservice teachers resulting from the scientific inquiry process in our study emphasizes the importance and necessity of introducing this instructional strategy in science methods. This practice not only promotes preservice teachers' appreciation for and utilization of integrating children's literature in science teaching but also reshapes their perspectives on the value of children's literature and the potential for cross-curricular learning. The identified gaps signify the need for professional development, such as workshops or training sessions, to hone their skills in literature selection, locating, and implementation that aligns with the curriculum objectives.

In conclusion, this study may contribute to the existing literature in several aspects. Firstly, it addresses preservice teachers' lack of confidence identified in teaching science (Mumba et al., 2019; Yoon et al., 2012), advocating for the use of children's literature as an intervention. Secondly, it elaborates on the factors crucial for the literature selection and pedagogical decision-making process, shedding light on the complexity of selection faced by preservice teachers (Crowther et al., 2005; Donovan & Smolkin, 2002; Sackes et al., 2009). Thirdly, this study reveals the perceived value of children's literature for elementary science teaching, from the perspectives of preservice teachers.

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References

Abd-El-Khalick, F. (2002). Images of nature of science in middle grade science trade books. *New Advocate*, *15*(2), 121–127.

Allen, P. (1996). *Who sank the boat?* Puffin Books.

Ansberry, K., & Morgan, E. (2010). *Picture-perfect science lessons: Using children's books to guide inquiry*. NSTA Press.

Armstrong, J. (2010). Naturalistic inquiry. In N. J. Salkind (Ed.), *Encyclopedia of research design* (pp. 881-885). SAGE Publications, Inc., https://dx.doi.org/10.4135/9781412961288.n262

Bandre', P. E. (2005). *The status of the selection and use of children's literature in K-6 rural Ohio public school classrooms* (Doctoral dissertation, The Ohio State University). http://rave.ohiolink.edu/etdc/view?acc_num=osu1121782590

Barker, S. (2006). Interactive starters and closures for deep learning. *Alberta Science Education Journal*, *38*(1), 3-5.

Brunner, J. L., & Abd-El-Khalick, F. (2020). Improving nature of science instruction in elementary classes with modified science trade books and educative curriculum materials. *Journal of Research in Science Teaching*, *57*(2), 154–183. https://doi.org/10.1002/tea.21588

Butzow, C. M., & Butzow, J. W. (2000). *Science through children's literature: An integrated approach*. Libraries Unlimited.

Bybee, R. W. (2014). The BSCS 5E instructional model: Personal reflections and contemporary implications. *Science and Children, 51*(8), p.10–13.

Bybee, R. W. (2019). Using the BSCS 5E instructional model to introduce STEM disciplines. *Science and Children*, *56*(6), 8–12. https://doi.org/10.2505/4/sc19_056_06_8

Carnegie Corporation of New York. (2009). *The opportunity equation: Transforming mathematics and science education for citizenship and the global economy*. https://www.carnegie.org/publications/the-opportunity-equation-transforming-mathematics-and-science-education-for-citizenship-and-the-global-economy/

Children's Book Council. (2020). Reading Lists. https://www.cbcbooks.org/readers/reading-lists/

Creswell, J. W. (2005). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (2nd ed.). Merrill.

Creswell, J. W. (2012). *Qualitative inquiry and research design: Choosing among five approaches* (3rd ed.). SAGE Publications, Inc.

Creswell, J. W., & Poth, C. N. (2017). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). SAGE Publications, Inc.

Crowther, D. T., Venable, C., & Barman, C. (2005). The making of "the list": Understanding the selection process for the outstanding science trade books list. *Science and Children*, *42*(6), 43–44.

Denzin, N. K. (1978). *The research act: A theoretical introduction to sociological methods* (2nd ed.). McGraw-Hill.

Dewey, J. (1902). *The child and the curriculum* (No. 5). University of Chicago Press.

Donovan, C. A., & Smolkin, L. B. (2002). Considering genre, content, and visual features in the selection of trade books for science instruction. *The Reading Teacher, 55*(6), 502–520.

Duran, L. B., & Duran, E. (2004). The 5E Instructional Model: A Learning Cycle Approach for Inquiry-Based Science Teaching. *Science Education Review 3*(2): 49–58.

Feathers, K. M., & Arya, P. (2012). The role of illustrations during children's reading. *Journal of Children's Literature, 38*(1), 36–43.

Flick, L. B., & Lederman, N. G. (Eds.). (2006). *Scientific inquiry and nature of science: Implications for teaching, learning, and teacher education*. Springer.

Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative inquiry*, *12*(2), 219-245.

Ford, D. J. (2004). Highly recommended trade books: Can they be used in inquiry science? In E. W. Saul (Ed.), *Crossing borders in literacy and science instruction: Perspectives on theory and practice* (pp. 277–290).

Ford, D. J. (2006). Representations of science within children's trade books. *Journal of Research in Science Teaching*, *43*(2), 214–235. https://doi.org/10.1002/tea.20095

Fredericks, A. D. (2008). *More science adventures with children's literature: Reading comprehension and inquiry-based science*. Teacher Ideas Press.

Furner, J. M. (2018). Using children's literature to teach mathematics: An effective vehicle in a STEM world. *European Journal of STEM Education*, *3*(3), 14.

García, T., Rodríguez, C., Betts, L., Areces, D., & González-Castro, P. (2016). How affective-motivational variables and approaches to learning predict mathematics achievement in upper elementary levels. *Learning and Individual Differences*, *49*, 25–31. https://doi.org/10.1016/j.lindif.2016.05.021

Gonzalez, H. B., & Kuenzi, J. J. (2012). Science, technology, engineering, and mathematics (STEM) education: A primer. *Congressional Research Service, Library of Congress*.

Green, K. B., Gallagher, P. A., & Hart, L. (2018). Integrating mathematics and children's literature for young children with disabilities. *Journal of Early Intervention, 40*(1), 3–19. https://doi.org/10.1177/1053815117737339

Gutierrez, K., Rymes, B., & Larson, J. (1995). Script, counterscript, and underlife in the classroom: James Brown versus Brown v. Board of Education. *Harvard Educational Review, 65*(3), 445-472.

Hachey, A. C., An, S. A., & Golding, D. E. (2022). Nurturing kindergarteners' early STEM academic identity through makerspace pedagogy. *Early Childhood Education Journal*, *50*(3), 469–479. https://doi.org/10.1007/s10643-021-01154-9

Hackett, G., & Betz, N. E. (1995). Self-efficacy and career choice and development. In J. E. Maddux (Ed.), *Self-efficacy, adaptation, and adjustment: Theory, research, and application*. Springer. 249–280. https://doi.org/10.1007/978-1-4419-6868-5_9

Hanuscin, D. L., Lee, M. H., & Akerson, V. L. (2011). Elementary teachers' pedagogical content knowledge for teaching the nature of science. *Science Education, 95*(1), 145–167. https://doi.org/10.1002/sce.20404

Heisey, N., & Kucan, L. (2010). Introducing science concepts to primary students through read-alouds: Interactions and multiple texts make the difference. *The Reading Teacher*, *63*(8), 666–676. https://doi.org/10.1598/RT.63.8.5

Honey, M., Pearson, G., & Schweingruber, H. (Eds.). (2014). *STEM integration in K-12 education: Status, prospects, and an agenda for research*. National Academies Press.

Howe, A. (1993). Science in early childhood education. In B. Spodek (Ed.), *Handbook of research on the education of young children*, Macmillan.

Huberman, M., & Miles, M. B. (2002). *The qualitative researcher's companion*. SAGE.

Kozoll, R. H. (2020). Content versus process. *The Electronic Journal for Research in Science & Mathematics Education*, 24(1), 5–25.

Krajcik, J. S., & Sutherland, L. M. (2010). Supporting students in developing literacy in science. *Science, 328*, 456-459.

Kuenzi, J. J. (2008). Science, technology, engineering, and mathematics (STEM) education: Background, federal policy, and legislative action. In *Congressional Research Service Reports*. University of Nebraska-Lincoln.

Larson, L. C., & Rumsey, C. (2018). Bringing stories to life: Integrating literature and math manipulatives. *The Reading Teacher*, *71*(5), 589–596. https://doi.org/10.1002/trtr.1652

Lederman, N. G. (2014). Nature of science and its fundamental importance to the vision of the next generation science standards. *Science & Children*, *52*(1), 8–10. https://doi.org/10.2505/4/sc14_052_01_8

Lederman, N. G., Antink, A., & Bartos, S. (2014). Nature of science, scientific inquiry, and socio-scientific issues arising from genetics: A pathway to developing a scientifically literate citizenry. *Science & Education*, *23*(2), 285–302. https://doi.org/10.1007/s11191-012-9503-3

Lederman, N. G., & Lederman, J. S. (2019). Teaching and learning nature of scientific knowledge: Is it Déjà vu all over again? *Disciplinary and Interdisciplinary Science Education Research*, *1*, 1–9.

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

Lynch-Brown, C. M., Tomlinson, C. M., & Short, K. G. (2011). *Essentials of children's literature* (7th ed.). Pearson.

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.

Manak, J. A. (2012). Exploring the American revolution from multiple perspectives: Integrating children's literature into the social studies curriculum. *Reading Today, 30*(2), 14-15.

May, L., Crisp, T., Bingham, G. E., Schwartz, R. S., Pickens, M. T., & Woodbridge, K. (2020). The durable, dynamic nature of genre and science: A purpose-driven typology of science trade books. *Reading Research Quarterly*, *55*(3), 399–418. https://doi.org/10.1002/rrq.274

Mcginnis, P. (2020). Using literature in the science classroom. *Science Scope*, *44*(2). https://www.nsta.org/science-scope/science-scope-novemberdecember-2020/using-literature-science-classroom

Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis: A methods sourcebook* (3rd edition). SAGE Publications, Inc.

Morrow, L. M., Pressley, M., Smith, J. K., & Smith, M. (1997). The effect of a literature-based program integrated into literacy and science instruction with children from diverse backgrounds. *Reading Research Quarterly*, *32*, 54–76. https://doi.org/10.1598/RRQ.32.1.4

Mumba, F., Miles, E., & Chabalengula, V. (2019). Elementary education in-service teachers' familiarity, interest, conceptual knowledge and performance on science process skills. *Journal of STEM Teacher Education*, *53*(2), 21–42. https://doi.org/10.30707/

National Research Council. (1996). *National science education standards*. National Academy Press. https://doi.org/10.17226/4962

National Research Council. (2000). *Inquiry and the national science education standards: A guide for teaching and learning*. National Academy Press. https://doi.org/10.17226/9596.

National Science Teaching Association. (2000). Position Statement: Multicultural Science Education. https://www.nsta.org/nstas-official-positions/multicultural-science-education

Nesmith, S. J. (2008). Mathematics and literature: Educators' perspectives on utilizing a reformative approach to bridge two cultures. *Forum on Public Policy Online* (EJ1099543). ERIC. *https://files.eric.ed.gov/fulltext/EJ1099543.pdf*

Nesmith, S. M., & Cooper, S. (2021). Connecting engineering design and inquiry cycles: Impact on elementary preservice teachers' engineering efficacy and perspectives toward teaching engineering. *School Science and Mathematics, 121*(5), 251–262.

https://doi.org/10.1111/SSM.12469
Nesmith, S., Ditmore, E., Scott, L., & Zhu, T. (2017). "This is more about a book than about science!" Preservice teachers' perceptions toward using literacy strategies in inquiry-based science lessons. *The Electronic Journal for Research in Science & Mathematics Education*, *21*(5), 1-13.
Next Generation Science Standards Lead States. (2013). *Next Generation Science Standards: For states, by states*. The National Academies Press. http://epsc.wustl.edu/seismology/book/presentations/2014_Promotion/NGSS_2013.pdf
Palmer, J., & Burroughs, S. (2002). Integrating children's literature and song into the social studies. *The Social Studies, 93*(2), 73–78. https://doi.org/10.1080/00377990209599886
Pappas, C. C. (2006). The information book genre: Its role in integrated science literacy research and practice. *Reading Research Quarterly*, *41*(2), 226–250. https://doi.org/10.1598/RRQ.41.2.4
Patton, M. Q. (2015). *Qualitative research & evaluation methods: Integrating theory and practice* (4th ed.). SAGE Publications, Inc.
Piaget, J. (1970). *Science of education and the psychology of the child. Trans. D. Coltman*. Orion.
Pinar, W. F., Reynolds, W. M., Slattery, P., & Taubman, P. M. (1995). *Understanding curriculum: An introduction to the study of historical and contemporary curriculum discourses* (Vol. 17). Peter Lang.
Pringle, R. M., & Lamme, L. L. (2005). Using picture storybooks to support young children's science learning. *Reading Horizons: A Journal of Literacy and Language Arts, 46*(1), 1–15.
Rice, D. (2002). Using trade books in teaching elementary science: Facts and fallacies. *The Reading Teacher, 55*(6), 552–565.
Rutherford, F. J., & Alhgren, A. (1990). *Project 2061: Science for all Americans*. Oxford University Press.
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.
Salehjee, S. (2020). Teaching science through stories: Mounting scientific enquiry. *Early Child Development and Care*, *190*(1), 79–90. https://doi.org/10.1080/03004430.2019.1653554
Saul, E. W., & Dieckman, D. (2005). Choosing and using information trade books. Reading Research Quarterly, *40*(4), 502–513. https://doi.org/10.1598/RRQ.40.4.6.
Shapiro, B. (1995). *What children bring to light: A constructivist perspective on children's learning in science*. Teachers College Press.
Shephard, K. (2008). Higher education for sustainability: Seeking affective learning outcomes. *International Journal of Sustainability in Higher Education*, *9*(1), 87-98. https://doi.org/10.1108/14676370810842201
Singh, S., & Yaduvanshi, S. (2015). Constructivism in science classroom: Why and how. *International Journal of Scientific and Research Publications*, *5*(3), 486–490.
Spencer, B. H., & Guillaume, A. M. (2011). Integrating curriculum through the learning cycle: Content-based reading and vocabulary instruction. *The Reading Teacher*, *60*(3), 206–219. https://doi.org/10.1598/RT.60.3.1
Stadler, M. A., & Ward, G. C. (2005). Supporting the narrative development of young children. *Early Childhood Education Journal, 33*(2), 73–80. https://doi.org/10.1007/s10643-005-0024–4
Stake, R. E. (1995). *The art of case study research*. SAGE.
Taylor, J. A., Getty, S. R., Kowalski, S. M., Wilson, C. D., Carlson, J., & Van Scotter, P. (2015). An efficacy trial of research-based curriculum materials with curriculum-based professional development. *American Educational Research Journal*, *52*(5), 984–1017. https://doi.org/10.3102/0002831215585962
Tunks, K., Giles, R., & Rogers, S. (2015). A survey of teachers' selection and use of children's literature in elementary classrooms. *The Language and Literacy Spectrum*, *25*, 58–71.
van Garderen, D., Decker, M., Juergensen, R., & Abdelnaby, H. (2020). Using the 5E instructional model in an online environment with pre-service special education teachers. *The Journal of*

Science Education for Students with Disabilities, *23*(1), 1–13. https://doi.org/10.14448/jsesd.12.0008

Villegas, A. M., & Lucas, T. (2002). Preparing culturally responsive teachers: Rethinking the curriculum. *Journal of Teacher Education*, *53*(1), 20–32. https://doi.org/10.1177/0022487102053001003

Vygotsky, L. (1978). Interaction between learning and development. *Readings on the development of children*, *23*(3), 34–41.

Wadham, R. L., & Young, T. A. (2015). *Integrating children's literature through the Common Core State Standards*. Libraries Unlimited.

Ward, G., Donnan, L., & McNabb, K. (2016). Attitudes and experiences of classroom science: Children's voices. *International Journal of Education*, *9*(1), 10–16.

Welchman-Tischler, R. (1992). *How to use children's literature to teach mathematics*. National Council of Teachers of Mathematics.

Weng, X., Chiu, T. K., & Tsang, C. C. (2022). Promoting student creativity and entrepreneurship through real-world problem-based maker education. *Thinking Skills and Creativity*, *45*, 1–16.

Yoon, H. G., Joung, Y. J., & Kim, M. (2012). The challenges of science inquiry teaching for pre-service teachers in elementary classrooms: Difficulties on and under the scene. *Research in Science Education*, *42*, 589–608. https://doi.org/10.1007/s1116 5-011-9212-y

Zeece, P. D. (1999). Things of nature the nature of the things: Natural science-based literature for young children. *Early Childhood Education Journal*, *26*(3), 161–166.

Appendix

An Example of Teaching Lesson Plan on the Integration of Children's Literature

Name of the preservice teacher: XXX
Subject: 5th Grade Science
Title: Unit 5: Energy Resources

TEKS/Content Standards: 5.2 (D) Analyze and interpret information to construct reasonable explanations form direct (observable) and indirect (inferred) evidence 5.2 (F) communicate valid conclusions in both written and verbal forms 5.4 (A) collect, record, and analyze information using tools, including calculators, microscopes, cameras, computers, hand lenses, metric rules, Celsius thermometers, prisms, mirrors, pan balances, triple beam balances, spring scales, graduated cylinders, beakers, hot plates, meter sticks, magnets, collecting nets, and notebooks; timing devices, including clocks and stopwatches; and materials to support observations of habitats or organisms such as terrariums and aquariums 5.7 (C) Students will identify alternative energy resources such as wind, solar, hydroelectric, geothermal, and biofuels.	
Lesson Objectives: In their study of alternative energy resources, students will be able to give examples of and explain how wind energy, hydroelectricity, geothermal, and solar energy are used, and will share their results through wind energy and alternative energy resource activities, as well as through the lesson's closure (which will revolved around all four alternative energy resources touched upon).	
Content Overview:	

Omitted by the researchers here because of the space limitation.	
Prerequisite Skills: ● SWBAT identify and classify Earth's four main alternative energy sources (solar, wind, geothermal, and hydroelectric power), as well as draw upon prior knowledge of Earth's renewable and nonrenewable resources.	
Materials/ Supplies/ Technology: ● IPads ● Schoolhouse Rock: Energy Blues Video ● Energy 101: Wind Energy Video ● Children's literature: *The Windy Day* by G. Brian Karas ● Pinwheel Supplies: pinwheel template, straw, pushpin, markers, scissors ● Wind Energy KWL Sheet ● Geothermal Energy Video ● Hydroelectric Documentary Video ● Alternative Energy Foldable ● Alternative Energy Town Sheet	
Lesson Instructional Model (Circle appropriate model(s) for the lesson): Inquiry/ 5E: (Direct Instruction) Literacy- Read Aloud, Word Study, Guided Reading., Shared Reading, Literature Circle/ Novel Study, Shared Writing, Writing Workshop Mathematics- Developmental, Reinforcement, Practice, Problem solving Other: _____	
Steps/Sequence of Activities Correlated to Instructional Model: **1) Engage (Tuesday and Wednesday)** ● Once all of the students are ready to begin science, tell students that today's topic deals with alternative energy resources - more specifically, wind energy, hydroelectricity, geothermal, and solar energy. ● Ask students if they remember talking about different forms and sources of energy last year. Have them provide examples and explain where the different types of energy come from. ● Encourage students to think about why it is important for them to learn about different forms of energy. ● Since students are now thinking about alternative energy sources, inform them that today and tomorrow's lesson will involve them reviewing and investigating four alternative resources: winder energy, hydroelectricity, geothermal and solar energy. ● "Hook" students into today (Tuesday's) lesson topic by watching "Energy Blues" and "Energy 101: Wind Energy" ● Pose the following questions to students can ask themselves about alternative energy resources and why it's important to learn about them: 1) What four alternative energy resources am I	

learning about in today's activities? 2) Why is it important that I learn about alternative energy resources such as wind energy, hydroelectricity, geothermal, and solar energy? 3) Where can I find these different alternative energy resources?

- As a whole class (Wednesday), have students give a few examples of what we reviewed and learned yesterday in class.
    - Answers should involve the four types of alternative energy we were discussed (solar energy, geothermal, hydroelectricity, and wind energy).
    - Have students provide examples of each type of energy that they have either seen in their communities or via other resources (internet, social media, literature, etc.)
- Once students have reviewed Tuesday's lesson and topic- focused on wind energy, inform students that we will be reading *the Windy Day* to help students reflect and answer the following question:
    - If wind is always blowing somewhere in the world, it must have a lot of force and energy behind it. How could that energy be harnessed and used?
- Once students have answered and shared some of their thoughts and ideas, move into today's (Wednesday's) focus- overall review of four alternative energy resources (solar, wind, geothermal, and hydroelectric power).
- "Hook" students into today activities and topic by watching "Geothermal Energy" and "Hydroelectricity Documentary".
- Once again pose the following questions for students to think about throughout the day's activities: 1) What four alternative energy resources am I learning about in today's activities? 2) Why is it important that I learn about alternative energy resources such as wind energy, hydroelectricity, geothermal, and solar energy? 3) Where can I find these different alternative energy resources?

2) Explore (Tuesday)

- Before explaining the activity, explain to students that they will be working in groups at their tables. Tell students that we will be working on an activity that focuses on wind energy.
    - Once every student cleared off their desks and tables, inform the students that we will be making pinwheels and further exploring the concept of wind energy. Provide instructions and expectations for pinwheel activity.
    - Have other T.A.s in the classroom help distribute pinwheel supplies to each table/ group. Each student should receive: pinwheel template, straw, push pen, scissors.
    - Check student understanding by asking them:
        - Discuss the factors that affect how well the turbine works. (Answers: the strength of the wind, direction of the wind and actual construction quality of the wind turbine). Ask them where they think the wind is that strongest. (Answer: low to the ground or high up). Ask the students in what direction they should

point their pinwheel. (Answer: into the wind, at an angle to the wind or away from the wind). o Inform students that we will be going outside after constructing our pinwheels in order to test the power of wind energy in real-life. After going outside and exploring/testing the power of wind energy, have students to return to the classroom and sit with their groups. Then address the following as a whole class: ▪ Would they (the students) change anything on their wind turbine if they built it again? Can they (the students) think of anything that would improve the design of their wind turbines? ● Things that teacher should understand: o How the process of converting wind into energy works, be about to provide different examples of wind energy seen in our environment, be able to explain why wind energy is a renewable resource. **3) Explain (Tuesday and Wednesday)** ● After the pinwheel activity, I will check my students' understanding of wind energy/wind turbines by asking them: ▪ Discuss the factors that affect how well the turbine works. (Answers: the strength of the wind, direction of the wind and actual construction quality of the wind turbine). Ask them where they think the wind is that strongest. (Answer: low to the ground or high up). Ask the students in what direction they should point their pinwheel. (Answer: into the wind, at an angle to the wind or away from the wind). ● I will ask students questions that will enable student to come to the realization that: o Wind energy and hydroelectricity are renewable resources. And once again review the fact that nonrenewable resources are scarce and cannot be made again (replenished) in a short period of time. Renewable resources are replenished naturally. Nonrenewable resources need to be conserved so that there will be some left for generations to come. ● Additional questions to ask students include: o What did you notice during the pinwheel activity? o What happened to the wind energy as time went on? Did it continue to make the pinwheel spin, or did we run out of wind energy/ did the pinwheel break? o How can we describe the wind energy? How can we describe hydroelectricity energy? o What are some examples of wind and hydroelectric energy? What do you think this activity can tell us about using energy in the real world? ● Have students complete KWL Sheet on Wind Energy	

- After the "engage" portion of Wednesday's lesson, move into "explain" portion of the lesson (alternative energy resources).
    - Check students' understanding on the four main alternative energies discussed (solar, wind, geothermal, and hydroelectric power) by posing the following questions: 1) Why is it important that I learn about alternative energy resources such as wind energy, hydroelectricity, geothermal, and solar energy? 2) Where can I find these different alternative energy resources? 3) Why are the four main alternative energy resources we have discussed in class classified as renewable resources? 4) Have students provide examples of each type of energy that they have either seen in their communities or via other resources (internet, social media, literature, etc.)
- Complete alternative energy resources foldable with class as a whole.

4) Elaborate (Wednesday)

- To develop a better understanding on alternative energy resources, we can discuss why it is important to have nonrenewable such as oil and gas. Some students may think we should try to use appliances that are primarily solar, wind, geothermal, or hydroelectric powered. It would be beneficial to explain that we need some "general" energy-powered appliance (i.e. cars, machines), but we can also work towards making more productive strides to expanding everyday household items and appliances more alternative energy friendly.
- They vocabulary introduced over the two-day lesson will be wind energy, hydroelectricity, solar energy, and geothermal energy. The vocabulary will benefit students because it gives some more examples pertaining to alternative energy appliances and uses.
    - Wind energy- energy conversion in which turbine convert the kinetic energy of wind into mechanical or electrical energy that can be used for power (windmill, wind turbine); considered a renewable resource
    - Hydroelectricity- electricity generated by hydropower; the production of electrical power through the use of the gravitational force of falling or flowing water (dams)
    - Solar energy- energy derived from the sun in the form of solar radiation (solar panels)\
    - Geothermal energy- energy derived from the heat of the earth (hot water springs, heats houses)

Closure

- To relate this lesson to our daily lives, we can talk about the impact that different energy resources have on people around the world and discuss what could happen if we were to switch to only alternative energy resources (solar energy, hydroelectricity, geothermal, and win energy).

○ To go a step further, we could investigate which of the four alternative energies discussed over the past two class days is seen the most in our everyday life; as well as which alternative forms of energy we could more easily integrate into our households and everyday life. **5) Evaluate (Provide the information in the Evaluation section of the lesson plan)**	
Differentiation: (An appropriate differentiation must be provided for each of the below-listed student populations; the information must be provided regardless of whether or not you are working with students in each of these populations.) **Struggling Students**: Students will be allotted extra time to complete activities from lesson. Have them engage in lesson via manipulative or "paired" group work. **G/T Students/ Students who Easily Understand the Content**: Students will be assigned to examine particular states, foreign countries. Students can then research what main forms of alternative energies (if any), those areas produce and what forms they consume. Students can begin by researching the country or continent, or by researching the alternative energies (solar energy, geothermal, hydroelectricity, and wind energy) themselves (using their IPads). **LEP Students:** Utilizing the drawings, models, activities, and videos should allow LEP students to participate successfully. Cards with the lesson vocabulary could be provided to students so they could write their own definition/description of the terms of main ideas in their native language. **LD Students:** Make sure that all elements of the students' IEP are being met. Using alternative energy example cards, remind students about like characteristics of solar energy, wind energy, geothermal, and hydroelectricity; allow students to classify different examples of each type of alternative energy.	
Evaluation: Occurs throughout the day's topic and lessons/activities: **Formative:** During the lesson, the teacher will be constantly monitoring and observing the progress of the groups. It is very important to see how the students are doing and to see if anything regarding alternative energy resources need to be retaught. **Summative:** Once the students have completed the activity and are confident that they know the differences between the four types of alternative energy (solar, wind, geothermal, and hydroelectric), the students will work on the "wind energy" and "alternative energy town" activity sheets as individuals. They will have to explain the differences between the four energies, give examples of each type of alternative energy resource discussed in class, and name different ways some cities conserve energy, and sort them into the correct category.	

Analysis of Assessment(s): Assessment occurred on Tuesday and Wednesday via informal group, whole-class, and individual activities. For instance, when I had my students working in groups, I was able to see which group members were lacking in understanding of alternative energies- which was even more evident when I had my students working individually. Overall, I think both Tuesday and Wednesday's activities helped me gauge the levels of understanding my students had on alternative energy resources, which helped me better modify particular portions of both day's lesson objectivities and activities	

Reflection:

I feel that the two days (Tuesday and Wednesday) that I devoted to whole-group teaching of alternative energy resources went fairly well. On Tuesday, I thought that the elements of the 5E lesson plan that I incorporated into the classroom and the activities were engage, explore and explain. Looking back, I would probably have students spend more time working on the KWL wind activity sheet and less time letting students making their pinwheels. Overall, I feel that my lesson and activities that I incorporated into the classroom on Tuesday (which revolved around a brief review of the four alternative energy resources- with an emphasis on wind power) was quite successful. On Wednesday, I started off the class time by engaging my students via *The Windy Day* book (to review Tuesday's topic) and had them use their IPads to watch two videos on geothermal and hydroelectric power. I then had my students explain why it is important to learn about alternative energy resources and have them explain and provide example of each. I ended the lesson by having my students elaborate on and connect their new knowledge and understanding of alternative energy resources to real-world situations. I closed both lessons (Tuesday and Wednesday) with a review of the main objectives for each day's topic. I feel that Wednesday's lesson and activities went very successfully.

I think my two days teaching alternative energy resources went pretty well. On both days I was able to successfully keep all of my students engaged and actively participating throughout the class discussions. I feel that I have definitely utilized my time in the classroom when teaching my students, and I also feel that I have learned a lot in the past few days in terms of how to better direct and run a classroom- as well as plan an effective lesson.