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Exploring the Science Teacher Identity of Elementary Pre-Service Teachers in A Science Method Course: A Mixed Methods Study

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Abstract

This study explores the science teacher identities of 35 elementary pre-service teachers enrolled in an elementary science methods course in the third year of their professional coursework. Using an explanatory sequential mixed methods approach, this research answered two research questions: How do pre-service teachers view themselves as science educators, and what factors affect their science teacher identity during science methods courses? Data was collected using a survey that included an adapted version of the McDonalds et al. (2019) STEM professional identity overlap (STEM-PIO) instrument. This instrument featured both quantitative components (a single-item pictorial response scale) and qualitative elements (two open-ended questions). Findings revealed that most participants (69%) perceived themselves as possessing a partial alignment between their self-image and that of a science teacher. Further results indicate that instructional experiences that prepare pre-service teachers for science instruction within a methods class play a significant role in shaping their identity as science teachers. This research is crucial for researchers and teacher education to understand the factors responsible for the development of pre-service teachers' science identity as it pertains to a science methods class.

Introduction

Teacher identity, also referred to as teachers' professional identity, is an extensively studied subject in teacher education and plays a crucial role in shaping teachers' instructional practices. Zhao and Zhang (2017) highlighted that this professional identity is a fundamental aspect of teachers' careers. Valentyn (2019) defined teacher identity as how educators perceive themselves and form connections in various situations. In a similar vein, Can and Karacan (2021) noted that teacher identity is influenced by interactions within diverse social, formal, cultural, and institutional environments rather than being solely defined by teaching activities.

Research has shown that teachers' self-perceptions as professionals significantly impact their effectiveness, their persistence in the field, and their overall feelings about their roles in the classroom (Hong, 2010; Ingersoll, 2003; Mahan, 2010). This indicates that identity is a construct shaped by a variety of experiences gained from different contexts. Khozan (2022) also stated that developing a teacher identity is difficult because of its dynamic nature and that teachers constantly construct ideas on how to act and understand their duties. This process is more

challenging for pre-service teachers because they are navigating coursework in addition to understanding their duties as incoming teachers. This underscores the importance of exposing pre-service teachers to a range of environments that support their development and help them reflect and articulate their evolving experiences, beliefs, and values that shape their present and future selves.

Purpose Statement

The purpose of this study is to examine the development of science teacher identities among elementary pre-service teachers enrolled in an elementary science methods course. Using a mixed methods approach, this research seeks to explore how pre-service teachers perceive themselves as science educators and identify the factors influencing their science teacher identity throughout the course. For this study we are examining the following two research questions:

- How do pre-service teachers perceive themselves as science teachers?
- What factors influence the science teacher identity of pre-service teachers in science methods courses?

Theoretical Perspectives

This section outlines the theoretical concepts that influenced this research. The study is based on three key frameworks: Gee's (2000) identity framework, Wenger's (1998) communities of practice, and Bandura's (1997) self-efficacy from social learning theory. Each framework is introduced individually, followed by a review of relevant literature.

Identity Framework

In his influential book "*Social linguistics and literacies: ideology in discourses*," (Gee, 1996) and later in his article titled: "*Identity as an analytic lens for research in education*," (Gee, 2000-2001), Gee provided a framework often used as an analytic lens for studying identity in various situations. Gee defined identity in relation to what kind of person one is by considering four key components including nature, institution, discourse, and affinity group membership or affiliation. He argued that in "today's fast changing and interconnected global world, research in a variety of areas have come to see identity as an important analytic tool for understanding school and society" (Gee, 2001-2001, p. 99). This dynamic approach implies that Gee's idea of identity requires intensive focus on how people recognize their own identities, the power structures that shape them, and how these identities affect pedagogy and dispositions.

According to Gee (2001), all people have multiple identities that are intertwined with their internal self and to their performance in society. Gee (2000-2001) points out four different identity categories or characteristics, Nature-Identity, Institution-Identity, Discourse-Identity, and Affinity-Identity (see Table 1). By using this framework, we can see how complex identity is as well as the formation of identity.

Table 1. Identity as an Analytic Lens

Category of Identity	*Process of Construction*
Nature-Identity	Identity that contributes to biological factors. Characteristics that are 'natural'
Institution-Identity	Positions an institution poses on an individual; both positive and negative
Discourse-Identity	How people see individual traits, achievements, and/or attributes
Affinity-Identity	Groups with whom one shares a common interest or experience

Note. Adopted from Gee, J. (2000-2001). Identity as an analytic lens for research in education. Review of Research in Education. 25, 99-125.

Science Teacher Identity

Avraamidou (2018) noted that science teacher identity formation is multidimensional and can be shaped by the many experiences that teachers have in the classroom. Examples of this include the actual teaching of science lessons, peer feedback, engaging in reflective practice, and working with actual students. The work of Avraamidou (2018) stresses the importance of researching identity formation in studying science educators.

Kier and Lee (2017) highlighted the usefulness of the identity framework in comprehending the roles of both students and teachers within science education. This framework explores how individuals relate to the culture of science, their connection to the discipline, and their sense of recognition as people of science. Avraamidou (2014) conducted a review of existing literature on the identity of science teachers, analyzing 29 empirical studies to explore how the development of science teacher identity has been investigated within science education. The author highlighted that the exploration of science teacher identity was emerging at that time. They emphasized the importance of viewing identity as a critical aspect of teacher preparation, as it underscores the need to create a supportive environment for pre-service teachers to shape their identities in science teaching. The findings of the study suggest that examining teacher identity provides valuable insights into teacher learning, broadening our understanding of science teacher development. Additionally, the study highlights the significance of context in the learning and growth of science teachers and allows for the exploration of their personal experiences with science.

Kier and Lee (2017) pointed out that examining identity can provide insights into how elementary pre-service teachers approach learning and practicing pedagogical skills with which they may feel less confident, especially in comparison to other subjects. Several factors have been identified as influencing the pre-service teachers' science identity. Some of these include a lack of confidence in content knowledge (Appleton, 2006), incomplete philosophy development (Darling-Hammond et al., 2005), the gap between theory and practice (Korthagen, 2010), fragmented curriculum (Zeichner & Conklin, 2008), the quality of support (Hudson, 2013). Khoza (2022) also highlighted factors such as prior experience, personal histories, and teacher preparation programs as influencing

pre-service teacher identity development.

Self-Efficacy Framework

Bandura describes self-efficacy as a person's belief in themselves, in their capabilities, and in their actions. It plays a significant role in the "triadic reciprocal causation" model, influencing how people behave, make decisions, react to changes, cope with challenges, and accomplish things in their lives (Bandura, 1977). This triadic model assumes that human action is the direct result of interactions between three variables: environment, behavior, and individual (see Figure 1).

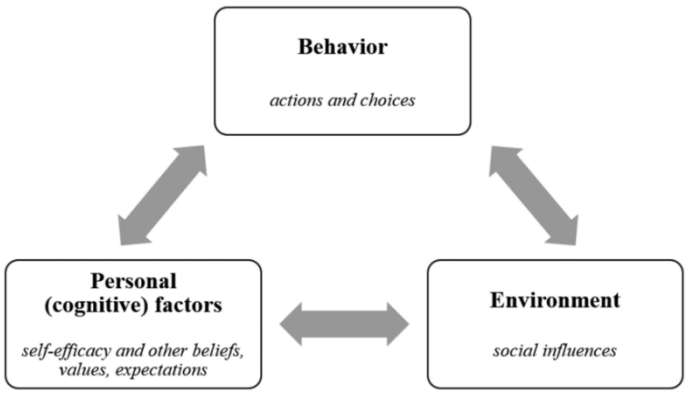

Figure 1. Triadic Reciprocal Causation Model

Note: adopted from Kuznetcova, Irina & Porter, Christopher & Peri, Joshua & Glassman, Michael. (2022). The Construction and Validation of the Visuospatial Self-Efficacy (VSSE) Scale. Journal of Science Education and Technology. 31. 10.1007/s10956-022-09964-1

An important idea relevant to teacher education is the sources of self-efficacy. Bandura (1997) noted that self-efficacy is developed through four sources: enactive mastery experiences, vicarious experiences, social persuasion, and physiological-emotional states, noting that the enactive mastery experience is the most influential source to improve self-efficacy. Menon (2020) showed the various contexts in the teacher preparation program where these four sources can be found.

Pre-service Teachers Science Teacher Identity and Self-Efficacy

The science identity of pre-service teachers is closely connected to their self-efficacy (Kier & Lee, 2017). Research has historically indicated that engagement in science content and methods courses within teacher preparation programs can enhance the self-efficacy and attitudes of pre-service teachers toward teaching science (Chen & Mensah, 2018; Howitt, 2007). Menon (2020) effectively illustrated the relationship between Gee's identity concept and Bandura's self-efficacy framework, highlighting that science methods courses and field experiences are key contributors to self-efficacy development. The findings emphasized that various identity aspects—including discourse, affinity, institutional, and nature identity—play a significant role in shaping the science teacher identities of pre-service educators. They found that mastery, as a source of self-efficacy, was a major element influencing the development of science identity in all cases studied, with other sources of self-

efficacy also making a substantial impact. Ultimately, they concluded that experiences in K-12 settings and coursework in teacher preparation significantly influence the science teacher identities of pre-service teachers. Additionally, Tsybulsky and Muchnik-Rozanov (2019) demonstrated that as pre-service teachers progressed through their practicum and engaged in co-teaching project-based science lessons, their professional self-perception improved, and they gained autonomy and self-efficacy.

Situated Learning Theory

The situated learning theory was proposed by Lave and Wenger (1991). This theory emphasizes learning as a situated activity, with a central defining process they called "legitimate peripheral participation." They additionally noted that "learners inevitably participate in communities of practitioners" and that "the mastery of knowledge and skill requires newcomers to move toward full participation in the sociocultural practices of a community" (p.29). Wenger's (1998) community of practice grew out of the situated learning theory. Four assumptions guided this new theory of learning: humans are social beings; knowledge is about competence with respect to valued enterprises; knowing is a matter of participating in the pursuit of such enterprises, that is, of active engagement in the world; and meaning- our ability to experience the world and our engagement with it as meaningful (Wenger, 2009 p.210). In that same study, Wenger put forward four key elements that should direct a social learning theory, advocating for communities of practice as a viable social learning framework. These are: meaning, a way of talking about our ability; practice, a way of talking about the shared historical and social sciences; community, a way of talking about the social configurations in which the enterprises are defined as worth pursuing and our participation is recognizable as competence, and identity, a way of talking about how learning changes who we are and creates personal histories of becoming in the context of our communities. The situated learning theory and the community of practice is a suitable framework to guide our work with pre-service teachers because pre-service teachers are learning within a social setting with people of the same profession and are negotiating meaning and their identity while preparing for and enacting their practice.

Pre-service Teachers in Methods Courses

Preservice elementary teachers' prior experiences with science, either in a methods course or in a science content course, have been shown to impact their thinking regarding science teaching (Chen & Mensah, 2018). For example, elementary teachers who employed inquiry-based teaching practices identified their experiences during their teacher preparation program as influential to the development of these teaching practices (Avraamidou & Zembal-Saul, 2010).

According to Avraamidou (2014), preservice teachers' development of science teacher identity is informed by their personal histories when they arrive in a teacher education program. Preservice teachers experience new discourse during their teacher preparation programs within methods classes that may challenge their prior views of science and science teaching. "While preservice teachers may encounter conflicting ideas, they negotiate science teacher identities as they engage in discourse within their coursework and school placements" (Menon and Azam. 2021, p.561). Feiman-Nemser (2008) suggests that teacher preparation programs allow for many

"intentional learning opportunities" that aid in allowing preservice teachers to become teachers of higher quality.

Menon and Azam (2021) propose that learning-to-teach experiences, such as those offered in methods classes, are useful in altering existing teacher identities as they are spread out over time and allow for the development of a teaching identity. These classes also offer a place for discourse, which allows for identity re-formation. The reason that methods classes are important in identity formation is that they offer opportunities, through field experiences and classroom activities, to think, feel, know, and act like a teacher (Menon & Azam 2021). Additionally, it was found that teachers' experiences as students in science classrooms, teacher preparation courses and field experiences, and the continued marginalization of science in schools all influence teachers' developing identities as science teachers (Carrier et al. 2017). The work of Wallace and Brooks (2015) highlights the importance of autonomy, collaboration, and relationships with children in a methods course, which can influence the development of a science teaching identity. Menon and Azam (2021) also underscored the role of prior experiences, interactions, and the teacher education program in shaping preservice teachers' identities. These studies collectively suggest that methods courses play a crucial role in shaping science teacher identity, with a particular emphasis on the influence of context, experiences, and prior knowledge.

Kazempour (2018) noted that it is vital for research to examine how individuals describe their experiences, beliefs, and values over time relevant to who they are and who they want to become. This is crucial, especially in teacher education, for us to understand how pre-service and science teachers' identities are constructed. While research has extensively investigated the enhancement of science teaching self-efficacy through science methods classes, there is limited research on how science methods courses play a role in the science teacher professional identity of pre-service teachers. This study aims to explore the self-perceptions of pre-service teachers regarding their professional identity in teaching science as they participate in a science methods course and what components of the science methods course contribute to this professional identity.

Methods

The purpose of this explanatory sequential methods study is to explore how the science methods course may have contributed to 35 elementary science teacher identity development while enrolled in a methods course. This mixed methods approach is employed because the open-ended questions, which constitute the qualitative data, are needed to explain pre-service teachers' responses to the questions in the quantitative portion of the study. The two research questions this study explores are:

- How do pre-service teachers perceive themselves as science teachers?
- What factors influence the science teacher identity of pre-service teachers in science methods courses?

Participants and Context

IRB approval was secured for this study in the spring semester, and recruitment was completed at the end of the spring semester. Thirty-five elementary pre-service teachers enrolled in different sections of a science methods

class at a large midwestern university constituted the participants for this study. The participants had one more semester of professional coursework before student teaching. The science methods class employs a reflection orientation framework (Abell & Bryan, 1997), which provides multiple opportunities for reflection for pre-service teachers through projects like the Think-aloud interview, reading of science instruction, instructional strategy texts, science inquiry labs, lesson planning activities, etc. Enrollment in the science methods course was the eligibility for the participants in this study. The teacher preparation program is a 4-year program where pre-service teachers take courses in four areas- general education, area of concentration, electives and professional education. Science for most elementary pre-service teachers falls under general education, although some may decide to go deeper into the science content and make science their concentration.

Data Collection and Analysis

The survey instrument constituted the quantitative data used in this study, which is an adaptation of the STEM professional identity overlap (STEM- PIO) by McDonald et al. (2019), in which the science teacher identity replaces the STEM professional identity. T The McDonald (2019) study evaluated the reliability of this instrument by assessing its test-retest reliability with a small group of students over a six-month period. Additionally, the authors broadened the measure to encompass competence, performance, and recognition, which enabled them to evaluate the internal reliability and ascertain whether the instrument effectively captured these key aspects of identity. Finally, they investigated the relationship between their measure and other STEM identity assessments that prioritize identity centrality to determine if their measure of typicality offered a unique perspective.

The quantitative section is a one-item pictorial response scale (see Appendix) that shows participants' perceived image of themselves and that of a future identity and had the following prompt: "*Select the picture that best describes the current overlap of the image you have of yourself and your image of what a STEM professional is."* The first picture on the survey depicts the least overlap, while the seventh picture depicts the most overlap.
The qualitative data consisted of two open-ended questions in the qualitative section of the survey. Hence, participants responded to both the quantitative and qualitative sections together. The two open-ended questions are

- Explain why this picture best describes your image of yourself as a science teacher.
- Can you recall and share a moment from your science methods class that contributed to your science teacher identity development?

We have classified each degree of overlap as "no overlap", "beginning overlap", "limited overlap", "partial overlap", "moderate overlap", "significant overlap", "almost complete overlap", with picture 1 representing "no overlap" and picture 7 representing "almost complete overlap".

The survey responses were uploaded to an online location for each analysis. The quantitative section was analyzed using the R programming language to conduct descriptive statistics, while the quantitative section was analyzed through content analysis. The first and second authors individually coded the participants' responses to the two open-ended questions from the survey instrument and met to reconcile the results. There was an initial inter-rated

agreement of 71% for the first question, a 90% initial agreement on the second question, and a 100% final agreement between the researchers for both questions.

Results

The findings outlined below are arranged according to the research questions that our study aimed to address. The first research question was answered quantitatively as well as qualitatively, while the second research question was answered qualitatively.

How do preservice teachers perceive themselves as science teachers?

Analyzing the pictorial question on the survey showed that 69% of participants (24 out of 35 participants) chose the fourth image—i.e., their image of themselves partially overlapped with an image of a science teacher halfway through. A high number of participants chose the fourth image, which represents an overlap between the image of oneself and the image of a science teacher. This suggests that many participants have an image of themselves overlapping equally with the image of a science teacher.

11% (4 participants) chose the second image (the image on the top right). This image is next to an image where there is no overlap between one's identity and that of a science teacher (see Figure 2). This suggests that this group of participants saw minimal overlap or commonality between their image of themselves and the image they have of a science teacher. Another 11% (4 participants) chose the third image, the first image to the left on the second row, which shows an increment in overlap, an improvement from the second image in the survey. This image suggests that participants who chose this see more overlap between their identity and that of a science teacher. Of the participants, 9% (3 out of 35) chose the 6th image, which shows the second most overlap between the image of the participants and that of a science teacher. There is still some room left between the image of self and the image of a science teacher. The chart below shows the distribution of participants' responses to the quantitative section of the survey.

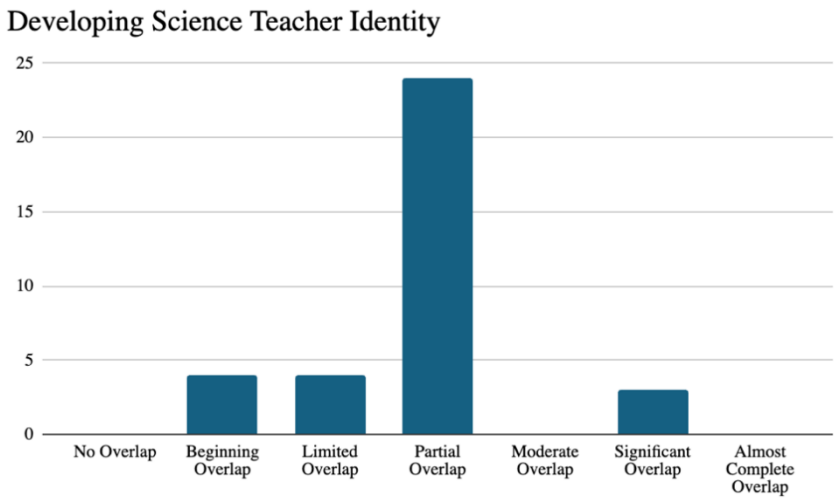

Figure 2. Developing Science Teacher Identity

What factors influence the science teacher identity of pre-service teachers in science methods courses?

The qualitative data in this survey were analyzed in response to both research questions this study seeks to answer. In response to the first research question, the two open-ended questions on the survey were analyzed to explain further participants' choices and responses to the quantitative section. The survey included two open-ended questions related to each research question. In other words, the first open-ended question was linked to the first research question, and the second one was related to the second research question. The results, presented below, are organized into two themes, one for each research question.

Developing a Science Teacher Identity

The codes that made up this theme include teaching experience, confidence, content knowledge, identity, instructional strategies, and knowledge gain. Examining the qualitative data showed that participants who fell into this category (almost complete category) chose that image because they felt more confident in their abilities and had a lot of experience with teaching. One of the participants in this category wrote, "This picture best described me as a science teacher because I don't feel 100% confident in teaching science, but the approaches and strategies taught to me were insightful and useful to use in my teaching." Another participant who chose the 6th image mentioned, "This image best describes me because I have many hours of experience in the classroom teaching and creating lesson plans that make me close to being a science teacher." Choosing the 6th image indicated that participants considered that there is almost an alignment between their images of themselves and those of a science teacher because of their preparation and their experience in the classroom.

Additionally, the qualitative data analysis showed that 69% of participants who chose the 4th image did so because they perceived themselves as possessing a partial science teacher identity. The fourth image shows a halfway overlap between their identity and their image of a science teacher. Some reasons for the partial identity included a knowledge gap- instructional strategy gap, teaching experience gap, and lack of confidence. A participant who chose the 4th image wrote, "I have a good grasp on lower elementary but not upper elementary, so half of the circle is left, which is the science portion." This participant alludes to their partial confidence due to the lack of content knowledge required to teach upper elementary. Another example from a participant who equally chose the 4th image is:

> I chose this image because I wouldn't call myself a science teacher but just a teacher, which includes teaching science. I wouldn't say being a science teacher is a huge part of my identity, but when teaching science, it is a big part

This participant sees their science teacher identity as separate from their teacher identity and they can assume their science teacher identity when teaching science.

Of the participants, 11% chose the 3rd image. The third image shows a less than half overlap between the image of the self and the image of the self and the image of a science teacher. An example of participants' responses is

given below by a participant: “I have never seen myself strictly as a science teacher, but I have some knowledge. I think my brain is geared more towards English.”

While the third image shows a lesser overlap than the fourth image between participants’ identities of self in the profession and those of science teachers, participants’ responses show that they shared some overlap in their identities with those of science teachers; however, most of their identities are taken up by another subject. Another participant expressed: “I chose that image because I still have so much to learn when it comes to teaching science. As the years go by, I will get more teaching experience, and I hope to achieve the last image.” This response also suggests that there is potential for their identity to develop. They believe their identity as a science teacher overlaps more than the second image, which is just starting to overlap.

Lastly, when the responses of the 11% of participants who chose the 2nd image were examined, all four participants expressed a lack of confidence and knowledge. Some examples of participants’ responses include: "I am not entirely confident in my science teaching," "I feel like I have not learned a lot about how to actually teach science," and "I don't feel knowledgeable about different science topics."

Influence on Science Teacher Identity

The codes that make up this theme include lesson planning, field experience, and teaching rehearsal. In answering the second research question on what factors influence pre-service teachers’ science teacher identity in a science methods class, participants were asked to recall and share if any part of their methods class helped develop their science teacher identity. Although they all had varied aspects of the methods class that influenced their perceptions of themselves as a teacher, a developing science teacher, or almost a science teacher, they perceived the benefits of participating in the various projects in the course as having some impact on their science teaching and science teacher identity. Findings showed that 42% of the participants noted that lesson planning and learning about the 5E learning cycle from their science methods class contributed to their identity as science teachers. One of the participants in this category noted that “learning the 5E and applying it to their lesson” were moments and topics they could point to in their methods that contributed to their science teacher identity. Another participant noted:

> Creating my lesson plan for my kindergarteners using the 5E helped me step out of my comfort zone and make my lesson more interactive than it usually would have been. I will be using this in the future (even though I don't plan on strictly teaching science as a standalone subject).

Lesson planning was a significant component of this class, as the participants had to plan the lessons to teach during field experience. In these method courses, the 5E learning cycle (Bybee, 2009) was the model used to plan their lessons.

Additionally, it was observed that another 18% of the participants noted that teaching rehearsal was a factor that contributed to their science teacher identity development. A participant noted with respect to the teaching rehearsal, “One moment for me was the teaching rehearsal workshop. I thought this was really helpful and allowed

me to gain feedback from the instructor and classmates." Another participant noted, "The workshop gave me good feedback on how to be a successful science teacher. I feel more prepared to teach science". The practice session took place right before the participants were scheduled to teach their lessons in their field placement. This allowed them to simulate a teaching session and get feedback from their peers.

Another 14% of the participants noted that the field experience was a component that contributed to their science teacher identity, as participants indicated that "being able to teach their lesson was helpful," alluding to the field experience as a factor that contributed to their science teacher identity development. Other factors participants gave include nature of science (6%), population connections (6%), Harlen textbook readings (6%), the inquiry labs (3%), relationships within the methods class (3%), and general knowledge gain (3%) as responsible for their science teacher identity development.

Discussion

This study explores 35 pre-service teachers' perceptions of their science teacher identities and the elements that shape this science teacher identity while enrolled in a science methods course. The two questions this study seeks to answer are: how do pre-service teachers perceive themselves as teachers of science, and what factors influence the science teacher identity of pre-service teachers in science methods courses? It is important to note that the findings discussed in this study are based on pre-service teachers' perceptions of themselves.

Kelchtermans (2000) emphasized that the teaching profession is highly self-involved and that a teacher's professional identity is the concept of the teacher as the teacher. Volkmann and Andersen (1998) observed that forming a teacher's professional identity involves a complex process of reconciling personal and professional roles. Our study asked participants to reconcile their image of themselves and their image of a science teacher and revealed that most participants failed to reconcile these two identities fully. They experienced discrepancies between how they saw themselves (their self-image) and how they perceived the expectations of their professional role. Participants noted that their partial identity as science teachers was rooted in feelings of inadequacy concerning their knowledge, teaching strategies, teaching experience, and overall self-confidence. This shows that this feeling of inadequacy has an impact on how confident they feel and view themselves as science teachers, as well as their perception of the roles of science teachers. This is corroborated in Mensah's (2016) work about elementary pre-service teachers not having a strong sense of self as a science person or science teacher. This weak sense of self as a science teacher, which relates closely to their science-teaching self-efficacy, influences their approaches to teaching science and affects their willingness to teach the subject in the future, particularly for those who are preparing to be elementary teachers. Not only does it impact their science teaching but extends to students' outcomes (Çarkiroglu et al., 2005) also noted that a teacher's belief about beliefs or perceptions of themselves often determines the positive teaching behavior and students' outcomes.

Those who perceived themselves as having a significant overlap indicated that they had done so because they felt confident in their teaching abilities and had enough teaching experience. Those who viewed themselves as having limited overlap noted that their knowledge gap and possessing conflicting identities across other content courses,

they have taken is responsible for their limited science teacher identities. This is supported by Chen & Mensah (2018), noting that elementary teachers, as generalists, tend to develop identities across the different content they take and acquire the specific skills, content, and pedagogical knowledge of each subject. Several studies have shown that pre-service teachers often arrive at their teacher preparation program with their own beliefs accumulated over the years. Tatar (2015) observed that the beliefs of pre-service teachers regarding teaching and learning are often shaped by their observations and experiences throughout their extended engagement, starting from their very first day in the preparation program.

Nguyen and Yang (2018) noted that it is important to pay attention to the influence of context on identity formation. The context within which this study is taking place is the science methods course, and the literature has shown that the science methods course has the potential to enhance pre-service teachers' science teaching efficacy (Settlage, 2000). The knowledge gaps expressed by pre-service teachers as being responsible for their identity are within the purview of a methods class. Pre-service teachers in this study are enrolled in the methods class, where they are also preparing for their early field experience to gain some teaching experience. While enrolled in the methods course, they are guided on how to prepare to teach their lessons in the field by the instructors, and they go out to teach in their field placement. For this class, pre-service teachers have taken a couple of science courses from the College of Arts and Sciences, as well as a science content course, as part of their professional work. Pre-service teachers often do not think this is enough to help them develop their knowledge or make them confident in their science teaching abilities.

Methods courses have been shown in the literature to contribute to the identity development of pre-service teachers. Abell and Bryan (1997) stated that a methods class with a reflection orientation framework has the potential to implicitly and explicitly assist pre-service teachers in developing a science teacher identity. Chen and Mensah (2018) noted that through planning and teaching their science lessons in the classrooms, pre-service teachers can enact their identities for the first time and practice their teaching strategies and lessons as informed by their teacher and science teacher identity. The responses provided by participants in this study show that engaging in activities learning activities during the methods course that are geared towards planning and teaching their lessons during field placement, such as using the 5E learning cycle for lesson planning and teaching rehearsal, contributed to the participants' science teacher identity. Participants noted that these aspects of their methods course aided their science teacher identity development and spoke to the impact they see their science methods course having on their developing identity.

Although data was collected after pre-service teachers had taught their lessons in the field, the teaching experience may have had some influence. While field experience may have influenced their identity development, as the literature suggests, it is important to examine how different segments leading up to the field experience help prepare them for teaching science.

This is different from what is found in the literature on how methods courses contribute to the development of pre-service teachers' science identity. The literature shows that when PSTs engage in reflective practices, this helps their identity development. While there is the possibility that this is the case, we cannot rule out the fact that

the participants have noted that activities that help them prepare to teach their lesson are responsible for their identity development.

Conclusion

The development of teachers' professional identity is a complex and ongoing matter, and even more so for pre-service teachers, that needs to be taken as an utmost priority. Pre-service teachers come into our classes with various beliefs and images of themselves and of science teachers, which they have accumulated over several years of schooling. Understanding these beliefs from the pre-service teachers' perspectives and how pre-service teachers see themselves as teachers of science proves many benefits for science teacher educators and teacher educator programs to know how to assist them specifically. This mixed methods study illuminates some of the factors that influence pre-service teachers' perceptions of themselves as teachers of science as they participate in a science methods class. Examining the components of the methods class that shape pre-service teachers' identities as science teachers and their self-efficacy is crucial for teacher educators, researchers, and teacher preparation programs to intentionally design the course to foster positive development of their identity and confidence in their teaching abilities.

The findings indicate that a lack of knowledge regarding instructional methods, coupled with low self-efficacy and teaching experience, leads some pre-service teachers to doubt their capabilities as developing science educators, while others do not share this concern. This research further explores the connection between the science teacher identity of pre-service educators and their self-efficacy in teaching science. Our results, along with previous studies, demonstrate that a pre-service teacher's identity is linked to their self-efficacy. Participants who felt a strong connection between their personal identity and their role as a science teacher exhibited greater confidence in their teaching abilities, whereas those who felt less connection had diminished confidence in their science teaching skills. Additionally, the study sheds light on which specific projects and objectives in teaching methods courses pre-service teachers view as significant and beneficial for enhancing their knowledge of science instruction.

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Appendix. One-item Pictorial Response Scale