A CAUSAL-COMPARATIVE STUDY OF TEACHERS' ATTITUDES TOWARD SCIENCE TEACHING BASED ON BIOLOGICAL SEX, TEACHING EXPERIENCE, AND AN INSTRUCTIONAL RESOURCE IN AN URBAN ELEMENTARY SCHOOL SETTING

by

Melissa Linette Davis

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A Dissertation Presented in Partial Fulfillment

of the Requirements for the Degree

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ABSTRACT

This quantitative, causal-comparative research study analyzed the difference in teachers' attitudes toward science teaching in an urban elementary school setting based on biological sex, teaching experience, and the use of a science instructional unit of study. The study was significant because it revealed that teaching experience influenced elementary teachers' attitudes toward science teaching, contributing to the body of knowledge about elementary teachers in an urban setting and related to science education. A convenience sample of 120 study participants in the Georgia urban area was selected. The teacher participants completed the online ten-minute Dimensions of Attitude Toward Science instrument that measured teachers' cognitive beliefs, affective states, and perceived control toward science teaching. The SurveyMonkey© website with anonymous settings collected the survey data. The researcher conducted three independent sample *t*-tests and a statistical analysis to evaluate each null hypothesis, which showed a statically significant difference in teachers' attitudes toward science teaching in an urban elementary school setting based on three or more years of teaching experience. This study showed a significant difference between experienced and less-experienced teachers' attitudes. Future research includes analyzing teachers' attitudes toward science based on each attitudinal component and subcomponent.

Keywords: attitudes, biological sex, curriculum resource, curriculum unit of study, preservice teachers, self-efficacy, teaching experience, urban schools

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LIST OF ABBREVIATIONS

Dimensions of Attitude Towards Science Instrument (DAS)

Next Generation Science Standards (NGSS)

The Primary Teachers' Attitude Towards Science (TPATS)

Tripartite Model of Attitudes (TMA)

CHAPTER ONE: INTRODUCTION

Overview

An individual's attitude is complex. The person's complex attitudes do not always lead to the desired behavior. This study analyzes teachers' attitudes towards science teaching. The dimensions of cognitive beliefs, affective states, and perceived control influences attitudes toward science teaching. Chapter One provides an outline for the study; it includes the background, problem statement, purpose, significance of the study, and research questions. The background information consists of the current relevant research, historical research, and the theoretical framework of science-teaching attitudes. The problem statement explains why the study was needed based on the current gap in the research. The purpose of the study is to describe how the researcher analyzes the problem. The significance of the study explains how it contributed to the body of research. Lastly, the research questions explored the relationship between the independent and dependent variables. The researcher used statistical testing to analyze the variables.

Background

Research shows that teachers directly impact students' attitudes toward science (Alwahaibi et al., 2019; Durdukoca & Önel, 2020; Maison et al., 2020; Matusov, 2018). Consequently, teachers' attitudes toward science teaching correlate with students' achievement and performance (Lee et al., 2017). Attitudes are the internal beliefs that influence actions learned indirectly through experiences and exposure to models (Schunk, 2016). Teachers generally have a positive attitude toward science teaching (Ualesi et al., 2018). Teachers had the most positive belief in understanding the purpose of teaching primary-level science and mixed attitudes about the enjoyment and anxiety of science teaching (Ualesi et al., 2018). Elementary preservice teachers' beliefs varied based on the dimension of authority and accuracy, knowledge construction, sources of knowledge, reason, and change (Bayraktar, 2019). The teachers held sophisticated beliefs about authority and accuracy and ambivalent beliefs about knowledge construction (Bayraktar, 2019). It was noted by Docherty-Skippen et al. (2020) that preservice elementary teachers would have a positive attitude toward science teaching and technology if they learned the subjects hands-on. The present research focused on preservice teachers' attitudes toward science teaching. The overall results are mixed. The research about elementary in-service teachers' attitudes toward science teaching is limited.

Historical Overview

Teachers have traditional views of science-related roles, knowledge, and instruction (Haidar, 1999). Further, traditional views of religion also help shape teachers' attitudes toward science teaching (Haidar, 1999). This is because, traditionally, science education was guided by religion and politics (Long, 2012). Long's (2012) research focused on the politics and religion of teaching evolution versus creationism. The study concluded that teaching evolution had been diluted in science education, and teachers' attitudes toward teaching this concept varied based on one's beliefs.

Factors Influencing Science Instruction

There was a strong correlation between teachers' beliefs pertaining to and attitudes toward science (Atwater et al., 1991). Teachers realize the importance of teaching science hands-on but fear implementing these activities (Atwater & et al., 1991). Teachers fear implementing hands-on activities due to classroom management and uncertainty of the science content. Science education has shifted from static concepts to inquiry-driven knowledge construction (Örnek, 2019). Elementary teachers are responsible for teaching English/Language Arts, Mathematics, Science, and Social Studies. Historically, teachers lack confidence and self-efficacy in science teaching (Fragnoli, 2005).

Research shows that teachers' attitudes toward using scientific text vary widely based on gender and science text’s contribution to learning and skills (Can & Öztürk, 2019). Female teachers showed a more positive attitude toward teaching with science text than their male colleagues (Can & Öztürk, 2019). They used science texts every day or every other day, and scored significantly higher in the dimensions of making use of science text when possible and the contribution of reading the same (Can & Öztürk, 2019). Elementary teachers have mixed attitudes toward science teaching (Bayraktar, 2019; Docherty-Skippen et al., 2020; Ualesi et al., 2018). Historically, principals' attitudes toward science teaching were positive (Nabors, 1999). Almost 100% of the principals surveyed encouraged teachers to use more hands-on science if they knew that active participation in science activities increases knowledge retention (Nabors, 1999). School leaders provide the guidance and support that helps shape teachers' attitudes (Rehman et al., 2019). The study concluded a positive relationship between leadership behavior and teachers' attitudes (Rehman et al., 2019).

Society-at-Large

This study of teachers' attitudes toward science teaching is essential to the scholarly society because school leaders directly impact student and teacher achievement (Mette, 2018). Research shows that teachers' attitudes, and actions affect students' achievement (Walma van der Molen & van Aalderen-Smeets, 2013). This dissertation's significance is the practical implication of how teachers' attitudes are a possible indicator of future teaching behavior (Wilder et al., 2019). This dissertation provided the research needed for schools and districts to guide teachers' and leaders' professional development. This development included targeted professional learning that addresses the immediate needs of the teachers. Based on the study's results, the attitudinal dimensions of cognitive beliefs, affective states, and perceived control guided the professional development offerings. For example, gender bias is a dimension of cognitive beliefs used as a professional topic for teaching equity in the science classroom. School leaders use professional development to improve their leadership skills (Lyons, 2019). Attending professional development classes showed their commitment to the school and the work (Lyons, 2019).

The shifts in science education instruction are needed for the United States to compete globally in the field of Science, Technology, Engineering, and Math (STEM) (A Framework for K-12 Science Education, 2012). The current United States worker needs to gain more substantial knowledge in STEM (A Framework for K-12 Science Education, 2012); the nation ranks 35th in mathematics and 27th in science achievement internationally (Rozek et al., 2017). The changes in science education push teachers to adjust their attitudes and instruction to include science and engineering practices, crosscutting concepts, and core ideas (A Framework for K-12 Science Education, 2012).

Theoretical Framework

This study's comprehensive theoretical framework is primary teachers' attitudes toward science teaching (van Aalderen-Smeets et al., 2012). The primary teachers' attitudes toward science (TPATS) was a relatively new theoretical framework and builds on the tripartite model of attitudes (TMA) that uses three components—cognition, affect, and behavior—for understanding attitudes (Eagly & Chaiken, 1993). TMA directly correlated attitudes to behavior (Eagly & Chaiken, 1993). The theoretical framework of TPATS uses the psychological construct of attitude based on cognitive beliefs, affective states, and perceived control (van Aalderen-Smeets et al., 2012). The perceived control component is where the primary teachers' attitude towards the science framework diverges from the tripartite model of attitudes. Perceived control deals with teachers' belief in their own ability and knowledge to teach science, as well as in controlling the context that allows for science instruction. The context relates to teachers having the necessary materials and designated time for science instruction.

The TPATS theoretical framework consists of three components and seven underlying attributes. The cognitive beliefs component has underlying attributes of perceived relevance, perceived difficulty, and gender beliefs (van Aalderen-Smeets et al., 2012). Cognitive beliefs pertain to the purpose and value of science teaching. The affective states include enjoyment and anxiety and are related to the teachers' positive and negative emotions while teaching science (van Aalderen-Smeets et al., 2012). Lastly, the underlying attributes of perceived control are self-efficacy and context dependency (van Aalderen-Smeets et al., 2012). Perceived control deals with the teachers' belief in their ability and knowledge to teach science, as well as in controlling the context that allows for science instruction.

The TPATS theoretical framework addressed this study's research question, which is: Is there a difference in teachers' attitudes towards science teaching based on biological sex, teaching experience, and science curriculum resource utilization? The components and underlying attributes align with the factors in the study. The cognitive beliefs have a subcomponent of gender beliefs related to science teaching. Gender beliefs have influenced teachers' attitudes toward science teaching (Ualesi et al., 2018; van Aalderen-Smeets et al., 2012). The more experienced teachers have higher science teaching self-efficacy (Ualesi et al., 2018). The theoretical framework's perceived control has an underlying attribute of self-efficacy, i.e., in the personal beliefs about one's capabilities to learn or perform actions (Bandura, 1977, 1986). Lastly, perceived control relates to context dependency, including the availability of science resources. Previous studies used the TPATS framework as it was used in previous research studies (Korur et al., 2016; Mulholland & Cumming, 2016; Ualesi et al., 2018). Mulholland and Cumming (2016) applied the TPATS framework to teachers' attitudes toward teaching students with disabilities. The other studies remained consistent in testing for teachers attitudes towards science teaching.

This present dissertation evaluated the difference in urban elementary teachers' attitudes toward science teaching based on biological sex, teaching experience, and the use of a science curriculum unit of study. The conceptual understanding of science teachers' attitudes relates to the TPATS framework. The current attitudes toward science research focuses on preservice elementary teachers, in-service secondary teachers, students, and the biological sex of the teacher. There needs to be more research on in-service urban elementary teachers' attitudes toward science teaching. The data gathered in this study was used for planning and designing job-embedded science professional learning for in-service teachers.

Problem Statement

Elementary teachers are students' first exposure to learning about science. The elementary teachers' beliefs about science teachers directly impacts students' science performance (Ecevit & Kıngır, 2022). Attitudes toward science are essential to study because there is a correlation between teachers' pedagogical beliefs and attitudes and students' achievement and performance (Lau & Ho, 2022; Lee et al., 2017). Enjoyment of science learning is found to be the strongest predictor of performance (Lau & Ho, 2022). Some junior high students have negative attitudes toward science due to the teachers' lecture method; however, the research also showed that some students have positive attitudes toward engaging in fun science lessons (Maison et al., 2020). Teachers constructed science lessons that created good scientific attitudes in students who felt happy when learning science and were interested in increasing their learning time for the subject (Maison et al., 2020). Another study showed no statistically significant difference in students' attitudes toward science based on gender (Cermik & Fenli-Aktan, 2020). The study also concluded significant differences in attitudes toward science based on whether students attended private or public school, parent's educational level, mother's career as a teacher, and if they were following a scientific magazine (Cermik & Fenli-Aktan, 2020). Marec et al. (2021) studied teachers paired with high school students during the teaching of science and technology concepts. Consequently, teachers' attitudes regarding self-efficacy and context dependency were significant (Marec et al., 2021).

The present research focused on preservice teachers' attitudes toward science teaching (Bayraktar, 2019; Docherty-Skippen et al., 2020; Kartal & Kırşehir Ahi Evran University Turkey, 2020). Bayraktar (2019) observed that teachers tend to have positive attitudes about the importance of science. However, the attitudes remain negative when it comes to science teaching self-efficacy (Bayraktar, 2019; Ualesi et al., 2018). Bayraktar's (2019) study concluded no significant difference between males and females regarding epistemological beliefs and attitudes toward science. Kartal and Kırşehir Ahi Evran University Turkey (2020) analyzed mathematics and science preservice teachers' efficacy and attitudes towards teaching. Generally, the teachers had positive efficacy and medium attitudes towards, and females showed higher efficacy and attitudes than male teachers (Kartal & Kırşehir Ahi Evran University Turkey, 2020).

The problem is that there is limited research on in-service teachers' attitudes toward science teaching in an urban elementary setting. Awareness of teachers' attitudes toward science teaching is worth studying because they are a possible indicator of future teaching behavior (Wilder et al., 2019). Additionally, there was a correlation between teachers' pedagogical beliefs and attitudes and students' achievement and performance (Lee et al., 2017). Attitudes toward science are a common topic in educational research; however, the topics are narrowed to preservice teachers, secondary teachers, students' attitudes, and professional development. Once teachers graduate to become in-service teachers, the research on their attitudes toward science has limited examination.

Purpose Statement

This quantitative, causal-comparative research study aimed to analyze the elementary teachers' attitudes towards science teaching in an urban elementary school setting based on biological sex, teaching experience, and use of a science unit of study. The target population was teachers in an urban elementary setting in Georgia's metro area. This dissertation used the variables of teachers' attitudes in an urban elementary toward science teaching, the biological sex of the teacher, years of teaching experience, and a science curriculum resource utilization for statistical analysis. The independent variables are the biological sex of the teacher, years of teaching experience, and the use of a science curriculum unit of study. A science curriculum unit of study is a detailed teaching guide comprised of lesson-by-lesson plans that provide teachers with objectives, content knowledge, and specific activities to implement with their students (Albornoz et al., 2020). Teaching experience is the years of science teaching experience used to measure teacher effectiveness (Wayne et al., 2017). Biological sex is the biological dimension of the anatomy-physiological characterization of humans (Afonso et al., 2019). The dependent variable is the teachers' attitudes toward science teaching. Attitudes are the internal beliefs that influence actions and are learned indirectly through experiences and exposure to models (Schunk, 2016).

Significance of the Study

This dissertation's significance was the practical implications of how teachers' attitudes are a possible indicator of future teaching behavior (Wilder et al., 2019). Additionally, there is a correlation between teachers' pedagogical beliefs and attitudes and students' achievement and performance (Lee et al., 2017). School leaders could find this information helpful in hiring and developing professional development opportunities. Such opportunities include building teachers' science capacity and the relevance or usefulness of science (Riegle-Crumb et al., 2015). School leaders can gauge a teacher's attitude towards science teaching to determine if science instruction implementation occurred as scheduled. Teachers with a favorable inclination and excitement toward teaching spend more time focusing on science instruction (Riegle-Crumb et al., 2015). The studies analyzed in the present research suggest that the findings are helpful in planning science-related professional development for in-service teachers (Korur et al., 2016; Mulholland & Cumming, 2016; Ualesi et al., 2018). Targeted professional learning is, therefore, aligned with the teachers' immediate needs based on the findings (Korur et al., 2016; Mulholland & Cumming, 2016; Ualesi et al., 2018).

This dissertation contributed to urban schools' research on science-teaching attitudes. The targeted population is teachers in an urban elementary setting in Georgia's metro area. The research on elementary teachers in an urban setting needs exploring in the context of current educational research. The dissertation results can reveal what teachers in an urban setting think about science teaching based on the factors of the teachers' biological sex, experience, and use of a science curriculum unit of study. Several studies evaluated the importance of studying preservice teachers' attitudes toward science (Bayraktar, 2019; Docherty-Skippen et al., 2020). However, the research on in-service elementary teachers' attitudes toward science is limited. The study contributed to the body of literature on in-service teachers' descriptive educational phenomenon of the theoretical understanding of attitudes toward science centered around cognitive belief, affective states, and perceived control.

Research Questions

RQ1: Is there a difference in teachers' attitudes toward science teaching based on the male or female biological sex in an urban elementary school setting?

RQ2: Is there a difference in teachers' attitudes toward science teaching based on less than three years of experience or more than three years of experience in an urban elementary school setting?

RQ3: Is there a difference in teachers' attitudes toward science teaching based on using a science curriculum unit of study or not using a science curriculum unit of study in an urban elementary school setting?

Definitions

1. *Attitudes-* The internal beliefs that influence actions and are learned indirectly through experiences and exposures to models (Schunk, 2016).
2. *Biological sex-* Biological dimension of the anatomy-physiological characterization of humans (Afonso et al., 2019).
3. *Curriculum resource-* Particular instructional print or digital material (examples include textbooks and online programs) used to engage students in the lesson (Matic, 2019).
4. *Curriculum unit of study-* A detailed teaching guide comprised of lesson-by-lesson plans that provide teachers with objectives, content knowledge, and specific activities to implement with their students (Albornoz et al., 2020).
5. *Experience-* The years of science teaching experience used as a measure in teachers' effectiveness (Wayne et al., 2017).

6. *Preservice teachers-* Prospective teachers studying in the educational field (Pekbay, 2023).
7. *Self-efficacy*- Represents "beliefs in one's capabilities to organize and execute a course of action required to produce given attainment" (Bandura, 1977, p. 3).
8. *Urban schools*- Working-class schools located in large metropolitan populations of marginalized and immigrant children (Sharma, 2018).

CHAPTER TWO: LITERATURE REVIEW

Overview

The literature review examined the current literature on elementary teachers' attitudes toward science teaching. The study evaluated differences between elementary teachers' science-teaching attitudes based on the biological sex of the teacher, years of experience, and the use of a science curriculum unit of study while teaching in an urban school setting. The literature review included an in-depth analysis of the theoretical framework of primary teachers' attitudes toward science teaching (van Aalderen-Smeets et al., 2012). The related literature section includes current research on urban education, attitudes toward science, science teaching, teaching experience, genders in science, science curriculum resources, and elementary science education that helped establish the purpose of this dissertation study. The literature review concludes with a summary of the current literature and how this dissertation contributed to the body of literature.

Theoretical Framework

This study was based on the comprehensive theoretical framework for the primary teachers' attitude toward science (TPATS), a relatively new theoretical framework built on the tripartite model of attitudes (TMA). TMA uses three components of cognition, affect, and behavior for attitudes, and directly correlates attitudes to behavior (Eagly & Chaiken, 1993). The TPATS theoretical framework used the psychological construct of attitude based on cognitive beliefs, affective states, and perceived control (van Aalderen-Smeets et al., 2012). The perceived control component is where the TPATS framework diverged from TMA. Perceived control deals with the teachers' belief in their ability and knowledge to teach science and their beliefs about controlling the context that allows for science instruction. This context relates to teachers requiring materials and designated time for science instruction.

The TPATS theoretical framework consisted of three components and seven underlying attributes, as given by van Aalderen-Smeets et al. (2012). The cognitive beliefs component has underlying attributes of perceived relevance, perceived difficulty, and gender beliefs. Cognitive beliefs pertain to the purpose and value of science teaching. The affective states included enjoyment and anxiety and pertain to the teachers' positive and negative emotions while science teaching. Lastly, the underlying attributes of perceived control are self-efficacy and context dependency. Perceived control deals with the teachers' belief in their ability and knowledge to teach science and confidence in controlling the context that allows for science instruction.

The TPATS theoretical framework addressed this study's research question: Is there a difference in teachers' attitudes toward science teaching based on biological sex, teaching experience, and instructional resource utilization? The components and underlying attributes align with the factors in the study. The cognitive beliefs have a subcomponent of gender beliefs related to science teaching. Gender beliefs have been found to influence teachers' attitudes toward science teaching (Ualesi et al., 2018; van Aalderen-Smeets et al., 2012). The more experienced teachers have more self-efficacy in science teaching (Ualesi et al., 2018). The theoretical framework's perceived control has an underlying attribute of self-efficacy. Self-efficacy is the personal belief about one's capabilities to learn or perform actions (Bandura, 1977, 1986). Lastly, perceived control relates to context dependency, including the availability of science resources.

Primary Teachers' Attitude Towards Science in Literature

The TPATS theoretical framework has been used in current research studies (Korur et al., 2016; Mulholland & Cumming, 2016; Ualesi et al., 2018). Mulholland and Cumming (2016) applied the TPATS theoretical framework to teachers' attitudes toward teaching students with disabilities. The instrument was slightly modified to address characteristics related to the specific student group. The other studies remained consistent in analyzing primary teachers' science-teaching attitudes using this theoretical framework (Korur et al., 2016; Ualesi et al., 2018).

Related Literature

Teachers' attitudes toward science teaching were examined throughout current research; however, topics related to teachers' attitudes have yet to be explored. The related literature section includes recent research on topics connected to urban education, attitudes toward science, science teaching, teaching experience, genders in science, science curriculum resources, and elementary science education that helped establish this dissertation study's purpose. The research topics had an explicit connection with the underlying attributes of cognitive beliefs, affective attributes, and perceived control. These broad topics revealed that the specific teaching group of urban elementary in-service science teachers needed to be explored in the present research. The factors of gender, years of teaching experience, and utilization of a science curriculum related to in-service urban elementary teachers have not been thoroughly examined in the literature. This dissertation contributed to the body of literature on urban elementary in-service teachers' attitudes toward science teaching.

Cognitive Beliefs

The cognitive beliefs component of attitudes toward science has underlying attributes of perceived relevance, perceived difficulty, and gender beliefs (van Aalderen-Smeets et al., 2012). Cognitive beliefs pertain to the purpose and value of science teaching. Lee et al. (2021) found that teachers' cognitive beliefs changed because of their involvement in professional development. The teachers participated in cognitive apprenticeship professional development, where they developed science-related tasks that promoted writing and constructing explanations in science (Lee et al., 2021). Another study found that teachers' positive cognitive beliefs directly impacted the successful implementation of cooperative learning and instructional learning (Veldman et al., 2020).

Conversely, teachers with negative cognitive beliefs about cooperative learning did not successfully implement it (Veldman et al., 2020). Schooner et al. (2022) found that technology teachers' cognitive beliefs were impacted by their knowledge of and experience with specific assessment tools. The study also suggested that professional development positively affects teachers' cognitive beliefs (Schooner et al., 2022). The overall research showed that teachers' cognitive beliefs directly impact their instructional practice. The cognitive beliefs component of attitudes toward science has underlying attributes of perceived relevance, perceived difficulty, and gender beliefs (van Aalderen-Smeets et al., 2012). Cognitive beliefs pertain to the purpose and value of science teaching. Lee et al. (2021) found that teachers' cognitive beliefs changed because of their involvement in professional development. The teachers participated in cognitive apprenticeship professional development, where they developed science tasks that promoted writing and constructing explanations in science (Lee et al., 2021). Another study found that teachers' positive cognitive beliefs directly impacted the successful implementation of cooperative learning and instructional learning (Veldman et al., 2020).

Conversely, teachers with negative cognitive beliefs about cooperative learning did not successfully implement it (Veldman et al., 2020). The evaluation of teachers' cognitive beliefs is extended to technology teachers. Schooner et al. (2022) found that technology teachers' cognitive beliefs were impacted by their knowledge of and experience with specific assessment tools. The study also suggested that professional development positively affects teachers' cognitive beliefs

(Schooner et al., 2022). The broad research showed that teachers' cognitive beliefs directly impact instructional practice.

Affective States

The affective states included enjoyment and anxiety (van Aalderen-Smeets et al., 2012). Affective states are the teachers' positive and negative emotions while science teaching (van Aalderen-Smeets et al., 2012). Kahveci et al. (2018) explored teachers' affective states related to discontent, self-efficacy, and intent to reform. The finding showed there was a statistically significant difference between younger teachers (20–24 years old) and older teachers (40–45 years old) based on pedagogical discontent, with the former showing lower pedagogical discontent (Kahveci et al., 2018). Additionally, the study revealed that teachers with advanced degrees or training in science showed lower pedagogical discontent (Kahveci et al., 2018). Chan and Lay (2021) had similar findings about affective states. There was a statically significant finding of teachers' affective states and the relationship between self-efficacy and the motivation to teach science (Chan & Lay, 2021). The research showed that teachers' affective states directly impact their instructional practices.

Perceived Control

The contributing attributes of perceived control are self-efficacy and context dependency (van Aalderen-Smeets et al., 2012). The concept deals with the teachers' belief in their ability and knowledge to teach science and as well as in controlling the context that allows for science instruction. Spektor-Levy and Yifrach's (2019) study showed that some biology teachers had negative perceived controls about teaching students with learning disabilities. The teachers responded positively to adapting the teaching method; however, the support and guidance for teaching students with learning disabilities were lacking (Spektor-Levy & Yifrach, 2019).

Nordlöf et al. (2019) studied technology teachers' perceived control and revealed that self-efficacy was optimistic based on experience and education. Conversely, some teachers had negative attitudes based on the lack of support and resources (Nordlöf et al., 2019).

Self-Efficacy in Science Teaching

Self-efficacy is a construct that is part of attitudes toward science teaching. Perceived control is a component of attitudes measured during this dissertation. It refers to the teachers' belief in their ability and knowledge to teach science as well as in controlling the context that allows for science instruction. The context relates to teachers having needed materials and designated time for science instruction. Elementary science teachers' self-efficacy in one's ability to effectively teach science continued to be negative after participating in a traditional science workshop (Fazio et al., 2020). One reason is the teachers' previous exposure to science learning (Fazio et al., 2020). If this experience was negative, the teachers' self-efficacy was lower. Some teachers engaged students based on how the teacher received science instruction (Fazio et al., 2020).

Conversely, the same teachers changed their negative beliefs after participating in an inquiry-based science workshop (Fazio et al., 2020). The workshop included inquiry-based teaching approaches focused on scientific investigation and discovery. These findings are similar to other studies about teachers' change in beliefs and practices due to professional development (Bell et al., 2018; Sikma & Minshew, 2018). Contradictory to the previous findings, there was a negative relationship between one's science teaching beliefs and one's science belief score (Catalano et al., 2019). In other words, the more efficacy the teacher possessed, the lower their content knowledge (Catalano et al., 2019). The findings have implications for student achievement in science because the teacher may believe they are more effective than the data displays.

The current research on teachers' attitudes toward science teaching showed mixed findings of positive and negative attitudes related to self-efficacy. The factor of professional development also revealed mixed results. More research is needed to analyze how self-efficacy impacts teachers' attitudes. This unique study provided findings on how self-efficacy as a part of attitudes toward science measurement relates to the teachers' sex, experience, and curriculum resource.

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Teachers' Attitudes toward Science

Attitudes toward science are common in educational research; however, the related topics are limited to preservice teachers, secondary teachers, students' attitudes, and science-related professional development. This study contributed to the literature by reducing the research gap between teachers in an urban elementary setting and their attitudes and beliefs toward science teaching. The current comparative research emphasized preservice teachers' attitudes toward science teaching (Bayraktar, 2019; Docherty-Skippen et al., 2020). The preservice teachers' self-reported attitudes toward science are a possible indicator of future teaching behavior (Wilder et al., 2019). The study attempted to validate the Preservice Elementary Teacher Affect Scale for

Science (PETAS-S), which is designed to measure preservice teachers' positive effect on science (Wilder et al., 2019). The study's limitations are due to participants coming from only one state and there being no implications being studied for in-service teachers.

Similarly, Docherty-Skippen et al. (2020) found a connection between the preservice teachers' K-12 experience with science and technology and one's attitude. The teachers exhibited more positive attitudes toward science teaching (Docherty-Skippen et al., 2020). However, the study did not use a valid and reliable instrument to measure attitudes toward science and failed to explain the data analysis used to provide findings and results. Their beliefs may impact the teachers' instructional practice about content relevancy, their ability to teach students, and their overall attitude.

Primary teachers' attitudes toward science teaching showed contradictory findings (Bayraktar, 2019; Ualesi et al., 2018). A qualitative study in Turkey provided the feelings and emotions associated with science-teaching attitudes (Ualesi et al., 2018). Teachers had the most positive belief in understanding the purpose of teaching primary-level science while possessing mixed attitudes about the enjoyment and anxiety of science teaching (Ualesi et al., 2018). The study only consisted of six participants. The study's limitation is the small sample size; therefore, this research, which had a larger sample, was needed for comparison. The elementary preservice teachers' beliefs varied based on the dimensions of authority and accuracy, knowledge construction, sources of knowledge, reason, and change (Bayraktar, 2019). Preservice elementary teachers' attitudes were optimistic about the importance of science; nevertheless, the attitudes were less favorable related to anxiety about science teaching (Bayraktar, 2019). The study found a weak positive relationship between scientific epistemological beliefs and attitudes (Bayraktar, 2019). Science method courses positively impact preservice teachers' attitudes toward science teaching (Long, 2019). Preservice teachers showed significant gains in attitudes in (1) scientific inquiry, (2) adoption of scientific attitudes, (3) leisure interest in science, and (4) interest in science careers after completing the science methods course (Long, 2019).

Impact of Attitudes on Teaching

Attitudes have a meaningful impact on learning (Durdukoca & Önel, 2020). Middle- and high-school teachers generally have positive attitudes toward teaching biology (Durdukoca & Önel, 2020). Ilhan (2021) analyzed teachers' attitudes toward science after integrating evidence-based educational research into their teaching. Teachers who used educational research had significantly enhanced positive attitudes (Ilhan, 2021). Thibaut et al. (2019) studied how professional development in STEM integration correlated with teachers' positive attitudes. Conversely, more experienced teachers close to retirement correlated with negative attitudes about teaching with STEM integration. The overall research findings of teachers' attitudes toward science revealed contradictory results. They displayed both positive and negative attitudes toward science teaching. The factors of professional development and inquiry were common themes throughout the current research. The following section examined teachers' self-efficacy in science teaching, which was measured as a component of teachers' attitudes toward science during this dissertation.

Students' Attitudes Toward Science

Teachers directly impact students' attitudes toward science (Alwahaibi et al., 2019; Durdukoca & Önel, 2020; Maison et al., 2020; Matusov, 2018). Some students have negative attitudes toward the subject due to the teachers' lecture method (Maison et al., 2020). Research by Alwahaibi et al. (2019) showed that engaging teaching strategies and curricula helped create positive science-learning intentions. The study showed a statistically significant relationship between students' attitudes and their intention to learn science (Alwahaibi et al., 2019). Additionally significant was the relationship between the science curriculum and students' intention to learn science (Alwahaibi et al., 2019). The study was limited by the small sample size, the study location in Oman, and the science courses were not delineated between biology, chemistry, and physics. The small sample size cannot be generalized, and the location is outside of the United States that has a different educational system.

Matusov's (2018) case study revealed that students did not have positive attitudes toward science due to preservice teachers stifling their science inquiry. Matusov's (2018) case study analyzed urban students' attitudes toward science and their suburban preservice teachers. Students were dissuaded from sharing personal science-related experiences because it was at odds with preservice teachers' designated science curriculum (Matusov, 2018). Durdukoca and Önel's (2020) study evaluated preservice teachers' attitudes toward a biology lesson and found similar findings, in that students' negative attitudes toward science attributed to teachers' past experiences. The overall research showed that teachers have positive attitudes toward science teaching. The research focused on preservice teachers, which creates a need for in-service elementary teachers to be examined. This study addressed said need. The following section discusses the factor of teaching experience related to teachers' attitudes toward science teaching.

Teaching Experience

Teachers are often delineated by years of teaching experience. The current research does not reflect teachers' attitudes toward science teaching based on teaching experience. However, there is contradictory research on teaching experience and teachers' scientific process skills and beliefs (Caleon et al., 2018; Killough & Stuessy, 2019; Yildirim et al., 2020).

Teachers' experience affects their perceptions related to scientific process skills, which are defined as accessing information, constructing knowledge, and using scientific means (Yildirim et al., 2020). There was a significant difference between preservice teachers' and in-service teachers' perceptions of scientific process skills (Yildirim et al., 2020). Nonetheless, the perceptions among the three groups of in-service teachers of less than 10 years of teaching experience, 10 to 20 years of teaching experience, and more than 20 years of experience showed no significant difference between the preservice teachers (Yildirim et al., 2020). The study was conducted outside of the United States with high-school teachers.

Conversely, Killough and Stuessy's (2019) study showed a significant difference between reformed beliefs pertaining to science between veteran and less-experienced teachers. The high-school teachers who participated in a four-day advanced placement training were administered a pretest and posttest. Veteran teachers with five or more years of teaching experience showed a more statistically significant change than teachers with less than five years of teaching experience (Killough & Stuessy, 2019). Similarly, Caleon et al. (2018) found that novice and experienced physics teachers have differing views about teaching and learning science. Experienced teachers had constructivist beliefs about teaching, while inductive teachers focused on how they learned physics instead of how physics is taught (Caleon et al., 2018).

Experienced elementary teachers scored the lowest mean on the pedagogical content knowledge assessment as compared to novice teachers (Hanuscin et al., 2020). The composite score of experienced elementary teachers in a particular grade level aligned with their years of teaching experience. In other words, the more experience a teacher is at teaching a specific grade level, the higher is their pedagogical content knowledge score (Hanuscin & Zangori, 2016; Hanuscin et al., 2020). Preservice teachers who participated in a Next Generation Science

Standards (NGSS) methods course felt more prepared to teach and assess elementary science (Hanuscin & Zangori, 2016). However, when elementary teachers are re-assigned to a new grade level, their science professional content knowledge is adversely impacted (Hanuscin et al., 2020).

Teaching Experience in Other Content Areas

The differences based on teaching experience have been studied in other content areas (Burkhauser & Lesaux, 2017; Murray-Orr & Mitton-Kukner, 2017). The experienced teachers were able to adapt a researched-based ELA curriculum to meet their students' needs. In contrast, novice teachers needed help to implement the curriculum in ways other than those prescribed (Burkhauser & Lesaux, 2017). The teacher's ability to incorporate content literacy strategies during instruction became more sophisticated from preservice to the first year of teaching (Murray-Orr & Mitton-Kukner, 2017). The overall research shows contradictory findings on the effects of teaching experience related to science teaching. The conflicting findings warrant this dissertation to conduct research on urban elementary teachers' attitudes toward science. Further research is needed to analyze how teaching experience affects teachers' attitudes toward science teaching. The following section explains the role of gender in science related to teaching attitudes toward the subject.

Genders in Science

Previous research indicated that gender beliefs do not influence teachers' attitudes toward science teaching (Bayraktar, 2019; Bridwell-Mitchell & Fried, 2020; Durdukoca & Önel, 2020; van Aalderen-Smeets et al., 2012). Research showed no statistically significant difference in science teachers' attitudes based on gender (Bayraktar, 2019; Durdukoca & Önel, 2020). There was no statistically significant difference between male and female preservice teachers' scientific epistemological beliefs and attitudes toward science (Bayraktar, 2019). The research from high school biology teacher candidates showed similar outcomes of no statistically significant difference in attitudes toward science based on gender (Durdukoca & Önel, 2020).

There were contradictory findings related to gender and attitudes toward science, and teachers' attitudes toward science were statistically significant based on gender and years of experience (Ambusaidi & Al-Farei, 2017). Female teachers were more positive than male teachers, and more experienced teachers had more positive attitudes (Ambusaidi & Al-Farei, 2017). The study did not include elementary teachers, and the participants taught in grades fifth through tenth. This study was used to compare and examine the difference in science-teaching attitudes of elementary teachers based on gender and experience. The general research showed mixed findings related to genders and attitudes toward science.

Women's Participation in Science

Women's participation in science varies between developing and developed countries. According to the UNESCO Institute of Statistics data, women around the world represent 29.3 % of scientists (for conciseness, we will employ the word "scientist" as shorthand for "staff member involved part-time or full-time in R&D in a STEM field"). However, there are large regional variations—the highest percentages are seen in Central Asia (48.2 %), followed by Latin America and the Caribbean (45.1 %), the Arab States (41.5 %), and Central and Eastern Europe (39.5 %). It is worth noting that (except for some of the oil-rich countries in the Persian Gulf) most of the countries in these areas would be labeled as "developing". In contrast, Western Europe and the USA have a relatively low percentage (32.7 %) of women scientists; this percentage is almost the same as that in sub-Saharan Africa (31.8 %). By far, the lowest percentage is found in South and West Asia (18.5 %) (Narasimhan, 2021).

Gender Bias

According to the National Center for Education Statistics, in 2017, college graduates with bachelor's or higher degrees in science, technology, engineering, and math tend to have more positive economic outcomes and higher median incomes than non-STEM graduates (Çetin, 2021). Additionally, females were awarded more bachelor's degrees, while males were awarded more bachelor's degrees in STEM fields. These findings are similar to that of the present research, in that female preservice teachers had higher STEM awareness than male preservice teachers; they also had higher STEM attitudes and achievement. However, the differences were insignificant (Çetin, 2021). Swafford and Anderson (2020) analyzed women's perceived barriers to pursuing STEM careers. One hundred percent of the participants agreed that male domination in STEM careers was a barrier (Swafford & Anderson, 2020). The lack of awareness of opportunities in STEM fields and careers was scored, with 94.4% of participants agreeing. STEM toys directed at boys and the lack of female role models scored 88.9% as barriers for females pursuing STEM careers (Swafford & Anderson, 2020). The lowest score was 44.4% for females' perceived level of intelligence (Swafford & Anderson, 2020). The remaining barriers with a score of more than 50% in the agreement were (a) personal expectations, (b) time required to become proficient, (c) lack of encouragement from men, (d) perceived glass ceiling, (e) intimidation by men, (f) societal gender roles, (g) respect for woman, (h) lack of encouragement from woman, (i) career wage gap, (j) sexism, (k) energy required to become proficient, and (l) educational expenses (Swafford & Anderson, 2020).

Research shows that some teachers' gender biases substantially impact boys' and girls' achievement gap (Lavy & Sand, 2018; Terrier, 2020). The study focuses on mathematics and French content areas; however, the more significant implication was that teachers' gender biases affect student achievement (Terrier, 2020). Lavy and Sand's (2018) study had similar findings—teachers' positive assessment of a specific gender in a content area significantly impacted the students' future selection and achievement in advanced science and mathematics. The study suggested that teachers' bias affected students' future income (Lavy & Sand, 2018). The research revealed that some teachers' gender bias affects student achievement and them selecting future STEM fields.

Gender Bias and Income

There is gender income inequality (Cin et al., 2021; Connor & Fiske, 2019). Sexism in the workforce contributed to income equality (Connor & Fiske, 2019). Income inequality also existed between women with and without higher education (Cin et al., 2021). The wage gap was significantly higher between these groups of women (Cin et al., 2021). In Turkey, women's hourly wages were 10.5% lower than men's (Litman et al., 2020). Regardless of the context of discrimination, education, experience, or labor segregation, there was a significant gender pay gap (Litman et al., 2020).

Elementary Science Education

The nearly 30 million elementary students in the United States should have access to high-quality science education. Research shows that schools have significantly less science teaching than reading or mathematics (Elementary science education position statement release, 2019). The shifts in science education instruction are needed for the United States to compete globally in the STEM field (A Framework for K-12 Science Education, 2012). The current United States worker needs to gain more robust knowledge in STEM (A Framework for K-12 Science Education, 2012). The changes in science education push teachers' attitudes and instruction to include scientific and engineering practices, crosscutting concepts, and core ideas

(A Framework for K-12 Science Education, 2012). Science education was also shifting in other parts of the world. Korea has expanded its science education course to include Science, Technology, Engineering, Arts, and Math (STEAM) pedagogy (Kim & Bolger, 2017). The study showed favorable attitudes of preservice teachers toward STEAM when they developed lessons (Kim & Bolger, 2017). The preservice teachers gained subject awareness, perceived ability, value, and commitment to teaching STEAM (Kim & Bolger, 2017).

High-stakes testing and accountability directly impact teachers providing laboratory experiences and investigations for elementary students in science (Hayes & Trexler, 2016). Teachers at high-accountability schools are 60% less likely to include laboratory experience during science teaching than their counterparts at lower-accountability schools (Hayes & Trexler, 2016). Laboratory experiences are essential to students conceptually developing science-related concepts and ideas (A Framework for K-12 Science Education, 2012). The findings support this study of the teaching context of urban elementary teachers at high-accountability schools. The research showed that students must prepare for STEM careers (A Framework for K-12 Science Education, 2012), and teachers play a role in preparing them for the same. This dissertation study evaluated teachers' attitudes toward science teaching, which is one area of STEM. The following section explores components of effective science teaching.

Elementary Science Instructional Time

Finding instructional time for science was a common issue for elementary teachers. They must balance instructional times for the four content areas: reading, mathematics, science, and social studies. Sandholtz et al. (2019) studied changes in science instructional time based on teachers' engagement with professional development. Some teachers' science instructional time increased from 20 minutes twice a week to 30–60 minutes twice a week. To compensate for the loss of science instructional time, some teachers integrate science learning centers during the literacy block (Lott et al., 2018). Teachers have created science learning centers to ensure that all standards are addressed during the abbreviated science instructional block (Stone, 2018). Science learning centers are self-directed exploratory activities where students engage with science-related concepts (Stone, 2018).

Pedagogical Content Knowledge

Science pedagogical content knowledge of elementary teachers has been a concern in science education (Catalano et al., 2019; Bradbury et al., 2018; Cite et al., 2017). Elementary preservice teachers possessed greater self-efficacy than in-service teachers in science content knowledge (Catalano et al., 2019). Preservice teachers who receive high-quality science methods courses and have content knowledge self-efficacy may help improve student achievement. The studies can be used for comparison of in-service teachers' self-efficacy with respect to science teaching. Conversely, another study has shown no connection between the choice of instructional strategies and students' understanding of the content (Walan et al., 2017). During the study, teachers reflected that the intended and experienced objectives varied vastly (Walan et al., 2017).

Elementary in-service teachers are concerned about managing science teaching and learning resources, arranging students for instruction, and reflecting on teaching practices (Bradbury et al., 2018). There was a limitation with the study because it was a self-study with just two participants. More research was needed on a larger scale. Another case study was evaluated to understand how college professors shifted from science teaching content to teaching preservice teachers how to teach science. The self-study found mentorship to be an effective strategy for engaging preservice teachers with understanding the science content with the intention of instructional implementation (Cite et al., 2017). The research consensus showed that teachers' self-efficacy about the science content varied based on the context. This dissertation determined how the teachers' experience affects self-efficacy related to pedagogical content knowledge.

Science Instructional Strategies

The investigation framework helps students better understand science-related concepts (Manz, 2019). During the investigation framework, the teacher provides opportunities for students to transition from the phenomenon, investigations, evidence, and explanations (Manz, 2019). Elementary teachers use an engineering design challenge instructional strategy when promoting design-based problem-solving (McFadden & Roehrig, 2019). Students used discourse practices during the analytical engineering design challenge (McFadden & Roehrig, 2019). The study was conducted as an exploratory case; hence, generalizations cannot be applied to all elementary teachers, prompting the need for more research.

The research showed the use of science instructional strategies. The use of the methods was related to the self-efficacy of pedagogical content knowledge. Self-efficacy was an underlying attribute of perceived control. This dissertation measured the perceived control component of attitudes toward science-related experience. The following section discussed arguments pertaining to science related to the relevancy and purpose of science teaching.

Argumentation has become a part of elementary science education used to promote scientific inquiry and improve students' scientific explanations. Teachers' role is to create opportunities for students to engage in argumentation (Boğar, 2019). They must construct activities such as expression tables, content maps, student-generated experiment reports, concept cartoons, story formation, ideas and evidence, and argument structures that create an argumentation environment (Boğar, 2019).

Some teachers at the collegiate level were not prepared to engage students in argumentation (Gilles & Buck, 2019; Özdem Yilmaz et al., 2017; Vieira et al., 2015). Science methods courses have begun training preservice teachers on incorporating argumentation into science instruction. Preservice teachers used information from the instructor to construct claims and institutional talk to engage in argument (Gilles & Buck, 2019). The preservice teachers failed to use evidence sources other than the ones provided by the instructor. Conversely, the teachers participating in graduate-level work could implement instructional strategies and model how to construct evidence and counterarguments from evidence (Özdem Yilmaz et al., 2017). The study was limited due to the small participant size.

Argumentation in science education has been studied at the secondary science level yet was limited at these elementary levels. The argumentation method varies with teachers. Argumentation can be taught in early grades by taking turns with proof discourse (Kim & Roth, 2018). Teachers play an essential role in developing students' use of evidence during argumentation in the early grades (Kim & Roth, 2018). Students learn the use of a claim, evidence, and explanation process as pattern learning (Kim & Roth, 2018). Kaya (2018) found similar results, in that argumentation in early elementary school has methodologic and conceptual understanding issues (Kaya, 2018). It helps promote students' dialogue about science content and students' reasoning; however, the correlation between argumentation and conceptual understanding needs to be addressed in the researcher's review of the study (Kaya, 2018). These argumentation studies were qualitative case studies that cannot provide generalizations. This dissertation study of in-service teachers is needed to contribute to the specific body of research.

Student Questioning

Science education requires students to participate in their learning, including students actively questioning. The student-guided questions were used as a catalyst for science learning (Herranen & Aksela, 2019; Kang & Noh, 2017; Kastens et al., 2020). Student questioning was used in learning to stimulate thinking and discussion (Herranen & Aksela, 2019). It leads to different inquiry levels where student-generated questions are investigated with teacher collaboration, or students may explore teacher-generated questions (Herranen & Aksela, 2019). Student questioning was skill-oriented, and students had to engage in the practice. Kang and Noh's (2017) study had similar findings: students involved in pre-inquiries showed improved science process skills and a positive learning effect. The overall research revealed argumentation and student questioning as the instructional strategies. One component of the teachers' attitudes towards science was cognitive beliefs based on perceived relevance and purpose. This dissertation measures teachers' cognitive beliefs that were analyzed in relation to sex, experience, and curriculum resource.

Real-world Science

Science education includes a curriculum that encourages students' awareness and agency for real-world science to increase scientific literacy (Birmingham et al., 2019; Davis & Schaeffer, 2019). Elementary teachers use real-world interdisciplinary lessons to teach science in order to provide a voice to marginalized students (Birmingham et al., 2019). Another example of real-world science was how students used the water crisis in Flint, Michigan to develop a scientific domain and justice-oriented analyses (Davis & Schaeffer, 2019). Elementary science education was multifaceted. Teachers were expected to allow students to engage in STEM or STEAM, argumentation, student questioning, and real-world experiences as they learned the science content. The research showed that elementary teachers need preparation to teach all facets of elementary science education. Cognitive beliefs were based on perceived relevance and purpose for science teaching. The research revealed that real-world science increases student agency and awareness around scientific literacy. This dissertation measures cognitive beliefs as a component of teachers' attitudes toward science teaching. The following section discusses the teaching context of urban education.

Urban Education

This dissertation focuses on elementary teachers teaching in an urban setting. The elements that make up urban education are studied to provide an overview of how teachers' attitudes toward science teaching may be impacted by the teaching context. In the context of this study, urban schools are working-class schools located in large metropolitan populations of marginalized and immigrant children (Sharma, 2018). Urban education has a unique teaching context with deficit thinking that guides decision-making (Sharma, 2018; Welsh & Swain, 2020); these decisions impact teaching and learning. Sharma (2018) based deficit thinking on a three-framework approach—sociological, cultural, and socioeconomic. Deficit thinking is essential because it has ethical implications related to the schooling of marginalized students (Sharma, 2018). This type of thinking impacts the way marginalized students are educated, standardized tested, and socialized. The deficit thinking has seeped into the schooling of marginalized students and those with a low socioeconomic status within the urban school context (Sharma, 2018). The deficit perspectives have become pervasive throughout urban education (Welsh & Swain, 2020). Urban education's conceptualization was multifaceted and based on location/geography, enrollment, student demographics, school resources, inequalities, and social and economic context (Welsh & Swain, 2020). The present research exposed the mechanisms surrounding urban education. The urban teaching setting was used as a comparison throughout the dissertation study. The following section helps explain how urban education was transforming to improve student achievement.

Transforming Urban Education

Urban education operates in a constant state of change to improve student achievement. The recent efforts to transform urban education included (a) early education initiatives, (b) teacher, human capital policy changes, (c) accountability with high-stakes testing, and (d) choice-based reforms (Steinberg & Quinn, 2017). The teacher, human capital policy involves high-stakes evaluation systems that help improve teacher performance (Steinberg & Quinn, 2017). Additionally, the transformation of urban education includes attending to the students' and staff's social and emotional needs. The school and university partnership helped provide behavioral strategies and interventions to urban teachers to improve student behavior (Miranda et al., 2018). The school and university partnership used mental health professionals to create a school-wide mental health program that provided wellness to teachers and mental health services to students, as well as engaged in community outreach (Miranda et al., 2018).

The research uncovered the complexity of urban education. The themes of high-stakes testing and accountability were evident in the research. Perceived control refers to one's belief about controlling the context that allows for science instruction. The context relates to teachers having needed materials and designated time for science instruction. The dissertation measures perceived control related to teachers' attitudes toward science. The following section explains how teachers adjust science instruction in an urban setting.

Urban Educators

Residency programs and professional development were offered to improve preservice teachers' skills to work in an urban district (Bell & Curcio, 2020). Residency opportunities were interwoven throughout college coursework to ensure that preservice teachers were exposed to the unique demands of teaching in an urban district (Bell & Curcio, 2020). Additionally, the context of accountability has led to undermining the best inquiry practices for science instruction (Marco-Bujosa et al., 2021). Several urban teachers have conformed to high-stakes testing of accountability pressures by shifting instructional methods to those better aligned with standardized testing. Some urban teachers attempted to make science relevant to students by connecting the subject to their local community (Brown et al., 2019; Marco-Bujosa et al., 2021).

Culturally Relevant Pedagogy

Culturally relevant pedagogy incorporates cultural perspectives that result in more profound knowledge of self-awareness and agency (Brown et al., 2019; Ray, 2019). Some teachers are aware of culturally relevant pedagogy; however, the theory does not translate into practice (Brown et al., 2019). Some STEM teachers in the study regulated culturally relevant science instruction keeping in mind the racially specific phenomenon and formative and summative assessments with culturally particular topics and appropriate context (Brown et al., 2019). After culturally relevant education training, the STEM teacher continued to have a differing understanding of how to implement the concepts (Brown et al., 2019). The teachers were also conflicted with implementing culturally relevant education; however, the students are assessed using standardized assessments. The urban teachers' connection to students helps build school culture and climate (Masko, 2018). The teacher-and-student relationship helps students stay connected to the school. Three themes emerged about the traits of an urban teacher from a study: (1) show care, (2) possess strong content knowledge, and (3) teach in a way students understand (Masko, 2018). Teachers' science teaching experiences in an urban context have been explored in the research (Marco-Bujosa et al., 2021).

Several themes emerged from the current research; these pertain to (a) accountability policies, (b) marginalization of science instruction, (c) relevance to students, (d) school context with the availability of resources, and (e) professional growth (Marco-Bujosa et al., 2021). Urban teachers have an awareness of cultural relevance connected to pedagogical instruction. The current research was relevant to the dissertation study because teachers' attitudes toward science teaching measure cognitive beliefs, affective states, and perceived control. The context of urban teaching may have an impact on teachers' attitudes. In the next section, the research explains the role urban leaders play in transforming urban education.

Urban School Leaders

Urban school leaders are pivotal in how well urban teachers and schools perform. The research showed an array of topics affiliated with urban school leaders of school reform, indigenous connections, and school improvement (Green, 2018; Kershner & McQuillan, 2016; Ononuju, 2016; Swaminathan & Reed, 2020; Watson & Bogotch, 2016). As urban cities go through revitalization, schools have become the link between school culture and community development (Green, 2018). Green's (2018) single case study was about a high school principal's plight in leading a school through revitalization. The limitation of the study was that the single case does not apply to larger populations.

Urban school leaders have additional pressures while leading. Constant leader turnover in urban schools leads to distrust and cynicism among staff (Kershner & McQuillan, 2016). The case study's principals shifted the power dynamics by distributing leadership among the faculty

(Kershner & McQuillan, 2016). The principal that distributed the power equally was viewed as effective; conversely, the principal who only had a distributive leadership appearance continued to struggle (Kershner & McQuillan, 2016). Urban leaders play a vital role in improving underserved students' outcomes through educational leadership and culturally responsive practices (Ononuju, 2016). The study examined how Black, indigenous educational leaders contribute to education in urban schools. The study used a case study design, so the leader's transformational findings and holding capital in the community are connected to this single case.

The overall research on urban schools and leadership revealed that it is constantly changing. The constant change has led to poor academic achievement and principal turnover (Ononuju, 2016). The limitation of the urban leader's studies is the study design of a case study. The study's finding lends itself to the specific study with no generalizations. In the next section, the present research on teachers' attitudes toward science teaching is examined. The research has shown that urban education is multifaceted with sociological and economic constraints (Sharma, 2018). The research about urban leaders relates to the dissertation due to the teaching context. Perceived control refers to one's belief about controlling the context that allows for science instruction. The context refers to teachers having needed materials and designated time for science instruction. The following section focused on the teachers' perceptions of leaders related to the attribute of perceived control with respect to attitudes toward science.

Urban School Students

Urban schools are working-class schools located in large metropolitan populations of marginalized and immigrant children (Sharma, 2018). Students who attend urban schools tend to live in higher poverty (Breger, 2017). Breger's (2017) study showed a highly correlated relationship between high poverty and low student achievement in Chicago Public Schools. The study also showed that students with poor attendance had low student achievement (Breger, 2017). Urban students experience inequities in receiving high-quality education (Nasir, 2020). Nasir (2020) suggested using social-emotional learning as an equity structure to meet the developmental needs of urban students.

Teacher Preparation Programs

The research is mixed about the effectiveness of teacher preparation programs for science teaching. Teachers are not prepared at the collegiate level to engage and develop students in argumentation (Cebrián-Robles et al., 2018; Gilles & Buck, 2019; Özdem Yilmaz et al., 2017). Conversely, studies show that preservice teachers' science efficacy increases after enrolling in a science methods course (Catalano et al., 2019; Cite et al., 2017). Recent literature showed that elementary preservice teachers possess greater self-efficacy in science content knowledge than in-service teachers (Catalano et al., 2019). Preservice teachers' science training centered around planning engaging activities for students with less emphasis on the conceptual understanding of science-related concepts (Subramaniam, 2022). Preservice teachers are prepared to teach science by planning, enacting, and reflecting upon a science lesson (Subramaniam, 2022). Subramaniam (2022) revealed that science instruction emphasized teacher-centeredness in instruction and student learning. Preservice coursework is designed based on the science students' learner outcomes based on a conceptual framework (Mach & Mach, 2018). Preservice teachers receive practical strategies that can be used to help students construct and inquire (Boyer, 2016; Mach & Mach, 2018).

Teaching styles were based on personal beliefs and self-efficacy (Birmingham et al., 2019; Buldur, 2017). Teachers' mental models changed from year one of the teacher preparation programs to year four of explicit science teaching, when they moved to exploratory science teaching (Buldur, 2017). The longitudinal study captured the shift in teachers' beliefs toward science teaching. Preservice teachers continued to have a varied understanding of integration. Students tend to learn science better from an interdisciplinary perspective (Birmingham et al., 2019). A personal relevance to science teaching made students' learning more impactful (Birmingham et al., 2019). Teachers viewed the interdisciplinary ecological unit as a powerful way to reach marginalized groups of students (Birmingham et al., 2019). Most teacher candidates plan to use a personal perspective in their future science teaching (Birmingham et al., 2019).

Science Methods Courses

First-year college students, sophomores, and juniors showed an average performance range of 161–179, and on the Praxis elementary education Science Subtest, the possible score range was 100–200 (Educational Testing Service, 2020). The science and social studies Praxis subtest had the lowest pass rates (Will, 2020). The traditional elementary teacher preparation programs consist of method courses for core content areas. However, more than 50% of K-8 preservice teachers feel they need more preparation to teach science after graduation (Kirst & Flood, 2017). St. Norbert College revised its courses by integrating science content with science methods courses. The findings revealed that preservice teachers gained a deeper understanding of the nature of science when aligned with the education courses (Kirst & Flood, 2017). The study was limited in attributing the changes in preservice teachers’ attitudes due to instrument selection. Another study revealed that preservice teachers developed pedagogical content knowledge through lesson planning, microteaching, and reflection (Subramaniam, 2022). This case study was also limited to eight participants.

Science method courses positively impact preservice teachers' attitudes toward science teaching (Hulings, 2022; Long, 2019; Wenner & Kittleson, 2018). Preservice teachers showed significant gains in attitudes in (1) scientific inquiry, (2) adoption of scientific perspectives, (3) leisure interest in science, and (4) interest in science careers after completing the science methods course (Long, 2019). Wenner and Kittleson's (2018) study had similar findings of elementary science method courses improving teachers' practice. Teacher candidates developed questioning, student participation, and discussion techniques (Wenner & Kittleson, 2018). The discussion techniques promoted discussion between students instead of between students and teachers. Preservice teachers' science-teaching self-efficacy was influenced by past experiences with science (Hulings, 2022). Hulings (2022) suggested that science methods courses focus on asset-based perspectives where what the teacher candidates lack is de-emphasized.

The studies show how greatly teacher preparation programs vary in content (Alayont, 2016; Bradbury et al., 2018; Cruz-Guzmán et al., 2020; Gilbert & Byers, 2017). Teachers were trained to use wonder as an inquiry strategy in science (Gilbert & Byers, 2017). Teachers' scientific thinking evolved due to infusing wonder into science teaching and the development of inquiry units (Gilbert & Byers, 2017). The qualitative study provided insight into how preservice teachers are taught to embrace wonder as a pedagogical tool. Another tool was developing quality questions in the use of scientific inquiry. Preservice teachers were asked to create different levels of questions based on the school's science content (Cruz-Guzmán et al., 2020). The preservice teachers' ability to generate higher-order thinking questions was based on the prescribed school science content (Cruz-Guzmán et al., 2020). Teachers should be trained to create questions based on various elementary science topics (Cruz-Guzmán et al., 2020).

Qualitative studies provided data on teachers' practice based on teacher preparation programs' involvement (Bradbury et al., 2018; Wenner & Kittleson, 2018). Bradbury et al.'s (2018) study revealed three themes related to the pedagogical content knowledge of two elementary teachers: (1) organizing resources for science learning, (2) organizing students for science learning, and (3) reflecting on science teaching. Students were grouped based on reading level, personalities, interests, and support needed for science instruction (Bradbury et al., 2018). Another program required teachers to record a video of their reflections on their science teaching practices (Wenner & Kittleson, 2018). Recent science method programs have combined math and science methods courses and created STEM method courses (Douglass et al., 2022). This shift in science teacher preparation prepares students to understand and solve real-world problems in an integrated manner (Douglass et al., 2022).

The general research on teacher preparation programs recognized that preservice teachers must prepare to teach science with the content knowledge and pedagogical skills needed for instruction. Colleges and universities have responded to the issue by changing method courses to provide more effective science teaching guidance. When teachers feel better prepared to teach science, their attitudes and beliefs toward science teaching improve (Long, 2019; Wenner & Kittleson, 2018). The teacher preparation programs and research on science methods courses are related to this dissertation because teachers' preparation may contribute to their attitudes toward science teaching. The underlying attributes of cognitive beliefs, affective states, and self-efficacy related to teachers' attitudes toward science appear throughout the research. The following section examines factors that impact student achievement.

Student Achievement in Science

High-stakes testing and accountability directly impact teachers providing laboratory experiences and investigations for elementary students in science (Hayes & Trexler, 2016). The student's performance on standardized assessments for elementary students in Georgia was 43% for proficient and above on the standardized Georgia Milestones Assessment (Georgia

Department of Education, 2019). The study's Georgia metro district's elementary students' performance was 38% for proficient and above on the standardized Georgia Milestones Assessment (Georgia Department of Education, 2019). Teachers at high-accountability schools are 60% less likely to include laboratory experience during science teaching than their counterparts at lower-accountability schools (Hayes & Trexler, 2016). High-accountability schools must make adequate yearly progress for five or six consecutive years (Hayes & Trexler, 2016). The findings support this dissertation study of the teaching context of urban elementary teachers at high-accountability schools.

The leadership quality of a school is a predictor of the teachers' performance and student achievement. Research showed that principal effectiveness positively impacts student achievement (Bartanen, 2020; Hitt et al., 2019). Principals have substantive effects on student absences (Bartanen, 2020). The study showed a substantial improvement in students' attendance when principals had a value-added score for attendance (Bartanen, 2020). Generalizations about principals' turnaround competencies cannot be made because the sample size needs to be bigger (Hitt et al., 2019). The research showed a positive relationship between effective school leaders and student achievement (Liebowitz & Porter, 2019; Wirawan et al., 2019;). Liebowitz and Porter (2019) conducted a meta-analysis of 51 research studies on the relationship between leaders' behaviors and students', teachers', and students' outcomes. The research showed a direct relationship between leaders' behaviors and students', teachers', and students' outcomes. The limitation of the study is that the data was observational. This student achievement research is relevant to this dissertation because teachers' behaviors influence students' achievement in science. This dissertation measures teachers' behaviors connected with teachers' attitudes toward science teaching.

Professional Development

Most science teachers view professional development as helpful (Shernoff et al., 2017). The study's teachers benefited from the project-based professional development model (Shernoff et al., 2017). Professional development helps improve in-service teachers' current practice (Antink-Meyer & Arias, 2020). Teachers participated in an engineering learning cycle course and shared positive results. One hundred percent of the teachers agreed with their ability to adapt math and science lessons to include the engineering learning cycle, and 90% of the participants agreed that their content knowledge improved due to the course (Antink-Meyer & Arias, 2020).

Another study analyzed the teaching practices based on social context and the teachers' experience level (Ferreira & Morais, 2020). The findings of the qualitative study showed that the social context, along with the teacher's experience and professional development, determines the science teachers' practices. The study also revealed that teachers used lower levels of complexity when teaching students from low socioeconomic backgrounds (Ferreira & Morais, 2020). Conversely, teachers with more professional development and higher education had higher conceptual demands (Ferreira & Morais, 2020). The qualitative study's limitations are the small sample size and the Portuguese teaching context, which cannot be applied in a larger context.

Bell et al. (2018) examined the professional development of elementary teachers based on the intersection of content, policy, and practices. Teachers in the United States, specifically Arkansas, and the country of New Zealand, were asked to implement new science standards. Teachers received professional development related to the new curriculum after the implementation date. Teachers benefit from continuous professional learning and building on students' learning (Bell et al., 2018). The local university partnered with school districts to provide professional development. The University of North Carolina partnered with the local school district in designing and implementing STEM kits through their Master Teacher program (Sikma & Minshew, 2018). The teachers' science content and pedagogical knowledge improved through participation in the program (Sikma & Minshew, 2018). The overall research has shown that professional development improves teachers' science practice. Perceived control is a component of attitudes that were measured during this dissertation. Perceived control deals with the teachers' belief in their ability. The context relates to teachers having needed materials and designated time for science instruction. The following section about teacher support shows how teachers were supported after professional development.

Science Curriculum Resource

The curriculum resources are instructional materials to engage students in a lesson (Matic, 2019). The common resource is a textbook; however, teachers use online and digital resources as well (Matic, 2019). Perceived control is a component of attitudes that were measured during this dissertation. One facet of perceived control deals with teachers controlling the context that allows for science instruction. The accessibility and usability of a science curriculum resource could pertain to using it along with other materials needed for teaching.

Some teachers frequently search for resources to teach a science lesson that promotes teacher agency (Andrée & Hansson, 2021). The resources include video clips, images, graphs, and quizzes (Andrée & Hansson, 2021). Some teachers used the resource differently than how it was initially designed (Andrée & Hansson, 2021). The science textbook resource uses concrete images to teach abstract concepts, which causes misconceptions in student (Akçay et al., 2020). Quigley et al. (2020) examined teachers using STEAM instructional units to teach science-related concepts. The results from the study shared the importance of teachers including the following components for STEAM integration—discipline integration, teacher facilitation, and authentic tasks. The present study only included one elementary school with limited teachers.

A science curriculum resource improved the quality of teachers' instruction (Apanasionok et al., 2020; Troupe et al., 2018). Teachers used a science curriculum to teach genetics, increased teaching time, and improved content knowledge and instruction quality (Troupe et al., 2018). Comparably, Apanasionok et al.'s (2020) study found that teachers had positive experiences using the science curriculum. The small study piloted an elementary science curriculum with nine students with disabilities. The study's teacher participants found the science curriculum helpful because it was scripted with teaching methods (Apanasionok et al., 2020). The study does not provide background information about the teachers' years of experience or age for comparison to the dissertation. However, the use of a science curriculum resource was used for comparison.

The elementary science biology curriculum was modified to improve students' interest in learning biology concepts; however, the research did not confirm positive results (Čipková et al., 2018). The students' interest at the monitored grade levels decreased due to a lack of interest in global issues (Čipková et al., 2018). The study used a reliable science interest survey instrument with a Cronbach's alpha value of .86. The results showed that a science curriculum is limited in changing students' science interests and attitudes. Another example utilization of a science curriculum is teachers using the questions provided within the curriculum to guide instruction (Biggers, 2018). The questions were teacher-directed, which contradicts the teacher-directed science instruction. Hence, teachers need strategies for adapting questions for student-driven investigative practices (Biggers, 2018). These findings are similar to previous studies concerning the teachers' use of a science curriculum. Some teachers tend not to deviate from a prescriptive science curriculum (Apanasionok et al., 2020; Biggers, 2018). The overall consensus of the research was that teachers' use of curriculum resources was positive. Some teachers used the resource as prescribed, while more experienced teachers utilized specific curriculum components. The teachers' utilization of a science curriculum resource is a factor for comparing teachers' attitudes in this dissertation.

Curriculum Unit of Study Resource

This study focused on a curriculum unit of study as the specific curriculum-related resource. The curriculum unit of study is a detailed teaching guide comprised of lesson-by-lesson plans that provide teachers with objectives, content knowledge, and specific activities to implement with their students (Albornoz et al., 2020). Teachers who utilized a structured curriculum unit increased student performance by 55% of the standard deviation compared to teachers who did not use a structured curriculum (Albornoz et al., 2020). Similarly, for teachers who used structured curriculum units and training, students' performance increased by 64% of the standard deviation compared to teachers with no unit and training. Additionally, teachers' perception of their science teaching practices increased in scale scores between 63% and 100% when using a curriculum unit (Albornoz et al., 2020).

Duruk et al. (2017) examined the variation of science process skills through the science curriculum in grades fifth through eight. The science process skills varied based on the grade level, and the science process skill of controlling variables needed to be improved in the seventh and eighth grades (Duruk et al., 2017). Duruk et al.'s (2017) study also revealed that students had the most misconceptions in the units with experimenting skills. This finding can be related to teachers needing coaching on the unit. Curriculum units of study have been utilized to integrate various content areas (Crotty et al., 2017; Mathis et al., 2017). When engineering was implicitly and explicitly integrated into the STEM unit, students' performance on engineering assessments improved (Crotty et al., 2017). Similarly, Mathis et al. (2017) examined integrating argumentation into STEM units, and one key takeaway is that the argumentation process supports the different engineering units.

Summary

The current general research was wide-ranging, thus creating opportunities for this dissertation study. The related literature section included recent research on urban education, attitudes toward science, science teaching, teaching experience, genders in science, science curriculum resources, and elementary science education that helped establish the purposefulness of this dissertation study. The research topics were explicitly connected to the underlying attributes of attitudes toward science of cognitive beliefs, affective attributes, and perceived control based on the TPATS theoretical framework. The overall research consisted of qualitative rather than quantitative data on urban elementary teachers' beliefs and attitudes toward science teaching. Most qualitative studies were case studies with small participant sizes; therefore, generalizations could not be formed from the research. The location of most of the science-related studies concerning attitudes was outside of the United States.

The research found a positive relationship between teachers' attitudes toward science teaching. The findings were used for comparison in this dissertation. The research concerning the factor of the biological sex—male or female—of the teacher was mixed for the impact on attitudes toward science, instruction, and achievement. Additionally, the factor of years of teaching experience showed mixed results. Teaching experience positively and negatively affected attitudes toward science, content knowledge, and instruction. The last factor of utilizing a science curriculum resource was consistent throughout the research to positively impact science instruction and teacher content knowledge. The current literature should have addressed urban elementary science teachers' attitudes. Hence, the need to review the topics is implicitly related to the research question of the effect of urban elementary teachers' attitudes based on the male or female sex of the teacher, the years of experience of teachers, and the utilization of a science curriculum resource by teachers. The research was subjugated to preservice teachers due to the limited research of in-service urban elementary teachers. The preservice teachers eventually become in-service teachers; however, the related literature focused on both teachers for comparison. The research showed how teacher preparation programs, science methods courses, or professional development impacted preservice teachers' beliefs, attitudes, and practices.

The research on urban education and urban teachers was consistent with a focus on sociological and economic factors. The theme of culturally relevant pedagogy was prevalent through urban education research. The current research in elementary science education supports the recent shifts in teachers' facilitation and the student's implementation of science engineering practices during science instruction. In summary, teachers' attitudes were generally positive concerning science teaching. Several studies evaluated the importance of studying preservice teachers' attitudes toward science (Bayraktar, 2019; Docherty-Skippen et al., 2020). However, the research is limited to urban in-service elementary teachers' attitudes toward science. The dissertation study contributed to the body of research on urban elementary in-service teachers' descriptive educational phenomenon of the theoretical understanding of attitudes toward science centered around cognitive beliefs, affective states, and perceived control.

CHAPTER THREE: METHODS

Overview

The study evaluated whether there was a difference in elementary teachers' attitudes toward science teaching based on biological sex, years of teaching experience, and science resource utilization shown by the Dimensions of Attitude Toward Science (DAS) Instrument. The study design is a quantitative, causal-comparative design that evaluates the attitudes toward science' educational phenomenon. Chapter Three discusses the research design, research questions, participants and setting, instrumentation, procedures, and data analysis.

Design

The research design is a quantitative and causal-comparative design. The purpose of causal-comparative research is to explain educational phenomena through cause-and-effect relationships (Gall et al., 2007). Causal comparative research designs seek to identify cause and effect relationships by forming groups of individuals whose independent variables are present or absent to determine if groups differ on the dependent variable (Gall et al., 2007). The causal-comparative design is the most appropriate because it can use one or several independent and dependent variables (Gall et al., 2007). The independent variable was measured in the form of categories (Gall et al., 2007). An advantage of the design is that forming the groups is consistent with how practitioners and other education stakeholders view the world (Gall et al., 2007). Another advantage is that the statistical results are easier to comprehend and interpret (Gall et al., 2007).

A variable was defined as a quantitative expression of a construct that varies in quantity in an observed phenomenon (Gall et al., 2007). The independent variables are the teachers' classification of the male or female sex, the years of teaching experience of fewer than three years or more than three years, and the use of a science curriculum or not using a science curriculum for comparison. The dependent variable is urban elementary teachers' attitudes toward science teaching. The science curriculum resource is a particular instructional print or digital material (examples include textbooks and online programs) used to engage students in the lesson (Matic, 2019). Teaching experience is the years of science teaching experience used to measure teacher effectiveness (Wayne et al., 2017). Biological sex is the biological dimension of the anatomy-physiological characterization of humans (Afonso et al., 2019). The dependent variable is the teachers' attitudes toward science teaching. Attitudes are the internal beliefs that influence actions and are learned indirectly through experiences and exposure to models (Schunk, 2016).

Research Questions

The research questions of the study are:

RQ1: Is there a difference in teachers' attitudes toward science teaching based on the male or female biological sex in an urban elementary school setting?

RQ2: Is there a difference in teachers' attitudes toward science teaching based on less than three years of experience or more than three years of experience in an urban elementary school setting?

RQ3: Is there a difference in teachers' attitudes toward science teaching based on using a science curriculum unit of study or not using a science curriculum unit of study in an urban elementary school setting?

Hypotheses

The null hypotheses for this study are:

$H_0$1: There is no statistically significant difference between teachers' attitudes toward science teaching based on the male or female biological sex in an urban elementary school setting as measured by the Dimensions of Attitude Toward Science (DAS) Instrument.

$H_0$2: There is no statistically significant difference between teachers' attitudes toward science teaching based on less than three years of teaching experience or more than three years of teaching experience in an urban elementary school setting as measured by the Dimensions of Attitude Toward Science (DAS) Instrument.

$H_0$3: There is no statistically significant difference between teachers' attitudes toward science teaching based on using a science curriculum unit of study or not using a science curriculum unit of study in an urban elementary school setting as measured by the Dimensions of Attitude Toward Science (DAS) Instrument.

Participants and Setting

The target population is urban elementary teachers in Georgia's metro area. The study participants were selected using a convenience sample drawn from a school district in the metro area of Georgia to acquire the adequate sample size needed when assuming a medium effect size. Convenience sampling was selected since it is purposeful and convenient for the researcher. The participants had varying education and experience. The area's population is over 500,000 people, with 40% White, 52% Black or African American, 4% Hispanic or Latino, and 4% Asian residents. Twenty-two percent of the metro's population lives in poverty. The district's metro area was considered as having a low socioeconomic status; therefore, 69% of the district's students are eligible for free or reduced lunch. Twenty-five percent of the district's schools are on the State's turnaround list—which contains schools that failed to make sufficient progress over four or more years—based on low student achievement.

The minimum sample size needed is 120 participants when assuming a medium effect size along with a statistical power of 0.7 at the 0.05 alpha level when performing an independent sample *t*-test (Gall et al., 2007, p. 145). The study's population size is 2000 teachers; hence, the anticipated sample size was at least 130 participants. Participants were recruited from the district's population. The sample was derived from the population size of 46 elementary schools with approximately 2000 teachers in the district. The participants have varying sexes, educational levels, teaching experience, and face-to-face, virtual, or hybrid teaching contexts. Table 1 displayed the demographics of the participants' sample population, the biological sex of males and females, years of teaching experience, the use of a science unit of study, and the face-to-face or virtual teaching context.

Table 1

Demographics of Participants

Group	N	Male	Female	Less 3 Yrs.	More 3 Yrs.	Use Unit	Do Not Use	F2F	Virtual
		20	20	20	20	20	20	20	0

The independent variables are the teachers' male or female sex, the years of teaching experience of fewer than three years or more than three years, the use of a unit of study, or not using a unit of study. The dependent variable is the composite attitudes score of urban elementary teachers' attitudes toward science teaching. The composite score comprised the science attitudinal dimensions of cognitive beliefs, affective states, and perceived control. The subscales of perceived relevance, gender stereotypes, and perceived difficulty align with cognitive beliefs. The subscales of enjoyment and anxiety are aligned with the attitudinal dimension of affective states. Lastly, the subscales of self-efficacy and context dependency align with perceived control.

Instrumentation

This dissertation utilized the DAS Instrument to measure the teachers' attitudes toward science teaching using the composite attitudes toward science score. The questionnaire was administered online and usually took 10 minutes to complete. The DAS Instrument comprises 28 questions that measure science attitudinal dimensions of cognitive beliefs, affective states, perceived control and underlying attributes of perceived relevance, perceived difficulty, gender beliefs, enjoyment, anxiety, self-efficacy, and context-dependency (van Aalderen-Smeets & Walma van der Molen, 2013).

The DAS Instrument was developed in 2013 by van Aalderen-Smeets and Walma van der Molen. This was done using the primary teacher's attitudes toward science (TPATS) theoretical framework (van Aalderen-Smeets et al., 2012). The instrument was developed in phases—developing the questionnaire, piloting the instrument, and validating the revised DAS Instrument study. The question wording, format, and sequence were considered in developing the instrument. The original instrument included a total of 28 items with subscales of (1) relevance of science teaching, (2) difficulty of science teaching, (3) gender-stereotypical beliefs regarding science teaching, (4) enjoyment in science teaching, (5) anxiety in science teaching, (6) self-efficacy, and (7) context factors (van Aalderen-Smeets & Walma van der Molen, 2013).

The initial version of the instrument measured the attitudes of 64 in-service and preservice teachers. The participants were asked to provide comments and feedback about the readability and perceived relevance. During the DAS Instrument's initial administration, teachers were administered a separate short questionnaire—the View of Science Scale. After the initial pilot, the questions were rewritten or deleted. The revised DAS Instrument was administered to 556 participants, of which 158 were in-service teachers and 398 were preservice teachers.

Demographic information was requested preceding the attitude questionnaire. During the validation study, participants took the Behavioral Intention Scale to measure how often they engaged in science teaching activities.

The DAS questionnaire includes a rating for each attitude dimension using a five-point Likert scale ranging from totally disagreeing with a score of one and totally agreeing with a score of five (van Aalderen-Smeets & Walma van der Molen, 2013). The DAS Instrument is grounded in the TPATS theoretical framework. The framework has been used in current research studies (Korur et al., 2016; Mulholland & Cumming, 2016; Ualesi et al., 2018).

Validity and Reliability

The DAS Instrument was analyzed for validity, internal consistency of the entire instrument and subscales, and the discriminating ability of each item. It has strong content validity and reliability (van Aalderen-Smeets & Walma van der Molen, 2013). The validation study used the revised 28-question survey. The revised DAS Instrument was administered to 556 participants, of which 158 were in-service teachers and 398 were preservice teachers. Demographic information was requested preceding the attitude questionnaire. During the validation study, participants took the Behavioral Intention Scale to measure how often they engaged in science teaching activities.

There was strong internal consistency reliability for both total scores and across the seven subscales indicated by Cronbach's alpha values between .74 and .93 (van Aalderen-Smeets & Walma van der Molen, 2013). A reliability higher than the 0.70 is needed (Gall et al., 2007). The data was suitable for confirmatory factor analysis based on the Kaiser-Meyer-Olkin (KMO) value of .92 and passed Bartlett's test of sphericity (van Aalderen-Smeets & Walma van der Molen, 2013). The instrument achieved construct validity through translation validity and criterion validity. Content validity was achieved based on the comprehensive theoretical framework and face validity through pilot testing and revising test items based on participant feedback.

This dissertation used the English version of the DAS Instrument. Wendt and Rockinson-Szapkiw (2018) conducted a psychometric evaluation of the Dutch version translated to English to validate content and face validity. The translation was performed by two translators, one of whom was an original author of the DAS Instrument. After the translations, six science education experts' expert reviews were conducted to achieve cross-cultural equivalence and establish face and content validity. Each expert reviewer evaluated the structure and item analysis of the DAS. The online English version of the 28-item DAS Instrument was administered using Google Forms® to 350 preservice and in-service teachers from across the United States using snowball sampling. The confirmatory factor analysis established construct validity and dimensionality of the seven factors of perceived relevance, gender stereotypes, perceived difficulty, enjoyment, anxiety, self-efficacy, and context-dependency aligned to the three dimensions of cognitive, affective, and perceived control (Wendt & Rockinson-Szapkiw, 2018). The fit indices values supported the original confirmatory factor analysis findings of van Aalderen-Smeets and Walma van der Molen (2013).

This dissertation used the composite attitudes toward science score. The English version 28-item instrument used a Likert scale of 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. The composite score range was 28–140. The Cronbach's alpha reliability coefficient for the composite score is an acceptable .89 (Wendt & Rockinson-Szapkiw, 2018). Additionally, the reliability was determined using Cronbach's alpha score for the internal reliability of the subscales. The subscales had Cronbach's alpha score of .88 for perceived relevance, .90 for gender stereotype, .94 for perceived difficulty, .98 for enjoyment, .96 for anxiety, .92 for self-efficacy, and .71 for context (Wendt & Rockinson-Szapkiw, 2018). The reliability is higher than the required 0.70 (Gall et al., 2007). The data supporting the English version of the DAS Instrument was valid and reliable.

There was a minimum score of five for each subscale (Wendt & Rockinson-Szapkiw, 2018). The subscales' maximum score for perceived relevance and gender stereotypes was 25 (Wendt & Rockinson-Szapkiw, 2018). The maximum score for enjoyment, anxiety, and self-efficacy subscales was 20 (Wendt & Rockinson-Szapkiw, 2018). The subscales of perceived difficulty and context have a maximum score of 15 (Wendt & Rockinson-Szapkiw, 2018). The attitudes composite score ranges from 65–140 (Wendt & Rockinson-Szapkiw, 2018). The researcher obtained written permission to use and publish results from the DAS Instrument. A sample of the instrument is located in Appendix C.

Procedures

The researcher obtained approval from the district through the Office of Research and Accountability to conduct research that includes schoolteachers' data collection. The researcher requested permission to administer the DAS Instrument in Appendix A. The researcher submitted the Institutional Review Board (IRB) application with supporting documents for consent, recruitment, permission, and debriefing to Liberty University to conduct this dissertation research. Once the IRB was approved, the execution of the research began. The IRB approval is in Appendix D.

The participants were recruited using a recruitment letter and flyer about the study sent via emails from the district's listserv following the district's technology policy to participate in the study. The recruitment letter is in Appendix E, and the recruitment flyer is located in

Appendix F. The flyer and recruitment letter contained the link to the survey. The survey was administered using the SurveyMonkey© website with anonymous settings. Once participants clicked on the link, the consent document appeared. A consent document was provided on the first page of the survey; it contained additional information about the research. After the participant had read the consent form, they clicked on the button to proceed to the survey. Doing so indicated that they had read the consent information and would like to participate in the survey. The following page contains demographic screening questions. A sample of the demographic screening questions is in Appendix B. Participants were asked to provide the following descriptive data for statistical analysis purposes: (a) male or female sex, (b) years of teaching experience, (c) the utilization of a science unit of study, (d) and the current teaching context of virtual, face-to-face, or hybrid model before proceeding with the survey. After completing the demographic screening questions, participants completed the DAS Instrument online survey.

The sample was derived from 46 elementary schools and approximately 2000 elementary teachers in the district. The directions for the DAS were followed as recommended. The survey assessment took approximately 10 minutes to complete. The administration of the survey was taken during a single occurrence. The participants had a three-week window to complete the survey. Reminder emails were sent during the three-week window, and a final email was sent after the survey. The response rate was lower than 25%; the researcher resent the participation email for more participants for specific groups of male teachers and teachers with less than three years. After the administration window closed, the researcher used the SPSS statistical program to conduct three independent sample *t*-tests to examine the results of the statistical analysis when assumptions were met.

Data Analysis

Three independent sample *t*-tests were used to analyze the data for all three null hypotheses. The tests measured the statistical significance of the differences between the means of the two groups. It was the most appropriate statistical analysis because the study groups are categorical and independent of one another, and the dependent variable is continuous data (Warner, 2013). The mean composite attitudes toward science score was used to determine the teachers' attitudes toward science teaching. The composite score consisted of the attitudinal dimensions of cognitive beliefs, affective states, and perceived control. The subscales perceived that relevance, gender stereotypes, and perceived difficulty are aligned with cognitive beliefs. The subscales of enjoyment and anxiety are aligned with the attitudinal dimension of affective states. Lastly, the subscales of self-efficacy and context dependency aligned with perceived control.

The researcher tested the three null hypotheses by conducting three independent sample *t*-tests. Data were sorted and screened for unusual scores or inconsistencies using visual analysis. A box and whisker plot were conducted to determine the extreme outliers (Warner, 2013). The assumption testing consisted of (1) the assumption of normality to determine the distribution of samples and (2) the test of equal variance (Warner, 2013). The Shapiro-Wilk test was conducted to determine if the assumption of normality was met. Levene's Test of Equality of Error Variance was conducted to determine if the assumption was met. It was found that the assumptions are met; therefore, the independent sample *t*-test was the most appropriate data statistical analysis.

If the *p*-value was more than the alpha value, i.e., if $p > .05$, then the researcher failed to reject the null hypothesis (Warner, 2013). If $p < .05$, then the null hypothesis was rejected (Warner, 2013). To limit the risk of Type I error when conducting multiple independent sample *t*-tests, the Bonferroni procedure was conducted to reduce $p < .05$ to $p < .017$ (rounded to .020) (Warner, 2013). The minimum sample size needed was 120 participants when assuming a medium effect size along with a statistical power of 0.7 at the 0.05 alpha level when performing an independent sample *t*-test (Gall et al., 2007, p. 145). The anticipated sample size was at least 130 participants. The effect size will be medium based on Cohen's (1988) *d*, where effect sizes are small, $d = 0.2$, medium, $d = 0.5$, and large, $d = 0.8$ (p. 25).

CHAPTER FOUR: FINDINGS

Overview

This chapter provides an overview of the results of the data analyses for the presented research questions and null hypotheses. These include methods of data screening of box and whisker plots and outlier examinations. Additionally, the results of descriptive statistics are reported for each teacher group. Furthermore, the assumption testing of normality and homogeneity of variance were performed for each independent sample *t*-test. Lastly, the results of each null hypothesis are discussed.

Research Questions

RQ1: Is there a difference in teachers' attitudes toward science teaching based on the male or female biological sex in an urban elementary school setting?

RQ2: Is there a difference in teachers' attitudes toward science teaching based on less than three years of experience or more than three years of experience in an urban elementary school setting?

RQ3: Is there a difference in teachers' attitudes toward science teaching based on using a science curriculum unit of study or not using a science curriculum unit of study in an urban elementary school setting?

Null Hypotheses

$H_0$1: There is no statistically significant difference between teachers' attitudes toward science teaching based on the male or female biological sex in an urban elementary school setting sex as measured by the Dimensions of Attitude Toward Science (DAS) Instrument.

$H_0$2: There is no statistically significant difference between teachers' attitudes toward science teaching based on less than three years of teaching experience or more than three years of teaching experience in an urban elementary school setting as measured by the Dimensions of Attitude Toward Science (DAS) Instrument.

$H_0$3: There is no statistically significant difference between teachers' attitudes toward science teaching based on using a science curriculum unit of study or not using a science curriculum unit of study in an urban elementary school setting as measured by the Dimensions of Attitude Toward Science (DAS) Instrument.

Descriptive Statistics

Descriptive statistics were obtained for the dependent variable as well as for the composite attitudes score of urban elementary teachers' attitudes toward science teaching for each teacher grouping of male and female. Table 2 provides the descriptive statistics for the dependent variable.

Table 2

Descriptive Statistics

Group	*n*	*M*	*SD*
Male	20	91.10	7.45
Female	20	89.55	9.61

Descriptive statistics were obtained for the dependent variable as well as for the composite attitudes score of urban elementary teachers' attitudes toward science teaching for each teacher grouping of teachers with less than three years of teaching experience and more than three years of teaching experience. Table 3 provides the descriptive statistics for the dependent variable.

Table 3

Descriptive Statistics

Group	*n*	*M*	*SD*
Less three	20	86.55	7.48
More three	20	94.40	8.16

Descriptive statistics were obtained for the dependent variable as well as for the composite attitudes score of urban elementary teachers' attitudes toward science teaching for each teacher grouping of teachers who utilized a science instructional unit of study and teachers who do not use a science instructional unit of study. Table 4 provides the descriptive statistics for the dependent variable.

Table 4

Descriptive Statistics

Group	*n*	*M*	*SD*
Use unit	20	91.35	10.67
Did not use	20	88.45	7.61

Results

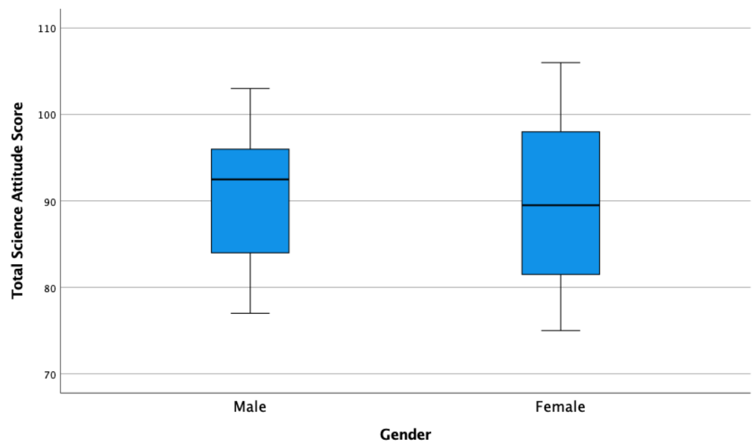
$H_0$1: There is no statistically significant difference between teachers’ attitudes toward science teaching based on the male or female biological sex in an urban elementary school setting sex as measured by the Dimensions of Attitude Toward Science (DAS) Instrument.

Data Screening

Data screening was conducted on each group's dependent variable. The researcher sorted the data on each variable and scanned for inconsistencies. No data errors or inconsistencies were identified. Box and whisker plots were used to detect outliers on each dependent variable. No outliers were found. See Figure 1 for box and whisker plots for male and female teachers.

Figure 1

Box and whisker plots for male and female teachers



Assumptions

An independent sample *t*-test was used to test the null hypotheses. The *t*-test required that the assumptions of normality and homogeneity of variance be met. Normality was examined using a Shapiro-Wilk test. This test was used because the sample size was less than 50. No violations of normality were found. The *p*-values were higher than alpha .05; therefore, the dependent variable assumed normality. Table 5 provides the results for the Tests of Normality.

Table 5

Tests of Normality

Group	*Statistic*	*df*	*Sig.*
Male	.961	20	.555
Female	.940	20	.243

The assumption of homogeneity of variance was examined using Levene's test. No violation was found where $p = .115$. The p-value was greater than .05; hence, the assumption is not violated. The assumption of homogeneity of variance was met.

Results for Null Hypothesis One

An independent sample t-test was used to test the null hypothesis regarding differences in elementary teachers' attitudes toward science teaching in an urban elementary school setting based on the biological sex. Equal variance was assumed. The researcher failed to reject the null hypothesis at a 95% confidence level where $t(38) = .570$, $p = .572$, $\eta^2 = .180$. To limit the risk of Type I error when conducting multiple independent sample t-tests, the Bonferroni procedure was conducted to reduce $p < .05$ to $p < .017$ (rounded to .020) (Warner, 2013). The p-value was greater than the alpha value .017; therefore, there was no statically significance difference. The effect size was small ($\eta^2 = .180$) (Warner, 2013). The male group ($M = 91.10$, $S.D. = 7.45$) had a higher mean attitude score than the female group ($M = 89.55$, $S.D. = 9.61$).

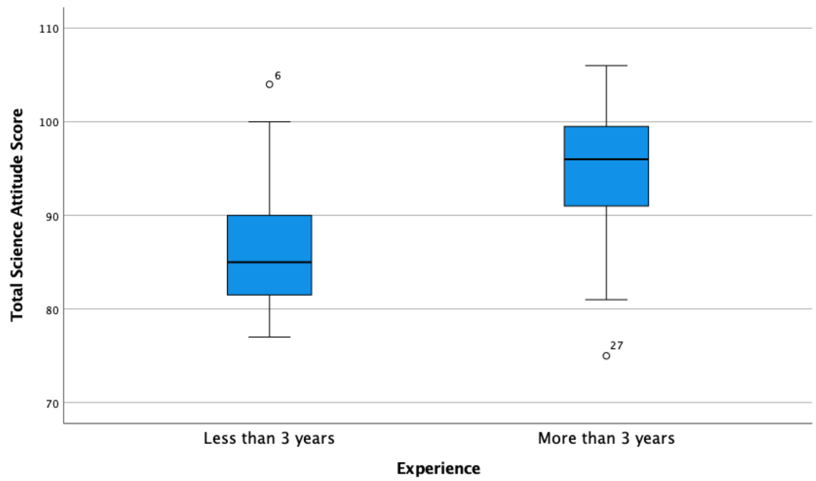
$H_0$2: There is no statistically significant difference between teachers' attitudes toward science teaching based on less than three years of teaching experience or more than three years of teaching experience in an urban elementary school setting as measured by the Dimensions of Attitude Toward Science (DAS) Instrument.

Data Screening

Data screening was conducted on each group's dependent variable. The researcher sorted the data on each variable and scanned for inconsistencies. No data errors or inconsistencies were identified. Box and whisker plots were used to detect outliers on each dependent variable. The outliers were identified and included. See Figure 2 for box and whisker plots less than three years of teaching experience or more than three years of teaching experience.

Figure 2

Box and whisker plots for less than three years of teaching experience or more than three years of teaching experience



Assumptions

An independent sample *t*-test was used to test the null hypotheses. The *t*-test required that the assumptions of normality and homogeneity of variance were met. Normality was examined using a Shapiro-Wilk test, which was used because the sample size was less than 50. No violations of normality were found. The *p*-values were higher than alpha .05; therefore, the dependent variable assumed normality. Table 6 provides the results for the Tests of Normality.

Table 6

Tests of Normality

Group	**Statistic**	***df***	**Sig.**
Less three	.928	20	.144
More three	.918	20	.091

The assumption of homogeneity of variance was examined using Levene's test. No violation was found where $p = .808$. The assumption of homogeneity of variance was met.

Results for Null Hypothesis Two

An independent sample *t*-test was used to test the null hypothesis regarding differences in elementary teachers' attitudes toward science teaching in an urban elementary school setting based on years of teaching experience of less than three years and more than three years. Equal variance was assumed. The researcher rejected the null hypothesis at a 95% confidence level with t (38) = -3.172, p = .003, η^2 = -1.003. Equal variance was assumed. To limit the risk of Type I error when conducting multiple independent sample *t*-tests, the Bonferroni procedure was conducted to reduce $p < .05$ to $p < .017$ (rounded to .020) (Warner, 2013). The *p*-value was less than the alpha value .017; therefore, there was a statically significance difference between elementary teachers' attitudes toward science teaching in an urban elementary school setting based on years of teaching experience of less than three years and more than three years. The effect size was large (η^2 = -1.003) (Warner, 2013). The teachers with more than three years of teaching experience (*M* = 94.40, *S.D.* = 8.159) had a higher mean attitude score than teachers with less than three years (*M* = 86.55, *S.D.* = 7.480).

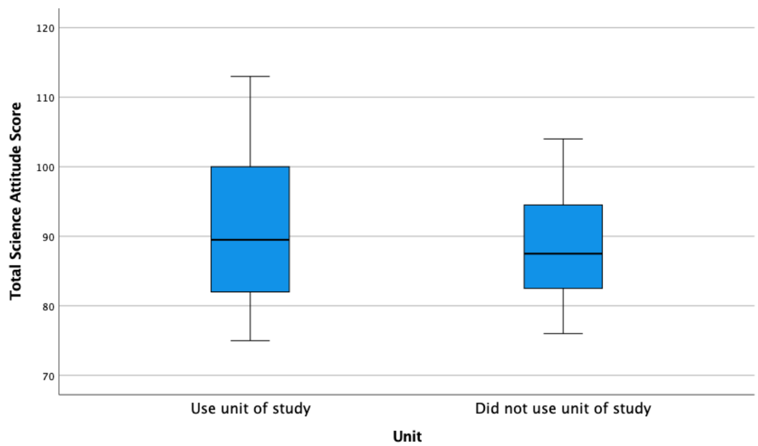
$H_0$3: There is no statistically significant difference between teachers' attitudes toward science teaching based on using a science curriculum unit of study or not using a science curriculum unit of study in an urban elementary school setting as measured by the Dimensions of Attitude Toward Science (DAS) Instrument.

Data Screening

Data screening was conducted on each group's dependent variable. The researchers sorted the data on each variable and scanned for inconsistencies. No data errors or inconsistencies were identified. Box and whisker plots were used to detect outliers on each dependent variable. No outliers were found. See Figure 3 for box and whisker plot using a science curriculum unit of study or not using a science curriculum unit of study.

Figure 3

Box and whisker plots for using a science curriculum unit of study or not using a science curriculum unit of study



Assumptions

An independent sample *t*-test was used to test the null hypotheses. The *t*-test required that the assumptions of normality and homogeneity of variance are met. Normality was examined using a Shapiro-Wilk test, which was used because the sample size was less than 50. No violations of normality were found. The *p*-values were higher than alpha .05; therefore, the dependent variable assumed normality. Table 7 provides the results for the Tests of Normality.

Table 7

Tests of Normality

Group	Statistic	*df*	Sig.
Used unit	.961	20	.560
Did not use	.965	20	.643

The assumption of homogeneity of variance was examined using Levene's test. No violation was found where $p = .071$. The assumption of homogeneity of variance was met. The *p*-value was greater than .05; hence, the assumption was not violated.

Results for Null Hypothesis Three

An independent sample *t*-test was used to test the null hypothesis regarding differences in elementary teachers' attitudes toward science teaching in an urban elementary school setting based on utilizing or not utilizing a science unit of study to teach science. Equal variance was assumed. The researcher failed to reject the null hypothesis at a 95% confidence level where $t(38) = .989$, $p = .329$, $\eta^2 = .313$. To limit the risk of Type I error when conducting multiple independent sample *t*-tests, the Bonferroni procedure was conducted to reduce $p < .05$ to $p < .017$ (rounded to .020) (Warner, 2013). The *p*-value was greater than the alpha value .017; therefore, there was no statically significance difference. The effect size was small ($\eta^2 = .313$) (Warner, 2013). The teachers utilizing a science unit of study to teach science (M = 91.35, S.D. = 10.67) had a higher mean attitude score than teachers not utilizing a science unit of study to teach science (M = 88.45, S.D. = 7.61).

CHAPTER FIVE: CONCLUSIONS

Overview

This chapter provides a discussion of this study's results. The result of each hypothesis was examined based on related literature, other studies, and theory. The discussion analyzed whether the results support or contradict other studies and theories. This chapter also includes the implications of the study and how the research findings may aid in improving teachers' practices. Lastly, the researcher discussed the study's limitations and recommendations for future research.

Discussion

This quantitative, causal-comparative research study analyzed elementary teachers' attitudes toward science teaching in an urban elementary school setting based on biological sex, teaching experience, and use of a science unit of study. The target population was teachers in an urban elementary setting in Georgia's metro area. For statistical analysis, this study used the variables of teachers' composite attitudes score, the biological sex of the teacher, years of teaching experience, and a science curriculum resource utilization. The independent variables were the biological sex of the teacher, years of teaching experience, and the use of a science curriculum unit of study. A science curriculum unit of study was defined as a detailed teaching guide comprised of lesson-by-lesson plans that provide teachers with objectives, content knowledge, and specific activities to implement with their students (Albornoz, et al., 2020). The teaching experience was defined as the years of science teaching experience used to measure teacher effectiveness (Wayne et al., 2017). Biological sex is the biological dimension of the anatomy-physiological characterization of humans (Afonso et al., 2019).

The dependent variable was the teachers' composite attitudes score toward science teaching. The researcher defined attitudes as internal beliefs that influence action and were learned indirectly through experiences and exposure to models (Schunk, 2016). This study was based on the comprehensive theoretical framework for the primary teachers' attitude towards science (TPATS)—a relatively new theoretical framework—and built on the tripartite model of attitudes (TMA). The TPATS theoretical framework consists of three components (cognitive beliefs, affective states, and perceived control) and seven underlying attributes (perceived relevance, perceived difficulty, gender beliefs, enjoyment, anxiety, self-efficacy, and context dependency) (van Aalderen-Smeets et al., 2012). This study analyzed teachers' overall science attitude scores related to biological sex, teaching experience, and science instructional unit utilization.

Research Question One

RQ1: Is there a difference in teachers' attitudes toward science teaching based on the male or female biological sex in an urban elementary school setting?

The independent sample *t*-test showed there was no statistically significant difference in teachers' attitudes toward science teaching in an urban elementary school setting based on the male or female biological sex. The results aligned with the current research that gender beliefs do not influence teachers' attitudes toward science teaching (Bayraktar, 2019; Bridwell-Mitchell & Fried, 2020; Durdukoca & Önel, 2020; Ualesi et al., 2018). The studies showed positive attitudes associated with science teaching; however, the attitudes were not statistically significant between male and female teachers. This study had similar findings. While previous research did not study in-service urban elementary teachers (Bayraktar, 2019; Durdukoca & Önel, 2020), this research adds to the existing body of knowledge by explicitly targeting this population. Bayraktar (2019) found no statistically significant difference between male and female preservice teachers' scientific epistemological beliefs and attitudes toward science. The research from high school biology teacher candidates showed similar outcomes of no statistically significant difference in attitudes toward science based on gender (Durdukoca & Önel, 2020). Furthermore, this study's findings contradicted research which showed that gender beliefs influenced teachers' attitudes toward science teaching (van Aalderen-Smeets et al., 2012). The theoretical framework for attitudes towards science teaching showed a difference in teachers attitudes based on gender (van Aalderen-Smeets et al., 2012).

Research Question Two

RQ2: Is there a difference in teachers' attitudes toward science teaching based on less than three years of experience or more than three years of experience in an urban elementary school setting?

The independent sample *t*-test showed a statistically significant difference in teachers' attitudes toward science teaching in an urban elementary school setting based on years of teaching experience. The teachers with more than three years of teaching experience (M = 94.40, S.D. = 8.159) had a higher mean attitude score than teachers with less than three years (M = 86.55, S.D. = 7.480). This study focused on in-service elementary teachers' attitudes toward teaching in an urban area; however, the findings were similar to related research on teachers' differences based on teaching experience (Caleon et al., 2018; Hanuscin & Zangori, 2016; Hanuscin et al., 2020; Kahveci et al., 2018; Killough & Stuessy, 2019). The aforementioned studies showed a statically significantly difference between teachers based on years of experience.

Kahveci et al. (2018) showed a statistically significant difference between younger teachers (20–24 years old) and older teachers (40–45 years old) based on pedagogical discontent, where younger teachers showed lower pedagogical discontent. Furthermore, Kahveci et al. (2018) revealed that teachers with advanced degrees or training in science showed lower pedagogical discontent. Moreover, the more experienced teachers possessed higher self-efficacy in science teaching (Ualesi et al., 2018). Caleon et al. (2018) found that novice and experienced physics teachers have differing views about teaching and learning science. The experienced elementary teacher in a particular grade level composite score aligned with their years of teaching experience. In other words, the more experience a teacher has teaching in a specific grade level, the higher the pedagogical content knowledge score (Hanuscin & Zangori, 2016; Hanuscin et al., 2020). Killough and Stuessy's (2019) study showed a significant difference between reformed beliefs with respect to science between veteran teachers and less-experienced teachers. Veteran teachers with five or more years of teaching experience showed a more statistically significant change than less-experienced teachers with less than five years of teaching experience (Killough & Stuessy, 2019).

While previous research did not study in-service elementary teachers' attitudes toward science (Caleon et al., 2018; Hanuscin & Zangori, 2016; Hanuscin et al., 2020; Kahveci et al., 2018), this study adds to the existing body of knowledge by explicitly targeting elementary teachers' attitudes toward science. This is significant because the educational experience of science-teaching attitudes is primarily centered around secondary science teachers in the existing body of knowledge. Lastly, this study contradicted similar research about the differences in teaching experience and teachers' scientific process skills and beliefs (Yildirim et al., 2020). The perceptions among the three groups of in-service teachers of less than 10 years of teaching experience, 10 to 20 years of teaching experience, and more than 20 years of experience showed no significant difference between preservice teachers (Yildirim et al., 2020).

Research Question Three

RQ3: Is there a difference in teachers' attitudes toward science teaching based on using a science curriculum unit of study or not using a science curriculum unit of study in an urban elementary school setting?

The independent sample *t*-test showed there was no statistically significant difference in teachers' attitudes toward science teaching in an urban elementary school setting based on the utilization of a science unit of study. The teachers utilizing a science unit of study as an instructional resource had a higher mean composite attitude score (M = 91.35, S.D. = 10.67) than teachers not utilizing a science unit of study as an instructional resource (M = 88.45, S.D. = 7.61). A science curriculum resource improves the quality of teacher instruction (Apanasionok et al., 2020; Hanuscin & Zangori, 2016; Troupe et al., 2018). The limited related research focused on the use and impact of an instructional unit of study; however, there was no association with attitudes toward science. This study adds to the current body of knowledge as the results showed teachers using a science instructional unit of study displayed a higher mean composite attitude score. This finding is significant because it shows teachers have positive beliefs about science teaching when a quality instructional resource was provided. Additionally, this finding aligned with the attitudinal component of context dependency. When teachers believe adequate resources and time were provided for science instruction, positive attitudes toward science teaching occurred.

The related research showed that teachers using a science curriculum to teach genetics increased teaching time and improved content knowledge and instruction quality (Troupe et al., 2018). Comparably, Apanasionok et al.'s (2020) study found that teachers had positive experiences using the science curriculum. Teacher participants found the science curriculum helpful because it was scripted with teaching methods (Apanasionok et al., 2020). Furthermore, related research revealed that teachers who used structured curriculum units along with training enhanced students' performance by 64% of a standard deviation compared to teachers with no unit and training (Albornoz et al., 2020). This study's results do not directly show a relationship between teachers' attitudes and the use of a science curriculum unit; however, the topic should be explored more in the future.

Implications

Attitudes toward science are a common educational occurrence; however, the interrelated areas were limited to the attitudes toward science of preservice teachers, secondary science teachers, and secondary science students. The problem was limited research on in-service elementary teachers' attitudes toward science teaching in urban schools. Once preservice teachers graduate to become in-service teachers, the research on their attitudes toward science has not yet been explored. This study was novel due to the targeted population of in-service elementary teachers in an urban school setting. Additionally, this study contributed to the body of knowledge by closing the research gap about in-service elementary teachers. This study’s findings were similar to related research on teachers' differences based on teaching experience (Caleon et al., 2018; Hanuscin & Zangori, 2016; Hanuscin et al., 2020; Kahveci et al., 2018; Killough & Stuessy, 2019). Furthermore, this study's findings contradicted the theoretical framework for the primary teachers' attitude towards science which showed that gender beliefs influenced teachers' attitudes toward science teaching. This study showed there was no statistically significant difference in teachers' attitudes toward science teaching in an urban elementary school setting based on the male or female biological sex.

A significant implication of the study was that it added to the existing limited body of knowledge about in-service elementary teachers in an urban setting. Teachers in an urban setting provided a specific niche in education. They had different experiences than rural educators. Another implication of this study was the practicality of school leaders using the key findings to develop professional development opportunities for teachers. Results of the independent sample *t*-test showed a statistically significant difference in teachers' attitudes toward science teaching in an urban elementary school setting based on years of teaching experience. School and building leaders should use these results to create communities of practice centered around professional learning for novice and veteran teachers independently. This study showed that teachers' attitudes toward science varied based on years of teaching experience; therefore, the training should be specific to teachers' years of teaching experience.

This study offered a glimpse into why elementary teachers provide limited science instruction. It showed a significant difference between experienced and less-experienced teachers' attitudes. The recommended professional development would focus on improving teachers' attitudes through building their science capacity and the relevance or usefulness of science. When teachers were confident in their ability to engage students, students had higher science achievement (Pamuk et al., 2017). School districts could benefit from this research study because it may reveal trends in teachers' instructional practices and beliefs around science that can be used for more intentional professional learning. The attitudinal domains of cognitive beliefs, affective states, and perceived control can be used to create professional development around the best instructional practices in science based on the attitudinal domains.

Limitations

This study had some limitations. The internal validity was good because quantitative research methods were thoroughly followed for an independent sample *t*-test; however, the maturation of the study was a possible threat to the study because of extending the administration of the survey to obtain the needed sample size for each group. The external validity was good since this study's findings can be extended to other populations. The effect size was large for the independent sample *t*-test, and results showed a statistically significant difference in teachers' attitudes toward science teaching in an urban elementary school setting based on years of teaching experience. Another limitation was the possible threat to selection bias. Inclusion and exclusion criteria were established to limit the threat of selection bias. The participants who did not meet the established criteria were not included in the survey data. The risk of Type I error due to multiple statistical analysis was another limitation to the study. In order to reduce the Type I error, the Bonferroni procedure was conducted to create a more conservative alpha value.

Recommendations for Future Research

The recommendation for future research includes the following:

1. The research will build on the current finding that there was a statically significant difference between teachers based on teaching experience by selecting a different population of elementary teachers. Elementary teachers who currently teach in the suburbs would be used for comparison.
2. The research will expand this study by analyzing each attitudinal component of cognitive beliefs, affective attributes, and perceived control based on the instrument subscales of teachers' attitudes.

3. The research will expand to a mixed method study with teacher interviews of veteran and novice qualitative study through interviews to analyze why attitudes toward science teaching vary.
4. The research will explore the impact of instructional resource on teachers' teaching attitudes.

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APPENDIX A

DAS Instrument Permission

[External] e: Dimensions of Attitudes toward Science Instrument (DAS)

[EXTE NAL EMAIL: Do not click any links or open attachments unless you know the sender and trust the content.]

Hi Melissa,
Thanks for reaching out with your request. I am pleased to hear of your plans to utilize the instrument. You have my permission to use the English version of the DAS, as presented in my co-authored published work, as long as you provide proper attribution.
If you have any other questions, please do not hesitate to reach out.
Best wishes,
Dr. Wendt

On Jan 9, 2021, at 6:34 PM, Davis, Melissa <mdavis113@liberty.edu> wrote:

Greetings,

My name is Melissa Davis, and I am currently a doctoral student at Liberty University. I am seeking permission to use the English version of the Dimensions of Attitudes toward Science Instrument (DAS) in my dissertation study. The research topic is Urban Elementary Teachers' Attitudes Toward Science Teaching Based on Sex, Experience, and Science Curriculum Utilization. The study uses a quantitative, non-experimental, descriptive design that evaluates the science attitudes' educational phenomenon. The current educational research is limited to pre-service teachers' attitudes towards science teaching. This study will address the literature gap of in-service urban elementary teachers' attitudes towards science teaching.

Please provide information about the permission, access, and compensation for the use of the DAS instrument.

Best regards,
Melissa Davis

APPENDIX B

Teachers' Attitudes Toward Science Teaching in an Urban Elementary School Setting

3. Demographic Screening Questions

Complete the demographic questions before proceeding to the survey.

1. Are you 18 years of age or older?

   ◯ Yes

   ◯ No

2. Do you currently teach science in an urban elementary setting?

   ◯ Yes

   ◯ No

* 3. Biological Sex

* 4. Years of Experience

5. Do you use a science unit of study to teach science?

* 6. Are you tenured?

* 7. Teacher Certification

8. What is your certification level?

- ☐ T4
- ☐ T5
- ☐ T6
- ☐ T7
- ☐ L5
- ☐ L6
- ☐ L7

9. What is your current science teaching context?

- ☐ Face to Face (in-person) Teaching
- ☐ Synchronous Online Teaching
- ☐ Hybrid Teaching- Combination of face to face (in-person) and synchronous online

10. What percentage of your current science teaching context is face to face (in-person)?

0 Percent 100

11. What percentage of your current science teaching context is synchronous online teaching?

0 100

12. What percentage of your current science teaching context is hybrid teaching (combination of face to face and synchronous online)?

0 100

APPENDIX C

https://search.ebscohost.com/login.aspx?direct=true&db=asn&AN=126896291&site=ehost-live&scope=site&custid=liberty&authtype=ip,shib

APPENDIX D

IRB Approval

LIBERTY UNIVERSITY
INSTITUTIONAL REVIEW BOARD

September 20, 2021

Melissa Davis
[redacted]

Re: IRB Exemption - [redacted] Teachers' Attitudes Toward Science Teaching in an Urban Elementary School Setting

Dear Melissa Davis, [redacted]

The Liberty University Institutional Review Board (IRB) has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study to be exempt from further IRB review. This means you may begin your research with the data safeguarding methods mentioned in your approved application, and no further IRB oversight is required.

Your study falls under the following exemption category, which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46:104(d):

Category 2.(i). Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording).
The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects.

Your stamped consent form(s) and final versions of your study documents can be found under the Attachments tab within the Submission Details section of your study on Cayuse IRB. Your stamped consent form(s) should be copied and used to gain the consent of your research participants. If you plan to provide your consent information electronically, the contents of the attached consent document(s) should be made available without alteration.

Please note that this exemption only applies to your current research application, and any modifications to your protocol must be reported to the Liberty University IRB for verification of continued exemption status. You may report these changes by completing a modification submission through your Cayuse IRB account.

If you have any questions about this exemption or need assistance in determining whether possible modifications to your protocol would change your exemption status, please email us at irb@liberty.edu.

Sincerely,

APPENDIX E

Dear Teacher:

As a graduate student in the School of Education at Liberty University, I am conducting research as part of the requirements for a Doctor of Education degree. The purpose of my research is to analyze the difference in teachers' attitudes toward science teaching in an urban elementary school setting based on the factors of biological sex, years of teaching experience, and the use of a science unit of study. I am writing to invite eligible participants to join my study.

Participants must be an in-service elementary teacher in an urban setting who teaches science. Participants, if willing, will be asked to first click on the link below to access the Dimensions of Attitudes Toward Science survey. The second procedure is to answer the demographic questions for approximately two minutes before proceeding to the survey. The third procedure to answer the Dimensions of Attitudes Toward Science survey. The survey will take approximately 10 minutes to complete. Participation will be completely anonymous, and no personal, identifying information will be collected.

To participate, please click here

A consent document is provided on the first page of the survey. The consent document contains additional information about my research. Because participation is anonymous, you do not need to sign and return the consent document unless you would prefer to do so. After you have read the consent form, please click the button to proceed to the survey. Doing so will indicate that you have read the consent information and would like to take part in the survey.

Sincerely,

Melissa Davis
Doctoral Candidate

APPENDIX F

Research Participants Needed

Teachers' Attitudes Toward Science Teaching in an Urban Elementary School Setting

- Are you an in-service elementary school teacher?
- Do you teach in an urban school setting?
- Do you teach science content to students?
- Are you 18 years of age or older?

If you answered **yes** to these questions, you might be eligible to participate in a teachers' attitudes research study.

The purpose of the study is to analyze the difference in teachers' attitudes toward science teaching in an urban elementary school setting based on biological sex, teaching experience, and using a science unit of study.

If you agree to be in this study, I will ask you to do the following things:
1. First, click on the SurveyMonkey© link below to access the survey.
2. Second, answer the demographic questions and the Dimensions of Attitudes Toward

Science Survey. The survey will take approximately 10 minutes to complete.

Melissa Davis, a doctoral candidate in the Doctor of Education: Leadership at Liberty University, is conducting this study.
Please contact Melissa Davis at for more information.

Liberty University IRB –