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Science Teachers' Perspectives on Empathic Teaching and Social-Emotional Learning

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Abstract

As schools place growing emphasis on social-emotional learning (SEL), educators are increasingly called upon to integrate students' social and emotional development with academic instruction across disciplines, including science. While empathy has received considerable attention in general education research, little empirical work has examined how science teachers conceptualize empathic instruction or its role in SEL-oriented science teaching. This exploratory qualitative study examined how experienced science teachers describe empathic science teaching and its contribution to students' social-emotional learning and preparation for future life outcomes. Two experienced science teachers, one secondary and one postsecondary, participated in semi-structured interviews, and transcripts were analyzed using a hybrid thematic analysis approach combining deductive and inductive coding to identify recurring patterns across participants' perspectives. Five interrelated themes emerged: understanding students' emotional experiences, understanding students' perspectives, backgrounds, and lived experiences, attentive listening, active engagement in students' lives, and teaching with students' future development in mind. Participants described empathic teaching as extending beyond academic instruction to fostering supportive learning environments that encourage student agency, social-emotional growth, and preparation for responsible participation in society. This exploratory study contributes to the growing literature on empathic teaching in science education and underscores the need for further research, with larger and more diverse samples, on the role of empathy in science learning and teacher preparation.

Introduction

Contemporary education increasingly recognizes that effective learning requires attention not only to students’ academic achievement but also to their social and emotional development. Social-emotional learning (SEL) has emerged as a central component of contemporary educational practice, emphasizing the development of competencies that enable students to understand and regulate emotions, build positive relationships, make responsible decisions, and engage effectively with others in academic and social contexts (CASEL, 2024; OECD, 2024). A growing body of research demonstrates that integrating SEL into teaching not only supports students’ social and emotional competence and well-being but also contributes to improved academic engagement, learning outcomes, and preparation for participation in an increasingly complex and interconnected society (Cipriano et al., 2023; Mahoney et al., 2021; OECD, 2024). Consequently, educators across disciplines, including science education, are increasingly expected to create learning environments that foster both disciplinary understanding and the social-emotional competencies necessary for meaningful learning, collaboration, and responsible citizenship.

Within this broader emphasis on social-emotional learning, teacher empathy has emerged as a critical professional disposition that shapes the quality of teacher–student relationships and classroom learning environments. Teacher empathy extends beyond recognizing students' emotions to understanding their perspectives, responding to their individual needs, and creating supportive learning environments where students feel respected, valued, and capable of learning (Cooper, 2011; Meyers et al., 2019; Warren, 2018). Research suggests that empathic teachers are more likely to foster students'

sense of belonging, engagement, motivation, and academic persistence while promoting positive classroom climates that support both cognitive and social-emotional development (Meyers et al., 2019). As schools increasingly prioritize students' holistic development, empathy is increasingly recognized not simply as a personal characteristic of effective teachers but as an instructional disposition that supports equitable, inclusive, and relationship-centered teaching practices.

These broader developments have particular significance for science education, where meaningful learning depends not only on students' conceptual understanding but also on collaboration, scientific discourse, inquiry, and participation in authentic problem solving. Contemporary science education encourages students to investigate real-world problems, construct evidence-based explanations, and participate in scientific discourse, all of which require learning environments characterized by trust, respect, and psychological safety (National Academies of Sciences, Engineering, and Medicine [NASEM], 2022). Within these environments, empathic teaching can help teachers recognize and respond to students' diverse experiences, encourage participation in collaborative inquiry, and support students as they engage with complex socio-scientific issues that involve multiple perspectives and ethical decision-making (Zeyer & Dillon, 2019). As science classrooms become increasingly student-centered and inquiry-oriented, empathy may serve as an important instructional disposition that strengthens student engagement, belonging, and meaningful participation in science learning.

Despite growing recognition of the importance of empathy in education, important gaps remain in understanding how empathy is enacted within science teaching. Existing research has largely examined teacher empathy in relation to general classroom practice, teacher–student relationships, culturally responsive pedagogy, or teacher education more broadly (Cooper, 2011; Warren, 2018). Comparatively fewer studies have explored how experienced science teachers conceptualize empathic instruction within the context of contemporary science education, where inquiry-based learning, collaboration, and engagement with socioscientific issues require teachers to attend to both students' cognitive and social-emotional development (Zeyer & Dillon, 2019). As schools continue to integrate SEL across subject areas, a deeper understanding of how science teachers perceive and enact empathic science teaching, SEL-oriented instruction may provide valuable insights for science teacher education, classroom practice, and future research.

In response to these gaps, this exploratory qualitative study examined how experienced science teachers conceptualize empathic teaching and describe its role in supporting social-emotional learning (SEL)-oriented science instruction and students' preparation for future-ready competencies. Using semi-structured interviews with two experienced science teachers from secondary and postsecondary educational settings, the study explored participants' understandings of empathy, the instructional practices they associate with empathic science teaching, and their perceptions of how these practices support students' academic, social, and emotional development. The study was guided by the following research question: How do experienced science teachers describe empathic science teaching and its role in supporting students' social-emotional learning and preparation for future-ready competencies? By foregrounding teachers' perspectives, this study contributes to the emerging literature on empathic

science teaching and offers insights that may inform science teacher education, professional learning, and future research on integrating empathy and SEL within science instruction.

Literature Review

Social-Emotional Learning and the Affective Dimensions of Teaching

Social-emotional learning (SEL) has become increasingly central to contemporary educational practice because it is grounded in the understanding that students' academic learning is closely intertwined with their social and emotional development (CASEL, 2024; Cipriano et al., 2023; OECD, 2024). Rather than viewing learning as solely a cognitive process, SEL emphasizes the development of competencies that enable students to understand and regulate emotions, establish and maintain positive relationships, make responsible decisions, and engage effectively in academic and social settings (CASEL, 2024; Mahoney et al., 2021; OECD, 2024). Evidence from meta-analyses, systematic reviews, and international studies consistently demonstrates that high-quality SEL implementation contributes to improvements in students' academic achievement, classroom engagement, emotional well-being, interpersonal competence, and long-term educational success (Cipriano et al., 2023; OECD, 2024). Furthermore, recent scholarship emphasizes that the successful integration of SEL depends not only on school-wide initiatives but also on teachers' capacity to cultivate supportive, emotionally responsive, and inclusive learning environments that foster both academic and social-emotional growth (Cipriano et al., 2023).

Teacher Empathy and Its Role in Science Education

Within the broader emphasis on social-emotional learning (SEL), teacher empathy has emerged as a critical professional disposition that shapes the quality of teacher–student relationships and classroom climate (Cooper, 2011; Warren, 2018; Meyers et al., 2019). Teacher empathy extends beyond recognizing students' emotions to understanding their perspectives, appreciating the social and cultural contexts that influence their learning, and responding in ways that affirm students' identities and promote meaningful participation (Cooper & Miness, 2014; Meyers et al., 2019; Jennings & Greenberg, 2009). A growing body of empirical research indicates that teachers who demonstrate empathy and establish positive relationships with students contribute to stronger classroom engagement, greater motivation, increased academic persistence, and a stronger sense of school belonging, particularly in psychologically safe environments where students feel comfortable expressing ideas, asking questions, and engaging collaboratively with peers (Jennings & Greenberg, 2009; Meyers et al., 2019; Wanless, 2016). Such environments not only promote positive interpersonal relationships but also create conditions that support the successful implementation of SEL within classroom instruction (Cipriano et al., 2023).

Although science education has traditionally emphasized conceptual understanding, scientific inquiry, and disciplinary practices, contemporary reforms increasingly recognize that meaningful science learning is also shaped by students' emotional engagement, sense of belonging, and opportunities to participate authentically in scientific communities (National Academies of Sciences, Engineering, and Medicine [NASEM], 2022). Inquiry-based science instruction requires students to ask questions, investigate phenomena, collaborate with peers, and revise their thinking in response to new evidence, learning experiences that often involve intellectual uncertainty and productive struggle, making emotionally supportive classroom environments essential for sustained engagement (Furtak et al., 2012; Pedaste et al., 2015; Wanless, 2016). Within these environments, teacher empathy can help students navigate the cognitive, emotional, and interpersonal demands of science learning: by recognizing students' perspectives, valuing their lived experiences, and responding to their needs, empathic science teachers can foster curiosity, collaboration, and the confidence to engage in scientific risk-taking (Calabrese Barton & Tan, 2020; Lee, 2021; Zeyer & Dillon, 2019). Such instructional environments may be particularly important for students from historically underrepresented groups, whose participation in science is shaped not only by academic preparation but also by classroom relationships, cultural responsiveness, and opportunities to see their identities and experiences reflected in science learning (Calabrese Barton & Tan, 2020; Lee, 2021; Mensah, 2011).

Empathic Teaching, Culturally Responsive Science Instruction, and Science Teacher Preparation

Preparing science teachers to teach effectively requires more than developing content knowledge and pedagogical expertise; it also requires cultivating the professional dispositions needed to build meaningful relationships with students and respond to their diverse cultural, social, and emotional experiences (Gay, 2018; Warren, 2018). Developing these professional dispositions is particularly important because science teachers routinely work with students whose cultural backgrounds, lived experiences, and perspectives shape how they engage with scientific ideas, inquiry, and classroom participation. Within culturally responsive teaching, empathy enables teachers to recognize students lived experiences as valuable assets for learning and to design instruction that promotes inclusion, participation, and equitable opportunities for engagement (Aronson & Laughter, 2016; Hammond, 2015; Mensah, 2011). Rather than viewing empathy as an innate personal characteristic, contemporary scholarship increasingly conceptualizes empathic science teaching as a professional disposition that can be developed through intentional preparation, reflective practice, and sustained professional learning (Cooper & Miness, 2014; Meyers et al., 2019; Jennings & Greenberg, 2009).

These perspectives have important implications for science teacher education. Preservice and practicing science teachers are expected to facilitate inquiry-based learning, collaborative problem solving, and discussions of complex socioscientific issues while creating classroom environments where all students feel valued and capable of contributing to scientific discourse (National Academies of Sciences, Engineering, and Medicine, 2022). Developing empathic teaching practices may therefore

strengthen teachers' ability to foster inclusive science classrooms, support students' social-emotional development, and encourage meaningful participation in science learning. Despite these emerging perspectives, relatively little empirical research has examined how experienced science teachers conceptualize empathic teaching within SEL-oriented science instruction. Addressing this gap may provide valuable insights for strengthening science teacher preparation, informing professional development, and advancing research on empathy in science education.

Theoretical Framework

Culturally Responsive Pedagogy as a Framework for Empathic Science Teaching

Culturally Responsive Pedagogy (CRP) provides the theoretical lens for understanding how empathic science teaching can support meaningful learning experiences in science education. Grounded in the work of Gloria Ladson-Billings (1995), CRP emphasizes that effective teaching extends beyond the transmission of academic content to include meaningful relationships, high academic expectations, cultural competence, and the promotion of educational equity. Rather than viewing students' cultural backgrounds, identities, and lived experiences as barriers to learning, culturally responsive educators recognize these experiences as valuable assets that enrich classroom instruction and support student success (Gay, 2018; Hammond, 2015; Aronson & Laughter, 2016). Contemporary perspectives further position culturally responsive teaching as an approach that fosters inclusive learning environments where students experience belonging, engagement, and opportunities to participate authentically in academic learning (Mensah, 2011).

Empathy is widely recognized as a professional disposition that supports teachers in enacting the principles of culturally responsive pedagogy. By seeking to understand students' perspectives, valuing their lived experiences, and responding to their academic, social, and emotional needs, empathic teachers create learning environments that reflect the relational and equitable foundations of CRP (Warren, 2018; Cooper & Miness, 2014; Gay, 2018). Rather than treating all students identically, culturally responsive educators acknowledge the diverse cultural, linguistic, and experiential backgrounds that students bring to the classroom and intentionally adapt instruction to promote meaningful participation and academic success (Aronson & Laughter, 2016; Hammond, 2015). Contemporary scholarship further suggests that empathy strengthens teachers' capacity to build trusting relationships, promote students' sense of belonging, and cultivate inclusive classroom communities where learners feel respected, valued, and empowered to engage in learning (Meyers et al., 2019; Jennings & Greenberg, 2009). Viewed through this lens, empathy is not simply an individual personality trait but a professional disposition that enables teachers to enact culturally responsive practices that support both students' academic learning and social-emotional development.

Science education provides a particularly important context for applying culturally responsive pedagogy because meaningful science learning depends on students' active participation in inquiry, collaboration,

scientific discourse, and the investigation of authentic scientific and societal problems. Contemporary science education encourages students to construct explanations from evidence, engage in scientific argumentation, and examine complex socioscientific issues from multiple perspectives (National Academies of Sciences, Engineering, and Medicine [NASEM], 2022; Lee, 2021). Recent science education scholarship further emphasizes that students develop scientific understanding by making sense of phenomena through collaborative sensemaking, evidence-based reasoning, and the continual refinement of explanations rather than through the passive acquisition of facts (NASEM, 2022). These instructional practices require learning environments where students feel psychologically safe to ask questions, express uncertainty, challenge ideas respectfully, and learn from mistakes (Furtak et al., 2012; Pedaste et al., 2015; Wanless, 2016).

This study employed Culturally Responsive Pedagogy (CRP) as the theoretical lens for exploring and interpreting experienced science teachers' perspectives on empathic science teaching within SEL-oriented science instruction. Guided by the principles of CRP, the study examined how participants described empathy as a professional disposition that supports meaningful relationships, values students' diverse experiences, and promotes equitable participation in science learning. The framework informed both the interpretation of participants' descriptions of empathic science teaching and the analysis of how these practices contribute to supportive, inclusive, and socially responsive science learning environments. By situating teachers' perspectives within the broader context of culturally responsive pedagogy, this study contributes to a deeper understanding of how empathy functions as a relational instructional disposition that supports inclusive science teaching, meaningful student participation, and social-emotional learning.

Methodology

Research Design

This study employed an exploratory qualitative research design to examine how experienced science teachers conceptualize empathic teaching and describe its role in supporting social-emotional learning (SEL)-oriented science instruction. An exploratory qualitative approach was appropriate because the study sought to gain an in-depth understanding of participants' perspectives, experiences, and interpretations of empathic teaching within the context of science education rather than to test predetermined hypotheses or establish causal relationships (Creswell & Poth, 2018; Merriam & Tisdell, 2016). Through semi-structured interviews, the study explored how participants understood empathy, enacted empathic instructional practices, and perceived the influence of these practices on students' academic, social, and emotional development. This design was particularly appropriate given the limited empirical research examining experienced science teachers' perspectives on empathic teaching within SEL-oriented science instruction.

Participants and Sampling

Purposeful criterion sampling was used to recruit participants who could provide rich, relevant, and information-rich perspectives on empathic science teaching (Patton, 2015; Merriam & Tisdell, 2016). The selection criteria required participants to (a) have at least five years of science teaching experience and (b) be recognized for demonstrating empathic teaching practices or a strong commitment to social-emotional learning (SEL) within their instructional contexts. The second criterion was applied based on the researcher's professional familiarity with each participant's teaching practice and reputation among colleagues, rather than a formal, independently documented nomination process; this reliance on researcher judgment in identifying participants is acknowledged as a limitation later in this manuscript. Because the purpose of qualitative inquiry is to obtain an in-depth understanding of a phenomenon rather than statistical representation, participants were selected based on their ability to provide meaningful insights into the role of empathy in science teaching.

Two experienced science teachers participated in the study. One participant taught physical science at the secondary level, while the other taught agricultural science at the postsecondary level. Both participants had more than five years of teaching experience and were selected because of their demonstrated commitment to fostering supportive, relationship-centered learning environments. Their varied teaching contexts provided complementary perspectives on how empathy is understood and enacted across science education settings. Although the sample was intentionally small, the participants’ differing educational contexts enriched the exploratory nature of the study by providing perspectives from both secondary and post-secondary science education.

Data Collection

Data were collected through semi-structured, open-ended interviews designed to elicit participants' perspectives on empathic teaching and its role in supporting social-emotional learning (SEL)-oriented science instruction. Semi-structured interviews were selected because they provide sufficient flexibility to explore participants' experiences while maintaining consistency across interviews through the use of a common interview protocol (Creswell & Poth, 2018; Merriam & Tisdell, 2016). This approach allowed participants to describe their understandings of empathy, discuss instructional practices they associated with empathic teaching, and reflect on how these practices influenced students' academic, social, and emotional development.

Each participant completed one individual interview lasting approximately 30 minutes. Interviews were conducted remotely using Zoom and audio-recorded with participants' permission. The researcher personally transcribed each interview verbatim, allowing for repeated engagement with the data and facilitating familiarity with participants' perspectives prior to formal analysis (Miles et al., 2020; Saldaña, 2021). The interview protocol included open-ended questions that encouraged participants to define empathy, describe how they demonstrated empathy within science instruction, and explain how they believed empathic teaching contributed to students' learning experiences and future development. Follow-up questions and probes were used, when appropriate, to clarify responses and encourage

participants to elaborate on their experiences (Patton, 2015). Interview recordings, transcripts, and related research materials were securely stored using password-protected electronic files accessible only to the researcher. Participants were assigned pseudonyms to protect their identities and maintain confidentiality throughout data analysis and reporting.

Data Analysis

Data were analyzed using a hybrid thematic analysis approach that combined deductive and inductive coding to develop a comprehensive understanding of participants' perspectives on empathic science teaching. A hybrid approach was appropriate because it allowed the analysis to be informed by existing literature and the study's theoretical framework while remaining open to new ideas and patterns that emerged directly from participants' experiences (Fereday & Muir-Cochrane, 2006; Braun & Clarke, 2021; Saldaña, 2021). This approach aligned with the exploratory nature of the study by integrating conceptually informed analysis with inductive theme development.

Following each interview, the researcher transcribed the recordings verbatim and read the transcripts multiple times to become thoroughly familiar with the data (Miles et al., 2020; Saldaña, 2021). Initial coding began with a set of a priori codes derived from the literature on empathy, culturally responsive pedagogy, and social-emotional learning. As analysis progressed, additional inductive codes were developed to capture participants' perspectives that were not represented within the initial coding framework. The coding framework evolved iteratively as deductive and inductive codes were continually compared, refined, and organized into categories that reflected patterns of shared meaning across participants' accounts (Braun & Clarke, 2021). Throughout this process, emerging codes and thematic interpretations were discussed during ongoing peer debriefing with an experienced qualitative researcher, allowing the coding framework and thematic structure to be further refined before the final themes were established. Feedback from these reviews informed the refinement of codes, the organization of themes, and the interpretation of participants' perspectives, thereby enhancing the credibility of the analysis and reducing the potential influence of researcher bias (Lincoln & Guba, 1985; Creswell & Poth, 2018). Through this collaborative and iterative analytical process, five themes were identified that captured participants' shared understandings of empathic teaching within SEL-oriented science instruction. The resulting themes represented shared patterns across participants while preserving the unique perspectives contributed by each teacher.

Researcher Positionality, Reflexivity, and Trustworthiness

Qualitative research recognizes that researchers bring their professional experiences, perspectives, and assumptions to the research process. The researcher is an experienced science educator who has taught in both Nigeria and the United States and is currently pursuing doctoral studies in science education. These professional experiences provided valuable insight into the diverse ways science teaching is enacted across educational contexts and contributed to the researcher’s interest in empathic

teaching and social-emotional learning within science education, while also underscoring the need for reflexivity, since prior experiences and professional beliefs could influence the interpretation of participants' perspectives (Creswell & Poth, 2018; Merriam & Tisdell, 2016).

To manage this influence and strengthen the trustworthiness of the study, several strategies were employed throughout data collection and analysis. Self-transcription of the interviews facilitated repeated engagement with the data and careful consideration of participants' intended meanings, and an iterative coding process supported credibility and dependability by ensuring that emerging codes and themes were continually reviewed and refined (Lincoln & Guba, 1985; Creswell & Poth, 2018). Ongoing peer debriefing with an experienced qualitative researcher provided opportunities to examine emerging interpretations, challenge potential biases, and refine the coding framework and thematic structure throughout the analytic process (Lincoln & Guba, 1985; Saldaña, 2021; Patton, 2015). Transferability was supported through rich descriptions of the research context, participant characteristics, and methodological procedures, enabling readers to determine the applicability of the findings to other educational settings (Lincoln & Guba, 1985; Merriam & Tisdell, 2016). Confirmability was strengthened through transparent documentation of analytic decisions and the inclusion of verbatim participant quotations that grounded the findings in participants' own words rather than the researcher's assumptions (Miles et al., 2020; Saldaña, 2021). Collectively, these strategies enhanced the rigor, transparency, and trustworthiness of the study.

Ethical Considerations

Ethical considerations were addressed throughout the study to protect participants' rights, privacy, and confidentiality. Participants were informed of the purpose of the study, the voluntary nature of their participation, and their right to decline to answer any question or withdraw from the study at any time. Interviews were conducted only after participants provided consent to participate and permission for the interviews to be audio-recorded. To protect confidentiality, pseudonyms were assigned to participants, and identifying details were removed from the presentation of findings. Interview recordings, transcripts, and related research materials were stored securely in password-protected electronic files accessible only to the researcher.

Findings

Participant Characteristics

Two experienced science teachers participated in this exploratory qualitative study. To protect participants' identities, pseudonyms are used throughout the findings. Martha taught physical science at the secondary school level, while Duronte taught agricultural science at the postsecondary level. Both participants had more than five years of science teaching experience and were purposefully selected because of their demonstrated commitment to empathic teaching and social-emotional learning (SEL).

Although participants represented different educational contexts, they shared similar perspectives regarding the importance of empathy in supporting students' academic, social, and emotional development.

Overview of Findings

Analysis of the interview data resulted in five interrelated themes describing how participants conceptualized empathic teaching within SEL-oriented science instruction: (a) understanding students' emotional experiences, (b) understanding students' perspectives, backgrounds, and lived experiences, (c) attentive listening, (d) active engagement in students' lives, and (e) teaching with students' future development in mind. Rather than representing discrete instructional practices, these themes reflect interconnected dimensions of empathic science teaching that collectively illustrate how empathy informs teachers' relationships with students and their instructional decision-making.

Theme 1: Understanding Students' Emotional Experiences

Both participants described empathy as beginning with an awareness of students' emotional experiences and recognizing how those experiences influence learning. They emphasized that effective science teaching requires more than delivering content; it requires understanding how students' emotions, challenges, and personal circumstances shape their engagement with science learning. Participants viewed this awareness as an essential foundation for building supportive classroom relationships and creating learning environments where students feel valued and capable of participating.

For Martha, empathy began with understanding students beyond their academic performance. She described empathic teaching as requiring teachers to recognize the personal, social, and emotional experiences that shape students' learning. She explained:

it’s just a deep level of understanding regarding a student’s personal, social and emotional elements in life.

Martha further emphasized that this understanding must be intentionally cultivated through the classroom environment, noting that meaningful learning cannot occur unless teachers consciously create a safe space where students feel valued. As she explained:

"This deep level of understanding is critical to learning and cannot be achieved unless a teacher consciously creates a safe space where students feel valued."

Similarly, Duronte emphasized that understanding students' emotions allows teachers to respond more effectively to students' individual learning needs. He stated:

Empathy goes beyond sympathizing, it involves somebody acting in the capacity, compassionately doing something like maybe providing help when someone has the need.

Theme 2: Understanding Students' Perspectives, Backgrounds, and Lived Experiences

Participants consistently described empathic teaching as requiring teachers to understand students from their own point of view while recognizing the diverse backgrounds and experiences they bring to the classroom. Rather than viewing perspective-taking and knowledge of students' lived experiences as separate processes, participants described them as complementary practices that enable teachers to make responsive instructional decisions. Understanding how students think, where they come from, and the circumstances shaping their learning was viewed as essential for adapting science instruction to meet individual needs.

Duronte described perspective-taking as intentionally placing oneself in students' positions when making instructional decisions. He emphasized that effective teaching requires understanding students' experiences beyond academic performance and preparing them for the demands of contemporary society:

"It is very pertinent that we always put ourselves in students' shoes because teaching is not all about passing exams in the 21st century… we must be very empathetic and know that students need to be trained to be able to live in today's world."

Similarly, Martha emphasized that understanding students' backgrounds and prior experiences enables teachers to adapt instruction in meaningful ways. She explained:

"Knowing that your students are coming from different backgrounds, so they connect their prior experiences in order to make connections to future experiences, just understanding all those connections is very vital for how you make adjustments for them."

Duronte further noted that teachers must also consider the broader circumstances influencing students' learning, explaining:

"Teaching in this time is not all about passing exams. It is about finding ways to help students adapt. Teachers must take real considerations on how our children are coping with the situation."

Together, these accounts suggest that empathic teaching involves understanding students' perspectives in light of their backgrounds, experiences, and current circumstances. Participants viewed this understanding as the foundation for responsive instruction that connects science learning with students' lives while supporting both academic and social-emotional development.

Theme 3: Attentive Listening

Participants collectively viewed attentive listening as an essential expression of empathic teaching. They emphasized that empathy requires teachers to move beyond hearing students' words to intentionally listening for students' emotions, concerns, and experiences. Participants viewed attentive listening as a relational practice that enables teachers to better understand students' needs, strengthen teacher–student relationships, and create classroom environments where students feel respected, valued, and supported.

Martha emphasized that attentive listening involves intentionally creating opportunities for students to reflect on their experiences and connect science learning to issues that are meaningful in their own communities. She illustrated this perspective by explaining:

"Additional time and space where students and teachers can do self-reflecting, and self-regulating… it opens that doorway where students get to think about 'how is it that there is release of certain gases in the atmosphere? How is this affecting my community?' So that they're able to develop that warm heart in wanting to be change agents."

Participants viewed attentive listening as more than a communication skill; it was described as a deliberate instructional practice that enables teachers to understand students' experiences and create opportunities for meaningful engagement in science learning.

Theme 4: Active Engagement in Students' Lives

Participants consistently described empathic teaching as moving from understanding students' emotions and experiences toward taking intentional actions that support students' academic, personal, and social development. Participants emphasized that empathy is demonstrated through responsive instructional decisions and meaningful engagement with students' individual circumstances. Rather than viewing empathy as a passive disposition, they characterized it as an active commitment to supporting students in ways that foster trust, resilience, and meaningful learning experiences.

Martha illustrated this commitment by describing a student who was balancing academic responsibilities with caregiving responsibilities at home. Recognizing the student's circumstances, she adjusted her instructional expectations by providing additional time to complete course requirements. Reflecting on this experience, she stated:

"If this moment has not been relative to teaching us empathy, I don't understand what other way we could get this."

Duronte similarly described empathy as being demonstrated through teachers' willingness to work alongside students and model the values they hope students will develop. He explained:

"During agricultural science practical lessons, we teach the students how to get in the field to cut grass and till the soil. And you demonstrate it with them as the teacher, and they see that as educated as you are, you can be involved in the work, which teaches them respect for dignity of labor."

Theme 5: Teaching with Students' Future Development in Mind

Each participant framed empathic teaching as reaching past students' immediate academic success toward preparing them for future learning, responsible citizenship, and meaningful participation in society. They emphasized that science education should equip students not only with scientific knowledge but also with the dispositions, values, and decision-making skills needed to navigate real-world challenges. Participants described empathy as an essential component of this broader educational purpose because it encourages teachers to consider the long-term impact of their instructional practices on students' personal, social, and civic development.

Duronte, the postsecondary instructor, emphasized that empathic teaching requires educators to look beyond examination performance and prepare students for the demands of contemporary society. As described in Theme 2, he framed this orientation as placing himself in students' shoes so they could be prepared to live in today's world; revisited here, that same commitment to perspective-taking extended into a longer-term concern for students' readiness for life beyond the classroom, linking present-day understanding with future-oriented teaching rather than treating them as separate practices.

Similarly, Martha viewed empathic science teaching as preparing students to apply scientific knowledge in ways that positively influence their communities. As introduced in Theme 4, she described creating opportunities for students to reflect on scientific issues affecting their daily lives, such as the release of atmospheric gases, so they could become thoughtful and compassionate change agents. Revisited here, this same reflective practice illustrates that attentive listening and future-oriented teaching were not separate for Martha but were enacted through the same classroom moments, as the space she created for students to listen and reflect was itself what oriented them toward long-term civic and scientific responsibility.

Taken together, participants situated empathic teaching within a longer time horizon, one that moved past immediate academic success toward preparing students to apply scientific knowledge responsibly, engage thoughtfully with societal challenges, and contribute positively to their communities. Across all five themes, empathy was described as a relational instructional disposition that shapes how teachers understand students, build supportive learning environments, respond to students' needs, and prepare learners to apply scientific knowledge responsibly in an increasingly complex world.

Discussion

Understanding Students as the Foundation of Empathic Science Teaching

The findings of this exploratory qualitative study suggest that experienced science teachers conceptualize empathic science teaching as a relational instructional disposition that extends beyond caring for students' emotional well-being. Rather than viewing empathy as an isolated interpersonal characteristic, participants described empathic science teaching as an instructional approach grounded in understanding students' emotions, perspectives, backgrounds, and lived experiences to inform responsive teaching practices. Collectively, these findings, drawn from the accounts of two experienced teachers, tentatively indicate that empathic science teaching begins with knowing students as individuals and recognizing how their experiences shape participation in science learning.

This conceptualization aligns with contemporary perspectives that position empathy as a professional disposition supporting culturally responsive instruction and positive teacher–student relationships (Gay, 2018; Warren, 2018; Cooper & Miness, 2014). However, the present findings extend this conversation by demonstrating how experienced science teachers integrate empathic understanding into responsive, inquiry-oriented science instruction. Rather than describing empathy solely as an interpersonal quality, participants consistently portrayed it as a pedagogical resource that informed instructional decision-making, classroom relationships, and students' engagement with scientific learning. Their emphasis on understanding students' backgrounds and lived experiences before making instructional decisions reflects a commitment to teaching that is responsive to learners' individual needs rather than driven exclusively by content coverage. These findings reinforce recent scholarship suggesting that equitable science instruction is strengthened when teachers recognize students' cultural knowledge, lived experiences, and community assets as valuable resources for learning rather than barriers to achievement (Lee, 2021; Mensah, 2011; National Academies of Sciences, Engineering, and Medicine [NASEM], 2022). Overall, these exploratory findings point toward a possible orientation in which empathic science teaching begins with understanding students before designing learning experiences that support meaningful participation in science, though confirming this pattern will require research with larger and more varied samples.

Empathy as a Relational Instructional Practice

Beyond understanding students, participants consistently described empathy as something enacted through instructional practice. Attentive listening, responsiveness to students' circumstances, and active engagement in students' lives were viewed as essential expressions of empathic teaching rather than optional interpersonal qualities. Rather than perceiving empathy as an individual personality trait, participants described it as a professional disposition demonstrated through intentional interactions, responsive instructional decisions, and meaningful relationships with students.

These findings reinforce contemporary perspectives that position teacher empathy as central to creating emotionally supportive and inclusive learning environments where students feel respected, valued, and

encouraged to participate (Jennings & Greenberg, 2009; Meyers et al., 2019). Within science education, these relational practices are particularly important because inquiry-based instruction requires students to ask questions, test ideas, collaborate with peers, and revise their thinking through scientific discourse. Such learning is more likely to occur when teachers intentionally cultivate classroom environments characterized by trust, psychological safety, and mutual respect (Furtak et al., 2012; Pedaste et al., 2015; Wanless, 2016). Viewed through the lens of culturally responsive pedagogy, participants' accounts can be mapped onto specific tenets of the framework rather than treated only as a general relational orientation. Attentive listening and responsiveness to students' circumstances, for example, reflect Ladson-Billings's (1995) emphasis on cultural competence, insofar as both teachers described adjusting instruction around students' backgrounds and lived circumstances rather than applying a uniform approach. Active engagement in students' lives, such as Martha's adjustment of deadlines for a student with caregiving responsibilities and Duronte's willingness to work alongside students in the field, illustrates high academic and personal expectations paired with support rather than expectations lowered out of sympathy. Teaching with students' future development in mind, particularly Martha's emphasis on helping students see themselves as change agents, resonates with critical consciousness, the CRP tenet concerned with preparing students to recognize and act on social and civic issues. Read this way, these findings tentatively suggest that empathic teaching may support science learning not only by strengthening teacher–student relationships but also by creating instructional conditions that encourage meaningful participation and collaborative scientific sensemaking (Gay, 2018; Warren, 2018; Lee, 2021).

Teaching Science with Students' Future Development in Mind

Perhaps the most distinctive finding of this study is participants' emphasis on preparing students for future participation in society. Rather than describing empathy solely as emotional support or relationship-building, participants conceptualized empathic science teaching as equipping students with the dispositions, values, and decision-making skills needed to address complex scientific and societal challenges. From their perspectives, empathy extended beyond supporting students' immediate academic success to preparing them to become thoughtful citizens capable of applying scientific knowledge in meaningful ways. This broader orientation toward students’ future development extends conventional understandings of teacher empathy beyond relationship building to encompass preparation for civic and scientific participation.

These findings contribute to the emerging literature on empathic science teaching by highlighting its perceived role in preparing students for responsible participation in an increasingly interconnected and scientifically complex world. Participants emphasized helping students examine issues affecting their communities, reflect on the societal implications of scientific knowledge, and develop a sense of responsibility toward others. These perspectives align with contemporary visions of science education that emphasize scientific literacy, ethical reasoning, and civic engagement as essential outcomes of science learning (National Academies of Sciences, Engineering, and Medicine [NASEM], 2022; OECD,

2024). They also reinforce recent scholarship suggesting that integrating social-emotional learning within science instruction can support students' ability to collaborate, make informed decisions, and address authentic community and global challenges (Cipriano et al., 2023).

Implications for Science Teacher Education

The findings of this study have several implications for science teacher education and professional practice. First, they suggest that empathy should be viewed as a professional instructional disposition that can be intentionally cultivated rather than as an innate personal characteristic. Science teacher preparation programs should therefore provide preservice teachers with structured opportunities to develop empathic teaching practices through reflective experiences, culturally responsive pedagogy, inquiry-based instruction, and authentic interactions with diverse learners. Preparing future science teachers to understand students' backgrounds, perspectives, and lived experiences may strengthen their ability to design inclusive learning environments that support both scientific understanding and social-emotional development. Developing these dispositions during teacher preparation may help future science teachers create learning environments where scientific inquiry and social-emotional learning reinforce one another.

Second, the findings highlight the importance of ongoing professional learning that supports experienced teachers in integrating empathy into everyday science instruction. Professional development should extend beyond instructional strategies and content knowledge to include opportunities for teachers to intentionally develop relational practices such as attentive listening, perspective-taking, and responsive decision-making. These professional learning experiences may help teachers create psychologically safe classroom environments where students feel respected, valued, and confident participating in scientific inquiry and collaborative sensemaking.

Finally, the findings suggest that empathy should be more intentionally integrated into science curricula alongside inquiry-based learning and scientific practices. Rather than treating social-emotional learning as separate from science instruction, educators should design learning experiences that encourage students to examine authentic scientific problems, consider multiple perspectives, engage in ethical reasoning, and connect scientific knowledge to issues affecting their communities. Integrating empathy within science education has the potential to support not only students' scientific literacy but also their development as thoughtful, responsible, and socially engaged citizens. For science teacher educators, these findings underscore the importance of designing teacher preparation experiences that intentionally model empathic science teaching while simultaneously developing preservice teachers' pedagogical knowledge, inquiry-based instructional practices, and social-emotional competencies.

Limitations

Several limitations should be considered when interpreting the findings of this study. First, this exploratory qualitative study included only two purposefully selected participants, both of whom were recognized for their commitment to empathic teaching and social-emotional learning. Consequently, the findings are not intended to be generalizable to all science teachers but rather to provide an in-depth

understanding of how experienced educators conceptualize and enact empathic science teaching. Second, the findings are based on participants' self-reported perspectives and experiences, which may not fully reflect their classroom practices. Future studies could incorporate classroom observations, reflective journals, or student perspectives to triangulate teachers' descriptions of empathic practice and provide a more comprehensive understanding of how empathy is enacted within science classrooms. Finally, because the study was conducted within a specific educational context, additional research involving diverse educational settings, grade levels, and cultural contexts would further expand understanding of how empathic science teaching is conceptualized and enacted across science education settings. Future research may also examine how empathic science teaching is experienced by students and how it influences classroom interactions, engagement, and science learning outcomes.

Conclusion

This exploratory qualitative study contributes to the growing body of science education scholarship by illustrating how two experienced science teachers conceptualized empathic science teaching within SEL-oriented instruction. The findings suggest that these participants viewed empathic science teaching not simply as a relational disposition but as an instructional approach that supports scientific inquiry, meaningful participation, and students' preparation for responsible engagement with society. Rather than describing empathy as an interpersonal characteristic alone, participants portrayed it as an instructional approach that informs responsive teaching, strengthens teacher–student relationships, and supports meaningful engagement in science learning.

The study further suggests that empathic science teaching goes beyond fostering supportive classroom relationships toward preparing students for thoughtful participation in their communities and an increasingly complex scientific world. Participants emphasized the importance of creating learning environments where students feel valued, engaged, and empowered to connect scientific knowledge to authentic problems and societal issues. These perspectives reinforce the view that social-emotional learning and science learning are not competing priorities but complementary dimensions of high-quality science instruction.

Although this study was exploratory and involved a small sample of experienced science teachers, it provides meaningful insight into how empathy can be understood and enacted within science education. The findings contribute to the emerging conversation on empathic science teaching by positioning empathy as a professional instructional disposition that supports equitable, inquiry-oriented, and socially responsive science learning. As science educators prepare students to address increasingly complex local and global challenges, fostering empathic science teaching may be an important step toward developing scientifically literate, socially responsible, and engaged citizens.

Declarations

Ethics approval

This study was approved by Morgan State University, Institutional Review

Participation was subjected to informed consent. It is hereby confirmed that this study was carried out in accordance with relevant guidelines and regulations including adherence to Helsinki declaration.

Participation statement

Informed Consents (Consent to Participate) were obtained from all participants.

Consent to publish

All participants consent to their data being published

Data availability

The data for this study are not available to the public due to ethical concerns but can be made available upon reasonable request.

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