A Phenomenological Inquiry on How Social Markers Inform Preservice Elementary Teachers Science Teacher Identity Through the Lens of Positionality

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A PHENOMENOLOGICAL INQUIRY ON HOW SOCIAL MARKERS INFORM PRESERVICE ELEMENTARY TEACHERS’ SCIENCE TEACHER IDENTITY THROUGH THE LENS OF POSITIONALITY

by

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A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the School of Teacher Education in the College of Community Innovation and Education at the University of Central Florida Orlando, Florida

Summer Term 2023

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ABSTRACT

This qualitative study explores the lived experiences of preservice elementary teachers (PSETs) in a teacher preparation course and the factors that informed their science teacher identity. The theoretical framework used was phenomenology, and the study addresses under-researched undergraduate preservice elementary teachers within teacher preparation courses with no teaching experience.

Methods included participant survey, semi-structured interviews, and a card sort activity. Analysis was conducted with basic statistical methods for the quantitative data, and coding followed by creating themes for the qualitative data.

Findings reveal that the responses (n=28) to an open question survey report 21 PSETs did not identify as science teachers. Further analysis of rich verbal discourse revealed how social markers of participants, through the lens of their positionality, shaped their science teacher identity.

This study explored the unconscienced day-to-day events of the participants. Reflective discourse was applied to reveal how sociocultural worlds informed science teacher identity. Reflecting on the science teacher identity phenomenon, one implication of the work is that increasing science content knowledge may not be the only factor that informs professional identity amongst the PSETs. Exploring science teacher identity in teacher preparation courses could increase awareness on how positionality informs professional identities. Studies with more participants are needed as well as future longitudinal studies to determine if science teacher identity informs the quality of science teaching in the K – 5 elementary science classrooms post-graduation.

Keywords: positionality, science teacher identity, social markers, preservice elementary teacher, teacher preparation program
DEDICATION

I would like to dedicate this work to my beloved mother Ana Deiter-Cruz and my late husband Steve Grady. They brought so much love, happiness, laughter, and light to the world.
ACKNOWLEDGMENT

This task so great would not have been accomplished without an amazing support group, especially during the challenges brought on by the novel coronavirus pandemic. Humans cannot reach such goals without the patchwork of the souls that have loved us. I would first like to thank my highly dedicated and patient mentor, professor, and dean, Dr. Malcolm B. Butler. His knowledge, empathy, experience, and compassion helped me navigate through this graduate program and research endeavors. A huge thank you to my committee for taking the time to guide and nurture my research experience. Dr. Shiva Jahani, your mentorship and guidance with feedback regarding my methodology has been indispensable. Thank you to Dr. Tonjua Freeman, whose formatting expertise, mentorship as a doctoral student, and content knowledge helped guide my dissertation proposal from the initial stages until the end. I am grateful for Dr. Su Gao’s insight regarding my literature review and methodology. Her commitment to excellence has pushed me to become a better researcher. Each member brought expertise to the study; for that, I am forever grateful. Thank you to Dr. Andrea Borowczak for taking on the role of head of my dissertation committee. Her generosity to commit to this study is selfless. Dr. Borowczak’s expert guidance and incredible wealth of knowledge has been instrumental in this study. Special thank you to Dr. Maria Busch, academic administrator in the School of Teacher Education. Her devotion, compassion and guidance to the student population goes above and beyond. A thank you to the resolute professors and staff at UCF’s College of Community Innovation and Education and more specifically School of Teacher Education, because every human made an impact on this journey. They helped with ideas, moral, emotional, and spiritual support.

I would not have accomplished this goal if it were not for the constant love and support of my family; the amazing Ana Deiter-Cruz, David Cruz, and Maria Guadalupe Prospero. The unbreakable bond of this unity led me to persevere for this overarching goal. Your unwavering
support and encouragement went above and beyond. The united effort to complete this research is not the compilation of one individual, but the collective thoughts and efforts of many. For that I am forever grateful.
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CHAPTER ONE: INTRODUCTION

“Teachers can be effective guides for students’ learning science only if they have the opportunity to examine their own beliefs” (National Research Council, 1996).

“Identities — they are alive, if they are being lived — are unfinished and in process,” wrote Holland et al. (1998, p. vii). Passmore et al. (2019) found that individuals have a multitude of identities, which are fluid, and particular identities become much more prominent depending on their roles. Lived experiences and roles shape and reshape these dynamic identities. Race, gender, religion, language, age, disabilities, education, and socioeconomic status are the social markers explored in this study that can inform an individual’s positionality. Positionality can inform the multitude of identities (Mensah, 2016). Through verbal discourse and framed by the positionality of four preservice elementary teachers’ (PSETs), I began this study with a phenomenological approach exploring the experiences of 28 participants to reveal the essence of how social markers informed PSETs science teacher identity. Verbal discourse derives from analyzing spoken or written language, which is then transposed as research data (Lemke, 2011).

The production and reproduction of identity requires an abstract perspective of an individual’s experiences and the expectations placed on an individual by others. Identity is shaped and reshaped in relation to a person’s daily events and associations. A person may narrate these daily activities to form a story of who they are and are supposed to be. The storyline of who we are as individuals could be culturally defined, racially defined, gender defined or religiously defined. For example, cultural models might impose stereotypical identities informed by past experiences. These identities influenced by cultural models are durable and reproduced socially but may be outdated.
Relationships and activities offer a sense of power and privilege associated with identities. “The world of romance and attractiveness plays a prominent role in the production and reproduction of gender privilege” (Holland et al., 1998, p. 57). Individuals are positioned with status and prestige. This power also exists within social classes. One’s role in certain academic institutions, certain socioeconomic classes one is born into, and social personages one associates amongst can all contribute to identities that elicit power and prestige. Lack of association amongst the powerful and prestigious communities may create certain unfavorable conditions. A hierarchy of social structures can determine inclusion or exclusion simply by the nature of the unspoken norms within society. Triumph and freedom seem destined amongst certain privileged identities whilst struggle and hardship consume another.

Determining how PSETs identify professionally may provide insight into the world they sense belonging to. This research is based on the premise that optimally, once PSETs have completed two science courses within this university’s teacher preparation program, they would possess a positive science teacher identity. This identity may not ensure that PSETs will, in fact, teach science postgraduation, but without this professional identity they may lack confidence to teach science. PSETs should feel like they belong in the community of science teachers. Communication and dialogue should begin in teacher preparation programs, which may help connect PSETs with other science teachers after graduation. If PSETs have the sense of belonging to the science community, they can then develop a desire to ensure elementary students learn science. PSETs identities and how these identities are formed play a role in the communities in which they have a sense of belonging.

The past 30 years have seen an influx of research on identity development, the fluidity amongst identities and the agents of change (Dy et al., 2014; Holland et al., 1998; Mensah, 2012). Intersectionality of social markers, including race, gender, religion, language, age, disabilities, education, and socioeconomic status (SES), may inform an individual’s positionality (Avraamidou, 2016; Hazari et al., 2013). There is an emergent body of research in teacher
preparation programs exploring the connection between social markers and science teacher identity development (Avraamidou, 2014a, 2014b; Bryan & Atwater, 2002; Mensah, 2016). More research is needed on the exploration of the science teacher identity of undergraduate preservice elementary teachers with no science teaching experience entering the K-5 classrooms.

**Background of the Problem**

Teacher preparation programs should encourage PSETs to take inventory of their beliefs and lived experiences. It is beneficial to give PSETs the opportunity to reveal the conscious and unconscious experiences informed by historical milieus, cultural, racial, ethnic, socioeconomic status, gender, and other social markers that make up their positional identity (Bryan & Atwater, 2002; Moore, 2008; Avraamidou, 2016). Contemporaneous with the time I was mapping out my research, I read *Studying Science Teaching Identity: Theoretical, Methodological and Empirical Explorations*, which was edited by Lucy Avraamidou (2016). She portrayed an intriguing version of identity work as “being recognized by others as a particular kind of person” (p. 179). It seemed likely that this concept could be transferred specifically to science teacher identity.

As a graduate teaching assistant at a research 1 university in the southeast United States, the first course I taught was a prerequisite course intended to increase elementary science content knowledge for preservice elementary teachers. Once PSETs completed that course, they took my next course intended to enrich students with the pedagogical approaches of teaching science in elementary school.

Reflecting on this coursework for elementary science teaching, I observed that increasing science content may not be the only factor that informs a professional science teacher identity. The goal of getting elementary teachers to teach science in their classroom postgraduation is a crucial problem that the nation faces (National Research Council, 2013). Most research addresses middle school and secondary school science teacher identity, but
more research is needed to deal with PSETs’ science teacher identity in undergraduate teacher preparation programs (Mensah, 2016). The focus of my study, then, is on how PSETs construct a science teacher identity. A positive science teacher identity may not be determined simply by exposing PSETs to more science content.

**Statement of the Problem**

Elementary students need authentic science experiences. Authentic science experiences generate a scientifically literate society and prepare students to compete in a technologically advanced global economy (Buxton, 2006). Therefore, elementary teachers need to teach science. There is a gap in research that focuses on the development of PSETs’ science teacher identity. More research is needed to explore how undergraduate teacher preparation programs facilitate science teacher identity.

The phenomenological inquiry reported in this dissertation explored how social markers informed the development of science teacher identity through the lens their positionality. The participants were four PSETs enrolled in an undergraduate teacher preparation program. One goal was to help them see “themselves as science teachers and [have] the confidence to teach science in their classrooms” (Chen & Mensah, 2018, p. 3).

In summary, the problem is that PSETs may not have a positive science teacher identity due to their lived experiences. These experiences may impact how a PSET engages students with authentic science experiences. National science education standards contend that science education can help produce scientifically literate societies and prepare students for competing in world markets. Constructing a science teacher identity may help ensure that authentic science experiences are taking place in elementary science classrooms. The following section supports the notion that elementary teachers need to teach science.
The National Research Council (NRC, 2012) outlined standards for science teachers to incorporate to create meaningful science experiences. These national standards are called the Next Generation Science Standards (NGSS) and are outlined in the *Framework for K-12 Science Education* (NGSS Lead States, 2013). It was determined that educators must possess a positive science teaching identity if they are to implement the standards as outlined in the NGSS (Avraamidou, 2014a; Bryan & Atwater, 2002; NGSS Lead States, 2013; Rodgers & Scott, 2008). The science goal for the Framework for K-5 science education:

The performance expectations in elementary school grade bands develop ideas and skills that will allow students to explain more complex phenomena in the four disciplines as they progress to middle school and high school. While the performance expectations shown in kindergarten through fifth grade couple particular practices with specific disciplinary core ideas, instructional decisions should include use of many practices that lead to the performance expectations. (NGSS Lead States, 2013, p. 2)

The NGSS provides all students and teachers the opportunity to implement inquiry-based learning and problem-based scenarios (NRC, 2012). These experiences are most beneficial for underserved K-12 student populations. This study examined how science teacher identity develops. The problem is that elementary teachers are not teaching science standards. If elementary teachers could examine, develop, and identify as teachers of science, then they are more likely to teach science with confidence (Chen & Mensah, 2018). With confidence, PSETs can create a generation of K-5 science students who have a foundation for going on to solve complex phenomena, investigate real world scenarios, and be prepared to expand this skill set into high school. Teaching the NGSS ensures authentic science experiences are being created. Constructing a science teacher identity provides confidence to teach NGSS science standards.
Interdependent science, engineering, and technology standards have been developed for students as young as kindergarteners (NRC, 2012, 2013). It is more important than ever to ensure elementary preservice teachers enter the workforce with an affinity to teach science. Constructing a healthy science teacher identity can help ensure all students are engaged in authentic scientific and engineering practices. This experience enriches the lives of elementary students and their future (American Association for the Advancement of Science, 2001; NRC, 2012, 2013). Elementary teachers are teaching less science, and research is needed to change this phenomenon (Cobern, 2000). Thus, an in-depth inquiry into what informs PSETs science teacher identity is crucial. A critical review through the lens of positionality may give insight into the development of PSETs’ science teacher identity.

Even with the science standards in place, elementary science may not be taught in the elementary classrooms (Cobern, 2001, O’Sullivan, 2019). There are few reasons reported why elementary teachers may not teach science. PSETs report they did not take science courses in college and therefore do not feel prepared to teach science (Luehmann, 2008; Moore, 2008; O’Sullivan, 2019). PSETs have traditionally reported that science was their least favorite subject (Luehmann, 2008; Moore, 2008; O’Sullivan, 2019). Gender differences in homes influence how females and males may feel about science (Cobern, 2000; Cobern & Loving, 2001; Hazari et al., 2013; Mattern & Schau, 2002). Research has revealed that gender differences in attitudes toward science and achievement begin to favor males around middle school years (Mattern & Schau, 2002). Race may impact whether PSETs construct the professional identity of science teachers (Cobern, 2001). The intersection of the social markers gender and race may inform science teacher identity. This intersection of race and gender is oppressive in nature. These observations are at the center of structural determinism. Structural determinism is “the idea that our system, by reason of its structure and vocabulary, is ill equipped to redress certain types of wrong” (Delgado & Stefancic, 2017, p. 31). This study utilized verbal discourse to delve deeper into how cognitive and noncognitive lived experiences may be pathways to developing science
teacher identity. This phenomenological method can bring to light how human experiences and social markers influence the science teacher identity of PSETs.

In a perfect world, more science knowledge brings greater satisfaction in teaching science. An intuitive belief is that effective teacher professional development programs are characterized by delivering more science content to elementary teachers. Unfortunately, elementary teachers report a disconnect with science, they lack science teaching self-efficacy, and they do not find science relevant in their daily lives (Canipe, 2016; Cobern, 2001). Most will teach science only if school administrators require it.

The NGSS offer elementary science standards with opportunities for integration of engineering and scientific practices (NGSS Lead States, 2013). The expectation to teach engineering while integrating science practices come on the heels of a dismal report. A survey of 7,000 elementary teachers a decade ago revealed that most days only 65% of students in grades 4-6 were receiving science education (Achieve, 2013; Baniflower et al., 2013; NRC, 2012, 2013). There is an expectation that all students engage in scientific practices in elementary school. In-service elementary teachers may be deprived of the professional development needed to gain confidence to be science teachers (Baniflower et al., 2013; McClure et al., 2017). Teacher preparation programs can explore how science teacher identity develops. This science teacher identity refers to the feeling of being a science teacher. In this context, science teacher identity refers to PSET’s graduating with a sense of competence in teaching science and embracing the role of a science teacher. When PSETs identify as science teachers, they will be more likely to teach science in future elementary classes. Inquiry into what informs science teacher identity is the first step into ensuring that PSETs may develop a positive science teacher identity. This study did not focus on shifting identity but only what informed the science teacher identity of four PSETs. This inquiry contributes to the literature in science teacher identity development amongst PSETs in undergraduate teacher preparation programs.
Undergraduate teacher preparation programs could benefit from better understanding how professional identities develop.

Scientifically Literate Society

These novel times have been perpetuated by the corona virus disease (COVID-19). COVID-19 was first publicly reported in December 2019 (Centers for Disease Control, 2020; Roser et al., 2020; Usak et al., 2020). This virus spread across Africa, North America, South America, Eastern Mediterranean, Europe, South-East Asia, and the Western Pacific. Within the first quarter of the year 2020, this pandemic propelled the importance of scientific literacy. Scientific literacy was the backbone of global safety and security. The entire planet's security, economy, and social structure relied on evaluations of scientific data, medicine, health, and wellness. Scientific literacy became a gatekeeper to technological, educational, and political opportunities during the global pandemic. The World Health Organization (WHO) vowed to analyze data and increase medical supplies to help countries prepare for the inevitable outbreak of the highly communicable infectious agent, COVID-19. This virus was blamed for the premature death of millions of global citizens (CDC, 2020; Hale et al., 2020; Roser et al., 2020; Usak et al., 2020).

COVID-19 was identified and reported by China on December 31, 2019, to the WHO. It was reported as a pneumonia, cause unknown, spreading in Wuhan City, Hubei Province, China (CDC, 2020). In global solidarity, the educational system transitioned into a remote learning mode. This mode of instruction impacted over 800 million students worldwide. This move was to secure social distancing to reduce the airborne transmission of the virus. Global citizens were instructed to social distance, and scientific literacy was needed to understand why. The reason this phenomenon is mentioned in this research is because it supports and validates the importance of science education being taught and conceptualized for the health and wellness of human civilization.
The ever-important goal of generating a scientifically literate society was important for safety. Understanding science was important for the survival of humankind (Wen et al., 202). The COVID-19 pandemic is evidence that this world needs more science as early as in the elementary classroom. Health and wellness of global citizens were left in the hands of individuals in society. They had to be critical thinkers, recognize illness, protect the spread of infections, and analyze data shared with communities. Students as young as elementary school need to learn the basics of science and problem solving to help family members on the front lines within their own homes. It is a united effort for family members young and old to recognize pseudoscience, false information, and relevant evidence to reduce the spread of a global pandemic. It is a contemporary example of why our preservice elementary teachers need to foster a healthy science teacher identity. Learning science in elementary school can help build a healthy community.

PSETs who report a positive science teacher identity have an affinity for teaching science. Learning science could contribute to scientifically literate citizens. Scientifically literate citizens can ask questions, create models, develop a plan, make observations, analyze their data, argue evidence, and communicate their findings (Cobern, 2001; NRC, 2012). The emergence of pandemics creates a climate with uncertainty of health, economic prosperity, and security. Science and scientific research were the topic of breaking news from multiple news outlets during the 2019 pandemic. Scientific knowledge, literacy, and health became a matter of global concern. Controlling and eradicating the spread of the looming pandemic was imperative, and families quarantined together were the first line of defense (Roser et al., 2020; Usak et al., 2020; Viner et al., 2020). Families around the globe were sharing the same lived experiences of gathering around media outlets, isolated in their homes like they were watching scenes from science fiction movies. Amid the COVID-19 pandemic, misinformation was increasingly rampant and created harm around the globe (United Nations, 2021). The pandemic era proved the
importance of differentiating between science and pseudoscience. A scientifically literate society is needed in combating a global pandemic. (NRC, 2012, 2013; Wen et al., 2020).

In the face of the 2019 pandemic, scientific literate citizens were expected to properly provide medical care for their sick at home. Citizens were told to self-isolate to contain the highly communicable disease. This was believed to help ensure the return to stability for the social, economic, and medical systems (CDC, 2020; Roser, et al., 2020; Usak et al., 2020). Science, scientific literacy, and engineering have permeated every facet of the emergence of the COVID-19 era. Society was bearing witness to the importance of scientific knowledge and critical thinking. Entrusting evidence-based informational sources were crucial to survival of the masses. Engineering and scientific practices were helping the global community combat a pandemic.

Innovative approaches to teaching science became an imminent resolution to keeping the integrity of rigorous science education. New restrictions included class size limitations, use of masks, and increased healthy sanitation measures within schools. Remote learning was set in place, and students around the nation from kindergarten to postsecondary were instructed through real-time virtual sessions with their classmates (Hale et al., 2020). States allowed for more leniency for face-to-face instruction in the United States, but overall education as we knew it had changed. Our World in Data, based in Oxford University, was designed to gather, and share scientific knowledge on real world problems. They generated a world map reflecting data retrieved from the European Centre for Disease Prevention and Control (ECDC, 2020). The data confirmed cases by the millions of COVID-19 for November 22, 2020 (see Figure 1). I included this data to show the documented cases of this virus. The reports of illness spanned the entire globe, as the map shows. As the map reports, this pandemic spanned the globe. Citizens were told to stay home and incorporate scientific literacy into their lives.

Teacher programs have an obligation to prepare the next generation of elementary science teachers. Teachers must meet the rigorous health, technological, and innovative needs
of the 21st-century science student (NGSS Lead States, 2013). Making sure our PSETs graduate with a positive science teacher identity is one step closer to ensuring our students are engaging in science literacy as young as kindergarten. Engaging elementary students with authentic science experiences will encourage scientific literacy and help students compete in the world market and technological advances.

![World Map of COVID-19 Cases in November 2020](image)

Figure 1: World Map of COVID-19 Cases in November 2020
Citizens are entering a new technological era that will eclipse the once innovative internet, handheld computers, and Bluetooth. Internet of things and artificial intelligence are flooding the global markets. The NGSS asserted that a solid science education starting as early as kindergarten is at the core of our citizens ability to “innovate, lead, and create the jobs of the future” (NGSS Lead States, 2013, p. xiii). Students, educators, and parents alike must shift their mindset to technological advances. Spacecraft National Aeronautics Space Association’s (NASA) Perseverance left Earth on July 3, 2020, and headed to planet Mars with the arrival date of February 18, 2021 (Potter, 2020). While a pandemic continued to spread across the globe, the launch of Perseverance’s exploration of planet Mars was being observed. This notion translates into the need for a diverse, well-prepared, innovative scientific, technological, engineering, and mathematics (STEM) workforce. This is imperative to our citizens’ health, economic prosperity, and security. The world is immersed in the new technological era that has surpassed the likes of internet capabilities and personal handheld computers. Space technology and artificial intelligence is center stage, but so is all the smart electronics students are in constant contact with. All these technological advances are giving form to a new way of doing business, and they are engineering and science based.

Ensuring students can compete in a world market will include proficiency in engineering and scientific practices. The internet of things (IoT) is creating all things connecting to the world wide web and artificial intelligence. Students are being inundated with technology, including space exploration, electronics, cars and even household appliances.

Communicating with citizens around the world is one way technology can help create jobs. Learning how to communicate, code, utilize technology, and incorporate scientific practices is necessary for the 21st-century worker. These opportunities are made possible with exposure to scientific practices as early as possible. Exposure to inquiry-oriented teaching can
help build the confidence to compete in the technological advances of a world market.
Elementary teachers can create meaningful science experiences to help create a generation of problem-solving. Exploring the development of science teacher identity can help cultivate a generation of elementary teachers engaging in inquiry-oriented science teaching. If all students were getting authentic science in the elementary setting, students would be more likely to be prepared to participate in problem-solving real-world issues.

Summary

Undergraduate teacher programs need to explore the development of science teacher identity amongst PSETs. Identity is connected to the “sociocultural, sociohistorical, and sociopolitical dimensions of who a person is, how a person chooses to define self, and eventually how the person teaches” (Mensah, 2012, p. 106). This “multimembership” and “interconnectedness” can be useful in understanding how identity is developed (Cho & Wang, 2020, p. 2). “Group membership plays a critical role in identity development” (Cho & Wang, 2020, p. 1).

Understanding how identity is developed can help “create meaningful interactions with family, teachers, and peers to build a sense of belonging within various communities” (p. 1). Cho and Wang’s case study on an elementary Korean American child was framed by positioning theory. Their 1-year study observed the construction of identity, more specifically ethnic identity. Dr. Mensah wrote, “Positionality told through stories offered useful insights into their developing identities as teachers and science teachers” (Mensah, 2016). Decreased confidence in teaching science and resistance to science may hinder the NRC goal of providing high quality science education to all elementary students.

Multiple agencies, including school districts and institutions of higher education, should develop a coherent approach to ensure science standards are being implemented (NRC, 2012).
The National Research Council believes science teaching is crucial for national concern, for careers in science, for engineering and to build student proficiency in science.

Each section in Chapter 1: National Science Standards for Elementary, Scientific Literate Society, and Competing World Markets are the reasons our nation needs PSETs to teach science. Teaching science is crucial to building a solid foundation for scientific literacy needed in the climate of pandemics, space exploration, and technological advances for the competing world markets (Cobern, 2001; Cobern & Loving, 2001; Mensah, 2016; O’Sullivan, 2019). Inquiry into the factors that inform the science teacher identity of PSETs in an undergraduate teacher education program is a first step into ensuring that elementary students engage in authentic science and engineering practices. This can help students become scientific literate community members. It will ensure health, safety and students will be able to compete in innovative world markets. In-service elementary teachers need to possess confidence to teach science.

This phenomenological inquiry was designed to elicit life experiences through the art of storytelling. PSETs’ personal descriptive and interpretive narratives of life experience reveal the way social markers impact their science teacher identity through the lens of their positionality. Society owes elementary students the affordances that an authentic science education can offer to protect, innovate, and secure a bright future. This inquiry was designed to explore science teacher identity development. The following section describes the procedures and focus of the study. These procedures were designed and implemented to allow PSETs an opportunity to share lived experiences, which provide insight into professional identity development.

**Overview of the Procedures**

A qualitative phenomenological study was used, and the procedures modeled Max van Manen’s methodical structure (Creswell, 2007; van Manen, 2016). The theoretical framework of phenomenology oriented the research around lived experiences of preservice elementary
teachers and the phenomenon, science teacher identity (van Manen, 2016). Using rich discourse, PSETs described their experience with the phenomenon (Starks & Brown Trinidad, 2007). The focus was to reduce this phenomenon to the very essence of its development within the PSETs through the lens of their positionality.

This conceptual framework, positionality, was used to analyze the data. Through the lens of positionality language made meaning to everydayness. Language revealing how PSETs self-identified social markers informed their life worlds. Positionality defined their social roles and assigned the participants, which may have gone unnoticed. Discourse framed with phenomenology through the lens of positionality brings to the surface the unseen of lived worlds. The research participants have described, through language, how their social markers have shaped their science teacher identity. As the researcher, I too have had to experience the phenomenon (van Manen, 2016). I isolated the human experience of PSETs science teacher identity. I left out other factors that contribute to science teacher identity and only focused on social markers through the lens of their positionality.

Approval was granted from the Institutional Review Board from the 4-year university in which the study took place. Participants were then conveniently sampled from 2 science methods courses taught by one of my colleagues. The course was purposely chosen because the students’ were enrolled in a teacher education preparation program pursuing careers in education. Twenty-eight participants agreed to complete a written survey. Four participants were purposely sampled from the 28 participants. Ashley, Lupe, Gilda, and Ana were conveniently sampled for their similar qualities. They may have differed in certain aspects, but they all agreed to a one-on-one interview, participation in a card sort activity, lacked science teaching experience, and wanted to teach elementary school aged students. They coincidentally were all females, though that was not a prerequisite. The four PSETs that participated in the interviews each experienced the phenomenon. Three participants did not identify as science teachers, and one did identify as a science teacher. Semi structured interviews elicit details of
the four participants life experiences. This rich discourse captured the essence of how their science teacher identity developed and which social markers most informed this identity (Starks & Brown Trinidad, 2007).

As a researcher I had to bracket out my experiences to ensure validity (Anderson & Spencer, 2002). Probing questions guided the semi structured one-on-one interview and card sort activity. Interviews and card sort were video recorded and transcribed verbatim (Anderson & Spencer, 2002). Participants gave detailed accounts of their experience with the phenomenon. I encouraged participants to elaborate on details shared on their survey while staying close to the social markers that informed their positionality. For validation, I would repeat my understanding of their dialogue to confirm that the message is properly relayed about their human experience (Valle & Bugental, 1989). As the researcher I reported the experience of science teacher identity as it was described by the participants consciousness. The goal was to collect and report experimental data.

Video interviews were transcribed verbatim so the analysis of the written and spoken words were analyzed. Conducted by first bracketing my personal experience with science teacher identity (Anderson & Spencer, 2002; Creswell, 2007). Edmund Husserl's bracketing or epoche is the concept of removing any of the researchers perceptions of the phenomenon and focusing solely on the participants’ experience with the phenomenon. It was crucial to start this research with personal reflection. This exercise allowed me to be aware of my personal presumptions with the phenomenon and remove bias to not impose onto my participants. As I meet with participants, a sense of fresh perspective is required. The participants had no knowledge of my theories or experience with the phenomenon (Valle & Halling, 1989). I had to imagine it is the first time I, the researcher, am experiencing the phenomenon. I now remove myself from the research and listen, read, and transcend to a sense of newness with this phenomenon of science teacher identity (Creswell, 2007).
Descriptions elicited by open ended questions framed around how participants experienced science and science teaching and what science teaching was like for them. As the phenomenological researcher I was drawing on the lived experiences of the participants. There was a full exploration of how social markers and positionality contribute to the essence of science teacher identity.

All transcripts were read multiple times to validate the findings. Subjective bias was a real concern, but a non-issue in this study. The member checking was a valid attempt to remove researcher bias and focus solely on participants experience for studies validity. Phrases and quotes were then highlighted onto another document and categorized under each of the four participants interviewed. The phrases were aligned with the research questions and offered descriptions of how the participants experienced the phenomenon of science teacher identity. The meanings of the quotes and significant phrases were clustered and coded into assorted colors according to the participants that shared. Themes were then revealed through the rich discourse. The findings were then injected into descriptions of the phenomenon.

Verification of the verbal discourse was elicited through member checking with the participants to ensure clarity. This was the first step in ensuring validity (Andersone & Spencer, 2002). As the researcher I repeated what I heard and how I understood the truths.

PSETs reported the social markers they identify with on the survey and through the interview shared which social markers informed their science teacher identity. I gave PSETs an opportunity to describe their experiences. This analysis revealed their positionality and the essence of their science teacher identity. This study could not confirm how the science teacher identity will inform their science teaching, simply isolating the factors that form science teacher identity. This study is not generalizable, but other researchers may experience similarities in the PSETs descriptions of science teacher identity.

A longitudinal study will be required to confirm how science teacher identity informs the amount of science teaching that will take place in an elementary classroom. Analyzing lived
experiences is a valuable resource for discovering the phenomenon of science teacher identity. If science teacher identity informs the amount of authentic science teaching taking place in an elementary classroom, then teacher preparation programs need to include identity work in the curriculum. This study was limited to two factors: social markers and positionality. Though literature supports other factors like inquiry-oriented teaching experiences shaping science teacher identity, this study is limited to two factors: social markers through the lens of positionality (Avraamidou, 2016; Bryce et al., 2016; Moore, 2008).

Teacher mentoring programs postgraduation would benefit from science teacher identity work, as well as teacher preparation programs. The study is comprised of surveys and interviews to elicit themes that inform science teacher identity. When a PSET shares certain experiences, something can be learned from that exchange; commonalities amongst PSETs’ experiences can help teacher preparation programs.

In summary, the methods for this research were guided with a phenomenological theoretical perspective through the lens of positionality. The participants discourse attempt to bring meaning to their science teacher identity development. The interpretations of the written and spoken words will be a judgement call. Different readers may develop different interpretations of the data, and none is necessarily more accurate than the other. For validation, there was constant member checking to ensure participants descriptions were fully understood and interpreted as they saw fit.

For a phenomenologist, the root of all research is the lived experience of human subjects. The procedures were an attempt to articulate the essence of social markers and how they informed science teacher identity. This was a reflective journey for all parties involved, bringing to life the unseen impressions that our lived worlds have on our identities.
Context of the Research

The focus of this study was to make meaning of the experiences of PSETs. None of the undergraduate PSETs interviewed had science teaching experience. This study explored the experiences and how their social markers may have informed the participants’ science teacher identity. This research is written from the first-person point of view. To successfully conduct a phenomenology, researchers must first share their own experiences with the phenomenon (Creswell, 2007; van Manen 2016). After this description, the researcher then must bracket out their own perspective before proceeding to describe the experiences of the participants (Creswell, 2007). The task was to bring meaning to a phenomenon I observed while teaching during graduate school. This was one interpretation and cannot exhaust the multitudes of plausible perspectives of the human experience revealed by the researcher and participants (van Manen, 2016). This “phenomenological human science is discovery oriented,” (p. 29) reveals how the phenomenon of science teacher identity is first experienced by the researcher and then the participants (van Manen, 2016). These identities are fluid. PSETs can begin to reflect on the sociocultural and historical milieu that inform their science teacher identity.

“Researchers have started to look at how teachers view themselves, how they are recognized by others and how teachers’ race, gender, personal histories and prior experiences with science shape who they are” (Avraamidou, 2014a, p. 145). Avraamidou (2014a) noted that science education journals had seen an uptick in published articles reporting on the development of professional teacher identities and sharing interventions to support the development of this professional identity. These interventions to help develop positive science teacher identities begin with identifying the science teacher identity and what informed this identity within the teacher education programs.

Undergraduate teacher preparation programs could benefit from learning what informs professional identity, specifically science teacher identity. “Identity-based research is significant
because it offers an ontological approach to learning,” and this exploration takes place in the teacher education programs (Avraamidou, 2014a, p. 146). Researchers have used the construct of identity to explore how preservice teachers see themselves as educators and why they may have developed an affinity or resistance to science (Shanahan, 2009). Through PSETs’ verbal discourse, the researcher and participants have attempted to make meaning of lived experiences through the lens of the PSETs’ positionality. Their social markers inform their positionality and how others see them in the community. Four PSETs described how their social markers informed their science teacher identity. A phenomenological inquiry explores the “the world as we ordinarily experience it” (van Manen, 2014, p. 65). The participants in the present study were asked to share the social markers that most informed their identity on a survey. Exploration of those social markers and lived experiences helped make meaning of how these aspects informed science teacher identity. The PSETs had all completed the science course work designed to prepare them to teach science in an elementary setting. The study was initiated after the PSETs completed their science courses in a teacher preparation program. Through verbal discourse, we attempted to make meaning of how their science teacher identity developed.

Research goals were to interpret the dynamic array of social historical factors that inform science teacher identity. Through the lens of their positionality, they were able to share life experiences that helped develop their affinity or resistance to science. Lived experiences may have been incidental in forming science teacher identity but may have been critical to the development. There were no absolutes in this phenomenological study. Implications for this research include reimagining the development of science teacher identity of PSETs within undergraduate teacher preparation programs.
Purpose and Rationale

More research is needed on how science teacher identities develop. What is the point of having a teacher education program if your graduates do not identify as teachers? That is the premise of this study. Are teacher education programs creating a generation of elementary teachers who view themselves as science teachers, who nurture this professional identity and continue with a growth mindset to evolve into an effective science educator? Avraamidou (2014a) made the conclusion after the review of 29 empirical studies on teacher identity:

Identity offers a powerful and multidimensional lens to studying teacher learning and development.

- The construct of teacher identity highlights the role of context in teacher learning and development.
- The construction of teacher identity has the potential to shed light on teachers’ personal histories in relation to science.
- The construct of teacher identity allows us to examine the impact of social markers on teacher learning and development (age, gender, emotions, and ethnicity status).

(p.164)

Elementary teacher preparation programs are the gateway to effective teachers of science. Dr. Marti Canipe, professor from the University of Northern Arizona, shared in a podcast interview that most elementary PSETs have not had science classes in college, have not experienced best practices in teaching science, and do not identify as a teacher of science (O'Sullivan, 2019). Preservice elementary teachers have developed insecurities about identifying as a science teacher. This may be due in part to their lived experiences and figurative science experiences as learners themselves (Canipe, 2016; Cobern & Loving, 2001; Holland et al., 1998,). These insecurities may lead PSETs to resist science teaching. They may, at best, focus on facts and vocabulary, thus avoiding inquiry-based learning. Authentic science
experiences are crucial for engaging students in the practice of science (Canipe, 2016; Cobern, 2001; McDuffie, 2001; Skamp & Mueller, 2001; Tosun, 2000; Yates & Chandler, 2001).

Having scientific knowledge may not be related to the affinity for teaching science (Canipe, 2016; Cobern, 2001; Cobern & Loving, 2001). Developing the intrinsic interest to teach science goes deeper than presentation of science content. Researchers seek to understand what factors contribute to an affinity or resistance to science. Cobern’s (2001) study revealed how social markers impact science affinity or resistance. He reported social markers like religion can lead to contradicting beliefs about science ideas. His study reported that gender biases in science restricted female participation in science communities. When these social markers intersect with a low socioeconomic status (SES), lack of opportunities give rise to social elitism (Cobern, 2001; Holland et al., 1998; Kincheloe & Steinberg, 1998; O’Brien et al., 1999). This study sought to understand how social markers informed the science teacher identity of four PSETs, with implications for in-service teachers teaching science in the elementary classroom.

There are few reasons reported why social markers contribute to elementary teachers not teaching science. Elementary teachers report that they did not take science courses in college. Studies suggest elementary teachers do not feel prepared to teach science and report that science was their least favorite subject (Luehmann, 2008; Moore, 2008; O’Sullivan, 2019). The Thinking About Science Survey administered to 398 PSETs by Cobern (2001) revealed a statistical significance in gender differences. The survey explored participants perception on science accessibility to women and minorities. Men reported that, “yes,” “science is open” to both social markers (women and minorities), and women were “neutral” about the idea (Cobern, 2001, p. 22). Gender differences in homes may influence a female’s affinity or resistance to science (Cobern, 2001; Cobern & Loving, 2001; Mattern & Schau, 2002). Research has revealed that science achievements begin to favor males around middle school years. In addition to gender, race may contribute to preservice teachers’ resistance to becoming science teachers (Cobern, 2001). The intersection of preservice teachers’ education and beliefs that
form their positionality contribute to lacking the interest or confidence to teach science (Avraamidou, 2016; Bryan & Atwater, 2002; Mensah, 2016; Moore, 2008). Social markers make up a PSET’s identity through the lens of their positionality. In the last two decades there has been an increase in teacher identity development, mostly for secondary science and middle school science teachers, but few have examined elementary science teachers (Avraamidou, 2016; Brand & Glasson, 2004; Enyedy et al., 2005; Proweller & Mitchener, 2004).

Historically, elementary teachers feel “intimidated” and “dislike” science (Gunning & Mensah, 2011). Preservice elementary teachers who possess a disconnect with science content may resort to addressing science teaching only to be compliant when school administration requires it (Canipe, 2016; Cobern, 2001). This statistic compels researchers to seek answers on developing professional identities. Discovering what informs PSETs science teacher identity is the first step in addressing lack of science teaching taking place in elementary schools.

The study described here was a phenomenological inquiry, a study that aimed to “let show itself” what is hidden (Heidegger, 2010, p. 33). The study, like all phenomenological studies, was a “philosophic method for questioning” (van Manen, 2014, p. 29).

Science teaching has a significant role. Science education can facilitate a healthy society, scientific literacy, and career opportunities. It can provide career opportunities in budding scientific and engineering disciplines, as well as allow citizens to compete in the global marketplace. Since Intercontinental business and trade has become the norm for global interdependence, science education can facilitate this future for students. The transformative effect PSETs have on the future of science education is limitless. The next section defines the keywords used in this study regarding the development of the PSETs professional identity. It begins with an explanation of the participants, what program they participated in, how science teacher identity was defined, and the factors that informed it.
Keywords

Science Teacher Identity

In the context of this research, science teacher identity is recognized as PSETs who were enrolled in an undergraduate teacher education program who can picture themselves as science teachers (Avraamidou, 2014a, 2014b, 2016; Luehmann, 2007, Mensah, 2016). Borrowed from Luehmann (2007) and Wright et al. (2020), I constructed the idea of science teacher identity as a self-recognition of confidence to execute competent and enriching science education and to engage learning experiences for elementary students. Self-recognition in this sense is recognizing oneself as an effective science teacher. It is assumed that, if elementary teachers will be effectively teaching science, they must first develop their identity as a science teacher (Avraamidou, 2014a, 2014b, 2016; Forbes & Davis, 2008; Luehmann, 2007).

Developing identity begins with self-recognition. Ensuring preservice elementary teachers (PSETs) have a positive science teacher identity has become ever more important. Avraamidou (2016) summed up identity work as an:

authoring of selves in much more complex ways than simply knowing and being able to do things; it involves recognizing self and being recognized as a certain kind of professional who believes, values, acts and interacts in identifiable ways. (p. 4)

Wenger (1998) claimed that “building identity consists of negotiating the meanings of our experience of membership in social communities” (p. 145). Teacher preparation programs should facilitate preservice elementary teachers in discovering and critiquing their beliefs regarding science teaching. Without intervention the educational system will continue to perpetuate cultural models, oppressive stereotypes, and prejudices that keep elementary teachers from teaching science (Bryan & Atwater, 2002; van Manen, 2016). Through the lens of critical theory, the goal of facilitating science for all students will not become a reality if teachers
continue to hold on to beliefs and attitudes that may be detrimental to science learning (Bryan & Atwater, 2002). Science teacher identity is a fluid multidimensional construct that can be shaped and reshaped over time (Avraadimou, 2016; Bryce et al., 2016; Mensah, 2016). The construct of identity has been realized as the interconnectedness of the human with the natural world, bringing into context how learning and development intertwines with “historical, institutional and sociocultural factors” (Gee, 2000, p. 100).

This research lends a fresh perspective on a recent concept of science teacher identity. The implications include science teaching in elementary schools. Identity research in science education has explored gender identity (Brotman & Moore, 2008), racial identity (White et al., 2019), ethnic identity (O’Brien et al., 1999), and discursive identity (Brown, 2004). Within the last 15-20 years, researchers have begun to examine science teacher development by analyzing how preservice teachers experience science, how they see themselves, how others recognize the preservice teachers, and how the preservice teachers’ social markers influence their science teacher identity (Avraamidou, 2014a; 2014b, Luemann & Markowitz, 2007; Moore, 2008; Rivera Maulucci, 2013; Varelas et al., 2005).

Science teacher identity is the idea that teachers see themselves as science teachers and intrinsically believe they can effectively execute science curriculum and content. As shown in Figure 2, there are factors collaborating interdependently with each other that inform science teacher identity. They include social markers (Mensah, 2016), positionality (Avraamidou, 2016; Gee, 2000), lived experiences (Mensah, 2016), an affinity or resistance to science (Cobern, 2000) and inquiry-oriented science teaching experiences (Avraamidou 2014a, 2014b, 2016; Bryce et al., 2016; Moore 2008).

Mensah (2016) found that social markers impacted the sociocultural lived experiences of 10 preservice elementary teachers of color in a “16-week graduate level elementary science methods course” program and helped frame science teacher identity (p. 51). Sociocultural factors (the society and culture in which the individual resides) and historical milieus position...
PSETs within a social context. This positioning may inform their resistance or affirmation to science, which can contribute to a science teaching identity (Cobern, 2000). Gee (2000) claimed that “we are what we are because of the experiences we have had within certain sorts of affinity groups” (p. 101). These affinity groups and experiences make up sociocultural factors. Positionality also influences the sociocultural experiences for the PSETs, and the sociocultural experiences help in the affirmation of the individual’s social markers (Avraamidou, 2016). Studies have revealed that positionality has implications in science teacher identity. In addition to social markers and positionality, inquiry-oriented science teaching experiences for PSETs can inform science teacher identity (Avraamidou, 2014a, 2014b, 2016; Bryce et al., 2016; Moore, 2008).

The social markers and how PSETs have positioned or how others have positioned the PSETs within a social context may help in the development of their science teacher identity (Moore, 2005). It is important to note that these factors interrelate in dynamic and crucial ways and do not work discreetly and categorically to make up a science teacher identity. The idea that preservice elementary teachers only need more science to ensure science is being taught in their classrooms is a fallacy and problematic (Canipe, 2016; Cobern, 2001).

Figure 2 was created for this study and informed by leading researchers (Avraamidou, 2016; Mensah, 2012; van Manen, 2016; Cobern, 2000). The figure attempts to relay how factors like social markers inform PSETs’ positionality and how their positionality informs their lived experiences. These lived experiences can inform an affinity or resistance to science and inquiry-oriented science teaching experience can shape and reshape science teacher identity (Cobern, 2000; Avraamidou, 2014a, 2014b, 2016; Bryce et al., 2016; Moore, 2008).

For the context of this study, the social markers are limited to religion, race, class / socioeconomic status, ethnicity, gender, upbringing (urban, suburban, rural, or regional), political affiliation, sexual orientation, disability/special need, age, education, and language. Positionality is informed by social markers and helps foster human lived experiences. The
PSETs’ positionality facilitates their everyday lives. For example, a thoughtful compliment on a science project can give feelings of value and worth. This compliment can help nurture an affinity for science. These stories and experiences featured in the PSETs’ positionality informed their science teacher identity. The social markers helped make up a person’s positionality and how others see them. These lived experiences, including the K-12 science classroom experience can inform an affinity or resistance to science. This affinity or resistance to science can shape a PSETs interest in facilitating inquiry-oriented science teaching experiences.
The research questions explored in this study include the following:

1. How have the lived experiences with preservice elementary teachers’ self-identified social markers impacted their science teacher identity?
2. How do preservice elementary teachers interpret the science teacher essence and what life experience informed this interpretation of the science teacher essence?

Figure 2: Factors That Shaped PSETS’ Science Teacher Identity
3. What life event can participants elicit that may have most informed their affinity or resistance to science as a preservice elementary teacher?

The research questions were designed to help facilitate a description of the science teacher essence. This focus helped four PSETs describe their experiences and how this positionality informed their science teacher identity. The role social markers played in the development of the science teacher identity of the four PSETs could have implications on how teacher preparations organize their curriculum. In addition to implications for teacher preparation programs, using this science teacher identity development information could also have implications on science teaching for in-service science teachers.

Preservice Elementary Teacher

This study focused on the lived experiences of four undergraduate preservice elementary teachers enrolled in a four-year teacher education program. Undergraduate teacher education programs at institutions of higher education can contribute to closing achievement gaps of all students in the K-12 classroom (McMahon Giles et al., 2016). The students that enrolled in the collegiate program were teacher candidates seeking certification to teach. McMahon Giles et al claimed that “teachers’ confidence in their own teaching abilities is known as self-efficacy” (p. 2). This self-efficacy is the goal for teacher candidates or preservice elementary teachers. In the context of this study, a PSET is a student seeking certification to teach elementary grades by completing necessary requirements within a 4-year university. The PSETs interviewed for this study had no classroom science teaching experience. PSETs are the future of education and are in the course work for becoming elementary school teachers.

Teacher Preparation Program

The research began by surveying 28 PSETs and interviewing four. This teacher preparation program prepares undergraduate students to practice in the field of elementary
education. Program providing the coursework and curriculum to ensure certification requirements are met by the state. The teacher preparation program is state accredited, which means students can graduate with the opportunity to teach in an elementary classroom upon completion of other mandatory requirements such as state or national exams.

Teacher preparation programs are the gateway for student achievement in the K-12 setting. Evaluation systems are evolving to hold teacher preparation programs accountable for providing PSETs the support and curriculum for teacher success (Sparks, 2013). National concerns are implementing efforts and analyzing the implications on “how teacher preparation is in addressing the supply and quality of STEM teachers” (Feuer et al., 2013, p. 21). The foundation of developing successful science teachers begins with teacher preparation programs.

Social Markers

Identity, to include professional identity, is built on the social markers one associates with. Social markers refer to the connection made by oneself or that society places upon them. Social markers can be made up of class/socioeconomic status, ethnicity, upbringing (urban, suburban, rural, or regional), race, gender, religion, language, age, education, political affiliation, sexual orientation, disability/special need, age (Dy et al., 2014; Holland et al., 1998; Mensah, 2012). This is not an exhaustive list of social markers; these examples were used in this study.

Wenger (1998) continued to describe identity congruent with the social characters as “the social, cultural, and historical” milieus (or environment) that make up the lived experiences of individuals (p. 145).

These social negotiations frame who we are and how others perceive us. Recognizing characteristics, stereotypes, and factors that are construed in the social context of human interaction because of social markers, one can start to develop a positioning in the society (Mensah, 2012; Mensah, 2016). This positioning within the community informed by social
markers starts to speak to our identity and how we are perceived by others (Maher & Tetreault, 1993). These social markers start to affect how we identify ourselves and see ourselves within this social context of human interaction.

Social markers can shape our experiences to reveal the dynamic dimensions that make up our self-talk, self-realization, and particular identities that frame our positionality within a social context (Avraamidou, 2016; Mensah, 2016; Moore, 2008). The multiplicities of intersectionality amongst social markers are fundamental aspects through which educational research can explore teachers and the learning process (Moore, 2008). Humans’ shared experiences speak to the context of how the intersection of social markers can truly impact our perceived identities and lived experiences. Generally accepted, there is an intersection of multiple social markers that may position an individual to have success or experience oppression (Mensah, 2016). Social markers may also influence and shape our perceptions of our abilities. The sociohistorical contexts that we have experienced or not experienced can shape our confidence level.

Sociohistorical contexts include speaking to the lack of representation. Little exposure to female scientists in the elementary classroom, lack of racial diversity amongst working scientists, or absence of gender fluid role models are sociocultural milieus that influence positionality. Social markers can allow PSETs to view themselves as a part of the community of science teachers or feel alienated. By exploring the social markers that help inform teacher beliefs and identity, PSETs can begin to reveal through verbal discourse the source of their science teacher identity.

Social markers make up the PSETs’ physical, emotional, and mental embodiment of being human. Scholars have argued whether race should be used as a category of social markers. Ladson-Billings and Tate (1995) argued that “thinking of race strictly as an ideological construct denies the reality of a racialized society and its impact on ‘raced’ people in their everyday lives” (p. 48). Objectively examining race as a condition dismisses the problem with
the idea of race itself. This research is not exhaustive in exploring all factors that may contribute to science teacher identity. It simply explores how social markers contribute to science teacher identity through the lens of positionality. The social markers the PSETs subscribe to have shaped their lived experiences and how others in society have positioned them.

Positionality

The science teacher identity of the PSETs was shaped by the lived experiences afforded by their social markers. These lived experiences may have positioned them for an affinity or resistance to science (Avraamidou, 2016; Mensah, 2016; Moore, 2008). Holland et al. (1998) defined *positional identity* as “how one identifies their position relative to others, mediated through the way that one feels comfortable or constrained” (p.127). Positionality (or positional identity) is defined in terms of locations amongst networks of relationships within life events, which can be related to one is social markers. It is fundamental to understanding how particular social markers intersect with the development of positional identity (Mensah, 2012; Mensah, 2016). Gee (2000) stated that “we are what we are primarily because of the positions we occupy in society” (p. 101), and this positionality informed by an individual’s life experience informs their identity. This identity is framed by their social markers.

Moore (2008) operationally defined positionality in relation to the way individuals view themselves through the multitude of their social markers throughout life events. This positionality influences preservice teacher’s science teaching identity. PSETs’ positionality of self is framed by the sociocultural experiences they have had and the social markers that make up their identity (Gunning & Mensah, 2011; Holland et al., 1998; Mensah, 2016; Moore, 2008; Wright et al., 2020). Positionality is one way to “capture a deeper understanding” of the events in life when exploring “science teacher identity” (Mensah, 2016, p. 49).

Framing this research through the lens of four PSETs’ positional identity lends a voice to the importance of life experiences. Life experiences inform the positionality of the PSETs within
a social context. This context speaks volumes regarding the ways the four PSETs developed an affinity or resistance to science. This relationship with science may have influenced their professional identity. “This means our positional identity is socially located (or positioned) in relation to others” (Mensah, 2016, p. 50). Mensah (2016) went further to suggest that these identities are not fixed, but fluid and are shaped and reshaped amongst shifting webs of relationships through life experiences.

The PSETs have agency of their own positional identity, but the ways others in the community position the PSETs may have impacted their positionality (Avraamidou, 2016; Gee, 2000; Holland et al., 1998; Moore, 2008; Rivera Maulucci, 2013; Wenger, 1998, Wright et al., 2020). The way others perceive and position an individual throughout their life should be considered as information and should not define who they are, especially when that positionality oppresses the individual in any way. That is why this inquiry is so important in exploring how social markers influence the science teacher identity through the lens of PSETs’ positionality. Teacher preparation programs should explore professional identities to confirm the source of science teacher identities.

There is constant social negotiation throughout all of life events. PSETs offer agency to their community, experiences, and the social context in which they reside. How PSETs are positioned within this social context helps in the development and essence of these multitudes of identities. The identities can sometimes be embedded with sociohistorical oppression or privilege that can influence an affinity or resistance to science (Holland at el., 1998). This affinity or resistance to science can influence science teach identity. Bryan and Atwater (2002) have researched the emergence of reflection on one’s own teaching belief systems. This reflection may help refine and lineate the notion that these identities are fluid, not static, and can be transformed. When confronted with the figured worlds and perceived worlds one has positioned themselves in, transformation and refinement can manifest. This fluidity and transformation are the root of identity work within a teacher preparation program.
Educational research in the last 20 years has taken a sociocultural approach to explore and examine how a preservice teacher's positionality intersects with their personal life and science experience. (Avraamidou, 2016; Gee, 2000; Moore, 2008; Rivera Maulucci, 2013; Wenger, 1998). Researchers used frameworks based in identity, like methodologies on studying identity and being recognized as members of a particular professional community (Gee, 2000), exploring social markers informing science teacher identity (Moore, 2008), importance of science teacher identity development (Avraamidou, 2016), a culturally responsive approach to positional identity amongst science teachers (Rivera Maulucci, 2013) and observing the act of learning as an experience of identity (Wenger, 1998).

Research has revealed that gender can play a role in the resistance to teach science (Cobern & Loving, 2002), depending on how lived experiences modeled an affinity to science and align with one's own gender identity. Whatley (1989) argued that the ethos of scientific work is unjustly less compatible for females than for their masculine counterparts. This gender imbalance can result in experiencing cultural barriers for non-masculine individuals and resistance to full participation in science (Cobern, 2001). These lived experiences can be conscience or subconscious and through verbal discourse may be elicited to explore what informed the science teacher identity of PSETs.

Bryan and Atwater (2002) continued to connect a teacher's explicit realization to high-quality science learning experiences. Teacher preparation programs should encourage PSETs to take inventory of their beliefs. They should draw from their experiences of cultural, racial, ethnic, SES, gender and other social markers that make up their positional identity (Avraamidou, 2016; Bryan & Atwater, 2002; Moore, 2008). Inquiry into science teacher identity opens the dialogue on how the essence of science teaching is defined and developed. Exploring how social markers and lived experiences inform the development of a science teacher can be instrumental. The human interactions within the teaching communities in which PSETs identify can shape the identity as an educator of science. Without interaction of inclusive
communities and subcommunities, teacher candidates lose an opportunity for healthy professional identity development. Instructors within teacher preparation programs need to examine their own participation in life experiences and the perpetuation of oppressive systems within academia.

Teacher preparation courses can help give agency to the personal experiences. Manifesting a healthy critique to reflect on spheres of influence can help preservice elementary teachers understand how they developed their science teacher identity. Science teacher identity does not develop in a vacuum. As a community, teacher preparation programs can help in understanding how social markers and lived worlds work interdependently.

Parsons (2008) described positionality as a concept that recognizes the dynamic relationship and impact that social markers have on an individual (p. 3). This conceptualization of the lived experiences within the world one occupies is the essence of their positional identity (Kincheloe & Steinberg, 1998). Maher and Tetreault (1993) stated that “scholars have helped us see the urgency of probing and analyzing the interactive nature of the oppressions of race, ethnicity, class, and gender” (p. 104). This positionality can be understood as relational to one's position within these social markers and not essential attributes of an individual's identity (Maher & Tetreault, 1993). The way others view a PSET can impact their science teacher identity.

Other people's opinion of a PSET is a useful source of information, but it is just information and should not define the individual. The implications of providing PSETs with an opportunity to uncover their fluid identity and positionality is enriching lives. Uncovering how science teacher identity and positionality was formed could be a productive step to inform teacher preparation programs in developing professional identities.

**Researcher’s Positionality**

Growing up in the southern United States with a home life immersed in Hispanic culture positioned me as a minority within my community. This positionality informed my life
experiences. I do not recall any science in elementary schools, but my godmother has a master’s degree in physical therapy from the University of Puerto Rico. As a young girl, she would take me to campus and show me around. This exposure to the university and science career informed my affinity for science. I, too, wanted to be a physical therapist like my godmother.

I identify as a Puerto Rican female. My ancestors are from Africa, Iberian Peninsula, and the Indigenous peoples of Puerto Rico. My social markers race, gender, upbringing, and SES have informed my identity and positionality. How others have positioned me during my K-12 education, doctoral student experiences, and scientific research endeavors have informed my science teacher identity. I am a first-generation college student. My brown skin and curly hair did not align with the scientist I was exposed to in the K-12 setting. Success came in part through my lower middle-class upbringing and godmother. This positioned me to explore more place-based educational experiences. My nuclear family did not have the affordances to fly cross-country for vacations, but we were able to load up in our orange station wagon and travel the East Coast with hot dogs and sandwiches in tote. We ate in the car to save money and shared one hotel room for six. We visit museums, explore new landscapes, and learn the history of our country and citizens. Being a female and first-generation college student meant that I was destined to push the science boundaries, even within my family. My Puerto Rican father did not like me to question phenomena or seek to understand the world around me. I was expected to sit quietly and not ask questions. I remember frustrating my father for merely seeking to solve problems and inquire about things I observed. I was supposed to just accept things the way they are. There was no room for curiosity. I was to get a job as soon as possible. What my father did not realize is that the more museums he took me to and the more monuments we explored, the more questions I had. His love of driving and our geographic proximity to some of the nation’s best museums and landmarks to explore had an enormous impact on my science teacher identity. This curiosity and exposure informed my affinity for science.
My skin color tells the story of my African roots and indigenous ancestors, but it did not align with my science teachers. It was my physical therapist godmother, Maria Guadalupe, who informed my science identity driving the pursuit of science. My father and mother told me I could be a scholar. My mother and father set my academic goals high but also wanted me to get to work, with or without a degree. It was these firsthand experiences and social networks that created an internal struggle and opened my eyes to the possibilities of the woman I am today.

Religion plays a significant role in my life now, but I was turned off during my formative years in middle school when I was not allowed to have a perspective that did not align with Catholicism. My Catholic upbringing painted a picture of the world that was not allowed to be questioned. It is this experience that also informed my positionality that resonates in my soul and helped inform who I am. It is this internal desire to question and curiosity to learn that inspired my affinity to science. The intersection of my upbringing, race, gender, religion, and SES informed my science teacher identity. Social markers could have been a deterrent, while others gave me the confidence to persevere.

Reflecting on my own positionality, my lived experiences as a first-generation college student informed how I viewed a college degree. The idea of college was novel but was not as important to my family as finding a job and earning money once I entered college. The culture within my home life as a Hispanic female impacted my identity and my roles in the community. At home, my brother was offered tools to build and allowed to engineer projects around the house. I had to ask for science kits and chemistry sets explicitly to explore any engineering projects. My siblings got older and started having children of their own; now my niece and nephews have experienced the same discrepancy in gifts. My nephew was offered science themed toys while my niece was offered rainbows and unicorns. I was advised to quit reading my science textbooks to my newborn niece because she would not be able to understand, but my nephew was born immersed in the content. It is with this experience within the culture of my home life that I decided to explore just how much social markers and lived experiences inform
science teacher identity of PSETs. This contextual deliberation of my positionality as the researcher while staying focused on fundamental questions was my primary task. I had to facilitate the PSETs to elicit their truths. I sought to understand how the social markers of my four undergraduate PSET participants informed their science teacher identity through the lens of their positionality.

**Summary of Chapter One**

This research was conducted in the context of an undergraduate teacher preparation. This inquiry explores the social markers that inform PSETs science teacher identity through the lens of their positionality. Our country needs to enrich elementary students with authentic inquiry-oriented science experiences to generate a scientific literate society. Those authentic science experiences can help prepare 21st-century learners to compete in this new technological era. PSETs’ science teacher identity can impact the quality of science teaching. The social historical milieus that formed the positionality of the PSETs may have impacted how the PSETs identified professionally as science teachers. The argument in literature is that simply adding more science content to teacher preparation courses may be a fallacy in developing this professional identity. There are a multitude of factors that may contribute to a professional science teacher identity like an affinity to science, a resistance to science, inquiry-oriented teaching experiences, social markers, and / or positionality (Avraamidou, 2016; Bryce et al., 2016; Moore, 2008)

This study embarks on two factors: social markers and positionality amongst PSETs within an undergraduate teacher preparation program. Exploring the development of their professional identity may have implications for how teacher preparation programs are implemented. The scope in research did not address the fluidity of science teacher identity of the PSETs, nor did it guarantee science teaching would take place as the participants evolved into in-service teachers. A longitudinal study would need to answer those probing questions.
The research was conducted at a 4-year research 1 university in the southeastern United States. Preservice elementary teachers were conveniently sampled. They were enrolled in a science teaching methods course. Twenty-eight participants completed a survey then four participants sat for one-on-one interviews. This rich discourse revealed how social markers played a role in the development of multitude of identities to include science teacher identity.

Chapter 2 outlines the selection process of the research and the relevant literature. The literature review in Chapter 2 discusses a variety of sources and viewpoints regarding the phenomenon of science teacher identity and its development. There is a gap in literature involving the research of preservice elementary teachers in undergraduate teacher preparation programs with no teaching experience. This research contributes to the conversation regarding science teacher identity within teacher preparation programs amongst preservice elementary teachers. This research opens the dialogue on how influential social markers, positionality and the lived experiences are in shaping and reshaping professional identities.
CHAPTER TWO: LITERATURE REVIEW

“Science Identity influences science persistence” (Hazari et al., 2013, p. 82).

This research drew on PSETs’ positionality and how their social markers informed their science teacher identity. I conveniently sampled 28 PSETs from a science methods course to explore their lived experiences through rich written discourse. I was curious how they positioned themselves in their lived worlds and if it aligns with the essence of a science teacher. I did not teach the course. From 28 participants, I then purposely sampled four PSETs. They were chosen for the following homogenous characteristics: they were all available for an interview, wanted to teach elementary school and did not have any science teaching experience (Koro-Ljunberg et al., 2009). The distinction of a positive science teacher identity could have implications for future science teaching.

It is important for PSETs to become integral participants in the community of science teachers (Hazari et al., 2013). This literature review evaluates what informs science teacher identity and the development as a fluid, socially constructed, and multifaceted. Reflecting on the sociocultural lived experiences of PSETs and how the historical roles may intersect with social markers can lend a voice to teacher preparation programs. The development of science teacher identity within teacher preparation courses could have implications for elementary science education.

What Informs Science Teacher Identity?

Social Markers Informing Identity

My inquiry into social markers is limited to religion, race, class/socioeconomic status (SES), ethnicity, gender, upbringing [urban, suburban, rural, or regional], political affiliation, sexual orientation, disability/special need, age, education, and language. This selection was
informed by the literature addressing science teacher identity amongst preservice teachers (Mensah, 2016; Mensah, 2012).

Identity cannot be defined without understanding how social markers intersect with students’ teacher identity (Mensah, 2012). Without exploration of social markers, researchers are missing the pieces of the whole that inform how a person views themselves. The whole PSET is a made up of their sociocultural milieus, life worlds and sociopolitical affiliations (Mensah, 2012). Social markers may offer privileges and an affinity to science or oppression and a resistance to science.

Larson and Witham (1998) surveyed a sample of top U.S. scientists to uncover their beliefs about religion. In 1996, the survey was sent to scientists who were amongst the 517 members of the National Academy of Sciences. There was a 50% return rate. The report revealed that 60.7% of the scientists surveyed expressed “disbelief or doubt in the existence of God” (Larson & Witham, 1998, p. 313). This article even suggests the results may be due to the “superior knowledge” of the scientist or the fact that they did not believe one “can be a real scientist” and believe in God (Larson & Witham, 1998, p. 313). The scientists who participated in this study report a disbelief in God.

If a PSET believes in God, would they then feel unaccepted in a community that is reporting a different or lack of religious beliefs. How religion positions PSETs may have implications for their science teacher identity. Larson and Witham’s survey (1998) only received a 50% return rate, which means it does not represent the entire population of scientists registered with the National Academy of Scientists, but the majority surveyed expressed disbelief in God. It is the social marker of religion or lack of that informed scientists identity.

The question lies, will the scientists in this study who have offspring instill that same logic in the next generation? Can upbringing then have an input on the science identity of their offspring and sphere influence. Not only religion but the intersection with upbringing can inform
someone raised in the household. In the next few passages, you will read how other factors inform science teacher identity.

Positionality

In addition to the social markers that make up positionality, Mensah (2016) concluded that positional identity informed and captured a true understanding of the science teacher identity. Mensah studied elementary preservice teachers of color who had just concluded a 16-week graduate level elementary science methods course. I modeled my Teacher Participation Overview survey for this research after her study (Mensah, 2016). Ten students who identified as elementary preservice teachers of color (PTOC) completed the survey for Mensah’s study. All but one student identified as a science teacher at the beginning of the course and reported lived experiences with their K-12 science setting as reasons for not identifying as a science teacher. In addition to the “negative images of school science,” other reports were “stereotypical descriptions of science or the science teacher,” and “not living up to the minority stereotypes” (p. 57). This result intrigued me, and I was curious whether the undergraduate students in my study would respond in the same way as the graduate students in Mensah’s study. Dr. Mensah’s study used a pre- and posttest model, but she emphasized the importance of “looking closely at the incoming view PTOC has about teacher and science teacher identity” (p.67). My inquiry on how social markers inform the science teacher identity of PSETs through the lens of their positionality was informed by Mensah’s research.

Lived Experiences

This phenomenological inquiry required four PSETs, Ashley, Lupe, Gilda, and Ana to take inventory of their epistemological belief systems that informed their positionality and science teacher identity. It also explored the sociocultural milieus and life experiences that may have helped inform their science teacher identity through the lens of positionality. The
epistemological belief system refers to the personal beliefs of an individual’s human experience (van Manen, 2014). The identity that is developed by lived experiences and driven by social markers influenced the positional identity of the four PSETs, which then may have informed their science teacher identity (Avraamidou, 2016; Gee, 2000; Moore, 2008; Rivera Maulucci, 2013; Wenger, 1998).

Science content knowledge and the ways other people in the community perceive the preservice elementary teacher play a critical role in developing a science teacher identity (Avraamidou, 2016; Bryce et al., 2016). Danielsson and Warwick’s student teacher participants’ essence of what it means to be an elementary teacher was highly influenced by their experiences as students themselves (Avraamidou, 2016). The essence of an elementary teacher was characterized as older females who were more interested in how children developed and less on content. Of the participants interviewed in their study, 9 were female and 2 were male (Avraamidou, 2016). These lived experiences shape and reshape our belief systems as human beings and can be used as an analytical process to explore identity. The sociocultural, sociopolitical, and sociohistorical milieus can help PSETs develop an affinity or resistance to science as you will read in the next passage.

Affinity or Resistance to Science

Cobern and Loving (2002) aggregated data from preservice elementary teachers’ responses on the Thinking about Science survey. The quantitative study illuminated how sociocultural factors can nurture an affinity or resistance to science. Cobern (2001) was able to quantify the “presence or absence of significant cultural concerns” (p. 1). These cultural concerns are informed by the social markers which the participants identified with. The instrument highlighted 35 concepts that on average were thought of as objections to science. The 700 PSET’s surveyed were part of a teacher education program that incorporated a “21-hour mathematics / science minor” (Cobern & Loving, 2002, p. 1022). This was a 60-item survey
with a Likert Scale response system. Response scale: strongly disagree, disagree, uncertain, agree and strongly agree (Cobern, 2001). The data revealed that social markers like religion, gender, and race were thought to suppress an affinity to science. Cobern and Loving (2002) discovered that PSETs were disinclined to accept that “science should be considered more important than religion” (Cobern & Loving, 2002, p. 1025). PSETs were also “uncertain over both the openness of science to women and minorities” (Cobern & Loving, 2002, p.1025). The study revealed there are social markers that are considered by PSETs to have less advantage in science. This study did not identify the social markers of the actual participants. This report informed my phenomenological inquiry on how the social markers that PSETs identify with may inform their science teacher identity through the lens of their positionality. Cobern’s Thinking About Science survey confirmed the intersection of social markers formed and reformed an affinity or resistance to science.

An example shared by Holland et al. (1998) revealed how caste is used as a form of stratification to position members of a community. In Naudanda a village in Nepal, underprivileged castes are required to wash their own dishes in local tea shops to avoid polluting the cups and saucers (Holland et al., 1998). This is an example of affordances or exclusions offered by positions in a community. Delgado and Stefancic (2017) go as far to say that the way humans speak to each other can aid in classism, sexism, and racism. Stereotypes shift with time and could position members of society into affordances for the elite or exclusivity for the minority. These lived experiences can shape and reshape our identities, to include science teacher identity. There are positive experiences that can leave an impression on PSETs. Exposing students to inquiry-oriented teaching can help develop an affinity to science.

Inquiry-Oriented Science Teaching

Inquiry-oriented science teaching experiences for PSETs and students of science are central to forming and reforming the science teacher identity (Avraamidou, 2016; Bryce et al.,
Data support that incorporating inquiry-based teaching pedagogy experiences may be linked to self-confidence and higher content knowledge (Avraamidou, 2016; Chichekian & Shore, 2016).

In addition to inquiry-based teaching pedagogy, participants can reflect on their self-reporting identity and where this identity came from through the lens of their positionality. This study has implications for teacher preparation programs offering these opportunities for PSETs. Danielsson and Warwick interviewed 11 student teachers from a post-graduate certification of education program in the United Kingdom (Avraamidou, 2016). The university in which these student teachers were enrolled sanctioned inquiry-based learning as mode of instruction. As a result, 7 of the participants considered hands-on inquiry-based learning at the core of their future science teaching lessons (Avraamidou, 2016). This science teaching identity was informed by their institutions inquiry-based teaching protocol. Interviewed participants in her study had teaching assistant experience. This experience proved to be highly meaningful in the development of their science teaching identity.

Steinbock translated Edmund Husserl’s 1921 philosophy on phenomenology (Steinbock, 1998). Husserl is adamant that every conscience experience leaves an impression on humans. He continues to state that “apperceptions lie in every present consciousness” (Steinbock, 1998, p. 136). These apperceptions help humans make sense of their experience and build on prior knowledge. Inquiry-based teaching experience can help PSETs conscientiously assimilate and therefore identify with a positive science teaching identity with examples afforded during school.

This study does not explore how inquiry-oriented science teaching informs science teacher identity. This study does not support this variable because my PSETs were chosen because of their lack of science teaching experience. I did not use this factor in my study of identity development. Inquiry-oriented science teaching experience was not explored. I wanted to specifically isolate how social markers inform science teacher identity through the lens of positionality.
Identity Work

Teacher preparation programs should “help raise students’ awareness of prejudice and discrimination as well as their ability to react to and constructively cope with these negative social realities’ (Ladson-Billings, 1998, p. 261). Identity is a fluid construct that can change at any time, depending on the moment and interactions within different social contexts (Gee, 2000). In this study I defined identity as a construct referring to the way individuals perceive themselves and how others perceive them (Sfard & Prusak, 2005; Wenger, 1998). This identity is developed, in part, by lived experiences and aspirations. This stems from who people are in relation to others stretching from the past and well into the future. These identities are dynamic and malleable in nature (Wenger, 1998).

Identity research spans the gamut of inquiry identity (Bryce et al, 2016), science teacher identity amongst graduate PSETs (Mensah, 2016), social justice identity (Rivera Maulucci & Fann 2016) and science teaching identity (Avraamidou, 2016).

A differing viewpoint is that this phenomenon of identity stems from the perceived notion that we as individuals really have little choice in the matter. We cannot control who we are positioned amongst, how others perceive us, or what drives our intrinsic motivations. This static positioning may lead to a lackluster social reality (Alcoff, 1988). To confirm these fixed realities, teacher preparation programs can employ personal autobiographies to gauge their sociocultural experiences with science and science education (Avraamidou, 2016; Luehmann, 2007).

Autobiographies can help nurture self-awareness of favorable science experiences that PSETs may want to replicate. This self-awareness may speak to the development of science teaching identities (Watzlawik, 2012).

Exploring the phenomenon of science teacher identity within teacher preparation programs through the lens of positionality can inform curriculum. The use of science lessons like autobiographies and having the opportunity to articulate one’s individual experiences can be
enlightening. This reflection of personal histories helps in the development of science teacher identity (Mensah, 2016; Eick & Reed, 2002). Mensah (2016) shared participant testimonies, “I see myself as a science teacher! I thoroughly enjoyed teaching science as a pre-service teacher. It is the only subject in which you can successfully integrate several other subjects” (Mensah, 2016, p. 59). Reflection of personal narratives helped Mensah’s (2016) graduate level preservice teachers of color develop a positive science teacher identity.

Teacher preparation programs can play an integral part in developing preservice teachers’ belief in teaching science (Avraamidou, 2016). Teacher preparation programs could facilitate the evolution from a PSET to an effective elementary science teacher. Teacher preparation courses can offer experiences that cultivate a positive affinity for teaching science and where all students see themselves as science teachers regardless of the social markers they possess. The experiences undergraduate PSETs have had as students of science themselves may contradict how they are learning to teach science in their teacher preparation programs, creating conflicting messages (Luehmann, 2008; Moore, 2008; O’Sullivan, 2019). This narrative needs to change and it begins with an exploration of how lived worlds, informed by social markers inform science teacher identity. Using methods of phenomenological theory, discourse will attempt to reveal the unseen impressions on our identities that are masked by the everydayness of living.

**Theoretical Perspective**

This inquiry exploring how social markers may have informed PSETs’ science teacher identity was framed by the theoretical perspective of phenomenology. Phenomenology can be used as a framework to explore using discursive narratives and make evident connections for PSETs’ science teacher identity through the exploration of lived experiences (Maher & Tetreault 2001; Mensah, 2016). “Research methods that allow participants to make meaning of multiple
social variables and life experiences in order to inquire about teaching may generate deeper understandings of positionality and teaching” (Moore, 2012, p. 4).

Phenomenological theory is the foundation of this research. This qualitative approach describes knowledge as constructed from one’s own belief and consciousness, and this conceptualization develops throughout one’s life world (Kruglanski et al., 2009, van Manen, 2014). This phenomenological approach is hermeneutic. That means that this research is oriented around the lived experiences of the participants (Creswell, 2007). This research interpreted the written and verbal language of the participants.

This research was brought into existence because the phenomenon seriously was of interest to me, the researcher. Teaching during graduate school, in a teacher preparation program, I repeatedly learned my brilliant students did not identify as science teachers. I taught science methods courses for elementary school and science content courses for elementary school. My students excelled in my courses, but after completing both courses would still have a negative science teacher identity. This was an “abiding concern” and sparked this exploration (Creswell, 2007, p. 59; van Manen, 2016, 2014). This research was framed through theoretical lens of phenomenology to reflect on themes, how social markers informed lived experiences, and how positionality informed science teacher identity.

Knowledge can be constructed from evidence, sociocultural lived experiences, interactions within a social context and personal beliefs (Bryan & Atwater, 2002; Moore, 2008). Phenomenology focuses on the descriptions of all these lived experiences (Valle & Halling, 1989). What is known by consciousness will be reduced to a single phenomenon. The development of this phenomenon, science teacher identity was shaped and reshaped by unconscious influences. This epistemic journey is to explore decision making and belief systems of PSETs. Their science teacher identities are based on cognitive dissonance (contrary beliefs), attitudes developed over time, and the persuasive negotiations within their sociocultural realm making up their positionality (Tulis & Fulmer, 2013; Petty & Cacioppo, 1986).
This theoretical framework is best due to its deliberate use of rich discourse to make sense of the everydayness of human existence. Recall, refocus and attempt to make meaning as co-collaborators with participants to truly discover who they are and how they got here. Recalling the memories, refocusing on the unseen, and bringing to light what has been in darkness. We are not attempting to describe material things but describe perceptions, renewed awareness and how science teacher identity presents itself in experience (Valle & Halling, 1989).

**Conceptual Framework**

This inquiry is framed with the concept of positionality. Positional identity (or positionality) is defined in terms of the diverse and multitude of social markers, sociocultural factors, and lived experiences that make up how an individual is positioned in a social context (Avraamidou, 2016; Holland et al., 1998; Mensah, 2016). The identity discussed in this study contributes to the body of knowledge of how PSETs in an undergraduate teacher preparation program with no teaching experience came to develop their science teacher identity. The social context in which we develop our identities and how people see us is embedded within our position in the world.

Framing this study through the lens of positional identity, I sought to understand the identities and the lived experiences that reveal the stories of PSETs. Felicia Moore Mensah (2016) described positional identity as “one way to capture a deeper understanding of identity when it involves teachers of color and studying science teacher identity” (p. 49). The positions within the social and community networks PSETs embrace may lack power for the attainment of certain goals and could require radical shifts in perception (Alcoff, 1988). Positional identities are made up of shifting contexts within social networks during life events involving economic status, religion, culture, and political ideologies (Alcoff, 1988; Moore, 2008; Wright et al., 2020).
Through a social critique, researchers can identify science teaching identity relative to one’s positional identity within their existing social and cultural network (Alcoff, 1988). Through a positional identity lens, multiple influences throughout life events can be explored that help and aid in the development of the science teacher identity of PSETs. An individual’s positionality affords the participant certain privileges, attainment of power, and the ability to navigate through the social elitist (Gilbert et al., 2005). As described with critical theory, modern society has been instrumental at normalizing the oppression of social markers within educational institutions, economy, politics, and the like (van Manen, 2014; Delgado & Stefancic, 2017).

Through verbal discourse and framed through positionality there was a reawakening of the lived experiences of participants data. I sought to understand if social markers offered affordances that attracted PSETs to identify as science teachers or caused resistance to a science teacher identity. This knowledge can be helpful to science teacher educators (Bullough, 1997; Cobern, 2001; Mensah, 2016). The concept of positionality was integrated into the human networks in which the PSETs aligned. These networks were revealed through data analysis and helped make meaning of the development of science teacher identity. The essence of science teacher identity was reduced from the positionality that the PSETs were placed in. By singling out the social markers and positionality of the PSETs, science teacher identity was re-imagined. The essence of the science teacher identity and its development was now a conscience experience. Through the lens of the conceptual framework, co-researcher
with participants, made meaning of how science teaching was experienced. Analyzing data through positionality allowed us to explore how social markers positioned PSETs in their everydayness. Analyzing how sociopolitical, socioeconomic, and sociohistorical milieus positioned the PSETs and informed their identities shed light on the development of their professional identities.

Current trends offer support in using a positional identity lens for an in-depth inquiry on science teacher identity (Avraamidou, 2016; Moore, 2008; Wright et al., 2020). Positionality frames the exploration of how social markers like the multifaceted religious associations, race, class SES, ethnicity, gender, upbringing [urban, suburban, rural, and regional], political affiliation, sexual orientation, disability/special need, age, education, and language impact the development of science teacher identity. It has been my experience as a science teacher educator that teacher candidates who have had a negative experience with science may not desire to teach science and do not identify as a science teacher. The critical review of science teacher identity has provided insight into the idea that identity is tentative (Gee, 2002; Moore, 2008; Mensah, 2016; Rivera Maulucci, 2013; Sfard & Prusak, 2005; Wenger, 1998).

**Critical Review**

Like all living things, humans can evolve and so can our identity (Gee, 2000). The tentativeness in this fluid identity is what researchers can build upon. An in-depth phenomenological inquiry on how social markers may inform PSETs’ science teacher identity through the lens of positionality can help inform the development of science teacher identity in teacher preparation programs. Recognizing that social markers may have privileged or oppressed effects on PSETs’ lived experiences can inform the development of their science teacher identity.

This exploration of PSETs’ multidimensional self-views as a science teacher, rapport with colleagues, content knowledge, personal beliefs, perception of how others recognize
candidates, and communities candidates identify with can all inform their science teacher identity. This research aligns with Bryan and Atwater’s (2002) conclusion that “knowing teachers’ beliefs and designing instruction and experiences to explicitly confront those beliefs facilitate refinement of and/or transformations of beliefs and practices” (p. 821). Development of science teacher identity amongst PSETs in an undergraduate teacher preparation program with no science teaching experience would be a useful contribution to the literature on science teacher identity.

The structural components of one’s positional identity can give rise to personal attributes. Some examples include confidence, self-realization as a science teacher, collegiality with members of the science education community, inclusive perception of how others see them, recognition into science communities in which PSETs seek to belong, development of content knowledge, and positive personal experiences with science teaching (Alcoff, 1988; Bryan & Atwater, 2002; Chichekian & Shore 2015, Mensah, 2016, p 57; Moore 2008). The opposite can be said, as well, through the lens of a critical theory.

Tripp-Knowles (1995) argued that autobiographies by teacher candidates contribute to the formulation of self-reflection and identity. Qualitative data from a card sort (Mensah, 2012) and quantitative data collected from the Thinking About Science Survey (Cobern, 2001) have shed light on how multiple identities impact science identity of the preservice teachers. A study conducted examining 15 undergraduate and graduate female students of color concluded that their positionality and, specifically, the intersection of the social markers ethnicity, gender and race played an integral role in the development of their science identity (Carlone & Johnson, 2007). Carlone and Johnson observed how the bid for recognition from others in the community shaped and reshaped the science identities of the women. Research supports that if preservice teachers are to make the leap from student to teacher, they need to develop a complex set of knowledge and understandings of effective pedagogy, in addition to the acknowledgement of their membership to the professional community (Avraamidou, 2016; Gee, 2000; Moore, 2008;
Rivera Maulucci, 2013; Wenger, 1998). An inquiry on how social markers may foster a positive or negative science teacher identity could be instrumental in professional identity development.

Holland et al. (1998) reported that “positional identities develop heuristically over time” (p. 137). These social positions develop into one positional identity which can then silence someone or create an opportunity to voice opinions, or the participation or rejection to participate in activities. Holland et al. compared positional identities that can be an embodiment or figured: An *embodiment* can develop with awareness of one’s social position (p. 139), and to the contrary, a *figures* positional identity is a result of the qualities that may be deemed important in a culture (p. 140). Bauman (2001) stated that social classes and positions were “relatively stable” with little room to change, and the goal was to “keep up with the Joneses” to maintain your position in society (p. 145). Mason (2004) argued that individuals can construct their personal identities through the narratives they share and tell themselves to make sense of their lived experiences (p. 145). A critical review into how lived experiences informed by social markers can contribute to identity could be instrumental in science education.

Preservice elementary teachers may not find relevance to science in their personal daily lives (Cobern, 2001). This disconnect may contribute to PSETs’ resistance to teaching science, and they may at best resort to teaching science merely to comply with state mandates (Cobern, 2001; Fulmer, 2014). This sentiment may demotivate elementary teachers from fully engaging in authentic science experiences for children. Educational researchers from this millennium claim there is little research that has evaluated to what extent PSETs attitudes toward science have been impacted by their epistemological belief systems (Fulmer, 2014). Preservice teachers’ epistemological beliefs can be shaped by social markers and nurtured to create a science teaching identity for preservice teachers (Canipe, 2016; Cobern, 2001; Mensah, 2012, 2016; Moore, 2008).

This research speaks to the more modern interpretation of the fluid nature of identity development and informs teacher preparation courses to reflect, identify, and confront beliefs.
that inform science teacher identities. The self-reporting of perceived science teacher identities and the social markers that may inform these identities is the essence of this phenomenological inquiry.

**Phenomenological Study**

This phenomenological inquiry explored the lived experiences informed by the social markers of 28 conveniently sampled PSETs. Four PSETs were then chosen to explore how the social markers informed their science teacher identity. The scope is not exploring the shifting of science teacher identity but simply to inquire what informed the identity, through the lens of positionality. This qualitative study evaluated personal narratives through semi structured and open-ended questions in a facilitated interview and card sort activity. The goal was to explore how PSETs identify themselves, position themselves within science teacher communities and what informed this identity (Cobern, 2001; Mensah, 2016; Moore, 2008).

The term phenomenology made its debut in 1764 by Immanuel Kant and is a derivative of the Greek word “phainein,” which means “to appear” (Yüksel & Yıldırım, 2015, p. 13). A mathematician from Germany, Edmund Husserl born in 1859, laid out the strong philosophical component in the early 20th century (Creswell, 2007). Phenomenology is a methodological approach for human science research where experiences are made to “appear” through inquiry. It is not an approach to finding truths, but an attempt to interpret and make meaning of the lived experiences of human beings through first person narratives (Qutoshi, 2018). The participants are co-researchers bringing to life the unseen consequences of everyday life worlds, from a first-person point of view. The basic idea of phenomenology is that it must describe the essence of the phenomenon as it is conscientely realized by the participants (van Manen, 2016). First-person point of view and shared conscious experiences of a particular phenomenon form the essence of phenomenology. This first-person perspective sheds light on a particular phenomenon as interpreted by first the researcher, then bracketed out to describe just the
participant (Creswell, 2007). There are no wrong or right answers in this phenomenological inquiry, just a quest to reveal the hidden meanings and development of science teacher identity (van Manen, 2014, 2016). The researcher simply seeks to understand how a PSET’s positionality and social, cultural, and historical milieu shape their experience to inform the phenomenon of science teacher identity. No one style of phenomenology can be confirmed, as styles are as diverse as the researchers who conduct them (Giorgi & Giorgi, 2003; Qutoshi, 2018; Spielgelberg, 1969).

Phenomenology is constructivist in nature because the phenomenon explored is constructed by human cognition. I chose this method of research because I wanted to explore the lived experiences of the participants and validate them. Max van Manen (2016) has stated that a “good phenomenological descriptions is something we can nod to, recognizing it as an experience that we have had or could have had” and the “validating process one has to learn to insert oneself in the tradition of the scholarship in such a way that one can become a participating member of the tradition” (p. 27). I chose to seek an understanding of the rich personal narratives of PSETs’ lived experiences through the lens of their positionality to explore the social markers that may have informed their own science teacher identities.

Data in a phenomenological study should come from multiple sources to ensure validity in the data and incorporate bracketing to reduce the chances for researcher bias (Yüksel & Yıldırım, 2015). The sources for this research come from 28 PSETs who describe their own experience with science teacher identity and the essence of a science teacher. Member checking is another component of a phenomenological study to ensure the validity of the information recovered. There are a couple of ways to perform member checking. One form of member checking with the participants is to confirm transcription of the interview (Merriam, 1995).

This research was a collaborative effort with the participants which aimed to get a clear and in-depth understanding of the lived experiences of this specific group. The members have
shared experiences and commonalities. Due to the small number of participants and the commonalities of the members, the findings are not generalizable, but they do play an informative role (Johnson, 1997).

The heart of phenomenological study is the rich discourse eliciting lived experiences. What are lived experiences? Lived experiences can be defined as “pre-reflective consciences of life” (van Manen, 2016, p.35). Dilthey (1985) suggested that a lived experience is a personal reality because participants have reflective awareness of it.

A lived experience is past and may not be grasped while it is happening but only reflectively. Interpreting this lived experience through the lens of positionality can help in the exploration of how social markers may inform the PSETs’ science teacher identity. The interpretation of this phenomenon is relating the parts to the whole, that is, exploring how social markers (the part) make up science teacher identity (the whole). What brings meaning to the phenomenon is the rich discourse of the lived experiences of the PSETs. By reflectively bringing back our memories, we are breathing life into our experiences. The research question in a phenomenological study “must not only be made clear, understood, but also lived by the researcher” (van Manen, 2016, p. 44)

Human Science Inquiry

This study employed phenomenological human science to methodically inquire on how social markers may have informed preservice elementary teachers’ science teacher identity through the lens of positionality. Phenomenological inquiry begins with a reflective awareness of lived experiences of the participants (van Manen, 2014, 2016). The participant may be unaware of the lived experience until an inquiry and reflective consciousness of the very essence of living is brought to light. Not clearly perceived at first, but with awareness it is recognized as very personal and solely belonging to the individual. Only through verbal discourse will this reality become articulated and objective.
Max van Manen (2016) has attempted to clarify this human science with “six methodological themes” (p. 34). Not to be mistaken as procedural or as a mechanistic step-by-step cookbook on phenomenological human science, and it is simply a six-step model to help grasp the very demanding qualitative approach for practitioners.

Van manen’s Methodical Structure of Phenomenological Inquiry

1. Commitment to the Phenomenon.

The commitment to a particular phenomenon is imperative to the qualitative research method of phenomenology. Max van Manen (2016) described this approach as “to confine yourself to a single thought that one day stands still like a star in the world’s sky” (p. 31). The deep and fullness of thought buried in this one single idea. The in-depth inquiry makes sense of the human experience. The recognition and attempt to explicate life experiences is the interpretation of one individual, the researcher. There is no limit to the possible interpretations from different perspectives. There is no wrong or right answer in restoring what it means to have lived and how it may inform experiences. The one thought that I will focus on in this study is how their social markers may have informed their science teacher identity through the lens of positionality.

2. Inquiry Into Lived Experience

This human science research establishes the reawakening of the lived experiences, a relearning of the lived experiences that make up our existence. A phenomenological study seeks to understand the nature and fullness of lived experience. The researcher becomes part of life to explore the interrelatedness of the shared scenarios.

This inquiry sought to awaken the consciousness of the PSETs’ life and experiences. The PSETs had the opportunity to reveal the part of them that may not have been made aware before. They revisited the original experiences of their life to inquire if social markers contributed
to the lived experiences through the lens of positionality that spoke to their affinity or resistance to the identity of a science teacher.

3. Reflection of Essential Themes

Truly unmasking the essence that makes an experience significant is the goal of awakening the lived experiences through verbal discourse with a phenomenological inquiry. Therefore, this human science research is unlike other qualitative research because it goes deeper, reflecting on the appearance of lived experiences and delving into the essence that grounds the factors of the experience. It brings into light what is in darkness, which evades our daily lives. I sought to understand a specific phenomenon and what constituted the allure of the lived experiences that informed this phenomenon.

The art of allure attempted to reveal the meaning and essence of how social markers might have informed the science teacher identity of PSETs. I attempted to grasp which lived experiences – whether it was through home life, society, culture, classroom experiences, family, friends, religion, or political affiliation informed the science teacher identity – which social markers may have manifested a PSET’s infinity or resistance to identify as a teacher of science. Awakening and finding the essence of the experiences marked by social aspects through the lens of positionality helped to shed light on where this science teacher identity manifested within PSETs.

4. The Task of Rewriting

Phenomenological study is to bring existence to something through discourse, most often through writing activity. Through language, what is spoken can be seen. The use of words allows the experience to be seen on more than a superficial level and can give rise to the true nature of the experience. Our own lived experiences are the reality of our thought and are brought to the surface through speech. Phenomenological inquiry discovers what it is the participants have experienced through careful and deliberate questioning. This inquiry employed
a semi structured interview to allow participants to bring to reality the essence of their lived experiences.

5. Maintaining Focus

Phenomenological human science is a daunting task for the researcher. The researcher must remain highly focused and homed in on the phenomenon at question. The temptation to steer off track is great with the enchanting desire to theorize, become opinionated, or wander with speculations. To orient oneself with a phenomenological inquiry is to develop a secure grasp on the question one seeks to understand. Consumed by superficial ambiguity and false truth negates human science. Staying interested and focused on what it is the researcher truly seeks to understand will reveal the full sense of what it is being inquired about.

The focus of this phenomenological inquiry was to allow the stories of the participants to reveal how social markers may have informed their science teacher identity through the lens of positionality. Unwavering from the task with semi structured interviews and facilitating the responses by keeping participants on track was crucial in maintaining the focus of this research. Removing any of the researcher’s tendencies to control the dialogue was crucial. Allowing the true reality of the understood lived experiences of the PSETs helped in revealing their truths.

6. Parts To a Whole

Phenomenological human science inquiry will require the practitioner to describe and interpret the essence of lived experiences from the shared narratives of the participants. A concrete plan of research questions is imperative before beginning, but the detailed methodology may not be confirmed until the inquiry is complete. This method of research requires a sense of openness to allow the narratives to come to life as the participants see fit. The participants dictate the direction, as it is their lived experiences they are bringing to life with rich discourse. There are challenges with asking participants to reawaken lived experiences. Parts of the whole may have been unseen before the inquiry, and discomfort or hope may develop from this awakening.
The realization of side effects with human science cannot be ignored. Awareness may bring liberation. But if the practitioner is not prepared, negative feelings may develop for the participants. A phenomenological inquiry often results in transformations within the researcher and the participants, as well. Deepness in learning about oneself and reliving experiences can bring a heightened consciousness due to connecting the parts from lived experiences impacting the whole individual.

I endeavored to allow the PSETs to narrate their truths as they saw fit. Their awareness may have had a transformative impact on their whole being and may have engendered emotions that were unseen prior to the inquiry. The method in which the stories came to life was dictated by the storyteller themselves. The importance of openness and fluidity was important to allow authenticity.

**Critical Theory**

The practical interest of human sciences, phenomenology, is rooted in an emancipatory lens (van Manen, 2016). Max van Manen (2016) argued that this qualitative research may reveal how lived experiences may be dominated by “oppressive economic, political and social practices” (p. 176). This inquiry into how social markers may have informed PSETs’ science teacher identity through the lens of positionality may have also revealed “critical consciousness and struggles to break down the institutional structures and arrangements which reproduce oppressive ideologies” (van Manen, 2016, p. 176). That wonder of humanness and existence revealed through verbal discourse begins to tell the story of life experiences. This life experience culminated through the lived experiences of the preservice elementary teachers. The critical theory underlying this phenomenological inquiry forged a dialect to understanding social markers and how they may have informed PSETs science teacher identity through the lens of the lived experiences that make up their positionality.
CHAPTER THREE: METHODOLOGY

The Research Questions

Conscience understanding of science teacher development can determine professional affiliation. How PSETs image their lived experiences with science teaching can be key in understanding their science teacher development. This phenomenological inquiry into how social markers informed the science teacher identity of undergraduate PSETs was framed by their positionality. The moment I began to wonder why such talented students in my Teaching Science in Elementary School course did not identify as science teachers, I began to question their lived worlds. It made me think about my science teacher identity development and when and where it stemmed from. I began to question what it must feel like to not identify as a science teacher with the expectation of having to teach science to elementary students. How did the essence of this identity evolve? How did their life experiences inform this identity? How have social markers made an impact on this identity? How do they conceptualize the essence of a science teacher? Most individuals do not reflect on how their identities have developed and may not have conceptualized their identity until explicitly asked (van Manen, 2014). Most PSETs are simply living their lives with little to no inquiry into how they identify or are positioned in society within the realm of science teacher identity. The following depicts the research questions that elicited a sense of wonder within me:

1. How have the lived experiences with preservice elementary teachers’ self-identified social markers impacted their science teacher identity?
2. How do preservice elementary teachers interpret the science teacher essence and what life experience informed this interpretation of the science teacher essence?
3. What life event can participants elicit that may have most informed their affinity or resistance to science as a preservice elementary teacher?
Context

The context of this inquiry takes place in a teacher preparation program for undergraduate students. These students were enrolled in a science methods course, titled Teaching Science in Elementary School. The program is within a large, diverse research university in the southeastern United States. The interview participants in this study did not have any real-world teaching or science teaching experience and were enrolled in the last 2 years of a teacher preparation course at the university. The undergraduate preservice elementary students enrolled in this course had to satisfy the prerequisites of being admitted into the Elementary Education Bachelor of Science program.

Screening Participants

The research participants (n=28) were preservice elementary teachers, who were undergraduate students enrolled in a teacher preparation program. The first phase called for an open reading of surveys. The study conveniently sampled 28 PSETs that had finished the second of their two science education courses. The courses were taught by a colleague who was also a graduate teaching assistant. The courses were purposely chosen to sample due to its content. The Teaching Science in Elementary course was designed to prepare PSETs with the tools and methodology to teach science in elementary school. This course was chosen to eliminate the bias of PSETs lacking the knowledge of how to teach science. This course was the second in a series of coursework to prepare PSETs to teach science in elementary school. These participants were purposely sampled because they functioned as informants by sharing their experiences with the phenomenon on a survey. All 28 participants who agreed to the survey were able to describe the essence of a science teacher. They conscientely experienced their affirmation of refutation to the phenomenon, science teacher identity (Valle & Halling,
This data can be reviewed on Table 1. This experience is limited to educators and may not be generalizable to the public.

The second phase revealed the sampled participants for interviewing. Four participants were purposefully sampled from the 28 surveyed because they agreed to the video recorded semi structured interviews, were interested in teaching elementary age students grades 1–6, lacked classroom teacher experience, and each had completed course work for both (a) Elementary Science for Teaching and (b) Teaching Science in Elementary School. The four interviewed participants of this study had completed the prerequisite Elementary Science for Teachers course and were wrapping up their course on science methodology, Teaching Science in Elementary School. The course, Teaching Science in Elementary School, was taught over a 14-week fall semester by a graduate teaching assistant other than me. The participants did not know the researchers. This may have refrained from conscientely or subconsciously responding to please researchers. I chose this course to sample participants because I wanted to rule out the notion that their science teacher identity was derived from their lack of science content. The prerequisite course Elementary Science for Teachers addressed all the science content for elementary teachers. It is important to offer science content to PSETs. This methodology course on Teaching Elementary Science ensured that science methodology and best practices were being taught for future elementary educators who had addressed the extremely specific science content required to teach elementary in the state. To eliminate the bias of some participants lacking science content for elementary and, thus, informing their science teacher identity, I chose to conduct my research at the conclusion of the course. By requiring the Elementary Science for Teachers course prior to the Teaching Elementary Science course, I was hoping to eliminate the lack of science content as an indicating factor for science teacher identity. Removing myself as the instructor on record from the course, I eliminated
researcher bias. Phase II revealed rich descriptions shared by the participants. Table 2 reveals examples shared by respondents.

This research attempted to capture the essence of current science teacher identity after their science courses. All 28 students in 2 classes of Teaching Science in Elementary were invited to participate in the initial “Teacher Participation Overview,” found in Appendix B. This survey was used to screen participants for Phase II.

Phenomenological studies focus on common lived experiences amongst a typical sample size between 1 – 10 participants (Starks & Brown Trinidad, 2007). Four PSETs were identified as prime candidates to complete the one-on-one interviews after an open reading of the surveys during Phase I of coding. The participants were homogenous in the sense they agreed to an interview, had all completed Elementary Science for Teaching were most recently enrolled in Teaching Elementary Science, and they lacked any teaching experience (Koro-Ljungberg et al., 2009). How they differ was in their science teacher identity, social markers, and/or positionalities. All four participants were asked to determine the essential qualities and events that have informed their science teacher identity through descriptive and interpretive language.

Their science teacher identities, positionality, social markers, and life experiences may all have been different, but the depth to which they brought to life their figured worlds with their speech and words was similar. The participants have encompassed the art of bringing to light that which may have not been noticed before. There were PSETs who report a positive science teacher identity. Others reported a negative science teacher identity. How participants may feel resistance to teaching science could be equally conclusive and informative. The interpretive language and descriptive essence of how the four PSETs reflected on their positionality and how it informed their science teacher identity was the focus of this phenomenological inquiry.
The key component was confronting my biases and abstaining from the humanistic urge to judge. The PSETS were surveyed with the Teacher Participation Overview, then interviewed. PSETs detailed with descriptive-interpretive deliberation on the following questions:

- What is your race/ethnicity?
- What is your age?
- What teacher education semester are you in?
- What is your specialization within teacher education?
- What is your grade level interest?
- What is your status in the course?
- What is your previous science experience?
- What is your previous science teaching experience?
- Do you see yourself as a teacher right now?
- What are the characteristics of a teacher and where did this teacher identity come from?
- Do you see yourself as a science teacher?
- What are the characteristics of a science teacher and where did this identity come from?
- How does your personal background influence your views on teaching science and teaching diverse students?
- Which three social markers do you most identify with?

Once the survey questions were answered, students confirmed whether they would agree to a virtual interview. The participants chosen had the ability to express and awaken experiences that helped inform their science teacher identity and met the homogenous sampling requirements of no teaching or science teaching experiences, desire to teach elementary age students, and were within the last 2 years of the teacher preparation program.
Once the participants were chosen on the similarities required, scheduling of virtual interviews began. The four participants were given the opportunity to articulate their lived experiences and personal narratives, during personal one-on-one, virtual semi structured interviews that ranged from 30 minutes to an hour. The interview involved a 12-card Card Sort Activity found in Appendix C and five Interview Protocol Questions found in Appendix D. The interview took place virtually. There were visual and audio recordings that were then transcribed, printed, and saved digitally on my computer.

Bracketing

The answers from the interview involving the Card Sort Activity found in Appendix C and five Interview Protocol Questions found in Appendix D were bracketed. Bracketing is the task of examining participants responses, not for right or wrong answers, but to identify key phrases that speak to the experiences of the participants while removing researcher bias (Qutoshi, 2018). These experiences are then defined by the themes that develop from participants perspective and not researcher. To confirm that the incidental and essential themes were free of researcher bias, data was examined thoroughly and multiple times with color coordination. The participants self-reported their perceptions of the essence of their science teacher identity and the lived experiences that may have been informed by their self-identified social markers. The semi structured interview and card sort activity was conducted and recorded with my laptop via the videoconference platform, Zoom. I guided as a moderator to assist with the facilitation of the interview to ensure participants stayed on task while respecting the openness of their narratives.

In Phase III, data was interpreted, coded, then categorized as shown in Table 2. There was an authentic engagement by my interpretive and systematic review, with laser focus on how the individual accounts of each participant reinforced the essence of the phenomenon, science teacher identity (Suri, 2020). This purposeful sampling provided an opportunity for the participants to share their rich, in-depth insights about the issues of vital importance regarding
lived experiences, social markers, and the essence of science teacher identity (Patton, 2002). As in all phenomenological studies, imaginative variations were developed. There was an attempt to make sense of the experiences through different views and perspectives, while bracketing out researcher experiences with the phenomenon. Themes developed amongst the participants’ responses. This data was compared, and interpretations recorded in the form of structural descriptions. The goal of the interview was to give the participants an opportunity to elicit their own narratives to share their figured worlds with rich description.

Incidental and Essential Themes

The art of conclusions with deep textual clarity through descriptive discourse required themes to be unraveled. There is a distinction between themes deemed incidental and essential. Not all themes encountered in a deep inquiry into lived experiences are unique to the phenomenon being studied. Though the theme may appear as an essential component of the experience, it may be incidental (van Manen, 2016; Creswell, 2007). The themes were shared in Table 3. To determine an essential component, I evaluated the quality of the phenomenon and determined if the theme was the essence of science teacher identity. In the case of this inquiry, an essential theme embodied what it means to be a science. Only after the interviews was I able to interpret the essence of how PSETs exemplified what it meant to be a science teacher and whether social markers contributed to that thematic profile. To confirm the authenticity of the essential theme, I questioned, “Is this phenomenon still the same if we imaginatively change or delete this theme from the phenomenon” (van Manen, 2016, p. 107). Developing themes and differentiating between essential and incidental helped make sense of that which PSETs deemed impactful in informing their science teacher identity.

Creswell (2007) described a qualitative study as a peek into perceived worlds, where the researcher triangulates data from multiple sources organized into themes. The phenomenological study incorporates an inductive form of data analysis constructing knowledge.
from the ground up. Creswell described a phenomenological study as a study of the lived experiences of individuals in the context of a particular phenomenon. The phenomenon explored in this study was the self-reporting science teacher identity. How PSETs interpreted the essence of a science teacher and how their lived experiences informed this phenomenon was the focus of this study.

Participants

The 28 students who participated in the research were juniors and seniors who aspired to be elementary school educators and were placed in the Elementary Science Teaching course. I selected students based on their similarities of science courses taken, affiliation to the teacher preparation course, and lack of teaching experience.

My role as the researcher was to elicit detailed language depicting clear points of view of participant lived experiences. Making sense through language was instrumental in articulating how PSETs explored their memories, the social markers’ role in their positionality, and how these social markers may have informed their science teacher identity. There was no wrong or right answer. This is simply a humanistic wondering of what experiences were had and interpreted by social markers. What may have led to an affinity or resistance to science. How PSETs identified and how they described the essence of what it means to be a science teacher.

The participants all shared the same phenomenon either accepting or rejecting a sense of science teacher identity. All names addressed in this qualitative research are pseudonyms: Ana, Lupe, Gilda, and Ashley. PSETs reported in the initial Teacher Participation Overview the social markers they identified with, if they identified as a teacher, if they identified as a science teacher, and exactly what events helped inform the essence of this identity. The list of social markers included religion, race, class/SES, ethnicity, gender, upbringing (urban, suburban, rural, or regional), political affiliation, sexual orientation, disability/special need, age, education, and language. I included the gender component even though the four PSETs interviewed were
all female. The social markers were informed by the card sort activity that was used in this study. It was modeled after the activity used by Felicia Moore Mensah’s (2016) study with preservice teachers teaching in urban classrooms.

The preservice elementary teachers critically described which, if any, social markers contributed to their science teacher identity. They were able to get a better understanding of how their science teacher identity developed over time through the lens of their positionality. Identity is a fluid social negotiation that can be shaped and reshaped (Mensah, 2016; Moore, 2012).

Describing the Essence of The Phenomenon

The phenomenon in this study, like all phenomenological studies, is not particularly concerned with facts, but with the linguistic interpretation of the participants’ science teacher identity. (van Manen, 2014, 2016). The research is focused on how PSETs experience science teacher identity. By mining the meaning behind how social markers may have informed the science teacher identity of participants, factors that inform development are revealed.

Data Collection

The major portion of the data source for this phenomenological inquiry modeled “interviews as conversations to elicit their perceptions of their positionality, social markers, and personal ideas about their science teaching identity” (Mensah, 2012). The interviews were made up of semi structured and open-ended questions that allowed for in-depth exploration of lived experiences. The prospective outcome is to gain an understanding of the lived experiences of the PSETs and what social marker may have informed their science teacher identity.
Instruments

Teacher Participation Overview

This phenomenological study used the analysis of the participant responses to the Teacher Participation Overview. This survey was administered by Felicia Moore Mensah in 2016, when she conducted research on a grounded theory approach within a graduate level course exploring the science teacher identity of preservice teachers of color. The Teacher Participation Overview was used in this research to gauge the social markers that aligned most with participants, the lived experiences that informed this identity, and whether social markers impacted this identity. I asked the PSETs to self-report their “race-ethnicity/age,” “teacher education semester,” “major, specialization within teacher education,” “grade level interest,” “status in course,” “previous teaching experience,” “previous teaching experience,” and “previous science teaching experience.” Then PSETs were asked to explain the following:

- “Do you see yourself as a teacher right now, or identify with being a teacher? Yes/No? Explain. In your explanation, what is the identity or characteristics of a ‘teacher’?”
- “Where did this identity come from?”
- “Do you see yourself as a science teacher right now, or identify with being a science teacher? Yes/No? Explain.”
- “In your explanation, what is the identity or characteristics of a ‘science teacher’?”
- “Where did this identity come from?”

Regarding the PSETs positionality, I asked them to reflect on their Teacher Participation Overview with the following questions:

- “How does your personal background/identity, influence your views of: a) teaching science, and b) teaching diverse students? (Be as honest as you can be.)”
• “Select your top three social markers: Religion, Race, Class / Socioeconomic status, Ethnicity, Gender, Upbring [urban, rural, regional], Political affiliation, Sexual orientation, Disability/Special need, Age, Education, and Language” (Mensah, 2012, p. 108-109; Mensah, 2016, p. 54).

Mensah (2012) suggested that more research should be employed to explore the intersectionality of multiple social markers to evaluate the development of teaching and identity. The research participants self-reported their science teacher identity and positional identity through the open-ended, guided questions. The participants were able to thoughtfully prepare their stories reported on the Teacher Participation Overview. The Teacher Participation Overview was presented at the end of their class session at the end of the semester. Participants completed the survey in 15–20 minutes.

Card Sort Activity

The Card Sort Activity was conducted during the 30 minutes to 1 hour semi structured interview. It asked participants to pick through 12 cards that were presented during their Zoom videoconference interview. The social markers listed on the cards were as follows: Religion, Race, Class/Socioeconomic status, Ethnicity, Gender, Upbringing (urban, suburban, rural, and regional), Political affiliation, Sexual orientation, Disability/Special need, Age, Education, and Language. The cards, or terms, could be chosen in any order, but participants were to choose social markers that most resonated with their identity and informed their science teacher identity. This positionality framed the semi structured interview. They answered open-ended guided questions facilitated, examining the reasoning behind their affinity for certain social markers making up their science teacher identity. The Card Sort Activity provides opportunity for further discussions on the intersections that make up preservice teachers’ identity.
research, participants were shown 2-inch cards on the screen, with each card depicting one of the social markers. At the end of the card sorting, three questions were asked:

1. “List the top 3 social markers and the life events associated with those social markers that may have informed your science teacher identity.”
2. “Can you recall any events in your life when your social markers impacted your science teacher identity and how you self-identify and when did this take place?”
3. “How have your lived experiences informed your science teacher identity?”


Interview Protocol

Before and after the Card Sort Activity, the participants participated in a semi structured interview to help create a narrative on the meanings of their lived experiences and how it related to their social markers and science teacher identity. The Interview Protocol Questions consists of five questions to facilitate the narrative to help awaken experiences that may have informed, consciously, or subconsciously, their science teacher identity. The five questions on the Interview Protocol:

1. “How do you feel about science as a subject?”
2. “What life experience informed your feelings about science?”
3. “What event throughout your life most informed your science teacher identity? And how?”
4. “Which experiences can you share that led to your interpretation of the essence of what it means to be a teacher of science?”
5. “Did any social markers that you identify with impact your current science teacher identity? Can you pinpoint any events in your life that may have informed this connection between social markers and science teacher identity?”
Once interview questions were answered, member checking took place to validate responses (Canipe, 2016; Mensah, 2012; van Manen, 2014, 2016). The Interview Protocol Questions and the Card Sort made up the whole interview, which took place between 30 minutes and 1 hour. They were conducted with participants on a one-on-one basis.

**Data Analysis**

During phase I of coding, the Teacher Participation Overview was used to screen the 28 participants. Phase II used the Card Sort and Interview Protocol Questions to elicit the essence of how social markers may have informed the science teacher identity of PSETs. The data transcribed. Bracketing then coding revealed categories for phase III. Coded with the facilitation of constant comparative analysis method to reveal different perspectives and confirmation of essential themes (Glaser & Strauss, 1967; van Manen, 2014, 2016).

The study elicited four willing and relevant participants from the 28 students enrolled in Teaching Science in Elementary course. A table was created to collect and code the self-reported identities and lived experiences shared through the interviews. The essential themes that arose from what informs the science teacher identity were developed for easy identifying with analytic coding.

Interviewing the four participants allowed for personal narratives and deeper understanding to serve as a tool to foster the embodied life experiences. The data derived from the Teaching Participation Overview, responses from the Card Sort and the Interview Protocol Questions. Table 4 outlines the data sources that aligned with the research questions and the findings. This data informed my analysis of the actual identity that the PSETs connected with. Revealed how PSETs interpreted the essence of this science teacher identity, any life experience that informed this identity, and how social markers may have informed science teacher identity The coding process consisted of a multitude of passes to refine the stories awakened by the participants’ rich discourse.
The last step in interpreting the data was critical discourse. The interpretative analysis of
the interview protocol required careful deliberation to reveal the true essence of the inquiry. This
phenomenological inquiry aimed at nurturing sensitivity to the PSETs’ lived experiences to gain
an essence of how social markers informed their science teacher identity. The interview findings
were an essential component to bringing to life the unseen, to reveal their truths. The next
section summarizes how data analysis was coded.

Coding

Phase I

1. An open reading of each of the 28 surveys was conducted and the PSETs’ narratives
   were transferred into a Google doc.

2. Verification was accomplished by bracketing out researcher experiences with
   phenomenon and keeping detailed notes of interaction with participants.

3. Coded for purposeful sampling for interview and card sort activity.

Phase II

1. Initial coding of the surveys to identify intersection of social markers most identified with

2. Verification was accomplished by bracketing out researcher experiences with
   phenomenon and keeping detailed notes of interaction with participants

Phase III

1. Data was organized by each aspect of the research questions in separate tables on
   Google Docs, keeping the experiences of the four PSETs separated by research
   question, science teacher identity, and demographics.
2. Within each of these Google Docs, the data for each aspect of the research questions was coded and these codes were grouped into categories.

3. Verification was accomplished by bracketing out researcher experiences with phenomenon and keeping detailed notes of interaction with participants.

Table 1 Coding in Phase I for Purposeful Sampling

<table>
<thead>
<tr>
<th>Open Reading of 28 Surveys Phase I</th>
<th>Participant Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade level interest</td>
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</tr>
<tr>
<td></td>
<td>“K-3”</td>
</tr>
<tr>
<td></td>
<td>“2nd”</td>
</tr>
<tr>
<td></td>
<td>“K-6”</td>
</tr>
<tr>
<td>Previous science teaching experience</td>
<td>“Tutoring 2nd &amp; 3rd grade”</td>
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<td></td>
<td>“Siblings throughout grade levels”</td>
</tr>
<tr>
<td></td>
<td>“None”</td>
</tr>
<tr>
<td></td>
<td>“No”</td>
</tr>
<tr>
<td></td>
<td>“Substitute Teaching”</td>
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<tr>
<td></td>
<td>“2 years of Pre-K”</td>
</tr>
<tr>
<td>Select top three markers that you most identify with</td>
<td>“Black, Jamaican, Female”</td>
</tr>
<tr>
<td></td>
<td>“Race, Gender, Age”</td>
</tr>
<tr>
<td></td>
<td>“Upbringing, Sexual Orientation, Disability (PTSD)”</td>
</tr>
<tr>
<td></td>
<td>“Urban, African American, Female”</td>
</tr>
<tr>
<td></td>
<td>“Race, Socioeconomic status, Sexual Orientation”</td>
</tr>
<tr>
<td></td>
<td>“Suburban Upbringing, Political Affiliation, Age”</td>
</tr>
</tbody>
</table>

Note. Qualitative data (surveys interviews, and card sort activity) to provide a more comprehensive description of lived experiences.
CHAPTER FOUR: FINDINGS

The Findings

The analytical process for qualitative research is subjective. Researchers must make judgements, find meaning, code, categorize and conceptualize the data. There is an ethical responsibility to insure rigor and honesty (Starks & Brown Trinidad, 2007). I was vigilant with my own experiences and was sure to bracket out these preexisting perspectives to capture the essence of how the participants experienced the phenomenon. This exercise was a valiant attempt in validity and reliability of the research.

A phenomenological study is not an approach to find truths, but an attempt to interpret and make meaning of the lived experiences of human beings through narratives (Qutoshi, 2018). Everydayness of the lived life means this hermeneutic method relies on the pre-reflective life of human existence as living through it. The reality revealed throughout the rich descriptions embodied the lived experiences of the 28 participants. Guided by van Manen’s method of structure, I attempted to serve as witness to the accounts relived by the participants (Starks & Brown Trinidad, 2007). I facilitated interviews with calm and ease to encourage a rich flow of open communication to reawaken the lived experiences. In this chapter I now share the outcome of their stories (Poggenpoel & Myburgh, 2003; van Manen, 2016,). The participants were made aware of their role in the research as a coresearcher, and they were immersed in the research goals and quest we were trying to explore (Yüksel & Yıldırm, 2015).

The Institutional Review Board at the university approved the research in the Fall of 2021 and I entered two evening classes of Teaching Science in Elementary School. Both classes combined made up 66 students. Those students all heard the Explanation of Research and were offered $10.00 electronic gift card to a national chain of coffee shops, Starbucks if they completed the survey, interview, and card sort activity. Twenty-eight agreed to participate in the research. The Teacher Participation Overview survey took about 15 - 20 minutes for the
PSETs completed over the two evening classes offered. An open reading of the surveys conducted, and narratives recorded.

The participants were made up of those that identified as a science teacher (33.3%) and those that did not identify as a science teacher (66.7%). In relation to the self-identified race, the “science teachers” identified as White non-Hispanic / Caucasian (71.4%), Hispanic / Latino (14.3%), and African American / Black (14.3%). The participants that did not identify as a “science teacher” self-identified as White non-Hispanic / Caucasian (47.6%), White / Hispanic (14.3%), Hispanic / Latino (10.0%), Asian / Hispanic (4.8%), African American / Black (14.3%), Puerto Rican (4.8%), Middle Eastern (4.8%).

From the 28 surveyed, the gathered descriptions revealed seven PSETs identify as a science teacher and 21 did not identify as a science teacher. In relation to social markers “science teachers” most identified with; upbringing (57%), education (85%) and language (67%) were revealed. In relation to the social markers for the surveyed participants that did not identify as a science teacher; most identified with their race (52%), gender (42%) and age (38%). The four PSETs surveyed were expected to interview for 30 – 45 minutes over zoom video recording, but some conversations went over an hour. One interview experiencing video technical difficulty went the least amount of time. The interviews were conducted over 4 days. The four interviewed were given pseudonyms to protect their identity, Ashley, Lupe, Gilda, and Ana. The interviews took place at the end of the semester and participants were not available for multiple interviews once they completed their Teaching Science in Elementary School course. They shared their demographics and professional identities in their survey. The social markers that most informed their science teacher identity was revealed in the interviews and card sort activity.

In relation to her self-identified demographics, Ashley is White, 22 years old, and female. She was the only participant that self-identified as a science teacher. In relation to her social
markers, Ashley described race, SES, and education most informed her science teacher identity. In relation to self-identified demographics, Lupe is a White, 20 years old, female. She did not identify as a science teacher. In relation to her self-identified social markers, Lupe describes gender, SES, and political affiliation most informed her science teacher identity. In relation to her self-identified demographics, Gilda is an African American 22 years old female. She did not identify as a science teacher. In relation to her self-identified social markers, Gilda describes race, gender, and her upbringing most informed her science teacher identity. Lastly, in relation to her self-identified demographics, Ana is a White 23-year-old female. She did not identify as a science teacher. In relation to her self-identified social markers, Ana describes race, SES, and sexual orientation most informed her science teacher identity.

The interviews were an insight into the positionality of Ashley, Lupe, Gilda, and Ana, and through rich discourse they shared their lived experiences. I created a data table to record the written and verbal descriptions. Themes were revealed from the rich discourse.

The Phenomenon: Science Teacher Identity

The commitment to the phenomenon of science teacher identity was imperative to this study. Max van Manen (2016) described this approach as “to confine yourself to a single thought that one day stands still like a star in the world’s sky” (p. 31). This study evaluated the science teacher identity. Ashley identified as a science teacher at the start of the research, as reported on her Teacher Participation Overview. The three remaining participants, Gilda, Lupe, and Ana, responded “No” to the question, “Do you see yourself as a science teacher right now?” The recognition of this identity was the first step to attempt an explication of which life experiences informed this identity. There was no limit to the possible interpretations from the different perspectives, and there were no wrong or right answers. Framed through their positionality, I allowed the participants an opportunity to make sense of this phenomenon.
Lived Experience

Gilda

Gilda is an African American 23-year-old female who would like to teach first grade. The life experiences Gilda articulated that led to her identity were informed by race and gender. She did not identify as a science teacher and associated science teachers with being inquisitive and investigating. The social markers she most identified with were race, SES, and sexual orientation. She explained, “Most of my science teachers were male” and “not African American.” She continued to state that she was “intrigued by seeing a female teacher” and remembered her as “very passionate about science.” This elementary teacher made her feel that “science can be fun.” Gilda recalled an event that triggered an interest in science, though it was not reflected in a positive identity as a teacher of science. She recalled being interested in hurricanes and having to prepare for Hurricane Charlie in August 2004. She initially described science as “not her favorite subject,” but through the verbal discourse she awakened her interest in hurricanes. There was a relearning of the lived experiences that made up her existence. Gilda was noticeably clear that she believed that “it is important” to learn “about science” in our “daily lives” and that students should “know how it works.”

Ashley

Ashley identifies as a White, 22-year-old female who would like to teach second grade. She was the only participant who claimed to see herself as a science teacher at the beginning of the study. She most identified with the social markers of SES, age, and her education. She wrote in her survey, “I am middle class, White American, so I feel that I have experience in teaching/learning science in a different way than lower-class or even higher-class peers due to available resources/money.” She had no classroom teacher or classroom teacher experience but addressed her experience as a child development teacher at the YMCA. She had not
started her internship for classroom teacher yet nor did she have classroom teacher or science teacher experience. The child development teacher position for the YMCA was described as an assistant in the program management and supervision of a group of children 5-12 years of age. Her role was to implement age-appropriate program activities that engage students in active and meaningful experiences.

In the interview I probed her with the question, “What event throughout your life most informed your science teacher identity?” Ashley stated, “I definitely think that the class that I just had.” She claimed “practice as a science teacher” in her course work was fantastic opportunity. Ashley’s race and SES intersected to help inform her science teacher identity.

Lupe

Lupe is a White female. aged 20, a junior in the teacher education program. She wants to instruct K-3 students. She wrote in her survey that she does not see herself as a teacher or a science teacher. She wrote that the characteristic of a science teacher is “one who is knowledgeable about and teaches science.” She stated that she mostly identifies with the social markers of gender and her political affiliation. “I was never too interested in science, so teaching science does not excite me too much.” In her interview she expressed that there were no female representations, and she did not have a hands-on experience growing up. She proudly expressed in our interview, “I’m a math person for sure. I’m a language arts person for sure.” The most influential life experience was reiterated in the interview as “just the way I was taught in schools, like we didn’t have a lot of hands-on experience.” Very similarly to Ashley, Lupe spoke highly of the positive outlook on science and science teaching that was taught in her two science courses in the teacher preparation program and reiterated that “growing up, I was not a science person.” Seeing how “it will go down” with real world science teaching examples by her graduate teacher was “really informative.”
Ana

Ana, a preservice elementary teacher, did not identify as a science teacher. She identified as an African American, 22 years old, junior who wants to teach students in grades K-6. She did identify as a teacher and characterized teachers as “kind, smart, helpful.” She wrote in her survey that this characterization of what a teacher should be like was derived from watching family and TV shows. She did not identify as a science teacher and characterized science teachers as people who “just do a lot of experiments.” This characterization came from personal experience with teachers she has had in the past. Ana wrote, “Not a lot of people in my community do hands-on projects.” The three social markers she most identified with were “urban upbringing, African American, and female.” She spoke candidly about the subject of chemistry and her lack of interest, with her poignant statement that “chemistry sucks.” The life experiences that led to this resistance to science and science teacher identity was “just having to keep writing stuff.” She stated, “I don’t really feel like I’m getting the hands-on experience,” when she had reawakened her fifth-grade memories with the interactive notebooks. She said that her experiences in elementary school informed her identity and resistance to science. This inquiry did awaken her consciousness of her life and experiences, and a positive memory surfaced. One college experience as a sophomore in Earth science did trigger the response, “Yeah, I can get into rocks.” Her professors’ attitude and presentation of rocks sparked an interest.

Through this verbal discourse, I became part of their life experience, exploring the interrelatedness of their shared scenarios. The PSETs all had the opportunity to reveal a part of them that may not have been made aware before, and they were revisiting their original experiences of their life that contributed to the lived experiences through the lens of positionality that spoke to the affinity for or resistance to science.
### Table 2 Coding PSETs Descriptions of Lived Experiences and Related Meanings

<table>
<thead>
<tr>
<th>Significant Participant Descriptions Phase II</th>
<th>Categories of Meaning Phase III</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Middle class...suburban setting...there was nature to explore &amp; I was able to be in like a great school with a lot of resources&quot;</td>
<td>Positionality and social markers can elicit and affinity or resistance to science</td>
</tr>
<tr>
<td>&quot;[In science class] we didn't have a lot of hands-on experience&quot;</td>
<td></td>
</tr>
<tr>
<td>&quot;My dad used to tell me; I was like really little...tell me like you can do anything that you put your mind to&quot;</td>
<td></td>
</tr>
<tr>
<td>&quot;[Science teachers] interactive fun, you know science experiments&quot;</td>
<td>Lived experiences informed PSETs essence of a science teacher</td>
</tr>
<tr>
<td>&quot;One who is knowledgeable&quot;</td>
<td></td>
</tr>
<tr>
<td>&quot;They just do a lot of experiments and theories&quot;</td>
<td></td>
</tr>
<tr>
<td>&quot;Most of my science teachers were male&quot;</td>
<td>Social markers like gender, race and religion can inform science teacher identity</td>
</tr>
<tr>
<td>&quot;No female examples growing up&quot;</td>
<td></td>
</tr>
<tr>
<td>&quot;[Science teachers] Not African American&quot;</td>
<td></td>
</tr>
<tr>
<td>&quot;[Religion] they were trying to compare stuff like...how the Earth forms&quot;</td>
<td></td>
</tr>
<tr>
<td>&quot;[Science teacher identity] It’s changed over time&quot;</td>
<td>Science teacher identity is fluid</td>
</tr>
<tr>
<td>&quot;Teacher experience really informed the science teacher identity&quot;</td>
<td></td>
</tr>
</tbody>
</table>

Note. Qualitative data (surveys interviews, and card sort activity) to provide a more comprehensive description of lived experiences

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### Themes Amongst Participants

With a phenomenological study, the researcher will facilitate interviews with calm and ease to encourage a rich flow of open communication to reawaken the lived experience (Poggenpoel & Myburgh, 2003, van Manen, 2016). It was necessary to make the participants aware of their role in the research as co-researchers, and they were made fully aware of the research questions we explored (Yüksel & Yıldırım, 2015). This is a phenomenological study with 28 participants total and four interviewed. This study findings are not generalizable, but
PSETs in this study had similar experiences with the phenomenon. Felicia Moore Mensah (2016) experienced similarities in her findings with her subjects, her three participants were preservice teachers working in urban classrooms and similarly chose the social markers as my participants: upbringing, race/ethnicity, religion, age, and gender. Out of the 12 social markers participants can choose from, the ones listed above were the recurring theme in her study as well. Even though this study is not generalizable, other researchers might get the same findings.

Unmasking the factors that informed the science teacher identity of the four PSETs was the goal of awakening their lived experiences through verbal discourse. This human science research is unlike other qualitative research because we went deeper and revisited their truths and appearance of their realities. I began to discern the themes that arose from the vivid details of the experiences through the lens of their positionality. The participants dove deep into their consciousness and had “aha moments” that grounded the essence of their experience. As a unit we were bringing to light what was in darkness, which evaded their daily lives. Common themes emerged from this inquiry. What was confirmed is that social markers did inform their science teaching identity, as well as their lived experiences that made up their positionality.

Theme 1: Science Teacher Identity is Fluid

Gilda expressed not identifying as a science teacher but recalled, “I did have a science teacher in elementary school. Made it fun.” Lupe did not identify as a science teacher but shared her defining moment in her childhood was when she did a hands-on activity in second grade on the moon phases. Ana did not identify as a science teacher but spoke highly about a college professor enlightening and sparking an interest in earth science. Ana spoke of how passionate the professor was and how it made her excited and the way the professor presented the information. Ashley, who did identify as a science teacher, felt like science was one of the
more fun subjects. This information revealed that all four PSETs were able to recall a positive experience in science once the conversation started and the memories were triggered. This verbal discourse can be incorporated into teacher preparation courses to give PSETs an opportunity to relive experiences that have been masked by daily life. When probed, the participants recalled that there was a spark of interest at one time. Positive moments were awakened by the rich verbal discourse about how they enjoyed science. This conceptualization through the mental exercise of speech facilitated with the interviews resurfaced good memories from the subconscious that mirrored an “aha moment.” These memories reminded them of the educators that made the subject exciting through their lessons and delivery. They all discussed that hands-on activities were the most enriching, influential experiences. These lived experiences of hands-on activities brought joy in science experiences. Allowing the participants an opportunity to dig up these memories can help influence the positive science experience and what triggered the enjoyable experience. It is hard to reflect on lived experiences while you are living through them, but reflecting can help reframe your thoughts on the phenomenon. The observation was made that the PSETs sounded optimistic about teaching science by the end of the interviews. To clarify, they were not asked to reassess their science teacher identity. The fluidity is observed in the language used. Lupe described how she would “like to present science as something that is you know, for the good.” This is enlightening to hear, the PSET is planning her future science lessons.

Theme 2: Place-Based Learning Informs an Affinity to Science

Place based learning generated an affinity for science. Gilda mentioned that her experience of living through a deadly natural disaster, Hurricane Charlie, made her become fascinated with hurricanes. The community in which she lived were involved with the same
experience. They all belonged to the community of learning about hurricanes as they braced for the storm. This unified sense of belonging and preparation made Earth science relevant and important. This positionality developed into an affinity for Earth science. Ashley described how her upbringing in a suburban setting allowed her to explore the outdoors, in nature. Language and representation can reframe our thoughts and truths; reverberation can transcend new destinations. The reliving and articulation of the memory declared an affinity for science content.

Theme 3: Gender Informs Identity

Participants were given as much time as needed to record their initial recollections of the “top three social markers you most identify with” on their Teacher Participant Overview. Twenty-one PSETs did not identify as science teacher and 42% chose gender as the social marker that they most identify with. The interview with the four purposively sampled PSETs elicited greater details of silenced memories. They were asked which social markers “impact your current science teacher identity?” Three interviewed participants who did not identify as a science teacher all chose gender as a social marker that impacted their science teacher identity. The female participants had the same perspective eluding to the lack of female science examples to which they were exposed. It was a coincidence that all participants sampled for the interview were female.

Theme 4: Upbringing / SES Informed Affinity or Resistance to Science

Twenty-eight PSETs were surveyed and 7 identified as science teachers. Of the 7 that identified as science teachers, 54% claimed that upbringing is the social marker that they most identify with. Ashley, too, spoke of her socioeconomic status informing her science teacher identity. Her middle-class upbringing influenced her development of a positive science teacher identity because of the resources from her K-12 education. Upbringing can offer affordances for a positive science teacher identity or feel as if they do not belong. Two of the participants’ life
circumstances from their lower socioeconomic and urban childhood informed their lack of identity as a science teacher. Lupe’s personal life histories spoke to less resources and money to fund expensive science fair projects that her more affluent counterparts could afford. This positionality excluded her from belonging to the community of “the kids [who] had tons of parental involvement, tons of money to do creative science fair projects.” Ana said that her urban upbringing did not afford her access to science, technology, engineering, and math (STEM) opportunities. She spoke of teachers having to “make it work” with the resources they had. Her interest in science was caused by lack of money. The money was needed to build the confidence to compete in science fairs. This identity was reflective of life choices that were beyond her control. She may not have been able to articulate those feelings until now.

Theme 5: Essence of Science Teacher

In this cluster of responses, PSETs focused on the essence of a science teacher. They developed this belief from their past experiences. PSETs were quoted as stating that science teachers have “knowledge of science.” This conscience description of a science teacher is present. The fascinating phenomenon seems easy to attain. Simply having “knowledge of science” makes one a science teacher, but oddly not realized within the PSETs. The essence of a science teacher and not identifying one appears to go deeper than simply “pushing students to explore topics” like it was described.

The PSETs have covered the science content that they will address in elementary science. The PSETs in the research describe science teachers as knowledgeable.” “Knowledge of science” should be embedded in all the PSETs after the course work they have completed prior to the survey. A science teacher was described by 26% of the participants as having “knowledge and understanding of science content”. None of the PSETs that made this claim had self-identified as a science teacher, even after extensive science content coursework. The profound impact of belief systems may be masking the ability to accept that they too have the
knowledge to teach science. The PSETs conscience reality of the essence of a science teacher was informed from the science teachers they have had in the past.

Table 3 Theme Clusters and Associated Meanings

<table>
<thead>
<tr>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science teacher identity is fluid</td>
</tr>
<tr>
<td>Science teacher in elementary school made it fun</td>
</tr>
<tr>
<td>Defining moment was a hands-on activity in second grade on the moon phases</td>
</tr>
<tr>
<td>Hands-on activities were the most enriching, influential experiences</td>
</tr>
<tr>
<td>College professor enlightening and sparking as interest</td>
</tr>
<tr>
<td>Like to present science as something that is you know, for the good [as future science teacher]</td>
</tr>
<tr>
<td>Place-based learning informs affinity to science</td>
</tr>
<tr>
<td>Living through Hurricane Charlie made PSET fascinated with hurricanes</td>
</tr>
<tr>
<td>Suburban setting allowed her to explore nature</td>
</tr>
<tr>
<td>Gender shapes identity</td>
</tr>
<tr>
<td>Science teacher in elementary school made it fun</td>
</tr>
<tr>
<td>42% of PSETs who did not identify as science teachers most identify with gender</td>
</tr>
<tr>
<td>Lack of female scientists examples</td>
</tr>
<tr>
<td>Most of my science teachers were male</td>
</tr>
<tr>
<td>Upbringing / SES informs affinity or resistance to science</td>
</tr>
<tr>
<td>Less resources and money to fund expensive science fair projects</td>
</tr>
<tr>
<td>Urban upbringing did not afford access for STEM opportunities</td>
</tr>
<tr>
<td>54% of the PSETs who identified as science teachers identify most with upbringing</td>
</tr>
<tr>
<td>Middle-class upbringing allowed for better resources from her K-12 education</td>
</tr>
<tr>
<td>Essence of Science Teacher</td>
</tr>
<tr>
<td>One who is knowledgeable about science</td>
</tr>
<tr>
<td>Knowledge of science</td>
</tr>
<tr>
<td>Knowledge and understanding of science content</td>
</tr>
<tr>
<td>Passionate for nature, life, and the things of this world</td>
</tr>
</tbody>
</table>

Note. Qualitative data (surveys interviews, and card sort activity) to provide a more comprehensive description of lived experiences
Hermeneutic phenomenological investigation served as an exploratory tool for revealing their truths and the vehicle to make meaning of the lived experience. This study was not on the fluidity of the phenomenon of science teacher identity but what informed this identity. Through the dialogue, the participants agreed about the importance of teaching science. Three of the four responded that they did not identify as a science teacher at the start of the inquiry. The quest to discern the meaning of the written word versus the verbal word is moot. They are both truths. Writing may be the reflective attitude of the memory, where speaking unravels the source of the phenomenon and brings to life the fullest extent of the experience, reframing our thoughts and ideas. These themes are temporary, as they may change as time evolves for the participants. The meaning of their experiences is temporal and the recollections reflective of their current worldly presence. They are not concrete but are fluid in nature, constantly evolving and form the lifeworld of the participants.

The Lifeworld

This phenomenological study brought existence through their verbal discourse, which began with a writing activity. Through our language, the spoken word made the unseen visible. Their words allowed these experiences to be seen on more than a superficial level and gave their unconscious thoughts conscious expression. The daily lived experience that was taken for granted was now brought to the surface and given a resurrection and purpose to their believed selves. The phenomenological human science offered the participants discovery through their careful thought and deliberation. Neither of the four participants were stoic or static in their thoughts but allowed themselves grace to travel through the fluidity of their realities that evolved with every minute of the journey. They trusted the process, and through their unique positionalities, there was one thing they all had in common. Their science teacher identity was informed by their positionality and the lived experiences that formed their positionality. The
social markers most informed science teacher identity for the four PSETs were gender, upbringing, socioeconomic status, religion, and political affiliation.

The Focus

This phenomenological human science was a daunting task trying to keep the participants on focus with the research questions, due to the natural desire to speak freely and where the thoughts took them. The temptation to steer off track was great with the enchanting desire to theorize, become opinionated, or wander with speculations. Staying interested and focused, I unveiled the full sense of what it is I inquired about and was summarized by the three research questions.

Balancing the Research

In summary, science experiences in the K-12 setting, place-based learning, social markers and positionality informed the essence of what it means to be a science teacher for the PSETs sampled. They shared common experiences with the phenomenon of science teacher identity. The implications lead to ensuring that teacher preparation programs allow PSETs to reflect on these science teacher experiences and relive the positive and negative experiences. These experiences informed the essence of what it means to be a science teacher.

Rich descriptions revealed never realized conscience influences on PSETs science teacher identity. Social markers like SES, race, and gender were expressed in writing and speaking to be the reason for a resistance to science. Positionality that embodied a community united with a common experience like Hurricane Charlie and COVID-19 embodied and awakened an affinity for science education. The united community needing to teach the difference between pseudoscience versus evidence-based science to prevail past a global pandemic was a driving force to awaken a desire for the PSETs to teach science in elementary school. This desire to teach science was awoken through verbal discourse, and the implications
reveal how belonging to a community with shared experiences can shape and reshape a science teacher identity. PSETs described the need to teach science because of their political affiliation and the manipulation by the media using politics to represent conflicting viewpoints of the COVID-19 pandemic of 2020.

In summary, social markers did inform the science teacher identity of the PSETs. The implications for teacher preparation programs to recognize that social markers inform the science teacher identity could enrich curriculum. Identity work could be a viable inclusion in teacher preparation courses. Representation of diverse gender roles in science teaching could have elicited an affinity for a science teacher identity. Through the lens of their positionality, it was described that SES divided those that belonged and those that did not belong to the science community. Not being able to participate in authentic hands-on-activities because of the urban upbringings generated a sense of not belonging to the science community. This translated to not identifying as a teacher of science. Participation in the science fair community required money and resources for success. These experiences can shape and reshape identities.

Each participant spoke through the lens of their positionality, which is individual to each human. There were commonalities on how they experience science teacher identity, though this research is not generalizable. The way their community, sphere of influential members, and society positioned them conceptualized their professional identity. Personal journey and positionality helped define who and how they saw themselves even at the most subconscious level. This was revealed through the verbal discourse and awakened a sense of reality they had taken for granted. Every breath, moment, experience, and lack of experience informed their science teacher identities through the lens of their positionality. The experiences created in teacher preparation programs can shape and reshape perspectives. The following chapter will attempt to make meanings of how PSETs experience the essence of science teacher identity.
guided by the research questions. The survey questions and interview questions were designed to answer the following research questions:

- How have the lived experiences with preservice elementary teachers’ self-identified social markers impacted their science teacher identity?
- How do preservice elementary teachers interpret the science teacher essence and what life experience informed this interpretation of the science teacher essence?
- What life event can participants elicit that may have most informed their affinity or resistance to science as a preservice elementary teacher?
<table>
<thead>
<tr>
<th>Research Question</th>
<th>Data Source</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>How have the lived experiences with preservice elementary teachers’ self-identified social markers impacted their science teacher identity?</td>
<td>“How have your lived experiences informed your science teacher identity?” <strong>Interview</strong></td>
<td>“Feel like science is male dominant and [not] women of color”</td>
</tr>
<tr>
<td>“List the top 3 social markers and the life events associated with those social markers that may informed your science teaching identity.” <strong>Card Sort</strong></td>
<td></td>
<td>“Gender, political affiliation and religion”</td>
</tr>
<tr>
<td>“I’ll start with gender”</td>
<td></td>
<td>“My socio-economic status… be in like a great school”</td>
</tr>
<tr>
<td>“Tons of money to do create science fair projects and I just didn’t have that upbringing”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>How do preservice elementary teachers interpret the science teacher essence and what life experience informed this interpretation of the science teacher essence?</td>
<td>“What is the identity or characteristics of a science teacher?” <strong>Survey</strong></td>
<td>“I did have a science teacher in elementary school….very passionate about science”</td>
</tr>
<tr>
<td>“Which experience can you share what led to your interpretation of the essence of what it means to be a teacher of science.” <strong>Interview</strong></td>
<td></td>
<td>”Knowledge of science”</td>
</tr>
<tr>
<td>“Came from observations of personal experiences with teachers I’ve had”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>What life event can participants elicit that may have most informed their affinity or resistance to science as a preservice elementary teacher?</td>
<td>“How do you feel about science as a subject and what life experiences informed your feelings about science?” <strong>Interview</strong></td>
<td>“Most of my science teachers were male…intrigued by seeing female teacher and African American too”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>“I probably can’t name more than one female scientist”</td>
</tr>
</tbody>
</table>

Note. Qualitative data (surveys interviews, and card sort activity) to provide a more comprehensive description of lived experiences
CHAPTER FIVE: CONCLUSION

The rich descriptions shared by the PSETs aligned with the research questions, shown in Table 4. The examples listed in the passages below elicit the essence of the phenomenon. These responses made a connection between the research questions and the lived experiences of the PSETs.

The first research question I sought to explore was, “How have the lived experiences with preservice teachers’ self-identified social markers impacted their science teacher identity?” A closer examination of this phenomenon revealed a dynamic relationship between social markers and positionality. The first research question embodied the science teacher identity and the social markers that informed this identity.

Ana and Gilda both wrote in their initial Teacher Participation Overview surveys “No” when asked, “Do you see yourself as a teacher of science right now?” Gilda spoke on her positionality as a female woman of color, and how there was not representation, “I feel like science is male dominant.” This was her world view, and what informed her feeling that “science not favorite subject.” Ana did not like the subject of science and found it boring. She was raised in an urban community which lacked resources to do science. Ana also spoke to the fact that her gender influenced her science teacher identity, but it was her family who encourage a liberal arts degree and reserved science for the males.

Lupe also answered “no” to a positive science teacher identity on the survey. Lupe wrote that she was “never too interested in science” and was not taught with “hands-on experiences.” The intersection of her gender and socioeconomic status informed her resistance to science. She did not see female “examples growing up” and could not afford the “tons of money for science fair project.” Through the lens of her positionality, she was able to conclude she did not belong to the science teacher community, and she had no interest in science because of her gender and SES.
Ashley did identify as a science teacher. Ironically, Ashley claimed she had “prior teaching experience” on her Teacher Participation survey. Her experience included “tutoring 2nd and 3rd grade”. She also shared that she was a “child development teacher at the YMCA” and would teach science to “siblings throughout grade levels” I chose to not use these examples as “teaching experience” and continued to include her in the interview component of the study. Her “teaching experience” was not apparent to me and I did not think that experience would include the rigor of science teaching. She was not prepared to create standards-based lessons or teacher certification required for those roles. I chose to not validate the identified “teacher experience” of “child development teacher at the YMCA.” This is not a teacher certified position, no curriculum or standards confirmed with the position as “child development teacher at the YMCA.” Her positionality, specifically her SES, allowed her a “great school” so she could be “educated enough to be an effective teacher of science. Her dad positioning with verbal encouragement letting her know she can “do anything she wants” helped create a sense of belonging. She genuinely believed she was a science teacher and embodied that identity.

Participants shared similar experiences with the phenomenon. They all shared examples of how they would teach science in their classrooms, regardless of how they identified at the start of the study. Ashley said that staying “as close to true as possible” motivated her to teach science. She felt the need to teach students to be open-minded and that it was okay to agree and disagree. Lupe spoke of presenting science as “something that is, you know, for the good of humanity.” Gilda addressed her political affiliation as a reason to teach science, though she initially did not identify as a science teacher. She could explain why she wanted to teach science by the end of the interview to help encourage scientific literacy. She spoke of the need informed by her political affiliation to teach science based on fact and not opinion after looking at news on COVID-19. Through personal life stories all spoke to the current events that were informing an identity and desire to teach science.
The second research question addressing the essence of a science teacher was answered very similarly. All four of the women discussed their personal lived experiences with science teachers informed this characteristic. The first of the series of questions on their survey involved Research Question 2, “How do preservice elementary teachers interpret the science teacher essence and what life experience informed this interpretation of the science teacher essence?”

Gilda said her teachers were male and none were African American like her. Intrigued by seeing female teacher and “not African American” too. Gilda reawakened her memories of the “science teacher in elementary school [being] very passionate about science,” and this made up the essence of what it means to be a science teacher. She remembered that science teachers had more knowledge. Ashley shared the “interactive fun” and “science experiments” that made up the science teacher. This interpretation of a science teacher developed from her experience in third grade, remembering that “our teacher brought us out” and explored. Ana felt “they just do a lot of experiments,” and this was informed from “observations of personal experiences” she has had. Lupe felt that the essence of a science teacher was informed from her experience with her science teachers, and they were “knowledgeable about science and teaches science.”

The third research question probed the participants to explore, “What life event can participants elicit that may have most informed their affinity or resistance to science as a preservice elementary teacher?” Ana was bewildered and enlightened by her Earth science teacher in her sophomore year in college. Her college professor and how she spoke about the content helped her navigate an affinity for science in college. Gilda’s resistance to science was driven by the intersection of her positionality through the lens of her gender and race. The lack of representation in her lived world fed the sense that she did not belong in the science field. Lack of representation, “not African American too.” Through verbal discourse, Gilda was able to awaken a good memory about a science experience. Her lived world of experiencing Hurricane
Charlie sparked a fascination for Earth science. Lupe spoke of lacking a science teacher that “stood out” in K-12 experiences but remembered one experience with a moon activity using Oreo cookies. Lupe spoke of rare experiences of hands-on activities and wrote on her survey, “I was never too interested in science, so teaching science doesn’t excite me too much.” Ashley did have an affinity for science and alluded to her middle-class upbringing that allowed her the available resources and money to do science. She claimed that her privileged upbringings contributed to her lived experience that “science was fun.” Her positionality gave opportunities that enriched her science experience.

This study spoke to the social markers that contributed to science teacher identity amongst PSETs in an undergraduate teacher preparation program through the lens of their positionality. Science teacher identity is a dynamic construct to interpret in educational research. Human identity is imprinted by personal history and life experiences and is in constant social negotiation that can never be permanently settled or fixed (Britzman, 1992).

Conveniently sampling 28 participants to survey because they were amongst a group of students who were finishing the semester coursework in a science methods course called Teaching Science in Elementary. They have all completed coursework for the prerequisite science content course, Elementary Science for Teaching. These two courses were not taught by the researcher, and purposefully chosen to help eliminate the bias of PSETs lacking elementary science content or science teaching methodology. From the 28 students surveyed, four were then purposively sampled (Koro-Ljunberg et al., 2009). The four PSETs that agreed to be interviewed all lacked science teaching experience and wanted to teach elementary school.

The original survey served as a tool to gauge previous teaching experience, self-proclaimed science teacher identity, self-identified social markers PSETs most connected with, essence of a science teacher, and where this essence of science teacher came from. The surveys were then analyzed in phase I of coding then prospective participants were emailed.
Phase II saw the incorporation of four participants. They were successfully contacted via email and scheduled for a virtual one-on-one interview and card sort activity. Rich discourse was used to make meaning of the phenomenon, science teacher identity. Phase III is where themes arose, and categories conceptualized by the rich descriptions revealed during phase II of coding.

Over the past 10-15 years, education researchers have embraced a multifaceted sociocultural lens to explore the construct of teacher identity development (Rodgers & Scott, 2008). Researchers now take inventory on how teachers self-identify and how they perceive they are recognized in the community. (Avraamidou, 2014). This research adds to the literature while closing the gap on research to include an exploration of PSETs in an undergraduate teacher preparation program with no science teaching experience. Taking inventory can help reveal what is hiding. What is hiding is how the science teacher identity develops. This phenomenological inquiry has revealed how science teacher identity developed through lived experiences informed by PSETs social markers.

By focusing on four PSETs’ lived experiences, I was able to reveal how their professional identity developed. My goal was to make meaning of the everyday practice of living. I focused primarily on experiences that informed the science teacher identity of the PSETs. The implications from my study are for PSET education programs and their educators. I began to bring out the original human experiences of the PSETs and how they have been positioned in their lived worlds, giving light to how they lived situationally and how it informed an affinity or resistance to science.

The PSETs verbalized their lived experiences and their affinity or resistance to science. This positionality informed their science teacher identity. PSETs may once have ignored how the intersection between their race, gender, or socioeconomic status played in the development of their science teacher identity. Experiences and social markers may have led to feelings of
belonging to the science community or feeling invisible within it. PSETs had little sense of how these lived worlds helped developed their professional identity, so they would go without recourse. Once the experiences were remembered, there was an “aha moment,” and their thinking evolved to a consensus that it is important to teach science. Gilda said, “I did have a teacher in elementary school, very passionate about science.” She continued that the teacher “made it fun and made me feel science can be fun.” Lupe did not identify as a science teacher but ended the interview sharing how “I can make it fun and engaging and, like, relevant for my students.”

Similarly, the few references to science education were not positive in nature. The public education system failed to capture the interest of three of the four female PSETs. Lupe said, “We didn’t have a lot of hands-on experience.” Ana spoke of “just having to keep writing stuff down,” and “I don’t really feel like I’m getting the hands-on experience” when reflecting on fifth grade. Ashley, who did identify as a science teacher, recalled “interactive fun, you know, science experiments.” It was through this verbal discourse that lived moments were brought to consciousness.

In the insightful discourse, PSETs painted compelling images of what informed their science teacher identity. There was little reference to their science coursework within the teacher education program. The PSETs did not only resist science, but they also rendered it unattainable. Developing a science teacher identity, then, seems limited to the lived worlds granted by their positionality and social markers. Interventions may work.

To reflect, this phenomenological inquiry drew on the theoretical framework of the four PSETs’ positionality. I explored how social markers and positionality informed their science teacher identity. Through 150 minutes of oral discourse transcribed to over 80 pages, attempts were made to provide firsthand accounts of the of an affinity or resistance to science. Written discourse facilitated by the teacher participation survey explored the consequences of the lived
worlds of the PSETs. This experience of reviving subconscious lived experiences allowed for open discussion around professional identity and responsibility. This revival required the PSETs to deal with uncertainty and conflicted expectations. PSETs reconciling and embracing a new perspective was an unexpected part of the discovery.

This research focused on science teacher identity, but participants’ focus led to their responsibility as an educator to ensure that science education is taught in elementary school. The PSETs were looking beyond their inherited beliefs of thinking, knowing, and engaging with science education. The traditional inclination to conform with conventional collective identities was challenged. My role as researcher was not to contain and preserve identity, but simply to uncover the root of its development. As a byproduct, the dynamic nature of identity became transparent through verbal discourse.

Science teacher identity is not a fixed construct. Facilitating an affinity for science within the teacher education program could have implications for science teacher identity (Hazari et al., 2013). Relieving of lived experiences manifested through this journey together. This research revealed the possibilities of the fluidity of identities. This discovery acknowledged the socially constructed, multifaceted, and complex intersectionality of sub identities that make up one’s identity. Reflecting on the rich discourse, historical roles intersect with social markers in science teacher identity development. This exploration uncovered the constructivist nature of science teacher identity.

The constructivist nature of the sociocultural experiences was revealed through this inquiry process. The essence of science teacher identity was built upon personal beliefs and the ways society positioned the PSETs. It is not necessary to tear down students’ beliefs but simply allow new ones to evolve with new experiences and personal discoveries. “Inquisitive and investigating” were characteristics given to a teacher of science by Gilda. Inquiry based experiences are central for framing and reframing the science teacher (Avraamidou, 2016;
Bryce et al., 2016; Moore, 2008). Data supports that incorporating inquiry-based teaching pedagogy experiences helps engage and generate an affinity for science (Avraamidou, 2016; Chichekian & Shore, 2016). That supports my data when Gilda shared that she did “not like science” when she was left only to answer questions out of a textbook. Ana said, “I don’t feel like I’m getting the hands-on experience,” when reflecting on her science education. Inquiry-based teaching pedagogy and reflective practices can help PSETs reflect on their professional identity through the lens of their positionality. Ana continued to say that her teacher experience in the K-16 classroom helped inform her science teaching identity. These educational experiences have been instrumental in generating an affinity for or resistance to science.

This phenomenological inquiry required four PSETs to take inventory of the social markers that informed their science teacher identity through the lens of their positionality. The social markers reported were education, gender, socioeconomic status, upbringing race, and political affiliation. Their epistemological belief systems that informed their positionality and science teacher identity were awakened to reveal sociocultural milieus that informed their science teacher identity. “Epistemological belief system” referred to their personal beliefs (Van Manen, 2014, p. 39). Lupe shared that her identity was informed by her political affiliation. She said science teaching “shouldn’t be political thing,” but it was for her. She reported on her survey that she did not identify as a science teacher but did want to “present science as something that is, you know, good for mankind.” She continued that science education “doesn’t have to be, you know, one side is right, and one side is wrong.” Her socioeconomic status also informed her identity. Lupe remembered “science fairs in elementary school. A lot of the kids had tons of parental involvement, tons of money to create science fair projects, and I just did not have that upbringing.” Those lived experiences generated a sense of exclusion with the science community. It will not take merely an influx of science content for Lupe to develop her science teacher identity. It will be critical for her teacher preparation program to nurture how other
people in the science community perceive her (Avraamidou, 2016; Bryce et al., 2016). An experience from over a decade ago informed her science teacher identity. It is important for teacher preparation programs to embrace the power of identity development.

This study uncovered the impact social markers made on four PSETs’ science teacher identity. Science teacher identity amongst PSETs in teacher preparation programs are a dynamic construct with multi-facets to its development. Professional identity should be explored in educational research. The four PSETs’ science teacher identity in this study was imprinted by their personal history and life experiences. This identity has been in constant social negotiation. This human identity can never be permanently settled or fixed (Britzman, 1992).

Phenomenological studies cannot be generalized to the greater public. Lived experiences can vary so much from person to person, but what informs these lived experiences seem to have a pattern.

**What Informs Science Teacher Identity?**

Through the inquiry of social markers, the phenomenon examined the development of four PSETs’ science teacher identity through the lens of their positionality. First surveying participants, Gilda wrote race, class/socioeconomic status, and sexual orientation were the top three social markers she most associated with. Ashley wrote class/socioeconomic status, age, and education were the top three markers she most associated with. Ana most identified with her urban upbringing, her African American roots, and being a female. Lupe mostly identified with her political affiliation and gender.

Ana described science as “boring, like chemistry sucks.” Ana shared in the interview that she did not “really feel like I’m getting the hands-on experience I should be getting.” The social markers may have informed this resistance, since she must identify with her gender, race, and upbringings. Her interest in science was piqued in her sophomore year in college during an Earth science course. Her passionate teacher shared enthusiasm about rocks. Her teacher
would bring in real world ideas that resonated with her. This pre-reflective experience informed her idea that the essence of a science teacher is that they “seems to know a lot about that particular topic.” Ana’s essence of a science teacher was embodied in a “one who is knowledgeable” construct. When asked, “Do you see yourself as a science teacher right now?” she replied, “no.” The teacher preparation program provided Ana and her PSET peers two courses to accommodate this construct of “characteristics of a science teacher.” Like Ana described that “they just do a lot of experiments and theories.” The science courses required were Elementary Science for Teaching and Teaching Science in the Elementary which exposed PSETs to science content and how to create engaging inquiry-based lessons. If all four PSETs completed the science courses, then why did three of the four still not identify as science teachers? They had learned the knowledge. The PSETs even create lessons and teach a science lesson to their peers in the course. To reveal the concrete meanings of this reflective experience, I interviewed Ana.

Through verbal discourse Ana revealed three social markers that informed her science teacher identity, and education was not one of them. The knowledge earned from education did not inform her science teacher identity. This insightful description of the way she experienced this phenomenon of science teacher identity was a breakthrough. She was able to delve deeper into the layers of her pre-reflective experience. This was how the phenomenon of science teacher identity appeared in her consciousness, informed by gender, religion, and urban upbringing.

Though this study is not generalizable, other researchers may find similar findings on how intersection of social markers shape humans identity. For example, Maher and Tetreault (2001) discussed the dynamic intersectionality amongst race, gender, and privilege then revealed that “people are defined not in terms of their fixed identities, but their location within shifting networks of relationships” (p. 164). In terms of gender, Ana felt a woman’s place was
not amongst the scientists. This plausible insight may have developed from her resistance to science early on. Her upbringing did not allow for rich science experience. The primary oppressors were gender and upbringing. Her family reserved science and math careers for the males and encouraged the liberal arts for the females. Religion is a part of the depth of her existence. She felt pressure to accept one perspective. A critique of science in the network of religion becomes the basis for religious argument. This consciousness of her gender, upbringing, and religion were all factors in shaping her science teacher identity. Her positionality amongst the science teacher profession was grounded in her firsthand experiences. Her PSET peers shared commonalities on their experiences.

Gilda did not consider herself to be a science person. She, too, described the lack of rich science experience filled with inquiry-based learning. She described women in multiple positions but not within the realms of science. Gilda was subconsciously understanding that her track as a woman was constructed socially and historically with her everyday life. Gilda was one of the three PSETs who did not identify as a science teacher. Her idea of the essence of what it meant to be a science teacher is one who “seems to know a lot about that particular topic.”

**Social Markers Informing Science Teacher Identity**

The phenomenological question arose as PSETs were completing elementary science courses in their teacher preparation program without a positive science teacher identity. How does this phenomenon reveal itself in their consciousness? How did this science teacher identity of PSETs come about? The aggregated data collected by Cobern and Loving (2002) from preservice elementary teachers corroborates with the responses from the PSETs from this phenomenological inquiry (Cobern, 2001). The responses on the Thinking About Science survey by Cobern (2001) revealed that PSETs were “somewhat skeptical about the openness of the science community to women and minorities” (p. 19). This intersection between gender and race revealed itself through verbal discourse amongst the PSETs interviewed in this research.
The rich realities of the PSETs revealed how deep sociocultural milieus impact science teacher identity, both on the Thinking About Science Survey and this phenomenological inquiry (Cobern, 2001; Cobern & Loving, 2002).

This inquiry was sensitive to human existence and was able to bring to consciousness how social markers like gender and race impacted science teacher identity. Cobern (2001) was able to quantify the existence of “socio-cultural sources of support and resistance to science,” while the participants of the present study were able to relive them through verbal discourse. Over 50% of the female PSETs surveyed in the Thinking About Science Survey revealed “neutral or low science interest,” which starkly contrast to men reporting about 31% (Cobern, 2001, p. 31). These data corroborate the female participants surveyed interest in science, an unnerving, abiding issue. This lack of science interest showed itself with Ana, who shared that “it can be pretty boring.” Gilda said that science was “not favorite subject.” Lupe said, “I don’t consider myself a science person.” The teacher preparation programs should be arenas where the female participants in this study could fashion their voices rather than find them” (Maher & Tetrault, 2001). The female participants in this study brought their own perspectives to the teacher preparation program, and they used relevant lived experiences to formulate this narrative of their identity. Social indicators like race are not a biological construct but a social construct manifested by how society has allocated work and privilege (Delgado & Stefancic, 2017). It is this intersection of gender and race that continues to blight the lives of those who possess the identities of the minority within science communities. Gilda did not identify as a science teacher because she did not see representation: “Most of my science teachers were male. Intrigued by seeing female teacher and not African American too.” The Thinking About Science survey also uncovered an additional social marker intersected with gender and race. This concept was reiterated with the participants in this study. Religion was thought to oppress the support of science, with Gilda revealing “a science teacher is very factual.” When referring to
religion and science, she stated that she can “not mix the two.” This religious identity may help inform the science teacher identity of PSETs. Cobern and Loving (2002) discovered the data revealed that PSETs were disinclined to accept that “science should be considered more important than religion” (p. 1025). Larson and Witham (1998) revealed that 60.7% of the scientists surveyed expressed “disbelief or doubt in the existence of God” (p. 313). There are social markers that are informing and nurturing affinity for or resistance to science and science teacher identity. These social markers have informed the PSETs’ lived experiences to position them within their lived worlds. It is this construct that makes up the PSETs’ positionality. The PSETs’ positionality was revealed through their verbal discourse.

**Positionality Informing Science Teacher Identity**

Mensah (2016) concluded that the PSETs’ positionality in her research informed their science teacher identity. This research supported Dr. Mensah’s conclusion. Ashley was the only PSET of the four who identified as a science teacher. She shared experiences of privilege as a “middle class White American.” She said, “I was able to be in, like, a great school with a lot of resources.” She discussed her science teacher identity was most defined by religion, socioeconomic status, and political affiliation. She said that she was “educated enough to be aware of my subjective” beliefs with the aspect of religion. Ashley did not believe “full objectivity is possible” but was “open to try to keep an open mind and my biases as low as possible.” She used this positionality to inform her future science teaching to be sensitive to “Christian students” or “other religious students” in her class, as she stated in the interview. She reflected that “some Christian families don’t appreciate the teaching of evolution or, like, the big bang.” Ashley spoke about the desire to “avoid conflict like that with those kinds of topics.” Ana shared that religion informed her science teacher identity. She expressed the pressures she felt when “trying to compare stuff like, what was the reason or how it was the Earth forms.” She shared how her sphere of influence “would go back and forth on that,” and her response would be, “I’m
not saying it didn’t happen.” There are multiple explanations for everything.” The affiliation with her religious community had positioned her to accept their one point of view. There was a perceived powerlessness as she was placed in a position in which questioning religious authority would be ridiculed. This positional identity informed and captured her true understanding of her science teacher identity. Mensah’s (2016) study revealed that lived experiences, like these, may have informed the negative science teacher identity.

The experiences reported by Mensah’s graduate PSETs were “negative images of school science, stereotypical descriptions of science or the science teacher,” and “not living up to the minority stereotypes” (Mensah, 2016, p.57). This was consistent with the three participants who did not identify as a science teacher. They reported that science “was not favorite subject,” “not a lot of hands-on experiences,” and “boring.” My research helped to bring to light that the undergraduate PSETs had similar experiences as the graduate PSETs in Dr. Mensah’s study. These lived experiences framed by the positionality of the PSETs brought awareness to their science teacher identity. The science teacher identity is not only a response to how the PSET viewed themselves but the external social expectations of the spheres of influence as well.

Science teacher identity development is an interpretation of how a PSET sees herself (or himself) and the imposed expectations of what the PSET is or is not (Passmore et al., 2019). The PSET’s professional identity is not static and involves construction incorporating all perceived selves awakened by the prior self, the present self, and the self they aspire to be. It is for this reason that this research was best theoretically framed through phenomenology.

My research findings speak to the multitude of identities of the PSETs and the role they play in their lived worlds. This modern era interpretation of the fluidity of science teacher identity development can inform teacher preparation courses. Teacher preparation courses should encourage PSETs to reflect on, identify, and confront their beliefs about science and science
teacher identity. Self-reporting became a productive tool for recognition of oneself in this study. Even if there was resistance to science, overall, there was an agreed perspective of the importance of science education.

The PSETs were all in favor of science education for their future science students, even if three out of four did not identify as a science teacher. Cobern (2001) found related results in his survey of PSETs. His survey quantified the sociocultural nuances that nurtured an affinity or resistance to science. It was an effective and valid tool with efforts to quantify the impacts of social markers on this affinity or resistance to science amongst PSETs. The “gender frequency amongst respondents” were divvied up as 82.9% females and 15.6% males (p. 20). Out of the 398 surveys returned, females completed 330 while males complete 62. Colbern found that the PSETs were not anti-science, and “they believe that science is a positive force for public health and in the economy” (p. 18).

PSET Ashley spoke of her future self as a science teacher. She described “education has also allowed me to become an effective science teacher.” I did not think that her experience as a “tutoring 2nd and 3rd grade”, “child development teacher at the YMCA” or having “siblings throughout grade levels” constituted teaching experience or science teaching experience. I included her in the interview component because of her lack of teacher certificate and lack of tasked with the creation of lessons. I classified her as “no teaching or science teaching experience.” Though she identified as having both teaching and science teaching experience, this was a non-issue for me as a researcher. She identified as a science teacher and spoke like an effective science teacher and I found that optimistic and fascinating.

Neither Lupe, Gilda, nor Ana possessed a positive science teacher identity. Yet, Lupe spoke about how she would “like to present science as something that is, you know, for the good of mankind.” Gilda said, “How I view science, not just one way” and that in her class she would make it “fun and more engaging.” Ana described her future self if she were a science
teacher, she said, “If I really, really wanted to do it, my biggest thing will be keeping an open mind.” All the identities that made up the PSETs’ current, past, or present selves made up the totality of them as humans. The experiences, how experiences were perceived and how others perceived them, were informed by social markers that the PSETs identified with.

The PSETs’ positionality has been defined by the diverse social markers, sociocultural factors, and lived experiences that have encompassed their lived worlds (Avraamidou, 2016; Holland et al., 1998; Mensah, 2016). This phenomenological inquiry embodied the rich notions of themselves. These realities were subconscious and were awakened through verbal discourse. This science teacher identity research laid out and framed by the positionality of four PSETs contributes to the body of research of the everydayness of our existence enriching the essences of our being. This knowing of ourselves is our identity.

The science teacher identity work discussed in this phenomenological research informs undergraduate teacher preparation programs. Researching the lived experiences allowed the participants to make meaning of how sociocultural milieus formed their science teacher identity. This epistemic journey gave insight into how science teacher identity was constructed from the beliefs and firsthand experiences of the four PSETs. This conceptualization of science teacher identity developed throughout their lives. Knowledge and meaning arose from the subconscious realization that was hidden with the everydayness of it all (Kruglanski et al., 2009, van Manen, 2014).

This science teacher identity and self-realization was constructed from PSETs’ sociocultural lived experiences, interactions within their social context, their personal beliefs, and the beliefs imposed on them through their sphere of influence (Bryan & Atwater, 2002; Moore, 2008). The overarching idea of epistemic theory was confirmed with the PSETs’ decision making. Their belief system was based on their cognitive dissonance, attitudes
developed over time, and the persuasive negotiations within their sociocultural worlds (Tulis & Fulmer, 2013; Petty & Cacioppo, 1986).

The participants in this research embodied consciously and subconsciously multiple influences throughout life events. These experiences were constructivist in nature in the development of their science teacher identity. Their positionality and social markers afforded the participants certain privileges, sense of oppression, and the ability to navigate through this professional identity within the community of science educators (Gilbert et al., 2005).

This research supports critical theory. Modern society has been instrumental in normalizing the oppression of social markers within educational institutions, economy, politics, and the like (van Manen, 2016). Through this verbal discourse, PSETs reawakened their lived experiences and social markers that informed that experience. They made meaning of the perceived affordances and oppressive perceptions that nurtured an affinity for or resistance to science. It was this affinity for or resistance to science that helped develop the science teacher identity. This knowledge is helpful to science teacher educators as programs invest in professional identity development (Bullough, 1997; Cobern, 2001; Mensah, 2016).

My understanding of science teacher identity has evolved since teaching PSETs, partly due to the critical review of current research and the evidence within the shared experiences of my participants. My experience as a researcher has been enlightened by the mere perceptions that one’s reality can change the trajectory of one’s life. The PSETs have overcome insecurities about their science teacher identity but still push forward and show optimism to do the right thing, teach science. If I had not had this inquisitive phenomenological journey with the PSETs, would they still be so optimistic to teach science? It has been reported that elementary teachers who feel a disconnect with science, like three out of the four PSETs interviewed, “will approach science teaching as something one does if school authorities demand it” (Cobern, 2001, p.1). This reality of PSETs is what teacher preparation programs should be exploring. Researchers
have been programed to believe we know why people are the way they are, but even we sometimes do not know how this idea of our own constructions (van Manen, 2014).

This search for meaning drives the phenomenological researcher. Our attempt to discern the secrets of what it means to be human. We search for meaning and the development of these identities. This research gave insight into how four PSETs formulated their science teacher identity and the social markers that made meaning to this professional identity. The PSETs all described social markers and sociocultural milieus that gave meaning to their perceived science teacher identity. This is not a generalizable study, but merely stimulating sensibilities for science teacher identities development. This inquiry’s conclusion aligns with Bryan and Atwater’s (2002) understanding that “knowing teachers’ beliefs and designing instruction and experiences to explicitly confront those beliefs facilitate refinement of and/or transformations of beliefs and practices” (p. 821). The tentativeness of science teacher identity was made visible as the PSETs spoke of their future selves. They were not asked how they would teach science, but they all ended their interviews discussing future selves as a science teacher. They gave recommendations for development for an effective science classroom and the lessons they would implement. Quotations shared regarding teaching science were:

- “Education has allowed me to become an effective science teacher.”
- “My biggest thing will be keeping an open mind.”
- “Fun and more engaging.”
- “Make relevant to students.”

This research did not speak to shifting science teacher identity. I did not ask PSETs what their science teacher identity was during the interviews. I used the original science teacher identity from the survey. They were all interviewed within 2 months of completing the survey. This new desire to speak on how the participants will present their science teaching simply points out the fluidity of science teacher identity. Teacher preparation programs would benefit
from allowing PSETs to explore the structural components of their science teacher identity. This could manifest itself with giving rise to confidence and self-realization as a science teacher. This could manifest into collegiality with members of their community, inclusive perception of how others see them, recognition into communities in which PSETs seek to belong, development of content knowledge, and positive firsthand experiences with science teaching (Alcoff, 1988; Bryan & Atwater, 2002; Chichekian & Shore 2015; Mensah, 2016; Moore 2008).

Consistent with Tripp-Knowles (1995), PSETs can generate autobiographies to give meaning to the formulation of their science teacher identity through self-reflection. This exercise can bring to light what is not seen on the subconscious that impacts PSETs science teacher identity (Cobern, 2001; Moore, 2008; Rivera Maulucci, 2013).

Like Carlone and Johnson (2007), this research concluded that the positionality and social markers, specifically the intersection of gender and race, played an integral role in the development of PSETs’ science identity. Along with the self-reflection of what gave meaning and rise to the science teacher identity, PSETs need to develop a complex set of knowledge, understandings of effective pedagogy, and a sense of membership in the professional community (Avraamidou, 2016; Gee, 2000; Moore, 2008; Rivera Maulucci, 2013; Wenger, 1998). This sense of belonging and making meaning of science teaching identity helps formulate the trajectory of PSETs’ positionality moving forward.

The PSETs’ positionality came into being heuristically with time (Holland et al.,1998, p.137). Societal positioning had oppressed most and offered privilege to one. This development moved in silence and was unseen at times but was felt and perceived by the PSETs. Their positional identity was both embodied and figured (Holland et al. 1998). PSETs had developed their positionality with awareness of where they have been positioned in society (embodiment) and by the qualities deemed important in their culture. Society played a role in Lupe’s positionality when she said, “I probably can't name more than one female scientist.” She also
felt her socioeconomic status positioned her to resist science. She recalled how science fairs made her feel. She felt the societal oppression of her upbringing and did not feel like she belonged to the community of science. The cultural bounds by Ana’s religious affiliation had her defending the "multiple explanations for everything." Bauman (2001) observed how these social classes and positions were historically embedded and “relatively stable” (p. 145). Mason (2004) spoke to the fluidity of identities. This fluidity can be translated into teacher preparation programs so PSETs can construct their own professional identities through the narratives that have evolved as they make sense of these lived experiences. This critical review into how lived experiences of PSETs and how their social markers can contribute to science teacher identity could be instrumental for science education.

**Science Teacher**

There is a sentiment that may demotivate PSETs from fully embracing an authentic connection as a science teacher. This millennium needs to see an influx of research to evaluate the extent to which PSETs lived science experiences and their positionality has impacted their epistemological belief systems (Fulmer, 2014). This phenomenon of science teacher identity was constructivist in nature and constructed the human cognition of the four PSETs. We as a collaborative whole, researchers, and participants, relived our experiences. We were breathing life into our experiences.

The research questions were clear with relatable responses (van Manen, 2016). The first research question asked, “How do preservice elementary teachers interpret the essence of what it means to be a teacher of science and what life experience informed this interpretation of the essences of a teacher of science?” The participants’ responses were similarly constructed to varying degrees. Gilda described the essence of a science teacher to be “very passionate about science” derived from her experience with a “science teacher in elementary school.” Gilda described these incidents in the classroom that made her “feel science can be fun.” She
remembered rejoicing in the days “when I liked science, which was big for me.” Lupe said that a science teacher is “one who is knowledgeable about and teaches science.” Ana notably said, “I think they just do a lot of experiments and theories.” When I asked where this interpretation came from, she said it “came from observations of personal experience with teachers I’ve had.” Ashley described the essence of a teacher of science as “interactive fun.” She remembered “science experiments.” One account recalled,

“In, like, third grade, we may have been learning about vibrations and sound. And I remember our teacher brought us out and had us blow through a graph that was, like, in between, or like, thumbs, and I made a cool little buzzing sound.”

Ashley recalled her engaging science experiences were made affordable by her privileged social economic status.

This science teacher narrative has been derived from the experiences the PSETs have had. Each PSET’s description is one interpretation and cannot exhaust all the possibilities of others. This renewed connection to original experience awakened the essence of science teachers, which is crucial if one is to become a science teacher. The essence of a science teacher is well within the reach of the PSETs. This qualitative research asked the important question of the “whatness,” that is the essence of a science teacher (van Manen, 1997, p. 33). PSETs given the opportunity to recount their reality, brought a tangible description of science teachers that may have been obscure. This essence of science teacher became about action: “do a lot of experiments,” “interactive fun,” “teaches science,” and “engaging.” The PSETs’ reflecting brought to the surface an identity that could be grasped. Once the essence of science teacher was realized, reflecting on how the PSETs felt about science had renewed significance.

Informing Affinity or Resistance to Science

The second research question asked to the participants was, “What life event can participants elicit that may have most informed their affinity for or resistance to science currently
as a preservice elementary teacher?” The third research question asked, “How have the lived experiences with preservice elementary teachers’ self-identified social markers speak to the science teacher identity?” This self-awareness of resistance to or affinity for science may have been unaware, and once awakened became “immediately as belonging to me” (van Manen, 1997, p. 35). This reality was possessed by the PSETs, and again, was unique to each participant. This sense of not seeing oneself in a particular form can create a conflicted identification. In this revelation, there was a realization of lack of a science mentor nor positive influence that resonated with Lupe. Interestingly Ana thought that the “majority of my teachers were passionate about what they did, what they taught.” She spoke highly of her Earth science teacher, who really engaged her students, and that is when Ana started to enjoy science. This affinity for science developed her sophomore year of college. The way her professor was so passionate about the content is most responsible for this awakening. Ashley resonated with the last class she took in her teacher preparation program. She had just completed the Elementary Science for Teaching course. She said the last class informed her affinity for science, because it “really helped me develop my future identity.” This PSET identified as a science teacher and spoke highly of her microteaching assignment, where she had to “teach science as a science teacher as if you were in front of like a real class.” She said her science teaching identity was inspired by the affordances of her socio-economic status. During her formative years she was exposed to great education with inquiry-oriented science experiences and resources. The experiments and hands-on learning helped promote a positive science identity. She grew up hearing her family tell her that she “can do anything you put your mind to.” This analysis reveals how the “distinctions between the outer and inner world melt into a single, unique, personal world” for the PSETs and their affinity or resistance to science (Langeveld, 1983, p.16).

The revelation from these questions speaks to the lived experiences that inspired the PSETs to develop an affinity or resistance to science. The lived experiences the PSETs
resonated most with in developing an affinity to science were being able to practice teaching science within their coursework in the teacher preparation program and experiencing science teachers who expressed a passion for their content. This valuable realization that having good science teaching experiences during the formative years and beyond impacted the PSETs in this study in a positive way. The sense of not belonging due to lack of representation that emulated their likeness had developed a disconnect with this science teacher identity for one PSET. There is no generalization with a phenomenological study, just an awakening of what is not seen, a sense of describing the “how” and “what” of the phenomenon that is science teacher identity. The PSETs were asked to reflect, specifically on their social markers. Their responses were meant as a reflective exercise and not to generalize to a larger whole, but a personal journey of how they embodied the development of their science teacher identity.

When asked to relive how lived experiences with self-identified social markers spoke to their science teacher identity? the subconscious impressions of lived worlds were revealed. Gilda revealed that gender, her political affiliation, and religion informed her science teacher identity. She reflected on how the female perspective was central to the disconnect of relating to a teacher of science because “most of my science teachers were male.” Gilda did not identify as a teacher of science 2 weeks prior to her interview, which she reported on her Teacher Participation Overview. During her interview she revealed that politics “drives me to want to teach science.” She said science teaching should be based “fact and not opinion,” and science teaching should “not be biased.” Gilda also reported that a “science teacher identity is very factual, does not matter what religion you were.” She clearly and enthusiastically spoke of wanting to teach science and during her interview shared the importance of teaching science. She reported that she did not express a science teacher identity on her original Teacher Participation Overview. Lupe said she did not consider herself to be a science person and that her education during her formative years informed that identity. She described how she “didn't
have a lot of hands-on experience.” Lupe revealed that she has learned through the teacher preparation program coursework that she “should use hands on” science approach with her “future students,” which she said gives her a “much more positive outlook on science.” Again, like Gilda, Lupe did not report having a science teacher identified on her Teacher Preparation Overview. During her interview she, too, understood the importance of teaching science and spoke of teaching science. Ana said, “I like the subject” of science but it depended on “what we’re doing, but other times it can be pretty boring, like chemistry.” Ana’s education informed her science teacher identity. Ashley was the only PSET who identified as a science teacher and described her positionality with an affluent socio-economic status to her affinity toward science. She revealed, “[I] definitely think my socio-economic status influenced my scientific approach as a teacher.” She continued, “I’m, like, middle class urban setting or suburban setting, so I could, like, there was nature to explore, and I was able to be in, like, a great school with a lot of resources.” She described her “teacher who was able to have, you know, dedicate themselves, make those connections.” The four PSETs’ personal narratives of what social markers informed their science teacher identity.

The social markers that informed the science teacher identity of the four PSETs revealed the connectedness of how their positionality played a role in their existential truth. The interviews brought to light what was in darkness, evading their daily lives. It was revealed through verbal discourse and the written word.

They revealed their truths informed by home life, society, culture, classroom experiences, family, friends, religion, and political affiliation. All these social markers informed the science teacher identity of the PSETs through the lens of their positionality. This phenomenological study brought to light through verbal discourse and the writing activity how PSETs conceptualize their science teacher identity.
The focus of this phenomenological study was exploring how social markers informed science teacher identity. Additional research is needed to explore how PSETs can shift their science teacher identity to construct a positive professional identity. This research is simply to report the realities through the lens of the four PSETs interviewed. Researching how PSETs’ science teacher identity informs their science teaching as an in-service teacher would be another useful follow-up to this research.

The focus of this phenomenological inquiry was to allow the personal narratives of the participants to reveal how social markers informed the science teacher identity through the lens of their positionality. Using the semi structured interviews to facilitate responses helped maintain the focus of this research.

The essence of the phenomenon revealed brought liberation. There was a deepness the PSETs experienced as they were learning about themselves and reliving experiences that heightened their consciousness. This awareness may have been transformative in nature, just like this experience might inform their science teacher identity. The impact on their whole being was brought on by emotions that were unseen by the participants themselves prior to the research. The stories evolved and came to life as they became the storytellers of their life experiences. I was compelled to facilitate the dialogue and how the PSETs revealed their truth. The openness and fluidity of the storytelling narratives brought authenticity to this identity work.

Identity Work Needed

Teacher preparation programs play an integral role in developing PSETs’ belief in teaching science (Avraamidou, 2016). Though the experiences of the four undergraduate PSET interviews were unique, this inquiry uncovered how lived human experiences informed the essence of the science teacher identity.

PSETs do not enter their profession as a clean slate. They have their embedded core philosophies and beliefs retained in their mind. This phenomenological approach was not about
finding truths. It was an attempt to interpret and make meaning of the lived worlds of four undergraduate PSETs through discursive narratives (Qutoshi, 2018). This idea of making meaning of how this phenomenon of science teacher identity was construed in the consciousness of the PSETs was the focus of the study (van Manen, 2016).

This phenomenological journey helped recognize an experience we can all recognize. We may have all experienced feelings of either not belonging, oppression, imposter syndrome, or even feelings of privilege. Like all good phenomenological inquiries, this research validated our own membership to this lived world experiences by the PSETs (van Manen, 2016). We may not have all addressed science teacher identity the same as the PSETs in this study, but we may have all felt the impact that our social markers have on our identity through the lens of our positionality.

Though we all have social markers that inform our identity, this collaborative effort with the PSETs gave insight to the lived experiences of this specific group. The PSETs shared experiences and commonalities, but the findings are not generalizable to the common public (Johnson, 1997). The “pre-reflective consciences of life” were awakened for the four PSETs and can be used to inform teacher education programs (van Manen, 2016, p.35).

I concluded a phenomenological inquiry on how social markers inform preservice elementary teachers’ science teacher identity through the lens of their positionality. I uncovered the essence of the phenomena of science teacher identity and how social markers play a role in the development of the phenomenon through verbal discourse of the participants’ life worlds. As a collaborative effort, each individual participant and I attempted to make sense of how they embodied the essence of their science teacher identity. Through the lens of their unique positionality, they self-identified social markers that informed the phenomenon of science teacher identity. Lived experiences may have been incidental in informing their science teacher identity but were critical to the development of this identity.
All four PSETs were able to recall a positive experience in science once the conversation started in the memories triggered. The daily lives masked these memories but when probed, there was a spark of interest at one time. The implications for teacher preparation programs to evaluate the verbal discourse and unpacking of beliefs could help inform science teacher identity.

Parts Make Up the Whole

This hermeneutic phenomenological inquiry was not a closed system. The epistemological awareness of how social markers informed the science teacher identity did not work in a vacuum. As the practitioner, I had to bring to light all the moving parts awakened by the participants’ personal narratives. A sense of openness and trust was needed to filter through the ambiguity of the lived worlds of each participant. The interviews required patience, objectivity, idealism, and grace to allow the journey to transcend in and out of each participant’s metaphorical view. The metaphorical idealism was made up of the firsthand experiences of each participant’s personal lived experiences. This metaphorical idealism is the reality formed in the mind of each participant and was at the core of their resistance to or affinity for science. This affinity or resistance to science was informed by the positionality and social markers of the PSETs.

The participants did a fascinating job at dictating the direction as it became known, as if the meaning of these lived experiences were just now being realized. They brought the essence of the lived experience into existence. They realized the parts of the experience that informed the phenomenon. PSETs were reflecting on the spheres of influence through the lens of their positionality. There were challenges with asking participants to reawaken parts of their lived experiences. They had to dissect the essence of that experience and how it had impacted their science teacher identity. The parts of the whole were not cognizant prior to this awakening and
grace granted to allow for reframing of their realities without becoming a new source of influence.

I was not aware of my own social markers until I was explicitly asked to identify them on a fourth-grade state test during elementary school, and it brought a sense of confusion. An awkward sense of gas lighting came over me as if to clarify what I am and what I am not. I had to depend on my sphere of influence to help with my identity and had to identify the bias from the multitude of answers to my inquiries. This same reality was elicited from the PSETs, and at the end they all discussed the importance of good and authentic science instruction, whether they possessed a science teacher identity or not in the beginning of this inquiry. This necessary development of science teaching may have been unseen before the inquiry.

This mental exercise produced the insight through the unexpected tumult. Two of the PSETs focused on how a political affiliation informed their decision as to why science teaching had to be taught in elementary school, even if they did not possess the professional identity of science teacher on the initial survey. Even if the PSET did not identify as a science teacher because it was “boring,” it was no longer relevant. It was realized how the social markers informed the science teacher identity and there may have been an awakening amongst the participants. This was the pinnacle moment of surprise for the research, when the science teacher identity no longer was relevant after learning how it was informed, and the social markers that once defined their identity now coexisted with this fluidity. Three of the PSETs may have initially reported that they did not see themselves as a teacher of science, but during the interview all four participants spoke of the importance of teaching science in the elementary classroom. There is validity to all truths shared, whether written or spoken, and all social markers were of valid importance to the participants. Just because the PSETs were now cognizant of the influence that informed the science teacher identity, it no longer defined the resistance or affinity for science.
Amongst the PSETs in this inquiry, social markers through the lens of positionality impacted their lived experiences and the affinity or resistance to science. The PSET who had positive lived experiences with science during her formative years due to the social marker she identified had an affinity for science and held a science teacher identity. The three PSETs who did not identify as a teacher of science awoke the intersection of upbringing, gender, and for one to include race, as the most influential factors informing their resistance to science. This resistance to science was attributed to lack of representation of women, and for one to include women of color, accompanied with science experiences that lacked resources and hands-on experiences due to their SES or urban setting. The three women who did not record on their Teacher Participation Survey that they had a positive science experience during their formative years did not identify as a teacher of science or had an affinity for science. Figure 2 illustrates how social markers inform the affinity or resistance to science, which informs the science teacher identity of the PSETs. This phenomenological study enriched the development of the science teacher identity and the reality of its development. Unrealized until awakened from the subconscious abyss, the catalyst that blindly defines us can be the same that oppresses us. The extent of just how influential a science teacher identity is to teaching science in elementary school amongst the PSETs was not determined.

Discussion and Implications for This Research

Moving forward, teacher educators and researchers alike can facilitate discursive narrative opportunities for PSETs with ease to encourage a rich flow of open communication to reawaken the lived experiences (Poggenpoel & Myburgh, 2003; van Manen, 2016). PSETs need to be made aware of their role in this science teacher identity development (Yüksel & Yıldırım, 2015). Educators and researchers alike should share their own experiences with the phenomena during the discovery process with PSETs (Seidman, 1998).
The population was limited to students in a teacher preparation program, and not generalizable. Even though it is not generalizable, other researchers may get similar findings. The PSETs sampled all identified as their specialization within the teacher preparation program as Elementary Education Majors. The students enrolled in the teacher preparation program hope to graduate with a Bachelor of Science in Elementary Education. The 4-year degree will prepare the students for elementary teacher certification. The curriculum includes coursework in pedagogy, content knowledge for all elementary subject areas and research-based teaching practices to accommodate all learners.

The participants surveyed did not identify their gender, but 42% that did not identify as a science teacher chose gender as the social marker they most identified with. The four participants surveyed all identified as female. I kept the social marker “gender” in the study since the “card sort activity” I modeled my instrument from used it. The social marker was chosen as a factor that informed the science teacher identity amongst the three participants surveyed that did not identify as a science teacher. That is a relevant experience for them, lack of representation. Moving forward, I would recommend adding a place for all participants to identify their gender on the survey. Evaluating how females versus males identify as a science teacher is a relevant discussion.

Implications for Practice

Implications for this research informing practice are to include reimagining the development of science teacher identity of PSETs through the lens of their positionality and rich storytelling to awaken silent truths. The need to enrich elementary students with hands-on authentic science experiences, generate a scientific literate society, and prepare students to compete in a technologically advanced global economy are reasons why PSETs may need a positive science teacher identity. Inquiry-oriented science teacher experiences for PSETs and students of science were a central theme in the literature review for forming and reforming their
affinity for science (Avraamidou, 2016; Bryce et al., 2016; Moore, 2008). The exploration of that factor could have implications for science teacher development in teacher preparation programs. Their positionality in their lived world and social markers did inform their affinity for or resistance to science, and awakening this reality through their verbal discourse was authentic in its realization. This affinity or resistance to science informed the science teacher identity recorded on their Teacher Participation Overview survey. Social markers informed the science teacher identity through the path of first creating an affinity or resistance to science during the formative years.

The implication for this information can be utilized by teacher preparation programs. Teacher preparation programs can incorporate assignments to encourage PSETs in identifying social markers they most connect with, reframing the spheres of influence in their lived realities, reawakening lived experiences informed by the social markers, and aligning with their personal belief systems.

**Implications for Policy**

Development of science teacher identity can have implications for professional development in the school setting for in-service teachers. Elementary science teaching may also delve into science teacher identity development. Additional research will be needed to explore how science teacher identity amongst undergraduate PSETs translates into authentic science experiences for elementary students.

**Ethical Considerations**

Approval for this study to analyze narratives collected from participants and recorded as data obtained through the Institutional Review Board of the Human Subjects Office at the institution where the study was conducted. The study used pseudonyms to protect the identity of the participants involved.
Limitations of the Study

This study investigated how social markers informed undergraduate preservice elementary teachers’ science teachers identify through the lens of their positionality. The social markers were limited to those addressed in previous research amongst pre-service teachers. Those social markers were limited to the ones listed on the card sort activity: religion, race, disability / special need, political affiliation, class / socioeconomic status (SES), ethnicity, age, gender, language, and education. I included female as a social marker even though all participants were female. There was no place on the survey to self-identify gender, so there is no data to support how males participated in the written discourse. All participants that agreed to an interview and card sort were female, coincidentally.

The findings cannot be generalized to an entire population of PSETs, since positionality is a dynamic conceptualization.

Additional research in the form of a longitudinal study will be recommended to ensure how PSETs’ science teacher identity informs the quality of their science teaching postgraduation. This inquiry did not confirm whether resistance to or affinity for science and a recognized science teacher identity will predict the incorporation of science teaching in the classroom. The current science teacher identity they hold may be fluid, but this phenomenological inquiry did not speak to that knowledge base. Questions arise on how reflecting on science teacher identity can help reframe this professional identity and encourage teaching science in elementary school postgraduation. This study was the first step in science education reform to inform teacher preparation programs for future elementary science teachers.

This phenomenological inquiry was the interpretation of the researcher, and there may be endless interpretations to the verbal discourse narrated by the participants in this study. This was a qualitative study and cannot be generalized with the entire preservice elementary teacher
population. This study was merely an inquiry into how social markers informed the science teacher identity of four PSETs through the lens of their positionality. This study did not address how to shift the identity and whether the identity PSETs possess predict the actual amount of time they will teach science in their classrooms. This study fills a gap in literature on exploring how science teacher identity develops amongst undergraduate preservice elementary teachers with no classroom science teaching experience.
Course Objectives

SCE 3310, Teaching Science in Elementary School, is designed to prepare you to incorporate the Educator Accomplished Practices/Professional Education Competencies within a science, teaching setting; and implement State Science Standards for science and English Speakers of Other Languages (ESOL) strategies. Additional standards from the Association for Childhood Education International and Technology will be met. NOTE: Activities linked with State mandated and with ESOL strategies can be used, along with the evidence produced, to meet professional portfolio and ESOL Notebook requirements. By the conclusion of SCE 3310, you will be able to

1) Display knowledge of science content and applications in life, physical, and earth/space science.

2) Develop, design, teach and reflect on lessons that relate science concepts to appropriate mental and physical abilities of children.

3) Demonstrate competence in assessment and teaching methods and strategies; and management and safety skills that encourage inquiry and creativity as children investigate their environment.

4) Identify science teaching resources found both within and beyond the school setting, including computer and technology resources.

5) Communicate justifiable reasons for teaching science in elementary school.

6) Incorporate art, music, and movement into the elementary science classroom.

Harassment Statement: Title IX makes it clear that violence and harassment based on sex that interferes with educational opportunities is an offense subject to the same penalties as offenses based on other protected categories such as race, national origin, etc. If you or someone you
know has been harassed or assaulted, you can find resources available to support the victim, including confidential resources, and information concerning reporting options at shield.ucf.edu. Perpetrators are subject to expulsion or termination and may also be subject to criminal penalties.

*University-Wide Face Covering Policy for Common Spaces and Face-to-Face Classes:* To protect members of our community, everyone is required to wear a facial covering inside all common spaces including classrooms. Students who choose not to wear facial coverings will be asked to leave the classroom by the instructor. If they refuse to leave the classroom or put on a facial covering, they may be considered disruptive. Faculty have the right to cancel class if the safety and well-being of class members are in jeopardy. Students will be responsible for the material that will have been covered in class as provided by the instructor.

*COVID-19 and Illness Notification:* Students or faculty who believe they may have a COVID-19 diagnosis should contact Student Health Services so proper contact tracing procedures can take place. Students or faculty should not come to campus if they are ill, are experiencing any symptoms of COVID-19, have tested positive for COVID-19, or if anyone living in their residence has tested positive or is sick with COVID-19 symptoms. CDC guidance for COVID-19 symptoms is located here: (https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html) Students should contact their instructor(s) as soon as possible if they miss class for any illness reason to discuss reasonable adjustments that might need to be made. When possible, students should contact their instructor(s) before missing class.

*Assignments:*

**Belief Paper** - In this paper, you are asked to reflect on your past science teaching and learning experiences through three guided questions. This type of personal reflection is especially important since your ability to be a successful science teacher is influenced by your experiences as a learner. Whether you know it or not, your own experiences with science in school helped to shape your beliefs about teaching and learning science. Your personal reflections hold the key
to uncovering these tacitly held beliefs about science. They also provide the opportunity to begin to modify these beliefs if you feel that is necessary.

You will include an APA 7th edition formatted citation for your resources if needed.

1. What do you consider are the features of effective science instruction? Have you heard about or conducted inquiry-based instruction before? Please use one example to explain what it is based on your learning experiences in the science classrooms.

2. What courses have you taken focusing on English language learners (ELLs) learning? What strategies/accommodations can be utilized to help beginning, intermediate, and advanced ELLs access the science content and meet the objectives of the science lesson?

3. What specialized literacy practices of science have you learned to promote students' science and literacy learning? Please provide a brief explanation.

4. Do you see yourself as a science teacher right now? Yes / No. Explain and describe the characteristics you identify as a "science teacher"?

5. Where did this science teacher identity come from?

Final Paper - Your final paper is to help you and I understand if your original beliefs of science teaching and learning have been changed through this semester. You will answer the following guided questions in this final paper as you did in your belief paper. You will also compare your pre- and post-answers to these questions and reflect on your learning experiences of this semester.

1. What big ideas have you taken away from this science methods course? Please specify each idea based on your learning experiences this semester.

2. What do you think are the features of effective science instruction? Comparing to your responses in your belief paper, whether and what have you changed in terms of perspectives on science teaching.
3. What do you think are the most effective strategies for teaching science to ELL students? Provide examples of how you would integrate these strategies within inquiry-based instruction. Please answer this question based on your learning experiences from this semester.

4. How do science-specific literacy strategies facilitate the process of inquiry and the development of students’ scientific knowledge? Please explain based on your learning experiences this semester.

5. Do you see yourself as a science teacher right now? Yes / No. If there was a change in your “science teacher identity,” what was that agent of change that shifted your identity?

Resource Reviews - As a teacher of science at the elementary level it is crucial that you be able to identify and locate quality resources since using only a textbook to teach science is at best ineffective. For this assignment you will be required to locate and review 2 resources that could be used in an elementary classroom.

Online Reading Response - Five online reading responses are designed to help students understand and reflect on the principles and foundations of the curriculum through reading book chapters or other reading materials. You will read or watch teaching materials that the instructor assigned, answer the focus questions, and respond to at least TWO of your peers.

Key Assignment: Lesson Plan - Each student will develop a science inquiry-based lesson within a group. We will discuss this assignment at length in class. The following basic description meets the state standard recommendations for graduation. The lesson must teach a specific life, physical, or earth/space science concept. Your written lesson plan must follow the provided rubric outlining the 5-E learning cycle with detailed procedures and planned for appropriate learning environments. Your written lesson plan must incorporate and identify applicable state science standards. It should enable all students to learn by drawing on appropriate resources for native speakers and ELLs. Modifications that support access to content and language
development for beginning, intermediate, and advanced ELs as well as mainstream students must include motivational strategies, assessment with appropriate accommodations for the three levels of EL proficiency, and collaboration (ESOL). The lesson plan will be assessed by rubric/checklist attached to the assignment. All resources must be referenced in a reference list at the end of the lesson plan in APA 7th edition citation style. This assignment will be used as evidence for your Professional Portfolio for SCE 3310.

*Inquiry Lesson Plan Criteria:*

1. **Rationale/Purpose**
   Grade level of the student population is identified, your name, and science concept is specified. The state science standards are identified. Objectives are developmentally appropriate.

2. **Preconceptions**
   What preconception/misconception about the goal conception is being addressed?  
   (Cite resource)

3. **Detailed procedures:**
   The **Engage** phase explains step-by-step how the lesson will be introduced to pique children’s interest and raise student questions about the science concept. Teacher questions are included to guide student thinking. Pre-assessment tools are described to determine level of student prior knowledge and focus student attention on the lesson.

   The **Explore** phase is an activity for students to gather evidence that can be used in making sense of the natural world. Students will be manipulating and observing, comparing, and contrasting, sorting simple objects, and exploring in their environment to learn the science content.
The **Explain** phase is an interpretation of collected data. Students will discuss data to construct inferences, make predictions, and build explanations that make sense of the world. Teacher could use questions to guide students in the interpretation of the data during class discussion.

The **Elaborate** phase activities for students to transfer or apply their new knowledge to new issues and problems. Students identify additional questions to investigate, collect evidence, and connect their newly constructed knowledge to the evidence through classifying, relating, inferring, predicting, and explaining.

The **Evaluation** could include formative or summative assessment. The assessment strategy is identified from class readings and discussions. The lesson evaluation tool is included with the lesson.

4. Adaptations for Unique Student Needs: (EL, Special Education, Gifted, Students who lack support for school) Explain ESOL accommodations to help beginning, intermediate, and advanced ELLs access the content of the lesson.

5. Science practices: List all science practices students learn or experience in the lesson.

6. Materials list

7. Safety precautions

6. References: ALL Resources used in lesson development are cited in APA citation style.

*Key ESOL Assignment:*

The above lesson is also the Key ESOL Assignment. Lesson plan should enable all students to learn by drawing on appropriate resources for native speakers and ELLs, modifications that support access to content and language development for beginning, intermediate, and advanced ELLs as well as mainstream students, motivational strategies, assessment with
appropriate accommodations for the three levels of ELL proficiency, and collaboration. In addition, various hands-on activities throughout the semester meet these standards.

Science Teaching Identity Card Sort - This assignment students will explore the intersectionality of the social markers that make up a science teaching identity. Students will reflect on their own lived experiences and choose the top three social markers that make up their science teaching identity.

The Thinking about Science Survey - Students will respond to a 60-item survey in the form of a Likert Scale. Students will respond according to how they feel about science and other disciplines. Students will record answers on the category recording form provided on the last day of face-to-face class. This survey is completely anonymous.

Teacher Participant Overview Qualitative Survey - This assignment will explore the social markers that make up the students self-reporting identities. Students will answer, as honest as possible, on how they position themselves in their lived worlds of race, culture, religion, and age. Students will then answer open-ended, guided questions regarding their positional identity, science teaching identity, and their teaching identity.

Group Teaching a Science Inquiry Lesson Presentation
You will teach a science inquiry lesson within a group to classmates via Zoom as if they were the intended elementary-age students. The presentation should contain a “teacher-to-teacher talk,” where you describe the context of the lesson, identify the standards addressed, and similar issues across K-5. Your written lesson plan should be posted prior to the start of class on the appropriate discussion board for sharing with your classmates.

Microteaching criteria:

1. Pacing and Materials Planning - Your lesson should be designed to fit in the designated period (45 to 50 minutes). You should be prepared with any materials or equipment needed for the lesson.
2. Presentation - Your presentation should be well-organized and demonstrate thorough planning prior to the class. It should follow the written Lesson Plan and should demonstrate appropriate teaching practices.

3. Engagement – You should plan the lesson in such a way that the audience remains actively engaged. Your facilitation of any discussion should allow and even encourage many class members to speak without allowing domination of the discussion by one or two students. Management of the class should be maintained through lesson plan design and/or effective strategies (for example, to get students’ attention to move to the next phase). You are encouraged to make use of the science notebooks as well!

4. Your teaching will be based upon co-teaching with other group members to help your classmates learn science concepts. Every presenter needs to be actively participating in this group work.
<table>
<thead>
<tr>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race - Ethnicity</td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>Teacher education semester</td>
</tr>
<tr>
<td>Major, specialization within teacher education</td>
</tr>
<tr>
<td>Grade level interest</td>
</tr>
<tr>
<td>Status in course</td>
</tr>
<tr>
<td>Previous teaching experience</td>
</tr>
<tr>
<td>Previous science teaching experience</td>
</tr>
<tr>
<td>Do you see yourself as a teacher right now, or identify with being a teacher? Yes/No.</td>
</tr>
<tr>
<td>In your explanation, what is the identity or characteristics of a “teacher”? Where did this teacher identity come from?</td>
</tr>
<tr>
<td>Do you see yourself as a science teacher right now? Yes/No.</td>
</tr>
<tr>
<td>In your explanation, what is the identity or characteristics of a “science teacher”? Where did this science teacher identity come from?</td>
</tr>
<tr>
<td>How does your personal background/identity influence your views of:</td>
</tr>
<tr>
<td>A) Teaching science, and</td>
</tr>
<tr>
<td>B) Teaching diverse students?</td>
</tr>
</tbody>
</table>
Select your top three social markers that you most identify with: Religion, Race, Class/Socioeconomic status, Ethnicity, Gender, Upbringing [urban, suburban, rural, regional], Political affiliation, Sexual orientation, Disability / Special need, Age, Education and Language.

If you would like to participate in the second part of this study which includes a Zoom interview that lasts no longer than 45 minutes, you will receive a $10 eGift Card for Starbucks at the completion of the interview. Please include your name and email address here:

Name: ______________________________________
Email: ______________________________________

(Mensah, 2016, pp. 52 – 55)
Select 3 of the social markers listed below that most have influenced your science teaching identity. With as much detail as possible, describe what life experience informed your science teacher identity.

<table>
<thead>
<tr>
<th>Religion</th>
<th>Class / Socioeconomic status</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Race</td>
<td>Ethnicity</td>
<td>Language</td>
</tr>
<tr>
<td>Disability/</td>
<td>Age</td>
<td>Education</td>
</tr>
<tr>
<td>Special need</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Political Affiliation</td>
<td>Sexual Orientation</td>
<td>Upbringing (Urban, suburban, rural, regional)</td>
</tr>
</tbody>
</table>

(Mensah, 2012, p. 109)

1. List the top 3 social markers and the life events associated with those social markers that may have informed your science teacher identity.
2. Can you recall any events in your life when your social markers impacted your science teaching identity and how you self-identify and when did this take place?
3. How have your lived experiences informed your science teacher identity?
1. How do you feel about science as a subject? What life experience informed your feelings about science?

2. What event throughout your life most informed your science teacher identity? And how?

3. Which experiences can you share that led to your interpretation of the essence of what it means to be a teacher of science?

4. Did any social markers that you identify with impact your current science teacher identity? Can you pinpoint any events in your life that may have informed this connection between social markers and science teacher identity?

5. (Researcher retells their story back to them) This is what I hear you saying about the lived experiences you shared that informed how social markers may have informed your teacher science, did I get this correct?

(Informed by Mensah, 2012; van Manen, 2014, 2016; Canipe, 2016)
EXEMPTION DETERMINATION

November 10, 2021

Dear Katherine Cruz-Deiter:

On 11/10/2021, the IRB determined the following submission to be human subjects research that is exempt from regulation:

<table>
<thead>
<tr>
<th>Type of Review:</th>
<th>Initial Study, Initial Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title:</td>
<td>A phenomenological inquiry on how social markers may inform preservice elementary teachers science teacher identity through the lens of positionality</td>
</tr>
<tr>
<td>Investigator:</td>
<td>Katherine Cruz-Deiter</td>
</tr>
<tr>
<td>IRB ID:</td>
<td>STUDY00003432</td>
</tr>
<tr>
<td>Funding:</td>
<td>None</td>
</tr>
<tr>
<td>Grant ID:</td>
<td>None</td>
</tr>
</tbody>
</table>

Documents Reviewed: 
- Faculty Advisory Review Form, Category: Faculty Research Approval;
- Appendix B- Teacher Participation Overview survey, Category: Survey / Questionnaire;
- Appendix C - Card Sort Activity, Category: Interview / Focus Questions;
- HRP-254, Category: Consent Form;
- HRP-255, Category: IRB Protocol;
- Interview Protocol Questions, Category: Interview / Focus Questions;
- Recruitment Email, Category: Recruitment Materials;
- Sample Syllabus of Course , Category: Other;

This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made, and there are questions about whether these changes affect the exempt status of the human research, please submit a modification request to the IRB. Guidance on submitting Modifications and Administrative Check-in are detailed in the Investigator Manual (HRP-103), which can be found by navigating to the IRB Library within the IRB system. When you have completed your research, please submit a Study Closure request so that IRB records will be accurate.
If you have any questions, please contact the UCF IRB at 407-823-2901 or irb@ucf.edu. Please include your project title and IRB number in all correspondence with this office.

Sincerely,

Gillian Bernal  
Designated Reviewer
REFERENCES


http://doi.org/10.1080/03057267.2014.937171


https://doi.org/10.1002/sce.10043


https://doi.org/10.1007/s11422-015-9725-1


https://doi.org/10.17226/5844


Mensah, F. M. (2012). Positional identity as a lens for connecting elementary preservice teachers to science teaching in urban classrooms. In M. Varelas (Ed.), *Identity*


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