2022

Teachers’ Perceptions of Their Self-Efficacy to Engage Elementary Students in Learning Science

Stacie I. Smith
Walden University

Walden University

College of Education

This is to certify that the doctoral study by

Stacie I. Smith

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee
Dr. Mary Lou Morton, Committee Chairperson, Education Faculty
Dr. Antoinette Myers, Committee Member, Education Faculty
Dr. Jennifer Seymour, University Reviewer, Education Faculty

Chief Academic Officer and Provost
Sue Subocz, Ph.D.

Walden University
2022

Abstract

Teachers' Perceptions of Their Self-Efficacy to Engage

Elementary Students in Learning Science

by

Stacie I. Smith

MA, University of Phoenix, 2002

BS, Eastern Michigan University, 1997

Project Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Education

Walden University

December 2022

Abstract

Science teachers in the local area lacked self-efficacy to teach science and were struggling to engage students in science learning, which resulted in student underachievement. Principals reported that teachers' lack of self-efficacy in teaching science may be limiting students' goals for scientific careers. The purpose of this basic qualitative study was to explore teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. The conceptual framework was Bandura's theory of self-efficacy, which connects instruction to the confidence teachers possess in the classroom. Data were collected from individual interviews with a purposeful sample of 10 elementary science teachers. Interviews were analyzed through open coding and comprehensive clustering to reveal patterns and themes to answer the research questions. Findings revealed that teachers need and desire training to bolster their self-efficacy to engage students in science learning. Many participants reported that they did not like teaching science. Professional development was created to meet the identified needs of teachers, improve their self-efficacy perceptions to engage students in science learning, increase their knowledge of the science standards, and broaden their instructional methods. Implications for positive social change include promoting the self-efficacy of elementary science teachers to increase student engagement and achievement in science.

Teachers' Perceptions of Their Self-Efficacy to Engage

Elementary Students in Learning Science

by

Stacie I. Smith

MA, University of Phoenix, 2002

BS, Eastern Michigan University, 1997

Project Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Education

Walden University

December 2022

Dedication

To God be the glory! Praise the Lord Jesus Christ for His mercy, grace, and kindness. This is dedicated to my dear children, Lauren and Lance because I love you with all that I have to offer. My message to you is, “always seek God’s will and follow your dreams!” To my parents, Glenna I. Smith-Gray and Oscar B. Smith, thank you for thoroughly loving me! Thank you for introducing me to Jesus and for being phenomenal role models. I will always do my best to make you proud of me.

Acknowledgments

In loving memory and gratitude to Dr. Margie Hobbs for your kindness and a gentle nudge toward achieving all goals. I greatly appreciate the time and energies of all who worked to ensure that this work came to fruition. A special note of appreciation goes to committee members, Dr. Mary Lou Morton, Dr. Antoinette Myers, and Dr. Jennifer Seymour, for supporting my career at Walden University and beyond!

Table of Contents

List of Tables

Section 1: The Problem

The Local Problem

The problem that prompted this basic qualitative project study was that teachers in the local area lacked self-efficacy to teach science and were struggling to engage students in science learning. Self-efficacy is defined as a judgment about one's ability to organize and execute the courses of action necessary to attain a specific goal (Bandura, 1977). Self-efficacy judgments are related to tasks in a given domain (Zimmerman, 2000). The mindset a teacher has about their teaching skills impacts students' engagement and achievement (A. D. Miller et al., 2017). Elementary science teachers who exhibit a lack of self-efficacy to teach science have been a topic of discussion during staff meetings and district-wide training sessions at the local site (Administration, personal communication, August 19, 2021). In a conference held by the local district to discuss the implementation of science at the local ABC Elementary School (pseudonym) in southern Michigan, a science coach expressed the lack of self-confidence science teachers demonstrate in the classrooms (personal communication, August 19, 2021). Despite the lack of self-efficacy, teachers are held to rigorous accountability measures and are required to show improvement in student learning in science, technology, engineering, and mathematics (STEM) education. The gap in practice of the current study was the teachers' lack of self-efficacy to develop appropriate strategies to stimulate student engagement in learning science.

Teacher self-efficacy for teaching science had been addressed in many studies. One of the major effects of low teacher self-efficacy is students not engaged in science and exhibiting low test scores throughout the school year (Sarı et al., 2018). A district leader in southern Michigan mentioned that teacher self-efficacy in science education was low and had negatively impacted performance and interest in students (personal communication, May 12, 2021). Researchers have found that positive teacher self-efficacy is attributed to positive outcomes including enthusiasm, commitment, and persistence (Alibakhshi et al., 2020). Seeking to learn more about teacher self-efficacy perspectives and student engagement may help teachers in the local district feel more confident and may promote stronger learning environments.

Exploring teachers' perceptions of their sense of self-efficacy to teach science and influence student engagement in science learning was a key concern at the ABC Elementary School where students were disinterested and underachieving in science. Barni et al. (2019) noted that low teacher self-efficacy is directly linked to student engagement and achievement. Achievement in science education had been low at ABC Elementary School for several years (MI School Data, 2021). Elementary students in the state were tested using an assessment called the Michigan Educational Achievement Proficiency Test. In 2020 the state halted testing for the school year, due to the global pandemic (French, 2021). The state of Michigan adopted new science standards in 2017 that led to the vetting of a new test and no release of test scores in the years 2018 and 2019 (Chambers, 2018). The state has not released science scores since the 2016-2017 school year. The 2016 science scores showed that 0.0% of elementary students at ABC Elementary School were proficient (MI School Data, 2021). Scores were below the state average of 20% (MI School Data, 2021) and are presented in Table 1.

Table 1

Data for Student Proficiency Percentages in Science

MEAP scores	Advanced	Proficient	Partially proficient	Not proficient
2015	0%	1.7%	16.9%	81.4%
2016	0%	0%	9.5%	90.5%

Note. Michigan Educational Assessment Program (MEAP), From" Michigan State Department of Education," by Michigan Department of Education, 2021 (Michigan Department of Education https://www.michigan.gov/mde/0,4615,7-140-28753---,00.html)

Low teacher self-efficacy and minimal student engagement demonstrated by students with decreased test scores at the local school needed to be addressed. Although this study focused on ABC Elementary School, student achievement in science education was low at all schools in the local district (MI School Data, 2021). Teachers with high self-efficacy yield highly motivated students who are more likely to achieve (Bae et al., 2020). Exploring teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science helped me identify the areas of need, where progress might be made, and where professional development could be targeted. Changes could be made that positively influence science learning at ABC Elementary School.

Science teachers who exhibit deficiencies in self-efficacy, self-concept, and self-esteem create students who are not engrossed in science learning, consequently producing underachievers who are likely to set low goals for scientific careers (Mohtar et al., 2019). The challenge in the current study was that elementary teachers did not feel as if they had the necessary skills and strategies to teach science and were not making it engaging for students (Administrator, personal communication, May 12, 2021). Studying teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science helped me identify the area of need, where progress might be made, and where professional development could be targeted to positively impact outcomes.

Problem in the Larger Population

Globally, there have been increasing concerns about students demonstrating a lack of interest and mastery in science education (Fauth et al., 2019). The number of students interested in science-related careers has shown a continual decline (Wiebe et al., 2018). These deficits in science education have been even more pronounced in diverse, urban populations (Wiebe et al., 2018). Findings from the current study provided data that may aid in positively identifying the link between teacher self-efficacy and student engagement.

Exploring teacher's perceptions of their self-efficacy to teach science may result in changes being made that may positively influence science learning. Implementing measures to increase teacher self-efficacy so that teachers feel confident when teaching science may contribute to improved student interest (Mosoge et al., 2018). Conversely, negative teacher self-efficacy may decrease student achievement, interest, and engagement in science. The findings from the current study could benefit ABC Elementary School as well as other educators and students throughout the United States.

Justification for Problem Choice

Elementary students at the local ABC Elementary School in southern Michigan were achieving below expectations in science. Conversations with teachers and district leaders were revealing about teacher self-efficacy, student achievement, and engagement. An elementary educator (personal communication, August 19, 2021) spoke of being uncomfortable teaching science and stated that “because I am uncomfortable, the students do not like it and they check out whenever I begin to teach science.” One district leader maintained a robust rationale about the correlation between teacher self-efficacy in science and teachers’ effects on student engagement (Administrator, personal communication, May 12, 2021). The administrator spoke of their childhood, how fun science classes used to be, and the need to increase teacher self-efficacy. The administrator also believes that teachers do not feel confident teaching science, which negatively impacts student engagement and achievement. District leaders feel that teacher self-efficacy in science is a problem and that increasing teacher confidence will lead to increased student engagement, more student interest in science careers, and improved standardized test scores (Administrator, personal communication, March 30, 2020).

In addition to these informal conversations, state test scores showed a decline in student achievement in science education. The district administers a science test to fifth-grade students, meant to mimic the state standardized test. The test intends to help prepare students for the state standardized science test. This test supports learners and educators because it has the same style of questions and categorizes results as the state standardized test. District data for the science test are presented in Table 2. Only 2.4% of students scored proficient in 2021, and 2.3% scored proficient in 2019 (MI School Data, 2021). District leaders agreed that there was a great need to reverse the trend of low test scores because it was evidence of a teacher self-efficacy problem (Administrator, personal communication, August 19, 2021).

Table 2

Southern Michigan Science Scores

District scores	Advanced	Proficient	Partially proficient	Not proficient
2021	0%	2.4%	21.7%	75.9%
2019	0%	2.3%	21.3%	76.4%

Note. From" Michigan State Department of Education," by MI School Data, 2021(MI School Data, https://Www.Mischooldata.Org/Dashboard-Home/)

According to a district principal in southern Michigan, "test scores related to science education are unacceptable and need an immediate intervention" (personal communication, March 30, 2020). "Low test scores are a result of boring science classes because students are not interested in what the teacher has to say" (Administrator, personal communication, March 30, 2020). The purpose of this basic qualitative study was to explore teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. The study helped me to identify the area of need, where progress might be made, and where professional development could be targeted. Teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science are vital to ensure that students receive the most impactful education possible (A. D. Miller et al., 2017). Supporting teacher self-efficacy to teach science should result in increased student engagement and achievement in science education (Sukma et al., 2020). The potential for positive change involved increasing the self-efficacy of teachers, as well as increasing student engagement and achievement in science. This study was the first step toward achieving these goals. Understanding the challenges and needs may provide direction for administrators and professional development that will increase teachers' self-efficacy, which may positively impact student outcomes.

Rationale

The rationale for the problem choice was derived from a review of literature and information from the local site, including informal conversations with teachers and administrators. The mindset that a teacher has about their teaching skills impacts student engagement (A. D. Miller et al., 2017). When school leaders support teacher self-efficacy, it can positively impact student interest and achievement (Hallinger et al., 2018). Due to a decline in teacher confidence and student interest in science, I explored teacher perceptions of their self-efficacy to teach science and influence student engagement, and what they perceived as the challenges to enhancing student engagement. This study helped me identify the area of need, where progress might be made, and where professional development could be targeted. Several educators at the local sited reported that teacher self-efficacy for teaching science needs to be increased, student engagement is waning, and achievement is low (Teacher, personal communication, May 12, 2021; Coach, personal communication, August 2021; Administrator, personal communication, August 19, 2021). Through these conversations, it was evident that science teachers needed support in increasing their self-efficacy in the science classroom to optimize instruction, student engagement, and achievement. The purpose of this basic qualitative study was to explore teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science.

Definitions of Terms

Researchers define terms so that readers can understand the language used in the study (Harnisch et al., 2017). I provided definitions so readers could understand the terms used to explore teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. The study helped me identify the areas of need, where progress might be made, and where professional development could be targeted. I used the following terms and definitions throughout this basic qualitative study.

Growth mindset: When an individual believes that their talents can develop through hard work, good strategies, or input from others (Yeager & Dweck, 2020).

Michigan Science Standards (MSS): Portions of the Next Generation Science Standards were adopted by the state of Michigan to increase science literacy in students in Grades K–12 (Michigan Science Standards, 2021).

Michigan Student Test of Educational Progress: A computer-based standardized science test given to students in Grades 3 through 8 as of 2017 (Michigan Department of Education, 2021).

Next Generation Science Standards (NGSS): Standards adopted by a variety of states to increase science literacy in students in Grades K–12 (NGSS, 2021).

Perceived self-efficacy: A person's belief about their capabilities to produce positive outcomes (Bandura & Wessels, 1994). In the current qualitative study, self-efficacy was the ability of a teacher to effectively teach science to elementary students (see Bandura, 1977).

Science, technology, engineering, and mathematics (STEM): A method of cross-curricular learning that is mutually beneficial during instruction. STEM was implemented at the local school site (U.S. Department of Education, 2021).

Significance of the Study

In this basic qualitative study, I explored teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. This study helped me identify the areas of need, where progress might be made, and where professional development could be targeted. Changes could be made that will positively influence science learning. The study was significant because it addressed a gap in practice, which was the teachers' lack of self-efficacy to develop appropriate strategies to stimulate student engagement in learning science. The number of students interested in science-related careers has shown a continual decline in the United States (Wiebe et al., 2018). This trend has been even more pronounced in urban populations (Wiebe et al., 2018). A lack of teacher self-efficacy can negatively impact student engagement and achievement (Barni et al., 2019). The current study allowed for measures to be taken to support elementary science teacher self-efficacy and student engagement. By gaining a better understanding of the perceptions of science teachers at ABC Elementary School in southern Michigan, administrators could adjust the way that teacher self-efficacy is approached to create a better learning experience for students. Supporting teacher self-efficacy perceptions and what they thought were the challenges to enhancing student engagement in science may positively influence science learning at ABC Elementary School.

This study was also significant because it provided ideas that administrators and teachers can use to increase teacher self-efficacy, which may improve student engagement in science. The study provided an opportunity for a purposeful sample of elementary science teachers to voice perceptions of their sense of self-efficacy to teach science and the challenges of enhancing student engagement. District leaders were concerned that self-efficacy in science education had been negatively impacting students (Administrator, personal, communication, May 12, 2021). The exploration of teacher perceptions fostered support for the district by providing an opportunity for teachers and district leaders to delve into what is working and what may need to be reevaluated to support teacher self-efficacy in science.

Results from this study could positively change the lives of students, educators, and administrators at ABC Elementary School in southern Michigan. Positive change may result from this study as strategic steps that could include professional development, are implemented to support teacher self-efficacy and student engagement. Supporting self-efficacy was important because students who participate in engaging science are more likely to be interested in the curriculum, select STEM careers, and perform well on standardized tests (Bae et al., 2020). The potential for positive social change as a result of increased engagement in science also involved elementary students having increased opportunities for higher education, better-paying jobs, lower poverty rates, and higher socioeconomic statuses.

Research Questions

The problem that prompted this basic qualitative study was that teachers in the local school lacked self-efficacy to teach science and were struggling to engage students in science learning. Research had shown that teacher self-efficacy perceptions can negatively impact student interest (Barni et al., 2019). The purpose of the current study was to explore teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. I conducted semistructured individual interviews with a purposeful sample of 10 elementary science teachers in the local setting. I sought to understand situations and events through the eyes of those experiencing them (see Merriam & Tisdell, 2016). Qualitative research allows the researcher to answer questions about "how people interpret their experiences, structure their worlds, and what meaning they attribute to their experiences" (Merriam, 2009, p. 5). The research questions were designed to guide the study and better understand teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science:

RQ1: How did local elementary teachers describe their methods of teaching science to engage students?

RQ2: How did local elementary teachers describe challenges to engaging students in learning science?

RQ3: How did local elementary teachers describe their self-efficacy for engaging students in learning science?

RQ4: What supports did local elementary teachers think they needed to help improve their science instruction?

Review of the Literature

The literature review provided information about related studies for this basic qualitative study. The review focused on the problem that teachers in the local area lacked self-efficacy to teach science and were struggling to engage students in science learning. Information collected was derived from online databases, peer-reviewed articles, bibliographies, research books, and journals. Resources for the literature review were gathered from the Walden Library using the following databases: Google Scholar, Sage Premier, Academic Search Complete, Taylor & Francis, and dissertations from ProQuest. Topics were researched that supported the purpose of exploring teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. Key terms and a combination of terms that were used in the search included *Bandura's theory of self-efficacy, Next Generation Science Standards, national low science test scores, teacher self-efficacy and science, science teacher self-efficacy*, *pre-service teacher self-efficacy*, *elementary science teacher self-efficacy*, *self-efficacy teacher impact*, *student engagement in elementary science*, *factors that increase student achievement in science*, *increase teacher self-efficacy*, *factors that increase student interest in science education*, and *the impact of high student engagement in science education*.

Conceptual Framework

The conceptual framework that guided this study was Bandura’s (1986) self-efficacy beliefs because efficacy is a critical factor in influencing individual behavior. Bandura’s (1977) theory of self-efficacy provided a connection between teacher perceptions of self-efficacy and teachers’ influence on student engagement. The self-efficacy of teachers when instructing students in elementary science education is an important subject. Bandura (1982) described self-efficacy as the judgments or beliefs that an individual holds about their capacity to take the required action to successfully cope with a given situation. Bandura (1982) further asserted that a person’s self-efficacy beliefs determine “how people behave, their thought patterns, and the emotional reactions they experience in taxing situations” (p. 123). If a person’s self-efficacy is likely to determine how people react, then teacher self-efficacy is important when it comes to instructional methods for student engagement.

Low achievement in science supported the need to increase teacher self-efficacy to teach science. Bandura (1997) declared that a science teacher’s self-efficacy is important because of its increasing significance to “scientific literacy and competency in the technological transformations occurring in society” (p. 242). Bandura (1977, 1986) argued that personal self-efficacy beliefs about teaching depend on a specific context and environment. The teacher’s overall level of self-efficacy might not accurately represent the teacher’s beliefs about their ability to execute effective programs in subjects such as science. Bandura (1986) noted, “how people judge their capabilities and how their selfprecepts of efficacy affect their motivation and behavior" (p. 391). Teacher self-efficacy perceptions can have a profound impact on science instruction.

When a person has self-efficacy, their accomplishments are magnified and their well-being is augmented in many ways. Bandura (1977) deduced that a person's self-efficacy beliefs are strongly aligned with their ability to face obstacles as well as their competence. People who are confident in their capabilities and skill sets approach challenges as tasks to be overcome rather than as hurdles to be avoided. When individuals have an efficacious outlook, they tend to invest deeply in the activities and interests at hand. These people will set high expectations, set challenging goals, and commit to staying on task. Difficulties do not detract these people, but they foster a heightened sense of awareness of obligations and responsibilities. Failed attempts or disappointments do not derail their self-efficacy. They value professional learning and the acquisition of knowledge or skills. They approach difficulties with the confidence that they can use them to orchestrate positive outcomes.

According to Bandura (1995), "an efficacious outlook produces personal accomplishments, reduces stress, and lowers vulnerability to depression" (p. 11). On the contrary, individuals with a low sense of self-efficacy avoid demanding tasks. They are threatened by the uncertainty of outcomes due to a sense of inadequacy and a limited skill set. Their aspirations are diminished due to a lack of commitment to a goal. When faced with difficult tasks, they ponder their inability to complete a given challenge. They give up quickly and are even slower to recover a sense of efficacy after an onslaught of failures. Individuals with a low sense of self-efficacy view a substandard performance as being due to a lack of personal intelligence. They tend to quickly lose faith in their ability to achieve. They also become agitated and stressed, and can experience episodes of extreme depression (Bandura, 1996). The work of Bandura provided insight into self-efficacy and how to support those who were exhibiting low self-efficacy in science.

Review of the Broader Problem

The purpose of this basic qualitative study was to explore teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. The study helped me identify the areas of need, where progress might be made, and where professional development could be targeted. This section contains a review of recent research on teacher self-efficacy perceptions to teach science and the influence on student engagement in science. Topics included were (a) understanding teacher self-efficacy, (b) impact of teacher self-efficacy, (c) low teacher self-efficacy, (d) elementary science reform in the United States, (e) NGSS, (f) low science achievement and engagement, and (g) teacher preparedness and perceptions. Topics were researched that supported the purpose to explore teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science.

Teacher self-efficacy had been a concern for some time. J. Chen (2019) stated that a lack of student engagement is due to a lack of teacher self-efficacy. Teachers who do not possess self-efficacy will not implement engaging science strategies that have been proven to increase interest (Menon, 2020). A volume of validating research supported the connection between teacher self-efficacy and student engagement (Burns et al., 2021;

Clark & Newberry, 2019; Gerde et al., 2018; Mahasneh & Alwan, 2018). Teachers who lacked self-efficacy were less likely to engage students, and studies have shown that students need early exposure to attain interest and build competency in a subject matter (Bae & Lai, 2020). Kolb's (2014) experiential learning theory promotes that student interest through engagement in the learning process is an essential classroom practice. One way to strengthen science instruction is to promote the use of engaging science practices by promoting curiosity in the classroom (Lindholm, 2018). Er (2020) found that the negative effects that a teacher with low self-efficacy has on students can last for years. Teachers who have more self-efficacy experience better job satisfaction, that leads to increased student engagement and achievement in science education (Sibagariang & Pandia et al., 2021; Wilson et al., 2018). According to Buechel (2021), higher teacher self-efficacy is linked to longevity in the teaching profession and lower chances of experiencing burnout. Self-efficacy impacts teachers, students, and science instruction.

Science has not been effectively taught in many schools. Kruse et al. (2021) concluded that science is not taught with fidelity in elementary schools due to a lack of teacher self-efficacy. Mostafa et al. (2018) found that if science were taught consistently using a myriad of strategies, students would be more engaged. Teachers with low self-efficacy are less confident, and students are less interested in science education (Mosoge et al, 2018). For example, Wiebe et al. (2018) confirmed that student engagement is key to student achievement in science education. There is a direct link between the quality of teaching, student interest, and engagement in science (Mohd et al., 2019). The literature review helped me ground the relevance of the current study on related research.

Understanding Teacher Self-Efficacy

Bal-Tastan et al. (2018) found that a lack of teacher self-efficacy is a barrier to student engagement in most elementary classrooms. Teachers' sense of self-efficacy has been explored over the years (Osborne et al., 2019; McKellar et al., 2020). These studies extended Bandura's (1977) social cognitive learning theory and related to a teacher's perception of their teaching ability and its impact on student learning (Kunnari et al., 2018). A teacher's sense of efficacy can influence many aspects of classroom instruction. According to Bandura (1997), an individuals' level of self-efficacy can significantly impact their ability to complete a task, the amount of energy they give the task, and how long they sustain this effort. Teachers who feel they can teach the most challenging students and prepare innovative lessons, usually have a high sense of self-efficacy (Ketelhut et al., 2019). If teachers believe their ability to teach science is insufficient, they may develop a dislike for teaching science (Ketelhut, et al., 2019). Low teacher self-efficacy reduces the effort students expend and limits science learning.

Teacher self-efficacy in a subject is very important for teaching effectiveness. One of the most important aspects of teaching is the ability of the teacher to feel confident enough to produce positive outcomes (Herman et al., 2018). Teachers with a high sense of efficacy are involved in the school community and usually sign up for professional development opportunities offered by various professional organizations (Akca et al., 2018). The ability to evaluate their teaching competencies aligns with Bandura's concept of self-efficacy. Bandura (1997) proposed that teachers who have a high sense of self-efficacy implement high-level questioning, inquiry, and positive feedback. If a teacher has a low sense of self-efficacy in a subject such as science, they are more inclined to avoid the subject. Elementary science teachers who do not allocate the appropriate time to science usually feel uncomfortable with the material. Researchers have shown that teacher self-efficacy can have a major impact on instructional competency.

Impact of Teacher Self-Efficacy

The topic of teacher self-efficacy has been at the center of many important studies. Teacher self-efficacy is the belief that one can produce positive change in students (Poulou et al., 2019). For example, research has uncovered that teachers who display positive self-efficacy when teaching can help students develop a love for the subject (Lazarides et al., 2018). Lazarides et al. (2018) found that teachers who display positive self-efficacy when teaching can also draw students into a deep understanding of the curriculum while increasing student engagement. Hallinger et al. (2018) showed that teachers and principals who have self-efficacy displayed more robust instructional and leadership skills, that had a positive effect on student engagement. Teacher self-efficacy is also a predictor of positive instructional behaviors and teacher retention rates (Feng et al., 2019). This means that the way teachers interpreted their past instructional behaviors informed and altered future instructional behaviors (Norris et al., 2018). As it relates to Bandura’s concept of self-efficacy, student engagement is directly impacted by the way a teacher views their educational skills (Bharata & Sutiarso, 2021). The research on teacher self-efficacy indicated that teachers with positive self-efficacy were superior classroom instructors.

Understanding a teacher's sense of self-efficacy requires that a specific matter be addressed. Schwab et al. (2018) made the point that self-efficacy is a broad and therefore tenuous variable to study, and any "teaching self-efficacy study should be framed in terms of perceptions about performance in a given area" (p. 28). Students demonstrating a lack of engagement in elementary science education are often linked to the self-efficacy of the teacher (Webb-Williams, 2018). Larry and Wendt (2021) found that what teachers believe about their abilities has a major impact on what students learn and what they are interested in, and directly correlates to students' achievement levels. In one elementary study, Naidoo and Naidoo (2021) found that many teachers were less confident and less interested in teaching science, which directly impacted their students' engagement. Research indicated the importance of positive teacher self-efficacy and the importance of taking steps to increase teacher self-efficacy perceptions.

Low Teacher Self-Efficacy

Low self-efficacy has been researched to reveal many important considerations. First, those with high self-efficacy blame external forces for all failures (Alt, 2018; van Rooij et al., 2019). Repeated failures can inhibit self-efficacy, confidence, and resilience (Alt, 2018; van Rooij et al., 2019). Handtke & Bögeholz (2019) found that failed experiences limit a teacher's desire for instructional success. Conversely, successful experiences build confidence and increase self-efficacy. External forces and experiences can impact the level of self-efficacy that teachers exhibit in the classroom (Norris et al., 2018).

Most elementary science teachers teach all content areas. According to studies, teachers may be required to teach content areas that were challenging to them as students (Ma & Cavanagh, 2018; Sheu et al., 2018). Adverse prior experiences inhibit teacher self-efficacy (Burić & Macuka, 2018; Putwain & von der Embase, 2019). Teig et al. (2019) found that low teacher self-efficacy translates into less effective instruction. Seals et al. (2017) found that teachers with low self-efficacy spend less time teaching science despite instructional mandates, which negatively impacts student engagement. Exploring teacher self-efficacy perceptions should help those who suffer from low self-efficacy. Promising findings (De Smul et al., 2018; Lewis et al., 2021) reveal that a method to increase teacher self-efficacy is by providing teachers with quality professional development programs. Support is needed to help elementary science teachers successfully meet the requirement to teach all subject areas.

Bandura (1997) discovered that positive teacher self-efficacy is the confidence that one has in their teaching skills. The teacher who exudes self-confidence in their teaching abilities will positively impact student engagement (Polizzi et al., 2021; Tsui, 2018). Sökmen (2021) found that self-efficacy has been linked to the degree to which a teacher positively impacts the classroom. According to Uzuntiryaki-Kondakci et al. (2020) teachers with high self-efficacy have thoughts of positivity while those with low efficacy have negative thoughts about their instructional practices. Donohoo et al. (2018) found that there is a direct correlation between teacher efficacy levels and student motivation levels. Liu & Liao (2019) note the importance that teachers place on science instruction is mirrored by students. Teacher mentorship programs have helped increase self-efficacy (Feng et al., 2019), retention, and job satisfaction (Edinger & Edinger, 2018). Positive self-efficacy has positive outcomes for teachers' thoughts and students' skills; the field of science education is in great need of improved self-efficacy for teaching science in elementary classrooms.

Elementary Science Education Reform in the United States

Science teaching is suffering for a variety of reasons in the United States, and reform is necessary to ensure the success of students. According to Ihrig et al. (2018) teachers are failing to capture the interest of the youth in scientific thinking and are not challenging their imaginations deeply enough. In addition, Ihrig et al. (2018) added that science education in the United States has suffered from decreased funding over the years. Also, science has suffered because core academic assessments in English language arts (ELA) and mathematics have become the priority for many districts, especially in the Northeast region of the United States. For example, Radloff & Capobianco (2019) found that one school district in southern Michigan spends the majority of the elementary school day teaching Mathematics and ELA for ninety-minute blocks, limiting the amount of time for science instruction and exploration. Science education is suffering because of a lack of time spent learning, a lack of challenge, and a lack of funding.

Science teaching needs to be reformed in the United States to better engage students. Former United States Presidential Science Advisor stated, "It is important to reach kids early in a way that makes elementary science exciting" (Holdren, et al., 2019). According to researchers, engagement in elementary science education is directly linked to the quality of the instructor (Havik & Westergard, 2020; Jones et al., 2019; Prewett et al., 2019). The recently adopted NGSS identifies specific cross-cutting concepts, phenomena-based instruction, and engaging science techniques. These standards are promising to increase student engagement. Bae & Lai (2020) found that new standards do not necessarily increase a teacher's effectiveness or self-efficacy. Helping elementary science teachers develop engaging strategies should be a priority but there is an overemphasis on mathematics and reading. Bae & Lai (2020) also found that many teachers prioritize teaching mathematics and reading. Wang & Hofken (2020) noted that "to be able to improve elementary science education is to improve teaching." According to Morrell et al. (2020), elementary science instruction is a key component of a complete and rigorous education for students. The consistent inclusion of science instruction should be viewed as a key component of the reform that is needed to support science teachers, student engagement, and student achievement.

NGSS

A major paradigm shift took place in science with the adoption of the NGSS. According to Holthuis et al. (2018), the NGSS moved science practices from a set of facts to rigorous standards demanding that teachers have a deeper understanding of content knowledge as well as how students think and learn. Cetin & Dede (2018) declared that to create a change in teacher self-efficacy, teachers needed to unlearn the values, beliefs, assumptions, and cultures underlying the school's standard operating practices. The NGSS promotes critical thinking and hands-on science best practices. According to Dewey (cited by Schmidt & Allsup, 2019), instructional practices for young children should include hands-on learning experiences to ensure that students build background knowledge and better understand science concepts. NGSS promotes a national approach to learning by doing so that students experience science in meaningful, real-world lessons, requiring teachers to have a deeper level of content knowledge.

Although the nation has moved science education to include best practices through the NGSS, students may still not reap the benefits of these national standards if teachers do not possess the self-efficacy to implement them. A. D. Miller et al. (2017) found that teacher perceptions of their abilities are vital to understanding and bringing a resolution to a lack of student engagement in science. To produce behavioral changes in teachers' instructional practices for future generations, an unlearning process is required to create a more productive pathway toward the transformational relearning that is essential. Priester (2020) concluded that the shift to NGSS standards requires teachers to know more than the content they teach. It necessitates those teachers to understand and acquire conceptual knowledge. Teachers need support to unlearn negative patterns and beliefs including low self-efficacy to adjust to the new standards outlined in the NGSS.

Low Science Achievement and Engagement

Throughout the United States, students are not achieving in elementary science; Below average test scores have been reported nationally. The problem that prompted this basic qualitative project study was that teachers in the local area lacked self-efficacy to teach science and were struggling to engage students in science learning. Sari et al. (2018) noted the trend of elementary students showing disinterest and underachieving in science education. According to Barni et al. (2019), low teacher self-efficacy can negatively impact student interest and achievement. Below-average test scores in science are reported nationally. According to the National Assessment of Education Progress (NAEP), 4th-grade student performance in science has declined overall from 2015 when the score was 154 and is now 150 (Reilly et al., 2019; Workman, 2021). The NAEP (2019) scores for 8th-grade and 12th-grade students show that they have flatlined in science with no growth from 2015 to 2019. The score remains at 154. Student test scores in science are low across the United States and this problem may be linked to low engagement and teacher self-efficacy.

Interest in science education is reflected in students who choose to enter science-related careers. Wiebe et al. (2018) found that in the United States, test scores and the number of students interested in science-related careers have shown a continual decline. These deficits are even more pronounced in urban populations. Bae et al. (2020) conducted research in an urban community and found that there was a 37% increase in interest in STEM careers when science classes are taught by a teacher with higher self-efficacy. Teaching science in the elementary classroom is critical to ensure that STEM-related careers are fulfilled (Esson et al., 2018; S. Huang et al., 2019; Sukma et al., 2020; Wiebe et al., 2018). The more that science is taught, the more likely students are to enjoy it and the more likely they are to choose STEM careers (Mohtar et al., 2019). Craig et al. (2019) noted that there has been a decrease in students selecting STEM careers so working to increase student interest in these fields should be a goal of science education. Low student engagement in science education has led to a decreased interest in STEM-related careers.

Teacher Preparedness and Perceptions

Teacher preparation can be a source for helping future teachers develop self-efficacy for teaching science. According to Agu & Ramsey (2021), self-efficacy and preparedness are intricately linked. The preparedness of teachers is important to positive student outcomes in science education (NSTA Board of Directors, et al., 2019). Elementary teachers are educated to be subject generalists, and science instruction is a fraction of their training (Bradford et, al., 2020; Hilton & Saunders, 2019). Most elementary teacher preparation programs require one or two science classes. These same programs require several mathematics and reading courses before a degree is awarded. Recent researchers found that most teachers do not like teaching science because they do not feel prepared to effectively instruct students (Y. L. Chen & Mensah, 2018; Mensah & Jackson, 2018; Novak & Wisdom, 2019). The link between teacher preparedness and their self-efficacy perceptions is an important focal point as steps are taken to improve student engagement.

Inadequate teacher preparation may be a reason for teachers' low self-efficacy when teaching science. A comparative study of teacher preparation programs found that there is a significant difference in teacher preparation programs from one university to the next but none of them fully prepare teachers for engaging and effective science instruction (Loach, 2021). According to d'Alessio (2018), most elementary teaching programs offer a single-semester course in science education. Studies have shown that single-semester courses are not adequate to yield effective instruction. Menon (2020) found that elementary science teaching programs are failing in the area of science instruction and students are not being prepared to remain globally and economically competitive. Lewis, Edmonds, & Fogg-Rogers (2021) promoted the implementation of science preparation programs beyond graduation, such as professional development because they foster rigorous instructional practices. Teachers need more exposure to science preparation courses during college and beyond.

According to Bandura (1977), one's belief in their abilities influences the outcomes of a situation. Bandura proposed that individuals with low self-efficacy experience anxiety because they think a task is harder than it is (Bandura, 1977, as cited in Sands et al., 2018). Bell et al. (2018) discovered that when science teaching perceptions caused anxiety, creativity and effectiveness are difficult to attain. Barni et al. (2019) found that the knowledge an elementary science teacher perceives they need to be effective is usually exaggerated. Herman et al (2020) noted that the thought of teaching science causes stress in many teachers due to the perceived level of content knowledge, materials preparation, and overall management of the classroom. Increasing perceptions of self-efficacy is vital to effective instruction (Beardsley et al., 2020). According to Rhew et al. (2018) teachers who developed a growth mindset displayed increased self-efficacy and decreased levels of stress which improved student learning and engagement in the classroom. Yeager & Dweck (2020) found that one method to increase self-efficacy is by helping science teachers develop a growth mindset. A teacher with a growth mindset has the internal belief that they can become better teachers through hard work, good strategies, or input from others (Yeager & Dweck, 2020). A growth mindset may help remove anxiety about teaching science and promote teacher self-efficacy.

Implications

Implications for a possible project based on findings included professional development to provide resources and strategies that may increase teachers' perceptions of their sense of self-efficacy to teach science and engage students. A position paper may have been appropriate to provide evidence to administrators about teachers' sense of self-efficacy linked to their need for improved instruction in science. Findings from this study helped me identify the areas of need, where progress might be made, and where professional development could target. The purpose of this study is to be the first step toward improvement.

Dejarnette (2018) found that teachers who are exposed to a variety of hands-on professional development opportunities and resources are more efficacious, become stronger teachers, and implement engaging science practices. The self-efficacy perceptions that teachers hold directly impacts student engagement in science (Mosoge et al., 2018). An effective professional development plan was developed after the interviews uncovered low teacher self-efficacy perceptions to engage students in science learning. The professional development supported increased teacher self-efficacy perceptions and strong science instructional strategies to better engage students in science. Implications for positive social change include increasing the self-efficacy of elementary science teachers to support student engagement and achievement in science. The final project was determined through a collaboration with the committee following data collection and analysis.

Summary

The purpose of this basic qualitative study was to explore teachers’ perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. The problem was that teachers in the local area lacked self-efficacy to teach science and were struggling to engage students in science learning. Exploring the topic of teachers’ perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science helped me identify the area of need, where progress might be made, and where professional development could be targeted to positively impact student engagement and achievement. Based on the data collected, a project was designed to address the teachers’ lack of self-efficacy. Studying this topic also supported school administrators as they work to provide quality professional development opportunities for teachers. Promoting student engagement through improved teacher self-efficacy may limit the decline of students demonstrating disinterest in science and science careers. In Section 2, I describe the selected qualitative research design and approach for the study, participants, ethical issues, data collection, data analysis, and limitations.

Section 2: The Methodology

Qualitative Research Design and Approach

The problem that prompted this basic qualitative study was that teachers in the local area lacked self-efficacy to teach science and were struggling to engage students in science learning. The purpose was to explore teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. Exploring teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement is important. The study helped me identify the areas of need, where progress might be made, and where professional development could be targeted. Steps were taken to positively influence science learning.

The research design of the current study was basic qualitative (see Worthington, 2013). According to Hatch (2002), qualitative studies allow participants' points of view to be used as foundations for their actions. R. B. Johnson and Christensen (2004) described qualitative research as descriptive and explorative with narrative information. Implementing the qualitative approach provided a foundation for presenting the perceptions teachers shared in the study. It was necessary to use a methodology in this study that was qualitative and purposeful to produce a systematic analysis. Qualitative data were required to perform a thorough exploration and gain an in-depth understanding. The basic qualitative design with semistructured one-on-one interviews was used to explore teachers' sense of their self-efficacy to engage students in science learning. The basic qualitative design was appropriate in this study because I sought to address a gap in practice regarding the teachers' lack of self-efficacy to develop appropriate strategies to stimulate student engagement in learning science.

A qualitative approach allowed for a focus on the self-efficacy perceptions of elementary science teachers and student engagement. Semistructured interview questions were designed to elicit the experiences and perceptions of a sample of 10 elementary science teachers. The number of participants would have been increased if saturation had not been achieved. Boyd (1993) regarded 2 to 10 research participants as sufficient for research saturation, and Creswell (2003) recommended: "long interviews with up to 10 people" (p. 65). The self-designed semistructured interview protocol was implemented to address the problem and purpose of the study.

The purpose of this basic qualitative study was to explore teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. Lindlof and Taylor (2017) stated that basic qualitative research contributes to a more comprehensive explanation of the participants' thoughts, experiences, and actions. Qualitative researchers seek to understand situations or events through the eyes of those experiencing them (Merriam & Tisdell, 2016). The basic qualitative design helped me examine the experiences acquired to develop the participants' meaning and comprehension (see Merriam & Tisdell, 2016). The following characteristics of a qualitative approach helped me determine why the qualitative design was appropriate for the study:

- In qualitative research, the primary role of the researcher is critical to data collection (J. W. Creswell & J. D. Creswell, 2017).

- The natural setting is used to collect data (Merriam & Tisdell, 2016).
- Qualitative research derives meaning from the participant's understanding and insight of the problem, not from the researcher (J. W. Creswell & D. L. Miller, 2000).
- Qualitative research seeks to answer questions on "how people interpret their experiences, and how they construct their worlds, and what meaning they attribute to their experiences" (Merriam, 2009, p.5).
- An inductive process is used in the qualitative approach, allowing the researchers to build meaning from the bottom up by creating themes and categories to organize their data (J. W. Creswell & D. L. Miller, 2000).
- A multitude of theoretical paradigms is used by qualitative researchers as they seek to understand the researched problem (Lodico et al., 2010).

Qualitative researchers seek to answer questions on "how people interpret their experiences, structure their worlds, and what meaning they attribute to their experiences" (Merriam, 2009, p. 5). A basic qualitative design was chosen for the current study because it "works to make sense of a central phenomenon through the eyes of those involved" (J. W. Creswell & D. L. Miller, 2000, p. 124). In a basic qualitative design, themes and patterns are developed (Lodico et al., 2010). I was seeking to derive meaning and insight into the problem from the participants' understanding (see J. W. Creswell & D. L. Miller, 2000). Qualitative research offers five definitive research designs: ethnography, grounded theory, phenomenological, narrative, and case study (Lodico et al., 2010). Each design is unique in its approach to research.

Ethnography is a qualitative design that the researcher uses to study a cultural group and phenomenon in its natural setting through observations and interviews (Fetterman, 2019). This approach offers detailed data otherwise known as thick descriptions or data gathered in the field. Observations and interviews are the sources of data collected over an extended period. Patterns over time are seen within the group's interactions to yield information about how the group functions in a particular situation. An ethnographic design was not used in the current study because this design is used to look at patterns over time and data are collected over an extended period. The current study did not require more than the 1-hour interview that was scheduled with each participant.

Grounded theory is developed from the data to explain the process being studied, thereby making it grounded in the data (Glaser & Strauss, 2019). Grounded theory is used to explore a process rather than the individual involved in the process (J. W. Creswell & D. L. Miller, 2000). The grounded theory design is also used to create an understanding of how things change over time. Similar to ethnography, grounded theory focuses on groups of people who have a particular phenomenon in common (Lodico et al., 2010). I did not select this design because a new theory was not the focus of the current study. The use of data to build a theory from the narrative is a primary component of the grounded theory design.

Phenomenology is the study of participants' lived experiences to interpret data and determine a shared experience (Moustakas, 1994). Van Manen (1990) stated "a good phenomenological description is collected by the lived experience and recollects lived experiences. It is validated by lived experience, and it validates lived experience." Phenomenology focuses on understanding the lived experience of its participants (J. W. Creswell & D. L. Miller, 2000). Through multiple interviews, the researcher gathers the participant's interpretations of experiences (Lodico et al., 2010). Researchers who use this design may observe participants in the natural setting before the interview (J. W. Creswell & D. L. Miller, 2000). In the current study, I gathered information from the lived experience of participants but not over an extended period, and observations were not included in this study. Phenomenologists may interact with and observe participants before interviews; therefore, this design was not appropriate for the current study.

The narrative design includes first-person accounts of experience as data (Merriam, 2009). Narrative analysis is employed when participants choose to tell their stories for the researcher to gain insight into their human experiences (Janesick, 2010). The main purpose of the narrative design is to convey events in chronological order. The design is unique for gathering data that communicates stories and information to understand a person's life (Bogdan & Biklen, 1997). Narrative analysis was not appropriate for the current study because I did not collect narratives to understand the participants' life experiences.

A case study design is popular and used to explore the activities, events, processes, and programs of one or more individuals (J. W. Creswell, 2014). Merriam and Tisdell (2016) described case study research as research developed from the investigation of deeper meaning and understanding. Data collection includes observations, questionnaires, interviews, and data review (Yin, 2009). Case study designs include thick descriptions to gather insightful data from individual participants involved in the research process (Bogdan & Biklen, 1997). A researcher uses more than one data source including interviews, making the case study design not suitable for the current study.

Basic qualitative research is useful for aiding the researcher in conducting an in-depth examination of techniques, training, implementations, and strategies that inform perceptions (Worthington, 2013). This type of research is used to make sense of how people interpret their lived experiences. The detailed firsthand interviews regarding teacher self-efficacy perceptions were the focus of the current study. I concluded that the basic qualitative design was the best choice for this research to explore teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science.

Qualitative research is founded on understanding or insight instead of determining relationships between variables. Basic qualitative studies are popular in research (J. W. Creswell & D. L. Miller, 2000). A basic qualitative study design was selected because I looked for the meaning teachers gave to self-efficacy and student engagement in their world (see Merriam, 2009). Basic qualitative research "works to make sense of a central phenomenon through the eyes of those involved" (J. W. Creswell & D. L. Miller, 2000, p. 124—130). Semistructured interview questions were implemented in this study. Qualitative researchers aim to study a phenomenon within a natural setting while gathering interpretations of its effect on participants' lives. Current participants were a homogenous sample of 10 elementary science teachers at ABC Elementary School in southern Michigan (see Michigan Department of Education, 2021). Findings from this basic qualitative study focused on the teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science, in the effort to support more productive learning environments. Exploring teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement helped me identify the areas of need, where progress might be made, and where professional development could be targeted.

Participants

Qualitative research is centered around the information that participants provide related to the questions that address the study (Lodico et al., 2010). Current participants were a purposeful sample of 10 kindergarten through Grade 5 science teachers at ABC Elementary School in southern Michigan. Purposeful sampling is popular with the qualitative approach because it provides information-rich cases for in-depth inquiry (J. W. Creswell, 2013). Volunteer participants were required to have taught science before the 2021–2022 school year for a minimum of 1 academic year. Teachers had a range of experience in science teaching because the local district hires at varying levels of instructional practice. Although the district was seeking to hire new teachers, most participants had 5 or more years of experience. A few teachers shared students with a co-teacher and taught science to more than one group of students each day. This basic qualitative study took place at ABC Elementary School in southern Michigan. Permission to conduct the study was requested and granted by the school principal (see Appendix H).

The population of participants consisted of kindergarten through Grade 5 science teachers. Selection criteria helps researchers secure appropriate participant selection and validity of results (Lodico et al., 2010). Participants volunteered for the current study. I used the realist sampling method to generate volunteer participants who were active examples of the research goal (see Ravitch & Carl, 2020). Volunteers taught before the 2021–2022 school year. They taught science for at least 1 academic year. First-year science teachers were not asked to volunteer because they lacked the experience to answer interview questions.

Ten participants were recruited for the study to ensure depth of inquiry. Creswell (2013) stated that saturation occurs in most qualitative studies with 10 participants. The current study focused on interviewing 10 participants, but more would have been recruited if saturation had not been reached. Small sample sizes contribute to higher quality inquiry for studies (J. W. Creswell et al., 2019). All procedures were appropriate and ethical in the search for participants.

To gain access to participants, I contacted the building principal to discuss the study's purpose and significance and to obtain written approval for the study to be conducted at ABC Elementary School in southern Michigan (see Appendix H). The request was to approve the use of the setting as a research site. After approval was granted by the IRB and building principal, I scheduled another meeting with school administrators to offer clarification about the study, as needed.

After obtaining approval from the Walden IRB and the school principal, I established a positive rapport with participants at the onset of the study. During a staff meeting, science teachers were informed of the study at ABC Elementary School in southern Michigan. I discussed the study including its purpose and the importance of confidentiality. Teachers were informed that due to the COVID-19 pandemic and safety protocols, interviews would take place on the virtual platform Zoom. Zoom was also used to transcribe the interviews by obtaining a business account. Email addresses for potential participants were acquired through the school's public website. To maintain the confidentiality of potential participants, I emailed the informed consent letter to all teachers who met the criteria. The letter served as both the letter of consent and the letter of invitation. If participants agreed to participate, they were asked to respond to the email using the words "I consent." Teachers were reminded that participation was voluntary. The IRB-approved interview schedule form was sent after consent was granted to participate in the study. Electronic mail invitations (see Appendix F) were issued to follow up with those who did not volunteer at the staff meeting because I did not receive consent from 10 teachers at the onset. I emailed potential participants again requesting their consent for the study. Eventually, a total of 10 teachers responded and agreed to participate in the study. If more than 10 teachers had given consent to participate, I would have selected the first 10 respondents and thanked the others.

Those who volunteered to participate, by responding via email, were asked to participate in a virtual interview. Prior to the interview, contact was made with participants via email (see Appendix F) to inform them of the process, answer questions, and schedule an interview date and time using the IRB-approved interview schedule form. A Zoom platform link was sent once the interview was confirmed by the participant.

A goal of the interviews was to make each participant feel at ease to trust the process because comfort and ease would yield more authentic responses (see Merriam, 2009). A safe and confidential environment was provided for participants to share details about self-efficacy perceptions. I worked to establish a researcher–participant relationship with each teacher, as educators in the same city and sharing the same students. I shared years of experience and personal passions as an educator. This was done to ensure that participants felt comfortable proceeding with the interview and would respond extensively to questions.

I ensured that each participant understood that confidentiality would be maintained throughout the study, regardless of the nature of their response to questions (see Lodico et al., 2010). The privacy and confidentiality of participants was protected from the start of the study until completion. I masked the exact years of teaching experience for each participant by using large categories, such as 1-5 years and 6-10 years. During data collection, I remained unbiased about the participant’s responses, experiences, and knowledge. I reminded participants about privacy and interview protocols while ensuring that they remained aware of the option to withdraw from the study.

To maintain confidentiality, participants were assigned a number that was written on each informed consent form. (see J. W. Creswell et al., 2019). The signed consent forms upheld the integrity of the study. All identifying aspects of the research study were eliminated to maintain discretion (see Triola, 2013). I gathered all written data from the interviews and stored them in a locked file cabinet, only accessible to me. Electronic data were collected and stored on a password-protected external hard drive. After 5 years, all data from this study will be destroyed. Hard copies of data, interview logs, consent forms, as well as confidentiality statements, and agreements will be shredded and disposed of. Also, after 5 years electronic data collected will be erased from each device. All procedures will be appropriate and ethical in the process to destroy data.

Data Collection

This study was a basic qualitative study with semistructured one-on-one interviews. Procedures outlined in the data collection process were critical to the credibility and dependability of the study (see Lodico et al., 2010). Creswell (2013) noted that data collection steps include setting boundaries for the study, collecting data, interviews, visual materials, as well as protocols for recording information.

Justification of Data Collection

According to Creswell (2014), a single source can be used for data collection in qualitative studies. In this current qualitative study, I collected data from a single source, semistructured one-on-one interviews with elementary science teachers. I employed purposeful sampling, considered by Welman and Kruger (1999) as the most essential to identify the participants based on their lived experiences, convenience, and availability. I purposefully chose volunteers who were elementary science teachers because they could relate to the study. Mertler & Charles (2008) suggests finding a small group of those who represent a diverse and vibrant set of perspectives to clarify the phenomenon under study

Interviews are one of the most common forms of data collection in a qualitative study (Merriam, 2009). Interview protocols were used to support the direction of the open-ended, data collection process (see McMahon & Patton, 2002). The Interview Protocol (see Appendix B) guided participants during the data collection process. Interview questions were designed to help me explore teachers' self-efficacy perceptions to teach science and what they thought were the challenges to enhancing student engagement in science.

Data Collection Instrument, Sources, and the Interview Protocol

Semistructured one-on-one interviews yielded data to answer the research questions in the examination of each teacher's perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. After approval was granted by the IRB and school principal, I contacted participants via email with specifics about the location for the interview along with 2 date and time options. When a date and time had been selected, a reminder was sent to participants, the day before the interview. I remained flexible and adjusted the dates and times if it was requested by a participant. Approximately 1 hour was allotted for each interview. A safe and confidential environment was provided for participants to share self-efficacy perceptions. I established a researcher-participant relationship with each teacher by reminding them that I am an educator in the same city with a similar population of students. I shared my years of experience and personal passions as an educator. This was done to ensure that participants feel comfortable responding extensively to questions during the interview process.

On the day of the interview, I recorded each interview using a password-protected, computer. Interviews were held on Zoom and I recorded each session on my cell phone, as a backup device. I used transcripts provided by Zoom after attaining a business account. I took notes during each interview to support the research findings but was careful to focus my attention on interactions with the participants.

A safe and confidential atmosphere was maintained during each interview (see J. W. Creswell & D. L. Miller, 2000). At the start of each interview, I made participants feel relaxed by reminding them of my commitment to confidentiality. Confidentiality was of the utmost importance; therefore, participants' names were protected by assigned pseudonyms (see Kvale & Brinkman, 2009). An interview protocol form (see Appendix B) was employed during each interview session. Teachers were able to express their perceptions and shared experiences (J. W. Creswell & D. L. Miller, 2000). The interview protocol included open-ended questions designed to spark thought, elicit dialogue, and provide an opportunity for follow-up questions. Interview questions were focused on the teachers’ perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science.

Sufficient data were collected using research questions and semistructured one-on-one interviews. During the interviews, if participants provided a limited response, I probed using follow-up questions to elicit a thorough response. The collection of data continued until saturation was achieved (Merriam, 2009). Participant responses provided the data needed to answer research questions. Since the purpose of this study is to explore teachers’ perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science, participant input was vital (see J. W. Creswell & D. L. Miller, 2000). Exploring teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement helped me identify the areas of need, where progress might be made, and where professional development could target. The goal is to show where changes could be made that may positively influence science learning.

Procedures of Data Collection

Data collection began after Institutional Review Board approval, principal approval (see Appendix G), and receipt of Informed Consent. Interviews were scheduled using the IRB interview scheduling form. Participant interviews were held in a confidential atmosphere via Zoom. Data generated were recorded on an electronic device in preparation for transcription and coding (see Klassen et al., 2012). Data that were electronically recorded remained in a password-protected environment. I had sole access to handwritten interview data because it was stored in a secure location.

Data Collection Tracking System

A timeline and schedule were established for interviews to be conducted with participants at ABC Elementary School in southern Michigan. I tracked the data using a list with the file name of each interview, date of the interview, date of transcript review and cleanup, date of first open coding, date of second open coding, and date of thematic coding to create an audit trail. A reflective journal was used to capture personal reactions to what was uncovered during the interviews. Written data gathered was protected in a locked file cabinet at home, that was only accessible to the researcher. Electronic data were collected and stored on a password-protected external hard drive. A level of saturation was reached before the conclusion of data collection (Merriam, 2009). After 3 weeks additional participants were required because only 6 participants responded and were interviewed. I used snowball sampling by asking one participant to recommend others to be interviewed (Crabtree & W. L. Miller, 1992). I also used follow-up emails to reach the goal of 10 participants. Semistructured one-on-one interviews were electronically recorded via Zoom and transcripts were retrieved at the end of each interview. I also took notes using the interview protocol form (see Appendix B).

Role of the Researcher

I have been an educator for 24 years. During this time, I served as an elementary educator, lead science coach, and administrator. Interest in elementary science and teacher self-efficacy stems from a desire to promote educational success for all parties. I have never been employed by ABC Elementary School in southern Michigan. To reduce the potential for bias, participants were not recruited from the school where I am employed. I am hopeful that findings from this study will encourage efforts to increase teacher self-efficacy in science.

During interviews, I was responsible and obligated to seek and accurately report rich personal accounts while maintaining ethical standards to protect the integrity, values, and rights of each participant (see Creswell, 2003; McMahon & Patton, 2002; Moustakas, 1994). I did not coerce responses from teachers. I probed for additional information if responses were insufficient. Conversations were guided by research questions. The interviews felt like a normal conversation between colleagues. It was critically important that I not engage in judgmental thinking but use all data for coding and analysis. To further reduce the chance of bias, I did not interject an opinion when a common experience was shared by participants.

Data Analysis

Determining how to organize data is an important aspect of qualitative research. Data analysis is a process that should be approached with caution and skill. I used two phases to analyze the collected data as suggested by Rubin (2005). First, all data were collected from the 10 interviews and prepared for analysis by printing out transcribed interviews from Zoom (see Appendix D). To protect participants, names were not used during the study. Each interview file was labeled according to the number assigned to participants at the start of the interview. Before coding the data, I read and reread all transcribed interviews to ensure that I had an understanding of participant comments. Transcripts were compared to field notes to maintain evidence of quality.

Member checking was used to engage participants in the initial research findings. According to Merriam & Tisdell (2016), member checking ensures that the researcher records the participant’s thoughts and ideas with accuracy. Member checking ensured accuracy of initial research findings (see J. W. Creswell et al., 2019). Each participant was invited to review and comment on the initial findings. I supplied each participant with the codes that came from their interviews, definitions of each of those codes, and a short quote from the transcript. I asked participants if any of the codes were incorrect; did I misunderstand something they said? These findings were emailed to participants requesting feedback in the form of a suggestion within three days. Although no one replied to the email with a suggestion, I received 2 email responses thanking me for the interview. All participant suggestions would have been included in the research findings to ensure accuracy of the data.

Next, I read the transcripts again. The purpose was to write down emerging ideas from the analysis of the interview data and to begin coding ideas. According to Saldaña (2021), a code is a researcher-generated interpretation that symbolizes data. I assigned code words or phrases to explain ideas that were found in the study and directly linked to the research questions. Initial coding revealed 84 emerging ideas. As in vivo coding was completed, it allowed me to find commonalities in the data. I made use of a Word document as data were grouped into categories that organized similar ideas. Next, I developed a table with the assign participants' pseudonyms across the top and selected codes on the left. A check mark was added to the table under participants and next to the assigned code words or phrases given during interviews. I studied the table repeatedly and began to code responses. Then I looked for patterns in the data. I organized the captured codes into meaningful categories. These meaningful categories led to the development of themes that were used to answer research questions (see J.W. Creswell, 2014; Merriam 2009). Coded ideas and patterns that occurred frequently in the interview data were considered a major theme. I began the process of analysis with coding, followed by the development of categories, that were organized into themes.

Discrepant Cases

Discrepant cases should be expected and included in the data analysis process. All participant responses were considered in the data analysis for the current study. Hatch

(2002) stated that the perception and comprehension of the meaning of something begins with specific elements and finding connections among them. The purpose of this basic qualitative study was to explore teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. Exploring teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement helped me identify the areas of need, where progress might be made, and where professional development could be targeted. Teacher perspectives can shift from person to person. When analyzing the data, dissimilar experiences can occur (J. W. Creswell & D. L. Miller, 2000). Data that may not fit into a specific category could be a discrepant case. Responses in this study did not fall into the category of discrepant. If discrepant data had been found, it would have been factored into the analysis.

Data Analysis Results

The problem prompting this current qualitative study was that elementary teachers in the local area lacked self-efficacy to teach science and were struggling to engage students in science learning. The purpose was to explore teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. Ten participants were interviewed and given a numerical code to ensure privacy and confidentiality. This numerical code was referenced on each document related to the study. The following four themes were ascertained from the data collected through semistructured one-on-one interviews with 10 local elementary science teacher participants: a) elementary science teachers have limited methods of teaching science to engage students, b) elementary science teachers face several challenges, c) elementary science teachers do not feel confident engaging students in learning science, and d) elementary science teachers desire specific training to improve their science instruction. I organized the codes into categories and then into themes that are included in Table 3. The table is followed by a presentation of the four themes supported by participants' quoted statements.

Table 3

Themes: Perceptions of Elementary Science Teachers

Data category	Theme
Approaches to engaging students: • Videos • Reading/Reading Aloud • Q&A • Demonstration lessons	Elementary science teachers have limited methods of teaching science to engage students
Current challenges: • Reading and mathematics are viewed as a priority over science • Time limits • Lack of science instructional skills • Teacher observations/evaluation	Elementary science teachers face several challenges
Barriers to teaching science: • Lack of confidence • Lack of training • Lack of resources and strategies • Limited college preparation	Elementary science teachers do not feel confident engaging students in science learning
Desired professional developments: • MSS • Time management • Fun science strategies • Science resources	Elementary science teachers desire specific training to improve their science instruction

Theme 1: Elementary Science Teachers Have Limited Methods of Teaching Science to Engage Students

Elementary science teachers perceived that they lacked the necessary strategies to engage students in science. The first theme was derived from the limited current methods used to engage students in science learning. Participants described the following current methods: (a) videos, (b) reading/reading aloud, (c) Q&A, and (d) demonstration lessons.

This theme revealed the limitations of participants' methods for teaching science. Several participants shared that they used videos to engage students. For example, Participant 3 stated,

> I mostly use videos to engage students. They watch videos at home most of the time anyway, but I admit that I could use some more ideas for teaching science. Every once in a while, I will do a demo lesson, but I usually run out of time.

Similarly, Participant 5 stated, "I search for YouTube videos to match the topic or lesson unit." Participant 7 communicated, "I was able to find a wonderful collection of videos from a teacher group that I joined. Videos make science instruction 10 times easier."

Other teachers use reading aloud as a means to teach science. Participant 8 stated, "I use colorful text, oral readings, and sometimes we have time for an experiment that I do in front of the class." Participants 9 and 10 affirmed the same idea as Participant 8. Participants 9 and 10 teach science along with reading using what they called a, "cross-curricular approach."

Other teachers had a variety of approaches to engage students. Participant 1 stated, “I use a lot of videos. Probably more videos than I should but afterwards we are able to discuss it and learn from it. I have done a demonstration lesson or two as well.” Participant 6 responded, “I pretty much follow the textbook method- reading, investigations, some videos online.” Participant 4 stated, “I try to make everything I teach exciting by acting like I am excited about the topic, even if I am not.” Participant 2 mentioned, “I mostly use take-home reading projects with Q&A since we usually run out of time during class. This allows the students to still learn science even when they are not at school.” Participants shared methods currently used to engage students but most chose videos, reading/reading aloud, and demonstration lessons for science instruction. Teachers felt that they do not have enough methods to engage students in science learning.

Teachers made several confessions about not preparing for variety when lesson planning, indicating that they do not have the ability to engage students in science learning. Participants 1, 3, and 5 shared similar responses. Participant 1 responded, “I do my best to search for videos that match the curriculum and I do my best to not fall behind with the pacing outlined by the local district. I do not think I am a strong science teacher.” Participant 3 stated, “I am a strong Earth science teacher, but that topic is not completely taught in elementary grades. In general, I do not feel like a strong elementary science teacher because I keep using the same methods to teach. A real science teacher would have more strategies than I do.”

Teachers frequently expressed that they were not strong science teachers, supporting this theme that they have limited science instructional methods. Participant 6 stated, “My strength is that I am willing to ask other science teachers for support. I am willing to learn how to be a better science teacher.” Participant 5 responded, “I am not a strong science teacher. I am stronger at mathematics or social studies. Students seem bored during science time; so, I try my best to excite them, but it is not working.” Participants 8 and 10 had similar feelings and communicated that they do not have strengths. Participant 9 stated, “Honestly, I do not like science, and I do not like teaching science. Therefore, I am not a strong science teacher.” Participants expressed that they have limited methods and few strengths to engage students in science learning.

Teachers discussed details about the science trainings they have experienced and where they learned to teach science. Participant 9 stated, “I took the required science course in college and since I do not like science, I have not attended any trainings.” Participant 3 responded similarly, “In college I took the required two or three classes and that has been all the trainings that I have had in science.” Participant 2 stated, “Three semesters in college and a few professional developments since I started teaching nine years ago.” Participant 10 stated, “Besides college, I recently attended some science professional developments to keep my certification. Other than that, I have not had any trainings.” Participant 5 responded, “I had to take a class in college, and I have attended maybe 1 other trainings in the past.” Participant 6 responded, “I have been to one professional development on science. I also had 1 semester of science in college.” Participant 1 stated, “Well, I have been to a few science workshops. I can’t remember the names but the last one was maybe 5 years ago. I have had a lot of training in math and reading but not science or social studies." Participant 7 stated, "I have not been required or offered any science training because the focus is always on mathematics and reading." Participant 8 and 4 stated that they have not attended any science trainings outside of college, but they would if it were offered at the school. All participants expressed a lack of training in science.

Theme 2: Elementary Science Teachers Face Several Challenges

Data from the second theme shows that elementary science teachers face several challenges. These challenges include: (a) viewing reading and mathematics as priorities, (b) time limits, (c) lack of instructional skills, and (d) teacher observations/evaluations.

Local elementary science teachers face several challenges. Seven out of ten participants expressed that a focus on reading and mathematics keeps them from teaching science for 50 minutes each day. Participant 5 stated, "Students want to be entertained and I can't spend too much time looking for strategies or resources especially since science is not really the emphasis at our school. Reading and math scores are what the school administrators evaluate us on each year." Participant 2, 7, and 10 had similar ideas about time limits and its effect on student achievement. Participant 2 stated, "Students are not exposed to science because teachers run out of time trying to help students learn how to read and perform in mathematics." Participant 7 stated, "Teachers have to focus on other subject areas to keep our jobs. Reading and mathematics are the focus at most schools and that is why achievement is very low in science." Participant 10 stated, "I think teachers do not have time to teach science. Or should I say teachers do not make time to teach science? Exposure is everything!"

Participant 2 discussed specific challenges, "The challenge to engaging students in science is that they do not have a good foundation in science education. They lack background knowledge. They do not have background knowledge because teachers focus on teaching reading and math not science." Participant 2 continued, "My specific challenge is that I need support to focus less on reading and give proper time to science instruction."

Participant 3 stated, "We are stretched too thin as self-contained teachers. We have to teach too many subjects and most days of the week we run out of time and do not teach science. I need time management support so that students do not miss curricular content." Participant 9 expressed the same idea stating, "We have too much on our plates because we teach all subjects and that is the challenge to engaging them. My specific challenge that I face is that I do not like science, and I do not know the curriculum like other teachers do." Participant 4 stated,

> Students do not like science. They seem bored by the topics. Maybe more materials would help. The school needs to place more emphasis on science instruction. Most of our professional developments are about reading and math. Also, most days I run out of time and do not teach it. Specific challenges that I face when teaching science is that I just learned about the new MSS standards but still need more help learning how to teach them to students.

Participant 6 had a similar response regarding their instructional skills and stated, "I am the challenge to engaging students in science learning. I need to be more excited to teach science." My specific challenge is my limited expertise in teaching science." Participant 8 also expressed being challenged because of limited science instructional skills.

Participant 1 and 10 both expressed that the curriculum is boring, and it is the challenge. Participant 10 stated, "The curriculum is so dry; it even bores me. Reading is more exciting than science. Science should be fun. We need new, exciting science lessons. Specific challenges that I face are that I do not have the skills I need to teach science. I was not trained enough to do a good job of teaching science for students to learn."

The participants concurred that there are several challenges to engaging students in science learning. These challenges include an emphasis on reading and mathematics in the local district and an inability to teach science the required amount of time. Teachers were also challenged by a lack of instructional skills, and teacher observations/evaluations that focus on reading and mathematics.

Participants 1 and 4 had similar ideas about low achievement in science and blamed it on the students. Participant 1 stated, "Science is boring to students. We have a book to read and students get tired of reading when they just read during reading class. I try to read it to them aloud, but they still do not seem interested and they don't do well on tests. That is why I introduced videos to make it more interesting." Participant 4 stated, "Achievement is low in science because students do not like science." Participant 8 stated, “Teachers and administrators should focus on science and social studies just as much as they focus on reading and math.” Most participants attribute low student achievement to the teacher lacking time management, focus, or skills.

Participants shared ideas on how to resolve the challenges that they are facing in the effort to engage students in science learning. Participant 9 stated, “Although it is not my favorite subject, teachers should have regular opportunities to learn science instructional strategies in school, during our staff meetings. I need training to improve.” Participant 2 stated,

> I want more training in science and more emphasis on science instruction. My concerns could be addressed by speaking to administrators so that I can attend more professional developments. Also, I can request that more emphasis is placed on science so that students come to my class more prepared.

Participant 5 stated, “I do not have the skills necessary to teach science, so I need help with it. To address my concerns, I guess I could look for and attend science trainings to increase my skills.” Participant 7 stated, “I should not have to join a teacher group outside of the school to get science materials that are interesting to students. The school should provide an updated curriculum with technology to match. We spend too much time focusing on reading and math.” Participant 4 stated, “The school does not do enough to support science education. Teachers have to do everything without support from the admin team.”

Participant 6 agreed,

> I need more training. Honestly, there is not enough time in the day to teach science because we have to focus on reading and math. I could address this by, being better with time management because it is a problem; more professional developments are needed too. I would like to have lessons modeled so that I can have more strategies.

Participant 1 stated, “I am concerned about not teaching it as often as I should and not having enough strategies to make science fun. I could attend more workshops to help me teach science better with more strategies and I could use a timer to make me stop teaching reading and math so that there is time for science. Participant 8 and 10 discussed concerns regarding student achievement. Participant 8 stated, “My concern is that I want students to achieve, and right now most students have higher grades in the other subject areas that I teach. Maybe my concerns would be addressed if I spent the time teaching science that I am supposed to so that my students could achieve.” Participant 10 stated, “My concern is that other teachers do not take science seriously because it is not a part of our evaluations or classroom observations. This concern could easily be addressed if science education and student scores in science became part of our evaluations.”

Participant 3 stated,

> My concerns when teaching science are a lack of resources, a lack of science training, budget cuts, no science role-models to look up to in the community. My concerns could be addressed by the school having a dedicated science lab with materials related to the new standards and professional development to help get teachers acclimated to the curriculum.”

Participants expressed concerns about the many challenges that they face. They acknowledged the need to teach science but articulated reasons why it is a struggle.

Theme 3: Elementary Science Teachers Do Not Feel Confident Engaging Students in Learning Science

Local elementary science teacher expressed that they do not feel confident engaging students in science learning. This theme represents the problem that the study addresses and identifies the barriers to self-efficacy when engaging students in science learning. Barriers identified by the participants were (a) lack of confidence, (b) lack of training, (c) lack of resources and strategies, and (d) limited college preparation.

Eight of ten participants described a lack of confidence when attempting to engage students in science learning. The other two participants described not feeling fully confident to engage students. Participants shared feelings about their level of confidence. Participant 1 reiterated, “Like I said, I am not confident teaching science but maybe I would be if I taught it the way that I am supposed to, or I had more skills to teach it and make it interesting. I do not feel confident teaching science because students fall asleep or do not pay attention during science.” Participant 9 stated, “I feel confident when a student remembers something from the science lesson that I taught. As I said earlier, I do not feel confident because I do not like science. My lack of confidence is due to a lack of college preparation or training after college.” Participant 3 stated, “I feel the most confident when students get excited because they watched a science video that I selected to match the curriculum. Conversely, I do not feel confident when students are not interested in what is being taught or fall asleep during a lesson.” Participant 7 stated, “I feel confident when I have done my best to prepare a lesson. I feel unconfident when the lesson I did my best to prepare is not interesting to students." Participants 5 and 10 had very similar responses to the question. Participant 5 stated, "I feel confident when I have a lesson that is interesting, that I know will capture the attention of students. I do not feel confident when I am forced to rush through a science lesson because I ran out of time due to teaching reading or math." Participant 10 stated, "I feel confident when I can get to the science lesson for the day and do not run out of time. I do not feel confident because science is not my best subject. I am not confident teaching science because I have not had any other trainings for it, outside of college." Participant 2 stated, "I feel confident when students score better on the posttest than they did on the pretest. I lose my confidence when teaching a science lesson if students receive low test scores after I have instructed them. Also, when students look bored when I am teaching." Participant 8 said, "I feel confident when I prepared a lesson and it seems fun to me. I feel unconfident because I need more science strategies." Participant 10 stated, "I feel like a weak science teacher due to the university I attended. Elementary teachers should have been required to take just as many college courses [in science] as they did reading and mathematics courses." Participant 6 emphasized:

> There are times when I can integrate part of the science curriculum with ELA and that is when I feel pretty confident. I am confident in ELA, but lack confidence in my weaker area of science. From this interview I realize that I need to seek the help I need because my students deserve so much more. I do not feel confident teaching science because I feel that I lack the right training

Participant 4 stated,

> I feel confident when I know the content and have a fun demo lesson or video to share with my students. But, when I keep using the same strategies and I see that students are not interested in what I am teaching I become a bit discouraged which leaves me feeling unconfident.

Participants spoke of their personal strengths and weaknesses. Participant 5 stated, “A weakness that I have when teaching science is that I do not find ways to get students excited about the lesson.” Participant 6 stated, “My weakness is that I feel rushed and overwhelmed. I have a strong ELA background. Science is difficult for me to give a full 100%.” Participant 2, 4, and 10 had similar comments about a lack of strategies and resources being a weakness. Participant 2 stated, “The weaknesses that I have are related to using outdated science materials, having limited strategies, and resources to use when teaching science.” Participant 7 stated, “Well, I guess that even though the video set works well, my weakness is a lack of other resources or strategies to keep the kid’s attention in science.”

Participant 4 stated,

> Personally I think my weakness is that I seem to use the same strategies (videos and demonstration lessons) over and over again. I could use some new resources to mix things up. I also do not teach science every day because we run out of time.

Participant 10 stated, “The weakness that I have is that I do not always get to teach science because reading and math lessons run over. I need help with time management.”

Participant 9 stated, “My weakness is that I do not like science, and I am still expected to teach it to increase student achievement.” Participant 8 stated, “My weakness is running out of time to teach it on a daily basis. I focus too much on reading.” Participants openly shared their concerns about science instruction.

Theme 4: Elementary Science Teachers Desire Specific Trainings to Improve Their Science Instruction

Elementary science teachers shared their desires for specific science professional development training. They expressed a desire to learn more about (a) MSS, (b) time management skills, (c) engaging science strategies, and (d) resources to help improve science instruction. Participants openly shared why they feel student achievement is low in science and most believe that it is because of their instructional skills. Eight out of ten participants agreed that the reasons for low student achievement is due to their instruction or lack of instruction. Participant 3 and 6 had similar statements. Participant 3 stated, “Science teachers are needed to raise achievement. We need more training to feel like science teachers.” Participant 6 simply stated, “Not having teachers with strong science backgrounds is the reason for low student achievement in science.” Participant 9 displayed frustration and stated, “My lack of training is the reason for low student achievement. In college, I was required to take 1 semester of elementary science. Since graduating from college, I have not been required to take any continuing education classes in science and now they expect me to teach science well?”

Data derived from the current study indicates that elementary science teachers would welcome professional development opportunities. Participant 1 stated, “I would like to know more about the new science standards and how to teach it so that it is fun, and how to make time for all subjects." Participant 3 and 4 responded similarly. Participant 3 stated, "The science training that would be most beneficial to me would be managing the time between all content areas, learning about the new standards, and new science strategies." Participant 4 declared, "I need more strategies and resources. I would also like ideas on how to make sure science is taught daily." Participant 8 and 9 both wanted to know more about the MSS and how to implement it in their science classroom. Participant 8 said, "We had a science assembly for students and the presenter mentioned that there are new standards. I had no idea, but I would like to learn about the new standards and strategies to implement and engage my kids. I would also like help with teaching all subjects each day." Participant 2 stated, "I would like more PD with strategies on the MSS and technology to teach science in an exciting way." Participant 5 affirmed, "Professional developments to help me feel more confident when teaching science. I want to do the fun science stuff while still helping students learn the content." Participant 6 and 7 had a similar response as Participant 5. Participant 6 stated, "A science strategies training (is needed), and professional developments for novices like me. Also, I am finding it difficult to teach science each day, so I need help with that too." Participant 7 stated, "I want to have fun in my science classroom and teach MSS. I need training to help me get there." Participant 10 stated, "I want to learn how to make time for a full science lesson instead of always using a cross-curricular approach."

Participants shared the type of support that would be most beneficial to engaging students in science learning. Participant 5 shared, "I need support to learn new strategies to make students enjoy science." Participant 4 and 7 had similar points of view. Participant 4 stated, "I would like to learn more about the new science standards. I should not have to go to a workshop outside of the district to learn about the MSS. We should be taught in the school building maybe during a Professional Learning Community (PLC)." Participant 7 stated, "I should not have to join a teacher group outside of the school to have more science resources. I would like a PD that teaches me how to keep science a fun subject for students." Participant 3 stated, "It would be supportive to have in-house PD's focused on science and time management." Participant 8 stated, "I would like to work with my colleagues. Maybe we can lesson plan together during a science workshop where we all get to learn new science information." Participant 10 stated, "Administrators should support us by providing a science workshop." Participant 1 stated, "I would really like some training, maybe a workshop so that I can make science interesting to me and the students. I would also like some resources and lessons that are hands-on. Participant 2 had a slightly different viewpoint and stated, "More science field trips, science professional developments, STEM and STEAM activity resources." Participant 6 simply stated, "An intense but fun professional development series." Participant 9 stated, "I need the district to provide more in-school professional developments to ensure we are effective even if we do not like science." In summary, teachers desired very specific professional development opportunities that would support engaging science instruction. Participants expressed a desire to learn more about the MSS, time management skills, engaging science strategies, and resources to help improve science instruction.

Evidence of Quality of Data

I followed procedures to ensure the accuracy of data. Rich and thick descriptions of data collection procedures, findings, and experiences are included in the current study. Providing extensive details about the data collection process and personal reflections adds to the strength of the study (see Merriam, 2017). Data collection continued until saturation occurred with 10 participants to safeguard the accuracy of data. All interviews were transcribed and coded with copious detail. I compared transcribed data to field notes to maintain accuracy and quality of data. A sample transcript is included in the Appendix (see Appendix D). To establish credibility, after all interviews were transcribed and I identified the initial findings, member checking was implemented. Member checking was used to engage participants by having them review the initial findings. They were asked to respond to the findings. According to Candula (2019), member checking ensures that participant responses have been recorded with accuracy and do not include bias from the researcher.

Summary of Outcomes

The following is a brief outline of the research questions and how they were answered according to the results. In exploring elementary science teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science, I addressed four research questions:

RQ1: How do local elementary teachers describe their methods of teaching science to engage students? Theme 1 indicates that elementary science teachers acknowledge their limited methods of teaching science to engage students. Participants admitted that they have limited strategies to engage students in science learning. Currently, teachers use videos, reading/reading aloud, Q&A, and/or demonstration lessons.

RQ2: How do local elementary teachers describe challenges to engaging students in learning science? Theme 2 indicates that local elementary teachers face challenges. One challenge is that they allot more instructional time to reading and mathematics while teaching science at the end of the school day or not at all. Participants discussed issues teaching science because the school’s focus is on reading and mathematics. Student test scores in reading and mathematics are attached to teacher observation and evaluation scores. Participants explained that time limits and their lack of instructional strategies negatively impacted science instruction.

RQ3: How do local elementary teachers describe their self-efficacy for engaging students in learning science? Theme 3 indicates that local elementary teachers do not feel confident engaging students in science learning. Eight of the ten participants revealed a lack of confidence when attempting to engage students in science learning. The other two participants revealed limited confidence to engage students in science. Participants articulated barriers in this area related to their lack of confidence, a lack of training, a lack of resources or strategies, and limited college preparation.

RQ4: What supports do local elementary teachers think they needed to help improve their science instruction? Theme 4 indicated that local elementary teachers desire training to learn more about the MSS, time management, strategies, and resources to improve their instruction. Participants desired professional development to improve instruction and learn new science strategies. All participants were aware of the new standards but only one participant had been trained in MSS. Participants requested time management guidance to help them transition from reading and mathematics at the appropriate times.

Summary of the Findings

Research questions guided the study in the effort to better understand teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. Research questions were open-ended, unbiased, and objective to maintain validity (J. W. Creswell & D. L. Miller, 2000). Participant responses to the research questions provided insight to the study and lead to the four themes.

The following themes were derived from the data, are discussed in this section, and connect to literature: a) elementary science teachers have limited methods of teaching science to engage students, b) elementary science teachers face several challenges, c) elementary science teachers do not feel confident engaging students in learning science, and d) elementary science teachers desire specific trainings to improve their science instruction.

Theme 1: Elementary Science Teachers Have Limited Methods of Teaching Science to Engage Students

Participants emphasized that they lacked sufficient and varied strategies to engage students in science learning. Currently, teachers use videos, reading/reading aloud, Q&A, and/or demonstration lessons. Loeser (2018) noted that teachers should use a variety of methods for science instruction. Coenders and Verhoef (2019) found that the use of numerous science teaching strategies is most effective in science instruction. Conversely, Hall & Trespalacios (2019) discovered that when science instruction was limited by a few strategies, students were not engaged, they did not learn, and it impacted their achievement. Participants asserted limited training in science as causation for limited methods of teaching science to engage students (Clark & Newberry, 2019). Most participants stated that beyond college, they had few or no science professional development. Recent researchers found that most teachers do not like teaching science because they do not feel prepared to effectively instruct students (Y. L. Chen & Mensah, 2018; Mensah & Jackson, 2018; Novak & Wisdom, 2019). Fitzgerald et al. (2019) found that science teachers who do not experience professional learning beyond college are not as effective as those who do, and instruction is negatively impacted. Kolb's experiential learning theory (2014) promotes that student interest through engagement in the learning process is an essential classroom practice. Participants in this study stated that they have limited instructional methods to engage students in science learning.

Theme 2: Elementary Science Teachers Face Several Challenges

The second theme reveals that local elementary science teachers face several challenges. Participants discussed their issues with teaching science because reading and mathematics test scores are the school's focus. Moreover, student test scores in reading and mathematics are attached to teacher evaluations and observations. According to Reilly et al. (2019), elementary teachers feel pressured by school administrators because their evaluation is based on student test scores in reading and/or mathematics. The pressure to perform in reading and mathematics causes many educators to teach science at the end of the school day or not at all, at the expense of science education (Bae & Lai, 2020). Hall and Trespalacios (2019) found that elementary science is vital because it provides students with the confidence to achieve and participate in more advanced scientific studies. According to Karadağ (2019), if teachers believe their ability to teach science is insufficient, they may develop a dislike for the subject and not teach it as mandated.

Participants explained that when teaching science, they are impacted by time limits and their lack of instructional strategies and skills. Research supports what participants have expressed. Sawlane and Shaikh (2018) found that most elementary teachers do not teach science as outlined in the curriculum. Most elementary teachers experience the pressure of inadequate time because they are required to teach reading, mathematics. science, and social studies (Sawlane & Shaikh, 2018). Mosoge (2018) found that teachers with low self-efficacy were less confident and students were less interested in science education. Participants revealed that they are challenged by the pressure to ensure that elementary students can read fluently and perform in mathematics to the detriment of science instruction.

Theme 3: Elementary Science Teachers Do Not Feel Confident Engaging Students in Learning Science

The third theme revealed that local elementary science teachers do not feel confident engaging students in learning science. Eight of the ten participants revealed that they do not feel confident engaging students in science. The other two participants revealed that they are not fully confident. According to Rew et al. (2018), teachers who do not possess self-efficacy will not implement engaging science strategies that have been proven to increase interest. Participants discussed many barriers including a lack of confidence, lack of training, lack of resources or strategies, and limited college preparation. Acar et al. (2018) found that problems in science teaching range from a lack of time for instruction to a lack of teacher knowledge. According to Gardner et al. (2019), a lack of teacher self-efficacy can have a negative impact on student engagement and achievement. White and Rotermund (2019) found that science teachers who lack resources or appropriate strategies to teach produce students who dislike the subject. Participants expressed concerns about science training after college. According to Menon (2020), most elementary teacher education programs inadequately prepared them to teach science, which leads to a lack of confidence. Bandura's theory of self-efficacy provides a connection between teacher perceptions of self-efficacy and its influence on student engagement (Bandura, 1977). The self-efficacy of teachers when instructing students in elementary science education is an important subject. Bandura (1982) described self-efficacy as the judgments or beliefs that an individual holds about their capacity to take the required action to successfully cope with a given situation. What teachers believe about their abilities has a major impact on what students learn, are interested in, and directly correlates to achievement levels (Larry & Wendt, 2021). It is important to support the confidence of teachers in the effort to ensure that students receive an impactful science education.

Theme 4: Elementary Science Teachers Desire Specific Trainings to Improve Their

Science Instruction

The final theme revealed that local elementary science teachers desire training to learn more about the new science standards (MSS), time management, strategies, and resources to improve instruction. According to Sprott (2019), teachers need continuous exposure to current trends in education to maintain their instructional confidence and capacity. Participants desired professional development to improve science instructional practices and student engagement. According to Ketelhut et al. (2019), elementary science teachers need instructional support to ensure that students are prepared for the next level of education and beyond. Participants expressed interest in learning the MSS. All participants were cognizant of the new standards but only one participant had received training. Participants requested time management support to assist them in transitioning from reading and mathematics at the appropriate times. Research suggests that professional development is especially important to elementary teachers. Polly (2017) continued to state that if elementary teachers do not participate in professional development, they will become confident teaching one subject area and lose confidence teaching others.

The conceptual framework that guided this study was Bandura's (1986) self-efficacy beliefs because self-efficacy is a critical factor in influencing individual behavior. Bandura's theory of self-efficacy provides a connection between teacher perceptions and its influence on student engagement (Bandura, 1977). Bandura asserted that a person's self-efficacy beliefs determine, "how they behave, their thought patterns, and the emotional reactions they experience in taxing situations" (1982, p. 123). In 1997, Bandura found that a science teacher's self-efficacy is important because of its significance to "scientific literacy and competency in the technological transformations occurring in our society" (p. 242). Bandura's theory provides the basis for understanding the self-efficacy of elementary science teachers and the need to increase their perceptions because self-efficacy profoundly impacts student engagement.

The four themes showed that local elementary science teachers lack self-efficacy to teach science and they desire professional development support to improve student engagement. Participants described limited methods of teaching science to engage students. They also discussed several challenges. All participants mentioned the importance of professional development to improve instruction and increase student engagement in science. Participants desire professional development to learn about MSS, time management, fun science strategies, and resources.

Based on the findings, I propose developing a science professional development to provide elementary teachers with content-specific support. This professional development will address the problem that prompted this current study teachers lacking the self-efficacy to teach science and struggling to engage students in science learning. Elementary science teachers need support to increase their self-efficacy and to address identified challenges. In section 3, the findings were used to inform the direction of a 3-day professional development project to facilitate elementary science teachers' lack of self-efficacy.

The Project Deliverable

Based on the finding of this current study the project deliverables include recommendations for future research. Future research could include the replication of this study with teachers from various grade levels or districts. Second, future research might comprise of interviewing science teachers after the implementation of the professional development and then again after a full semester of teaching with the science strategies and resources. Third, future research could include classroom observations at the local site to identify science best practices to engage students. These best practices would then be shared and implemented by all elementary science teachers at the local site. Last, future research might shift to focus on student needs and what might help them to be engaged in science.

Another project deliverable is the elementary science professional development template (see Appendix A) with resources that can be used by teachers who need self-efficacy support to engage students in science learning. The elementary science professional development template could also be used by educational leaders who support teachers that need self-efficacy support. The 3-day professional development was designed based on the findings of this study. The goal of this 3-day professional development is to bolster teacher self-efficacy to teach science, engage students in science learning, and meet the identified needs of teachers as expressed during interviews. During the 3-day professional development project, positive social change may occur as teachers experience an increase in their self-efficacy perceptions to teach science and engage students in science learning. This may take place as teachers experience an increase in their self-efficacy perceptions as they explore their beliefs through relevant readings, videos, self-reflection, and growth mindset training. During the 3-day professional development, teachers will also delve into MSS, science best practices, engaging science strategies, and collaborate with colleagues to plan stimulating science lessons for implementation in their classrooms. This project deliverable has the potential to make a positive social impact on elementary science teachers' self-efficacy perceptions and student engagement.

Section 3: The Project

In this section, I describe the project. Section 3 includes a description of the professional development plan, goals, rationale, resources to support participants, implementation plan, and potential barriers. A second literature review supports the emerging themes that were identified through data collection. The conclusion of Section 3 includes project details and implications for positive social change.

The purpose of this basic qualitative study was to explore teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. The problem prompting this basic qualitative study was that elementary science teachers in the local area lacked self-efficacy to teach science and were struggling to engage students in science learning. During the data collection process, I explored 10 local teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. The themes I developed during data analysis included (a) elementary science teachers have limited methods of teaching science to engage students, (b) elementary science teachers face several challenges, (c) elementary science teachers do not feel confident engaging students in learning science, and (d) elementary science teachers desire specific training to improve their science instruction. Based on these emerging themes, professional development was planned. This 3-day professional development session will focus on elementary science instruction to improve teacher self-efficacy perceptions by providing information about the new standards and new skills through the use of engaging science strategies and time management techniques to support students in science learning.

I developed a project that consists of a comprehensive and engaging 3-day professional development session to address the emerging themes that were found in the study. The four emerging themes revealed that elementary science teachers desired and could benefit from these sessions. This professional development was designed to address the problem that prompted this study: teachers lacking the self-efficacy to teach science and struggling to engage students in science learning. Moreover, this project addressed the gap in practice, which was the teachers' lack of self-efficacy to develop appropriate strategies to stimulate student engagement in learning science. Interviews revealed that many teachers struggled with science due to limited science instructional skills, the need for time management, and the need for strategies to effectively engage students in science learning. During professional development, teachers may experience an increase in their self-efficacy perceptions as they explore their beliefs through relevant readings, videos, self-reflection, and growth mindset training. They will also delve into MSS, science best practices, engaging science strategies, and collaborate with colleagues to plan stimulating science lessons to implement in the classroom. The goal of this 3-day professional development is to bolster teacher self-efficacy to teach science, engage students in science learning, and meet the identified needs of teachers as expressed during interviews.

Project Description and Goals

The purpose of this study was to explore teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. The problem that prompted this basic qualitative study was that teachers in the local area lacked self-efficacy to teach science and were struggling to engage students in science learning. Semi-structured individual interviews were used to collect data. During interviews, many teachers asserted that they struggled with science due to limited science instructional skills, the need for time management, and the need for strategies to effectively engage students in science learning. Therefore, the project was a 3-day professional development to bolster teacher self-efficacy to teach science, engage students in science learning, and meet the identified needs of teachers as expressed during interviews.

This 3-day professional development project was designed for elementary science teachers during three consecutive weeks in summer professional learning days prior to the 2022–2023 school year. Each session will begin at 8:30 a.m. and end at 3:00 p.m. The timing of this professional development will allow teachers to have an opportunity to plan and incorporate new learning, skills, and strategies into science instruction during the new school year. The project was based on the emerging themes derived from teacher interviews: (a) elementary science teachers have limited methods of teaching science to engage students, (b) elementary science teachers face several challenges, (c) elementary science teachers do not feel confident engaging students in learning science, and (d) elementary science teachers desire specific training to improve their science instruction.

The 3-day professional development will address these emerging themes and the purpose of this study.

The goal of this 3-day professional development is to bolster teacher self-efficacy to teach science, engage students in science learning, and meet the identified needs of teachers as expressed during interviews. The target audience is local elementary science teachers who participated in data collection but all elementary science teachers at ABC Elementary School in southern Michigan will receive invitations to attend. Each pragmatic session was designed to incorporate a PowerPoint presentation, modeling of engaging science strategies, self-efficacy evaluation, growth mindset activities, MSS training, video clips, hands-on lessons, collaborative lesson planning, and a variety of technology resources. All activities were designed to enhance teacher self-efficacy as they learn to better engage students in science learning.

Day 1 Professional Development

Materials include computer, internet access, projector and screen, teacher laptops, table space, PowerPoint, three-ring binders, dividers, hard copies of resources and strategies shared on Day 1, Science Self-Efficacy Pretest, growth mindset video clip and verbal mantra, paper, pens/pencils, chart paper, markers, and exit tickets. Day 1 of this 3-day professional development will begin by ensuring that teachers enter a relaxed environment. 10-minute breaks will be given in the morning and afternoon of each day during the professional development. Ambient music will play in the background as teachers enter the professional development session. I will welcome teachers as they enter the room to sign in and enjoy a continental breakfast. Participants will be given a three-ring binder with daily dividers to compile a notebook of elementary science strategies and resources. The session will commence with teachers constructing tent cards with their names and a picture of their favorite food. Each teacher will introduce themselves and share their favorite food. I will conclude this time by sharing a favorite food and details about my personal passion for science education. An overview of the day and days to come will be shared with the group. I will review professional development norms, and they will be posted in the room to ensure visibility. Norms will ensure that participants are aware of the rules prior to the start of the session. Teachers will then take an Elementary Science Self-Efficacy Pretest. They will be invited to share the results of their pretest and hopes for future self-efficacy perceptions.

Participants will watch a growth mindset video clip that explains this research-based topic and how important it is to the classroom teacher. A whole-group discussion of the video will ensue. After the video and discussion, participants will repeat a growth mindset mantra. Teachers will then silently read a short article called “Would You Want to be a Student in Your Own Classroom?” The article is for self-reflection about their science instructional practices. The article will provide practical tips for engaging students in science learning. Teachers will be grouped for discussion after self-reflection. Groups will write key takeaways on chart paper. One person from each group will share what the group discussed.

I will then share a detailed overview of MSS including but not limited to its history, purpose, and website location. Subsequently, teachers will participate in a website scavenger hunt. This will lead to participants learning how to easily locate the

MSS and engaging science lesson materials as well as instructional strategies. Prior to the professional development, participants will be asked to bring a laptop computer to each session but the school will have a few available for use. Participants will be instructed on phenomena-based instruction, which is the core of MSS. Phenomena-based instruction is an anchor event that grounds science learning. Its purpose is to inspire inquiry and thought that leads students to investigative actions. Participants will then be partnered with another teacher to complete a digital phenomenon search and find an activity to help them identify and locate phenomena on websites that address science topics. Each team will share the results of the phenomenon search and find with the whole-group.

Day 1 will end with an exit ticket. Teachers will answer the following questions: "What engaged you the most today? What other strategies would help you feel confident to engage students in elementary science?" Participants will add all handouts and lesson plans to their binder before leaving for the day.

Day 2 Professional Development

Materials will include computer, internet access, projector and screen, teacher laptops, table space, PowerPoint, three-ring binders, dividers, icebreaker activity, growth mindset video clip, hard copies of resources and strategies shared on Day 2, paper, pens/pencils, chart paper, markers, hands-on activity stations, and exit tickets. Day 2 of this 3-day professional development will begin as teachers enter the room to ambient music playing in the background as they sign in. I will welcome each teacher and invite them to enjoy a continental breakfast. The session will commence with an icebreaker activity followed by a growth mindset video. A whole-group discussion of the video will ensue. After the video and discussion, we will repeat the growth mindset mantra aloud. I will read the exit tickets from Day 1, give an overview of Day 2, and review of Norms.

We will examine elementary science-specific time requirements as mandated by the local district. This will ensure that teachers are aware of the time requirements for science education prior to addressing the request for time management support as expressed during interviews. Teachers will then pair up to discuss problems and solutions with meeting these requirements. Then each group will share a summary of their discussion. Following the discussion, I will share time management resources (see Appendix A) designed to assist teachers with planning and transitioning between subjects. I will then share a video clip on the importance of engaging instructional strategies in the science classroom. Teachers will participate in a standards-based, hands-on activity focused on their grade band such as K–2 or Grades 3–5. Teachers will be tasked with looking at the MSS standards and correlating the engaging instructional activity to the standard. Next, teachers will share the results with the whole-group. I will then share several standard-based websites with resources, engaging lesson plans, instructional strategies, and hands-on activities.

Teachers will be tasked with selecting one of the websites and identifying an engaging hands-on lesson plan with a standard that they will teach in the upcoming school year. Teachers will share the results of the task with the whole-group. Day 2 will end with an exit ticket. Teachers will use prepared sheets of paper to answer the following questions: “What engaged you the most today? What other strategies would help you feel confident to engage students in elementary science?” Participants will add all handouts and lesson plans to their binder before leaving for the day.

Day 3 Professional Development

Materials will include computer, internet access, projector and screen, teacher laptops, table space, PowerPoint, three-ring binders, dividers, hard copies of resources and strategies shared on Day 3, Science Self-Efficacy Posttest, icebreaker activity, growth mindset video, paper, pens/pencils, chart paper, markers, and final evaluation. Day 3 of this 3-day professional development will begin with teachers entering the room to ambient music as they sign in. I will welcome each teacher by name and invite them to enjoy a continental breakfast. The session will continue with an icebreaker activity followed by a growth mindset video. A discussion of the video will ensue and the group will repeat a growth mindset mantra. I will read the exit tickets from Day 2 and provide an overview of Day 3.

Teachers will then be introduced to several engaging, technology-based instructional strategies and resources. Next, they will participate in a science engagement scavenger hunt to increase their confidence in locating and using engaging science lesson materials and instructional strategies. The teacher will then be tasked with collaborating with another teacher in attendance to develop two complete lesson plans. Lesson plans must include the standard, a phenomena, engaging strategies, engaging technology, and/or a hands-on activity. Teachers will showcase their lessons plans to the whole-group. Day 3 will conclude with a final celebration as teachers openly share lessons that they will implement during the 2022–2023 school year. Teachers will then complete exit tickets, the Elementary Science Self-Efficacy Posttest, and a final evaluation. Participants will add all handouts and lesson plans to their binder before leaving.

Rationale

The problem that prompted this basic qualitative study was that teachers in the local area lacked self-efficacy to teach science and were struggling to engage students in science learning. The purpose of this study was to explore teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. Findings from the data collection derived from teacher interviews revealed that (a) elementary science teachers have limited methods of teaching science to engage students, (b) elementary science teachers face several challenges, (c) elementary science teachers do not feel confident engaging students in learning science, and (d) elementary science teachers desire specific training to improve their science instruction. I developed a 3-day professional development project to improve teachers' self-efficacy perceptions to teach science, provide examples for how to engage students in science learning, and meet the identified needs of teachers as expressed during interviews.

The project genre I selected was a 3-day professional development for elementary science teachers. According to Sprott (2019), teachers need continuous exposure to current trends in education, which increases instructional confidence and capacity. In other research, Darling-Hammond et al. (2017) found the following strategies to be most effective for professional learning: job-embedded experience, active learning techniques, collaboration with colleagues, modeling, content focus, time for self-reflection, and knowledge building of the subject matter content. I used this guide to organize the professional development. Y. L. Chen et al. (2021) found that teachers who participated in a series of science professional developments were more focused and experienced an increase in self-efficacy. Improving teachers' self-efficacy perceptions to teach science and engage students in science learning, and to meet the identified needs of teachers as expressed during interviews was the goal of the professional development.

During interviews, many teachers asserted that they struggled with science due to limited science instructional skills, the need for time management, and the need for strategies to effectively engage students in science learning. According to Tallman (2019) collaboration with colleagues is an engaging technique because it allows for connection, reflection, and learning from others. Osman & Warner (2020) found that professional developments help practitioners foster experiences that increase self-efficacy and motivation." This project design intentionally incorporated collaboration and thereby met the pragmatic needs of teachers to increase self-efficacy perceptions to engage students in science learning. The 3-day professional development allows time for collaboration with colleagues. Participants will receive modeling and facilitation practice in engaging science strategies, self-efficacy support, growth mindset training, an introduction to MSS, hands-on lessons, collaborative lesson planning, and technology resources. The culminating activity will be the development of two, standards-based lesson plans using the instructional strategies learned during the 3-day professional development. Coenders & Verhoef, (2019) found that modeling and practice were effective to support teacher growth and helped to ensure implementation. The project allows teachers an opportunity to encounter modeling through engaging science strategies and then practice the newly acquired skills. Emerging themes were used in the development of the 3-day professional development project.

The PowerPoint I developed will drive topics, transitions, and engage teachers, throughout the 3-day professional development project. This project may increase teacher self-efficacy perceptions to teach science, engage students in science learning. Noell et al. (2019) found that when science instruction is demonstrated and skills are reinforced during professional development, teacher self-efficacy improves and student achievement increases. Embedded in the PowerPoints are a plethora of science instructional strategies and resources. I designed this professional development project to bolster teacher self-efficacy to teach science, engage students in science learning, and meet the identified needs of teachers as expressed during interviews.

Review of the Literature

This literature review supports 3-day professional development project. The goal of the project is to bolster teacher self-efficacy to teach science, engage students in science learning, and meet the identified needs of teachers as expressed during interviews. During interviews, many teachers asserted that they struggled with science due to limited science instructional skills, the need for time management, and the need for strategies to effectively engage students in science learning. Data collection informed the decision to host a professional development to increase teachers' perceptions of their sense of self-efficacy to teach science and engage students in science learning. I searched scholarly resources and analyzed peer-reviewed articles for the literature review. The resources that I used were through Walden's Library including but not limited to ProQuest, ERIC, Thoreau, SAGE Journals, Journal of Science Education and Technology, The Science Educator, Journal of Research in Science Teaching, ScholarWorks, Google Scholar, and Google. The following key words and phrases were searched: *teacher professional development strategies, Michigan Science Standards strategies, Next Generation Science Standards, engaging science instruction, effective professional development, student engagement in science, science best practices, self-efficacy professional development resources, increasing teacher self-efficacy, growth mindset, hands-on science, inquiry-based instruction, elementary science, technology integration, evidence-based instruction, project-based science.*

Significance of Professional Development

Professional development is vital to ensure that teachers receive relevant support to improve classroom instruction. Williford et al (2017) found that student learning and engagement are directly linked to the teachers' instructional skills that can increase through professional development. The American Educational Association (2005) suggested that, "professional development can influence teachers' classroom practices significantly and lead to improved student achievement when it focuses on (a) how students learn the particular subject matter, (b) instructional practices that are specifically related to the subject matter and how students understand it, and (c) strengthening teachers' knowledge of specific subject matter content." Sprott (2019) affirmed that teachers need continuous exposure to current trends in education to increase their instructional confidence and capacity.

Professional development has many benefits for teachers and students. Coldwell (2017) found that professional development supports teacher growth by improving their skill levels in a subject area. According to Palmer and Noltemeyer (2019), professional development is a precursor to student engagement and achievement. When teacher performance is improved through professional development, students reap the benefits in real-time (Pianta et al., 2019). Professional development can provide vital support to teachers by increasing their competence, knowledge, and confidence.

Professional Development Best Practices and Strategies

Research-based techniques should be implemented when planning effective professional development for teachers (Hayes et al., 2019; Hirsch et al., 2019). When planning professional development, facilitators and administrators should seek to ascertain which research-based techniques work best for teachers. Polly et al. (2017) found that a 3-day professional development led to increased teacher performance and student achievement. Darling-Hammond et al. (2017) noted that effective professional development results in positive change in how teachers teach, leading to improvements in student learning. Research-based techniques (see Appendix A) are included in the 3-day professional development project.

Engaging practices ensure that teachers benefit from professional development. Harper-Hill et al. (2020) found that teachers are only impacted by professional development when they are deeply engaged through practice. According to Pak et al. (2017) professional development should be data-driven according to teachers' needs shared through conversation, classroom observations, and student achievement results.

Hirsch et al. (2019) asserted that teachers should be allowed choice when participating in professional development because it increases ownership and the likelihood that they will implement the strategies shared. Bates & Morgan (2018) suggested that teachers consider “sit and get” professional developments a waste of time because they want to be actively engaged instead in the learning process. Zhang et al. (2021) found that teachers feel belittled when asked to participate in professional developments perceived as unproductive. This may lead to the teacher distrusting the administrator as an instructional leader that, “truly cares” about their professional growth and student achievement. Collaboration during professional development is an engaging and effective technique. Tallman (2019) found that collaboration with colleagues is an engaging technique because it allows for connection, reflection, and learning from colleagues. In summary, there are numerous factors to consider when planning for engaging professional development. Many of the strategies listed in this section were included in the 3-day professional development project.

Self-Efficacy and Professional Development

Teachers who lack self-efficacy benefit from professional development (Gess-Newsome et al., 2019). Gardner et al. (2019) found that a lack of teacher self-efficacy can negatively impact student engagement and achievement. Research by Thurm and Barzel (2020) concluded that professional development increases self-awareness and potentially leads to increased self-efficacy. In another study, researchers (Knowles, 2017; J. Chen et al., 2021) found that teachers who participated in a series of science professional developments were more focused and had an increase in self-efficacy. According to

Falloon (2019) teachers that acknowledge and seek to address instructional deficits during professional development, experience greater job satisfaction, enhanced intelligence, and an increase in self-efficacy. Noell et al. (2019) found that when science instruction is demonstrated and skills are reinforced during professional development, teacher self-efficacy improves and student achievement increases. White and Rotermund (2019) stressed the importance of elementary science teachers being exposed to relevant professional development to ensure that instruction does not become antiquated. Professional development can increase teacher self-efficacy to engage students in science learning.

Engaging Science Strategies and Professional Development

Professional development activities should address gaps in knowledge through the use of research-based techniques. Fischer et al. (2018) found that ongoing professional development is vital to science reform in the United States. The 2017 adoption of the MSS led to more engaging science practices (E. Miller et al., 2018). According to Hayes et al. (2019) when MSS is implemented, teachers immerse students in phenomena-based instruction, problem-solving, and critical thinking that is based on real-world issues. Teachers can benefit from professional development that addresses gaps in knowledge and increases their self-efficacy perceptions.

Variety is important to engaging science instruction and professional development is helpful to teachers when it is content specific (Gheyssens et al., 2019). Chai (2019) found that hands-on science professional developments engage the teacher and help them teach students to think critically about the content. According to Herro and Quigley

(2017), science professional development that integrates technology will encourage teachers to immerse students in STEM learning. Science educators that are not trained to implement technology-based instruction, miss the opportunity to connect deeply with learners (Herro & Quigley, 2017). According to Coenders and Verhoef (2019), science professional development should be a modeling and strategies-driven experience. Facilitators should model best practices and expose teachers to a variety of research-based practices. Coenders and Verhoef (2019) recommend that teachers have an opportunity to practice new skills with colleagues during professional development. Modeling and practice during professional development allow the teacher to become comfortable with newly acquired skills and increases the likelihood of implementation.

Engaging elementary students in science learning is vital to their achievement and future success. Hall and Trespalacios (2019) found that science at the elementary level provides students with the confidence to participate in more advanced scientific studies and increases student engagement. Formative years of education expose students to the important building blocks of scientific concepts and processes (Manjiante, 2018). According to Sawlane and Shaikh (2018), a key strategy for preparing all students for college, the 21st century, and its careers is higher-order thinking skills through STEM education.

School administrators should support teachers' development of instructional skills to facilitate an engaging science experience for students. According to Coenders and Verhoef (2019), all students should have a quality science instructor. Kaderavek et al. (2020) found that student learning cannot be properly assessed without considering the level of scientific literacy and training of the teacher. According to T. N. Johnson and Dabney (2018), poor preparation programs cause teachers to feel unprepared and inadequate to teach science. According to Acar et al. (2018) prior to the 1900s, teachers were seen as dispensers of knowledge, and students were taught through drill and rote memorization but learners of today need to be engaged in the learning process. Engaging science strategies is an important professional development topic to support student learning.

Project Description

Potential Resources and Existing Supports

The project is a 3-day professional development to increase teacher self-efficacy perceptions to teach science, engage students in science learning, and meet the identified needs of teachers as expressed during interviews. This will be done by increasing their science instructional skills, time management, and providing strategies to effectively engage students in science learning. Once data collection has concluded, I will request to meet with school administrators. During this meeting, I will share findings from the study, details of the proposed project, proposed daily agenda, and proposed timeline. This 3-day professional development was designed to take place during teacher Summer learning days, prior to the 2022-2023 school year. Sessions will begin at 8:30 a.m. and end at 3:00 p.m. After receiving permission to conduct the 3-day professional development, invitations will be emailed to elementary science teachers and administrators. Participants will assemble in a spacious, multi-purpose room with dry erase boards around the perimeter, tables, chairs, and a laptop cart. Resources provided by the school for the 3-day professional development include: internet access, Smartboard, laptop cart, pencils, paper, markers, pens, chart paper, 3-ring binders, 3-hole puncher, and sticky notes. All participants will be required to bring a laptop computer, their elementary science curriculum instructional guide, and a curriculum pacing chart. As the presenter, I will provide a personal laptop computer and the PowerPoint presentation. I will also provide hard copies and digital copies of resources that can be used during and after the 3-day professional development.

Potential Barriers

A potential barrier to this project's implementation is the timeframe. The project will be held for 3 consecutive weekdays during the mandated summer professional learning time. Teachers are permitted to use sick days during the summer months. The concern is that elementary science teachers may be absent from the 3-day professional development because they are spending time with family or friends. A practical solution to address this potential barrier is to work with administrators to provide incentives such as a coupon for an extra prep period that is redeemable during the school year.

During summer professional learning days, elementary teachers can select the professional development session they want to attend. The potential barrier is that they elect to attend the mathematics session instead of the science session. To address this potential barrier, I will ensure that teachers are aware of the daily raffle that will take place, which includes gift cards. I will make teachers aware of the science resources and strategies that will be shared according to identified needs as shared during interviews. I will also inform teachers that they will have an opportunity to collaborate with colleagues and plan lessons prior to the upcoming school year.

Proposal for Implementation and Timetable

The following timetable will be shared with administrators during the meeting to request permission for the 3-day professional development project.

Table 4

Proposed Project Timetable

Month	Purpose	Participant	Deliverable
Late June	• Meet with administrators	Administration and researcher	Study findings, project Agenda, project goals
Late June	• Plan Project dates with administrators using the school calendar • Share project resources and the PowerPoint with the administration	Administration and researcher	Scheduled dates, resources, PowerPoint
Early July	• Invitations sent to potential participants • Forward names of registered participants to administrators	Researcher	Invitations and list of participants
Late July	• Day 1 of Project	Participants and researcher	PowerPoint and resources
Late July	• Day 2 of Project	Participants and researcher	PowerPoint and resources
Late July	• Day 3 of Project	Participants and researcher	PowerPoint and resources

Roles and Responsibilities

The success of the 3-day professional development project depends on the accomplished roles and responsibilities of various individuals. I am responsible for (a) meeting with school administrators to share the study findings, proposed project, gain approval to proceed, and select dates from the school calendar, (b) planning and organizing the 3-day professional development project, (c) providing all agendas, strategies, resources, and personal equipment, (d) ensuring that participants are registered, (e) facilitating all sessions of the project, and (f) developing an evaluation to ensure that the 3-day professional development was impactful.

The role of school administrators is to (a) provide approval and schedule the project with me according to the school schedule, (b) encouraging teachers to register and participate in the 3-day professional development, (c) ensuring that the multi-purpose room and other materials are prepared for the session, and (d) encouraging teachers to implement strategies during the school year. The role of participants is to (a) register for the 3-day professional development, (b) actively participate in the 3-day professional development, (c) collaborate with colleagues during activities, and (d) complete the evaluation.

Project Evaluation Plan

The purpose of this basic qualitative study was to explore teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. The problem that prompted this study was that teachers in the local area lacked self-efficacy to teach science and struggled to engage students in science learning. During interviews, many teachers asserted that they struggled with science due to limited science instructional skills, the need for time management, and the need for strategies to effectively engage students in science learning. The goal of this 3-day professional development is to bolster teacher self-efficacy to teach science, engage students in science learning, and meet the identified needs of teachers as expressed during interviews.

According to Jabri et al. (2018), the evaluation plan is vital to the success of any professional development. The project will be evaluated based on daily exit tickets, Elementary Science Self-Efficacy Pretest and Posttest, as well as the final evaluation form (see Appendix A). Participants will be provided with daily exit tickets that must be completed before leaving. I will read exit ticket comments each day. The feedback will be used to make adjustments to the professional development that can accommodate participant needs (see Bates & Morgan, 2018). There will be an Elementary Science Self-Efficacy Pretest to assess teachers' levels of self-efficacy prior to the start of the 3-day professional development. I will make adjustments to planned activities according to teacher responses. Feedback will also be received from the Elementary Science Self-Efficacy Posttest and final evaluation. I will use the results of the summative evaluations to critique the 3-day professional development. Summative evaluations will be shared with school administrators to help them decide what other support elementary science teachers need as they engage students in science learning.

Formative and Summative Evaluation

Embedded in the 3-day professional development are formative and summative evaluations. Formative evaluations are in the professional development so that I am informed of necessary modifications to the content, delivery, intensity, or instructional environment. On day 1, formative evaluation activities include the Elementary Science Self-Efficacy Pretest. Participants will be invited to share the results of their Pretest and hopes for increased self-efficacy perceptions. Feedback from participants will serve as a formative assessment. Other formative assessments on day 1 include comments shared from participants during the following: MSS discussion, website scavenger hunt, phenomena-based instruction lessons, and phenomena search and find activity. Day 1 will conclude with a summative assessment and an exit ticket. Teachers will answer the questions, "What engaged you the most today? What other strategies would help you feel confident to engage students in elementary science?"

On Day 2 a formative evaluation will take place as I receive responses from teachers during the growth mindset video clip discussion. Another formative assessment will take place as I listen to solution-oriented conversations with teacher groups, as they work to solve time management concerns. Other formative assessments will take place during a feedback session after the hands-on instructional video clip, standards-based hands-on activity, MSS matching activity, website search, and lesson planning. Day 2 will end with a summative assessment and an exit ticket. Teachers will answer the questions, "What engaged you the most today? What other strategies would help you feel confident to engage students in elementary science?"

On day 3 a formative evaluation will take place during the discussion of a growth mindset video clip. Other formative evaluations will occur during feedback shared after an introduction to technology-based resources, technology scavenger hunt, and during collaborative lesson planning. As a summative evaluation, teachers will share their culminating activity lesson plans. A final summative assessment will take place on Day 3 with teachers completing the Elementary Science Self-Efficacy Posttest and final evaluation.

A goals-based approach will be used for the 3-day professional development project. The goal of this 3-day professional development project is to bolster teacher self-efficacy to teach science, engage students in science learning, and meet the identified needs of teachers as expressed during interviews. During interviews, many teachers asserted that they struggled with science due to limited science instructional skills, the need for time management, and the need for strategies to effectively engage students in science learning. Therefore, teachers will participate in a variety of experiences to ensure that they have the knowledge, resources, strategies, and self-efficacy to engage students in science learning.

Key Stakeholders

Teachers and school administrators are the key stakeholders in this 3-day professional development project. All elementary science teachers will be invited to attend the 3-day professional development. This professional development seeks to address teacher self-efficacy perceptions to teach science, engage students in science learning, and meet the identified needs of teachers as expressed during interviews using research-based techniques. During the professional development, teachers may experience an increase in their self-efficacy perceptions as they explore their beliefs through relevant readings, videos, self-reflection, and growth mindset training. They will also delve into MSS, science best practices, engaging science strategies, and collaborate with colleagues to plan stimulating science lessons to implement in the classroom. The goal of this 3-day professional development is to bolster teacher self-efficacy to teach science, engage students in science learning, and meet the identified needs of teachers as expressed during interviews.

Prior to the professional development sessions, I will collaborate with school administrators for planning and to ensure that their expectations are implemented. The principal and assistant principal will be asked to support the sessions by monitoring and providing feedback on the events of the day and the next steps, when the project has concluded. I will encourage school administrators to plan science professional development for elementary teachers during the school year to ensure they have the self-efficacy needed to engage students. The principal and assistant principal will be invited to attend the 3-day professional development. This will allow them to learn alongside teachers and collaborate during sessions. Fischer et al. (2018) found that when administrators are involved in the learning with teachers, a shared vision of excellence begins to emerge. Administrators will be invited to address teachers at the close of the 3-day professional development to provide a vision of future learning.

Project Implications

Implications for Social Change

This project has implications for positive social change and could positively impact the lives of students, educators, and administrators at ABC Elementary School in southern Michigan. Elementary science teachers at the local site lacked self-efficacy to teach science and struggled to engage students in science learning, which resulted in student underachievement. Elementary science teachers will benefit from the 3-day professional development because it addresses their direct concerns as expressed during interviews. The 3-day professional development is designed to bolster teacher self-efficacy to teach science, engage students in science learning, and meet the identified needs of teachers as expressed during interviews by increasing their science instructional skills. This will be achieved by increasing teachers' science instructional skills, providing time management support, and sharing strategies to engage students in science learning. Supporting the self-efficacy of teachers can positively impact students' engagement and achievement in science. According to Bae et al. (2020) students who participate in engaging science are more likely to be interested in the curriculum, select STEM careers, and perform well on standardized tests. Results from this study could help administrators, as strategic steps are implemented to support elementary science teachers' self-efficacy perceptions and provide strategies to increase student engagement beyond the 3-day professional development. As a result of this project, school administrators may provide teachers with additional professional development or one-on-one coaching to increase self-efficacy perceptions to engage students in science learning.

Importance of the Project in a Larger Context

In the larger context, this project has the potential to positively influence teachers and students. Palmer & Noltemeyer (2019) found that professional development is a precursor to student engagement and achievement. As teachers improve, their self-efficacy perceptions may increase. According to Tsui (2018), student engagement is positively impacted when teachers have self-efficacy. An increase in teacher self-efficacy perceptions produces students who are more engrossed in science education. Student potential for positive social change is increased interest in science education and STEM careers. This increased interest in science education and STEM careers may result in higher education, better-paying jobs, lower poverty rates, and higher socioeconomic statuses for students.

Conclusion

The 3-day professional development project was designed to bolster teacher self-efficacy to teach science, engage students in science learning, and meet the identified needs of teachers as expressed during interviews. This will be accomplished by increasing teachers' science instructional skills, providing time management support, and sharing strategies to engage students in science learning. I designed the 3-day professional development project to be hands-on, include research-based strategies, engage teachers in content knowledge, and address findings from the study. In section 3 I discussed, the professional development project plan, logistics, resources, stakeholders, potential barriers, solutions to barriers, and implications for social change. Section 4 will offer reflections and conclusions. The topics include strengths, limitations, alternative approaches, and several analytical viewpoints. Finally, I reflect on the work as a practitioner and scholar.

Section 4: Reflections and Conclusions

The problem that prompted this basic qualitative study was that teachers in the local area lacked self-efficacy to teach science and were struggling to engage students in science learning. The purpose of this basic qualitative study was to explore teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. Self-efficacy is defined as a judgment about one's ability to organize and execute the courses of action necessary to attain a specific goal (Bandura & Wessels, 1994). Barni et al. (2019) noted that low teacher self-efficacy links to student engagement and achievement. A teacher's mindset about their teaching skills impacts students' engagement and achievement (A. D. Miller et al., 2017).

Findings from this project study revealed that (a) elementary science teachers have limited methods of teaching science to engage students, (b) elementary science teachers face several challenges, (c) elementary science teachers do not feel confident engaging students in learning science, and (d) elementary science teachers desire specific training to improve their science instruction. This led to the development of a 3-day professional development project to address the findings of this study. Section 4 concludes this project study. This section contains project strengths and limitations, recommendations for alternative approaches, project development, reflections, implications for social change, and future research.

Project Strengths and Limitations

Projects Strengths

The project's strengths are that teachers' concerns, as expressed during interviews, will be strategically addressed during the 3-day professional development. According to Chai (2019), science professional development should be hands-on, include numerous research-based strategies, and engage the teacher in helping students think critically about the content. I designed the 3-day professional development to be hands-on, include research-based strategies, engage teachers in content knowledge, and address findings from the study. The findings revealed that (a) elementary science teachers have limited methods of teaching science to engage students, (b) elementary science teachers face several challenges, (c) elementary science teachers do not feel confident engaging students in learning science, and (d) elementary science teachers desire specific training to improve their science instruction.

During professional development, teachers should experience an increase in their self-efficacy perceptions to teach science and engage students in science learning as they explore their own beliefs through relevant readings, videos, self-reflection, and growth mindset training. Increasing perceptions of self-efficacy is vital to effective instruction (Beardsley et al., 2020). When science instruction is demonstrated and skills are reinforced during professional development, teacher self-efficacy improves and student achievement increases (Noell et al., 2019). Participants will delve into MSS, learn about science best practices, engaging strategies, and collaborate with colleagues to plan stimulating science lessons to be implemented in the classroom. The goal of this 3-day professional development is to bolster teacher self-efficacy to teach science, engage students in science learning, and meet the identified needs of teachers as expressed during interviews. Strategic instructional encounters through carefully planned professional development can positively impact science instruction and student learning (Harper-Hill et al., 2020). According to Tallman (2019), collaboration with colleagues is an engaging technique because it allows for connection, reflection, and learning from colleagues. As teachers spend time learning in a collaborative setting and as their identified needs are met, they should experience an increase in their self-efficacy perceptions to teach science and engage students in science learning, which is a strength of this project.

Project Limitations

A limitation of this project is timing. This professional development is planned to take place during the district's mandated summer professional development week. Pertaining to the professional development, teachers are permitted to use sick or personal business days instead of attending. This could cause a challenge because participants that were interviewed may be absent from the professional development. For educators, the summer is often used for vacationing. The absence of teachers would be counterproductive to the purpose of the study and the effort to address their identified needs as shared during interviews.

A second limitation of this project is the one-time occurrence of the 3-day professional development; it is a one-time event. Teachers will probably attend the professional development sessions with enthusiasm and leave with increased self-efficacy to engage students in science learning. This enthusiasm and increase in self-efficacy could be short-lived. When it is time for school to begin, participants may return to former science instructional habits and lose the increased self-efficacy to engage students in science learning. The time between the summer professional development sessions and the start of the school year might limit the momentum teachers initially experienced. These limitations could negatively impact the results of the 3-day professional development.

Recommendations for Alternative Approaches

Alternate Approaches to the Problem

A limitation of this project is timing, which could impact teacher participation. Since this professional development will occur during the summer months, teachers may opt to use a sick day or a personal day instead of attending the sessions. The absence of elementary science teachers would thwart the purpose of the study because they would miss a valuable professional development opportunity. One alternate approach to address this problem is to poll the opinions of teachers to select the best time for a 3-day professional development. Another option is to offer the session multiple times during the school year. This would alleviate the guesswork and may ensure teachers participate.

A second alternative approach to address the problem of participation in the 3-day professional development could be to observe elementary science teachers in action. This project study did not include teacher observations, which may support teacher self-efficacy perceptions to teach science and engage students in science learning. The data derived from teacher observations may provide insight into classroom structures, teaching styles, strategies, and engagement. These data could assist administrators in supporting teachers' efforts to improve their self-efficacy perceptions to teach science and engage students in science learning.

Alternate Definitions of the Problem

Alternative definitions for the problem are the following: (a) Elementary science teachers feel restricted by the demand to teach reading and mathematics and opt out of teaching science daily and (b) elementary science teachers feel unprepared due to a lack of training and do not effectively instruct students. Alternative definitions provide an alternative path to increasing self-efficacy perceptions to teach science and engage students in science learning. The alternative definitions support the original problem that prompted this basic quantitative study: Elementary science teachers lacked self-efficacy to teach science and struggled to engage students in science learning.

Alternate Solutions to the Local Problem

An alternate solution to address the local problem of elementary science teachers lacking self-efficacy to teach science and struggling to engage students in science learning is to provide one-on-one coaching. According to Kunnari et al. (2018), educational coaches help increase the competence and self-efficacy of teachers. Providing science coaches may give teachers one-on-one opportunities with a science liaison who can provide support according to individual needs. One-on-one coaching sessions have the potential to be quite efficacious because teachers may feel free to be authentic about their self-efficacy perceptions to teach science and what they feel they need to engage students in science learning. Science coaches would cater to the individual needs of the teacher instead of providing whole-group support in a 3-day professional development. Science coaches could also observe elementary science teachers and provide feedback prior to a formal observation from administrators. This would allow teachers to improve without the apprehension that may come from an administrative observation. Science coaches are a viable solution to the local problem of elementary science teachers lacking self-efficacy to teach science and struggling to engage students in science learning.

Scholarship, Project Development, Leadership and Change

My choice to enter the doctoral program was due to a personal passion for teaching and learning. My growth as a scholar may help others because I have an innate desire to increase the potential and capacity of learners at all educational levels. The initial stages of this doctoral program were intriguing and exciting, then tragedies hit. These tragedies hijacked the personal life vision that I once had. My passion for teaching and learning vanished. It took many years of healing and focusing on family matters before I was comfortable enough to reenter the doctoral program. Despite the challenges, I have learned more as a seasoned scholar than as a teacher in her prime. A retired friend urged me to find joy as a doctoral scholar. When she first said this, I thought the idea was ridiculous because of the anticipated tears, late nights, sleepless nights, heavy financial burden, and staying home when I would rather socialize with family or friends. However, I listened and worked daily to find joy in the doctoral journey. I learned the importance of research, analysis, and accuracy throughout the writing and literature review process. I learned humility, patience, and diligence when feedback was received from the committee. I learned to work with resilience, grit, hopefulness, and tenacity as I maneuvered through many life challenges as a scholar and leader during the COVID-19 pandemic. I learned to manage work, family, joys, sorrows, and a personal fight with the coronavirus but persevered as a researcher and scholar. The passion and joy for teaching, learning, and doctoral research increased each day.

This study and the development of the project allowed me to grow as a scholar, practitioner, project developer, and researcher. In this study, I explored teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. I worked hard to ensure that a quality project was produced. As a former science teacher, I desired to see teachers exhibit strong self-efficacy perceptions and have the ability to engage students in science learning. In this study, I desired to explore the implementation of the professional development sessions that were designed to bolster teacher self-efficacy to teach science, engage students in science learning, and meet the identified needs of teachers as expressed during interviews. During interviews, all elementary science teachers were eager to improve their content knowledge and instructional skills. All participants had experienced some form of professional development, but they desired more learning opportunities. As a scholar, I had to remove personal opinions from the project study and focus on being a scholar–researcher. This task was difficult because of my previous work as a science teacher, yet it was essential to ensure that the project study was free of bias. According to Merriam (2009), the researcher should monitor for the presence of bias throughout the research. In the effort to remove personal bias, I committed to remaining objective and receptive to participant responses. This commitment to remaining unbiased during the study allowed me to identify teacher self-efficacy perceptions and design professional development that would bolster teacher self-efficacy to teach science, engage students in science learning, and meet the identified needs of teachers as expressed during interviews.

Developing the project required extensive planning. The journey at Walden University afforded me the skills to research the topic and gather the data needed to plan an impactful 3-day professional development. The research findings helped me identify best practices to support elementary science teachers' self-efficacy perceptions to teach science and engage students in science learning with several resources to support student engagement. The most complex dimension of the planning phase was decided from the best practices and resources to incorporate into the 3-day professional development. As I focused on the identified needs of elementary science teachers as shared during interviews, this process became less complex. Once the focus changed, passion increased because of the numerous researched-based resources that I was able to locate. Findings from the analyzed data guided the development of the 3-day professional development. During the 3-day professional development, elementary science teachers will experience modeling and facilitation in engaging science strategies, self-efficacy support, growth mindset training to increase self-efficacy, MSS training, hands-on lessons, collaborative lesson planning, and a variety of exciting resources.

Analysis of Self as a Scholar

During the current study, I was able to grow as a scholar. I first noticed this growth as I delved deeper into the process while attending office hours with the librarian and IRB. Scholarly qualities were a vital part of the research and analysis, and I was committed to the process. I learned to formulate a suitable problem statement, construct a closely aligned purpose, develop research questions, collect data, and analyze data. During the one-on-one interviews, I learned to probe participants who provided short or incomplete responses. As a scholar, I listened to all 10 interviews several times, revisited journal notes, and transcribed interviews before attempting to code the data. The coding process was time-consuming and tedious but quite rewarding. Identifying repeated words and phrases led to patterns and emerging themes. I became passionate because the data collection and analysis were productive and gratifying. I was able to use scholarly skills to design professional development that would support the identified needs of participants as shared during data collection. I included member checking by allowing participants to review my interpretation of the data. My growth as a scholar has been dynamic.

Analysis of Self as a Practitioner

Throughout this study, I matured as a practitioner. Maturation occurred with an understanding of the effects of elementary science teachers' self-efficacy perceptions on student engagement. The research process of peer-reviewed articles triggered self-reflection on my experiences as a teacher and science instructional specialist. I reflected on my teaching experiences and the factors that influenced self-efficacy perceptions. As a science instructional specialist, I began to think about the many teachers whom I supported and what factors led to their growth or lack of change. Perspectives on education, educational best practices, and research-based techniques have impacted me positively. Throughout the data collection process, I gained a robust understanding of teacher self-efficacy perceptions through the eyes of the elementary science teachers who participated in the study. This robust understanding will guide how I respond and support the teachers I currently lead. Perspectives gained through one-on-one interviews with elementary science teachers led to the development of the 3-day professional development project designed to increase self-efficacy perceptions and address the identified needs of participants.

Analysis of Self as a Project Developer

Growth as a project developer first occurred during the processes of data collection and analysis. The data collection and analysis process are time-consuming and tedious, yet it led to moments of awareness. Awareness allowed me to gain a clearer understanding of teachers' needs and devise a plan on how to scaffold learning during the 3-day professional development. Developing the project was a rewarding experience because of my love for science education. I spent several hours researching ideas on elementary science strategies, best practices, research-based techniques, facilitation ideas, time management resources, and ways to increase the self-efficacy of elementary science teachers to engage students in science learning. Findings from the interviews revealed that (a) elementary science teachers have limited methods of teaching science to engage students, (b) elementary science teachers face several challenges, (c) elementary science teachers do not feel confident engaging students in learning science, and (d) elementary science teachers desire specific training to improve their science instruction. I developed a 3-day professional development project based on the emerging themes. I designed a 3-

day professional development to increase teachers' self-efficacy perceptions to teach science and engage students in science learning through relevant readings, videos, self-reflection, and growth mindset training. I incorporated opportunities for teachers to delve into MSS, science best practices, engaging strategies, and to collaborate with colleagues to plan stimulating science lessons. During the research and development of this project I learned that effective science professional development should actively engage participants with the following: (a) hands-on practice, (b) embedded instructional resources and strategies, and (c) involves the intellectual contributions of participants. As a project developer, I have constructed a research-based project that aligns with efforts to increase self-efficacy perceptions and meet the identified needs of participants.

Reflection on Importance of the Work

The study provided an opportunity for reflecting on the self-efficacy perceptions of elementary science teachers to teach science and engage students in science learning. Interviewed participants had completed at least 1 academic year as an elementary science teacher. According to Fischer et al. (2018), professional development is vital for all teachers to meet the needs of student learners. Even more important is the self-efficacy that one possesses as a science educator. According to Mosoge et al. (2018), the self-efficacy perceptions of a teacher have a direct impact and play an essential role in student engagement and achievement. The project was designed to increase teacher self-efficacy perceptions to engage students in science learning and to meet the identified needs of teachers as expressed during interviews. The project includes explicit self-efficacy support as well as numerous research-based strategies and resources to increase student engagement. As I reflect on the importance of this work, I am inspired by the plethora of literature that supports professional development for elementary science teachers. Teachers need time to learn, collaborate, reflect, and grow. As an educator, I value professional development experiences because they encourage my heart, and challenge my thinking while providing resources and strategies. By engaging elementary science teachers in professional development, I contribute to the overall success of science education. Currently, students in the United States of America are not engaged in science education. According Bae et al. (2020) students not engaged in science have limited opportunities for STEM careers. As a researcher, reflection is important because it can move educators toward instructional excellence. The study triggered deep reflection on the importance of the work of educators and the impact that we can have on the lives of students.

Implications, Applications, and Directions for Future Research

I explored teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. The problem that prompted this basic qualitative study was that teachers in the local area lacked self-efficacy to teach science and struggled to engage students in science learning. In this section, I will discuss the implications, recommendations for future practice, and recommendations for future research.

Potential Implications for Positive Social Change

An increase in the self-efficacy perceptions of elementary science teachers to teach science and engage students in science learning can create social change.

Professional development has potential implications for positive social change for teachers, students, and administrators. Implications will benefit teachers by offering growth mindset techniques to increase their self-efficacy perceptions to teach science and engage students in science learning. Thurm & Barzel (2020) found that teachers with high self-efficacy are more engaging and produce students who have higher achievement levels. Teachers with high self-efficacy are impetuses for positive social changes. During professional development, teachers may benefit from the research-based resources, strategies, and collaboration with colleagues as they plan lessons for use during the school year. The 3-day professional development project could serve as a model for other districts to increase teacher self-efficacy and student engagement in science. Implications for positive social change could occur as administrators participate in professional development. Administrators may learn from the research-based strategies allowing them to plan strategic professional development sessions to meet the needs of teachers and the educational requirements of students. Implementation of the strategies and resources shared during the professional development may engage students in science learning and increase student achievement. Implications for student potential and positive social change include elementary students having increased opportunities for higher education, better-paying jobs, lower poverty rates, and a higher socioeconomic status as a result of increased engagement in science. Increasing the self-efficacy of elementary science teachers to engage students in science learning could augment positive social change.

Methodological, Theoretical, and Empirical Implications

The problem that prompted the project study was that teachers in the local area lacked self-efficacy to teach science and struggled to engage students in science learning. There are important methodological, theoretical, and empirical implications of this study. A basic qualitative design was used as the methodology for the current study. This design is appropriate because I looked for the meaning teachers give to self-efficacy and student engagement in their world (see Merriam, 2009). I collected data from a single source, one-on-one, semistructured interviews. I employed purposeful sampling, considered by Welman and Kruger (1999) as the most essential to identify the participants based on their lived experiences, convenience, and availability. Using qualitative methods, allowed me to understand the participant's self-efficacy perceptions and uncover the reasons students are not making progress in science. Qualitative research allows the researcher to answer questions on, “how people interpret their experiences, structure their worlds, and what meaning they attribute to their experiences” (Merriam, 2009, p.5). I purposefully chose volunteers who were teaching science and could relate to the current study. The above mentioned are important methodological implications that were considered for the study.

Theoretical implications of the study suggest that providing teachers with self-efficacy support, which includes elementary science resources and research-based strategies may improve student engagement. Bandura’s (1986) conceptual framework guides the current study. His self-efficacy beliefs are critical factors that influence individual behavior. Bandura’s theory of self-efficacy provides a connection between teacher perceptions of their self-efficacy and its influence on student engagement (Bandura, 1977). Bandura asserted that a person's self-efficacy beliefs determine "how people behave, their thought patterns, and the emotional reactions they experience in taxing situations" (1982, p. 123). If a person's self-efficacy is likely to determine how people react, then teacher self-efficacy is important when it comes to instructional methods for student engagement. In 1997, Bandura declared that the self-efficacy of science teacher's is important because of its increasing significance to "scientific literacy and competency in the technological transformations occurring in society" (p. 242). Teacher self-efficacy perceptions can have a profound impact on science instruction and student engagement. The project was developed to equip elementary science teachers with strategies and resources to increase their self-efficacy perceptions. I researched methods, resources, and strategies to employ during the 3-day professional development project. An empirical implication for the study is the local elementary science teacher's awareness of their lack of self-efficacy to teach science. The data analysis reveals that participants desired professional development as a means for improvement. To address these implications, I designed the 3-day professional development project to be inclusive of the identified needs of participants.

Recommendations for Practice and Future Research

There are several recommendations for future research based on the current study. Future research could replicate this study to include science teachers from other grade levels and districts. It may be intriguing to analyze the differences between elementary science teacher responses from varying districts and grade levels. Additional future research may include interviewing elementary science teachers after the professional development and then again after a full semester of implementing the science strategies and resources. Future research may include teachers and administrators conducting classroom observations to identify elementary science best practices and strategies amongst teachers at the local site. These best practices and strategies could then be modeled and shared with other teachers at the local school site. Finally, the research could pivot to focus on students and what they need from teachers to be engaged in science. The results from this research could be shared during professional development sessions for teachers. The current study may have a positive impact on elementary science teachers' self-efficacy perceptions and student engagement in the recommended practice and options for future research.

Conclusion

The problem that prompted this basic qualitative study was that teachers in the local area lacked self-efficacy to teach science and struggled to engage students in science learning. I developed this project study to explore teachers' perceptions of their sense of self-efficacy to teach science and what they thought were the challenges to enhancing student engagement in science. The mindset a teacher has about their teaching skills impacts students' engagement and thus achievement (A. D. Miller et al., 2017). It is important to address teacher self-efficacy perceptions and student engagement. The gap in practice of the study was that teachers' lacked the self-efficacy to develop appropriate strategies to stimulate student engagement in science. The study was significant because it addressed the gap in practice.

During data collection, elementary science teachers were invited to share their self-efficacy perceptions. As I gathered and analyzed data from interviews, the goal was to produce a project that may positively influence science education at the local site and serve as a contribution toward positive social change. Findings from the study revealed that (a) elementary science teachers have limited methods of teaching science to engage students, (b) elementary science teachers face several challenges, (c) elementary science teachers do not feel confident engaging students in learning science, and (d) elementary science teachers desire specific training to improve their science instruction. The 3-day professional development project is an avenue to support elementary science teachers at the local site. Knowledge obtained from the 3-day professional development could lead to the positive social change needed to increase teacher self-efficacy perceptions and student engagement. Positive social change in students could stem from professional development as teachers implement new strategies, resources, and research-based techniques. Implementation has the potential to engage students in science learning, increase student achievement, and stimulate them to select a STEM career. The 3-day professional development project could cause a positive social change as administrators and stakeholders implement it as a model to support elementary science teachers self-efficacy perceptions. The current study has remarkable potential to positively impact teachers, students, and administrators in elementary science.

References

Acar, D., Tertemiz, N., & Taşdemir, A. (2018). The effects of STEM training on the academic achievement of 4th graders in science and mathematics and their views on STEM Training. *International Electronic Journal of Elementary Education*, *10*(4), 505–513. https://doi.org/10.26822/iejee.2018438141

Agu, P., & Ramsey, J. (2021). A comparison of teaching efficacy beliefs of generalist and subject-specific certified biology teachers. *Journal of Education Social Policy*, *8*(1). https://doi.org/10.1002/aga2.v2.2

Akca, F., Ulutas, E., & Yabanci, C. (2018). Investigation of teachers' self-efficacy belief, locus of control, and intercultural sensitivities from the perspective of individual differences. *Journal of Education and Learning*, *7*(3), 219–232. https://doi.org/10.5539/jel.v7n3p219

Alibakhshi, G., Nikdel, F., & Labbafi, A. (2020). Exploring the consequences of teachers' self-efficacy: A case of teachers of English as a foreign language. *Second Foreign Language Education*, 23(5). https://doi.org/10.1186/s40862-020-00102-1

Alt, D. (2018). Science teachers' conceptions of teaching and learning, ICT (Integrated Common Teaching) efficacy, ICT professional development, and ICT practices enacted in their classrooms. *Teaching and Teacher Education*, *73*, 141–150. https://doi.org/10.1016/j.tate.2018.03.020

Amtu, O., Makulua, K., Matital, J., & Pattiruhu, C. M. (2020). Improving student learning outcomes through school culture, work motivation, and teacher performance. *International Journal of Instruction*, *13*(4), 885–902. https://doi.org/10.29333/iji.2020.13454a

Bae, C. L., Hayes, K. N., & DeBusk-Lane, M. (2020). Profiles of middle school science teachers: Accounting for cognitive and motivational characteristics. *Journal of Research in Science Teaching*, *57*(6), 911–942. https://doi.org/10.1002/tea.21617

Bae, C. L., & Lai, M. H. (2020). Opportunities to participate in science learning and student engagement: A mixed-methods approach to examining person and context factors. *Journal of Educational Psychology, 112*(6), 1128. https://doi.org/10.1037/edu0000410

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Physiological Review*, *84,* 191–215. https://doi.org/10.1037/0033-295x.84.2.191

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37*(2), 122. https://doi.org/10.1037/0003-066x.37.2.122

Bandura, A. (1986). The explanatory and predictive scope of self-efficacy theory. *Journal of Social and Clinical Psychology*, *4*(3), 359–373. https://doi.org/10.1521/jscp.1986.4.3.359

Bandura, A. (1997). *Self-efficacy: The exercise of control*. W. H. Freeman.

Bandura, A. & Wessels, S. (1994). *Self-efficacy*. (Vol. 4, pp. 71–81). na.

Barni, D., Danioni, F., & Benevene, P. (2019). Teachers' self-efficacy: The role of personal values and motivations for teaching. *Frontiers in Psychology*, *10*, 1645. https://doi.org/10.3389/fpsyg.2019.01645

Bates, C. C., & Morgan, D. N. (2018). Seven elements of effective professional development. *The Reading Teacher*, *71*(5), 623—626. https://doi.org/10.1002/trtr.1674

Beardsley, M., Gutierrez, N., & Hernàndez-Leo, D. (2020, July). Examining university students' motivation, abilities, and preferences related to learning to learn. In *2020 IEEE 20th International Conference on Advanced Learning Technologies (ICALT)* (pp. 346—348). IEEE. https://doi.org/10.1109/icalt49669.2020.00111

Bell, D., Morrison-Love, D., Wooff, D., & McLain, M. (2018). STEM education in the twenty-first century: Learning at work—an exploration of design and technology teacher perceptions and practices. *International Journal of Technology and Design Education*, *28*(3), 721—737. https://doi.org/10.1007/s10798-017-9413-3

Bharata, H., & Sutiarso, S. (2021). Improving teachers' self-efficacy through training: An impact on the freedom of students' mathematical thinking. *Jurnal Didaktik Matematika*, *8*(1), 127—144. https://doi.org/10.24815/jdm.v8i1.19861

Bogdan, R., & Biklen, S. K. (1997). *Qualitative research for education*. Allyn & Bacon.

Boyd, C. O. (1993). Philosophical foundations of qualitative research. *NLN Publications*, (19-2535), 99-132.

Bradford, B., Hickson, C., & Berg, S. (2020). The teaching continuum: A framework for generalist trained elementary school teachers in physical education. In *The spectrum of teaching styles in physical education* (pp. 152—165). Routledge. https://doi.org/10.4324/9780429341342-14

Buechel, C. (2021). An investigation of the effects of self-efficacy on STEM implementation. *Curriculum and Instruction Undergraduate Honors Theses*

Retrieved from https://scholarworks.uark.edu/cieduht/24.

Burić, I., & Macuka, I. (2018). Self-efficacy, emotions and work engagement among teachers: A two-wave cross-lagged analysis. *Journal of Happiness Studies*, *19*(7), 1917—1933.

Burns, E. C., Martin, A. J., Kennett, R. K., Pearson, J., & Munro-Smith, V. (2021). Optimizing science self-efficacy: A multilevel examination of the moderating effects of anxiety on the relationship between self-efficacy and achievement in science. *Contemporary Educational Psychology*, *64*, 101937. https://doi.org/ 10.1016/j.cedpsych.2020.101937

Candela, A. G. (2019). Exploring the function of member checking. *The Qualitative Report*, *24* (3), 619—628. https://doi.org/10.46743/2160-3715/2019.3726

Cavazos, A. G., Hebbard, M., Hernández, J. E., Rodriguez, C., & Schwarz, G. (2018). Advancing a transnational, transdisciplinary and translingual framework: A professional development series for teaching assistants in writing and Spanish programs. *Advancing a Transnational, Transdisciplinary and Translingual Framework: A Professional Development Series for Teaching Assistants in Writing and Spanish Programs. Across the Disciplines*. 10.37514/ATD-J.2018.15.3.09

Cetin, C., & Dede, E. (2018). The effect of perceived stress dimensions on self-efficacy and job burnout of public school teachers. *Archives of Business Research*, *6*(7). http://doi.org/10.7176/ejbm/13-6-23

Chai, C. S. (2019). Teacher professional development for science, technology, engineering and mathematics (STEM) education: A review from the perspectives of technological pedagogical content (TPACK). *The Asia-Pacific Education Researcher*, *28*(1), 5—13. https://doi.org/10.1007/s40299-018-0400-7

Chambers, J. (2018, August 23). Michigan to withhold science test scores for two years. *The Detroit News*. www.detroitnews.com

Chen, J. (2019). Efficacious and positive teachers achieve more: examining the relationship between teacher efficacy, emotions, and their practicum performance. *The Asia-Pacific Education Researcher*, *28*(4), 327-337. http://doi.org/ 10.1007/s40299-018-0427-9

Chen, Y. L., Huang, L. F., & Wu, P. C. (2021). Preservice preschool teachers' self-efficacy in and need for STEM education professional development: STEM pedagogical belief as a mediator. *Early Childhood Education Journal*, *49*(2), 137—147.

Chen, J. L., & Mensah, F. M. (2018). Teaching contexts that influence elementary preservice teachers. Teacher, and science teacher identity development. *Journal of Science Teacher Education*, *29*(5), 420—439. https://doi.org/10.1080/1046560x.2018.1469187

Clark, S., & Newberry, M. (2019). Were we building preservice teacher self-efficacy? A large-scale study examining teacher education experiences. *Asia-Pacific Journal of Teacher Education*, *47*(1), 32—47. https://doi.org/10.1080/1359866x.2018.1497772

Coenders, F., & Verhoef, N. (2019). Lesson Study: Professional development (PD) for beginning and experienced teachers. *Professional Development in Education*, *45*(2), 217—230. https://doi.org/10.1080/19415257.2018.1430050

Coldwell, M. (2017). Exploring the influence of professional development on teacher careers: A path model approach. *Teaching and Teacher Education*, *61*, 189—198. https://doi.org/10.1016/j.tate.2016.10.015

Crabtree, B. F., & Miller, W. L. (1992). Doing qualitative research. *Annual North American Primary Care Research Group Meeting, 19th, May 1989, Quebec, PQ, Canada*. Sage Publications, Inc.

Craig, C. J., Evans, P., Verma, R., Stokes, D., & Li, J. (2019). A tribute to 'unsung teachers': Teachers' influences on students enrolling in STEM programs with the intent of entering STEM careers. *European Journal of Teacher Education*, *42*(3), 335—358. https://doi.org/10.1080/02619768.2018.1523390

Creswell, J. W. (2003). A framework for design. *Research design: Qualitative, quantitative, and mixed methods approaches*, 9—11.

Creswell, J. W. (2013). Steps in conducting a scholarly mixed methods study. DBER Speaker Series. Paper 48.

Creswell, J. W. (2014). *Qualitative, quantitative and mixed methods approaches*. Sage.

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.

Creswell, J. W., & Miller, D. L. (2000). Determining validity in qualitative inquiry. *Theory into Practice*, *39*(3), 124—130.

d'Alessio, M. A. (2018). The effect of microteaching on science teaching self-efficacy beliefs in preservice elementary teachers. *Journal of Science Teacher Education*, *29*(6), 441—467.

Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). Effective Teacher Professional Development. Research Brief. *Learning Policy Institute*.

Dejarnette, N. K. (2018). Implementing STEAM in the early childhood classroom. *European Journal of STEM Education*, *3*(3), 18. http://doi.org/10.20897/ejsteme/3878

De Smul, M., Heirweg, S., Van Keer, H., Devos, G., & Vandevelde, S. (2018). How competent do teachers feel instructing self-regulated learning strategies? Development and validation of the teacher self-efficacy scale to implement self-regulated learning. *Teaching and Teacher Education, 71*, 214—225. http://doi.org/10.1016/j.tate.2018.01.001

Donohoo, J., Bryen, S., & Weishar, B. (2018). Implementing high-leverage influences from the visible learning synthesis: Six supporting conditions. *Education Sciences*, *8*(4), 215. https://doi.org/10.3390/educsci8040215

Dweck, C. (2015). Carol Dweck revisits the growth mindset. *Education week, 35*(5), 20-24. https://www.edweek.org/leadership/opinion-carol-dweck-revisits-the-growth-mindset/2015/09

Dweck, C. (n.d.). *The power of believing that you can improve*. Carol Dweck: The power of believing that you can improve | TED Talk. Retrieved April 12, 2022, from https://www.ted.com/talks/carol_dweck_the_power_of_believing_that_you_can_improve

Edinger, S. K., & Edinger, M. J. (2018). Improving teacher job satisfaction: The roles of social capital, teacher efficacy, and support. *The Journal of Psychology*, *152*(8), 573—593. http://doi.org/10.1080/00223980.2018.1489364

Er, K. O. (2020). The relationship between teacher self-efficacy beliefs and educational beliefs of pre-service teachers. *Educational Research and Reviews*, *15*(1), 8—18. https://doi.org/10.5897/err2019.3820

Falloon, G. (2019). Using simulations to teach young students science concepts: An Experiential learning theoretical analysis. *Computers & Education*, *135*, 138—159. https://doi.org/10.1016/j.compedu.2019.03.001

Farnam Street. (2021, February 5). *Carol Dweck: A summary of the two mindsets*. Farnam Street. Retrieved December 12, 2021, from https://fs.blog/carol-dweck-mindset/

Fauth, B., Decristan, J., Decker, A. T., Buettner, G., Hardy, I., Klieme, E., & Kunter, M. (2019). The effects of teacher competence on student outcomes in elementary science education: The mediating role of teaching quality. *Teaching and Teacher Education*, *86*, 102882.

Feng, L., Hodges, T. S., Waxman, H. C., & Joshi, R. M. (2019). Discovering the impact of reading coursework and discipline-specific mentorship on first-year teachers' self-efficacy: A latent class analysis. *Annals of dyslexia*, *69*(1), 80—98. https://doi.org/10.1007/s11881-018-00167-1

Fetterman, D. M. (2019). *Ethnography: Step-by-step*. Sage publications.

Fitzgerald, M., Danaia, L., & McKinnon, D. H. (2019). Barriers inhibiting inquiry-based science teaching and potential solutions: perceptions of positively inclined early adopters. *Research in Science Education, 49*(2), 543—566. https://doi.org/10.1007/s11165-017-9623-5

Fischer, C., Fishman, B., Dede, C., Eisenkraft, A., Frumin, K., Foster, B., ... & McCoy, A. (2018). Investigating relationships between school context, teacher professional development, teaching practices, and student achievement in response to a nationwide science reform. *Teaching and Teacher Education*, *72*, 107—121. https://doi.org/10.1016/j.tate.2018.02.011

French, R. (2021, March 18). *Michigan GOP: Cancel standardized tests and 3rd-grade reading law this year*. Bridge Michigan. https://www.bridgemi.com/talent-education/michigan-gop-cancel-standardized-tests-and-3rd-grade-reading-law-year.

Gardner, K., Glassmeyer, D. M., & Worthy, R. (2019). Impacts of stem professional development on teachers' knowledge, self-efficacy, and practice. *Front Educ*. 4: 26. https://doi.org/10.3389/feduc.2019.00026

Gerde, H. K., Pierce, S. J., Lee, K., & Van Egeren, L. A. (2018). Early childhood educators' self-efficacy in science, math, and literacy instruction and science practice in the classroom. *Early Education and Development*, *29*(1), 70—90.

Gess-Newsome, J., Taylor, J. A., Carlson, J., Gardner, A. L., Wilson, C. D., & Stuhlsatz, M. A. (2019). Teacher pedagogical content knowledge, practice, and student achievement. *International Journal of Science Education*, *41*(7), 944—963. https://doi.org/10.1080/09500693.2016.1265158

Gheyssens, E., Coubergs, C., Griful-Freixenet, J., Engels, N., & Struyven, K. (2020). Differentiated instruction: the diversity of teachers' philosophy and praxis to adapt teaching to students' interests, readiness, and learning profiles. *International Journal of Inclusive Education*, 1—18. https://doi.org/10.1080/13603116.2020.1812739

Glaser, B. G., & Strauss, A. L. (2017). *Discovery of grounded theory: Strategies for qualitative research*. Routledge.

Growth mindset by Carol Dweck (animated book summary) - growth mindset and fixed mindset. YouTube. (2016, December 14). Retrieved April 12, 2022, from https://youtu.be/EyIF5VUOJc0

Hall, A. B., & Trespalacios, J. (2019). Personalized professional learning and teacher self-efficacy for integrating technology in K–12 classrooms. *Journal of Digital Learning in Teacher Education*, *35*(4), 221—235. https://doi.org/10.1080/21532974.2019.1647579

Hallinger, P., Hosseingholizadeh, R., Hashemi, N., & Kouhsari, M. (2018). Do beliefs make a difference? Exploring how principal self-efficacy and instructional leadership impact teacher efficacy and commitment in Iran. *Educational Management Administration & Leadership*, *46*(5), 800—819.

Handtke, K., & Bögeholz, S. (2019). Self-efficacy beliefs of interdisciplinary science teaching (SElf-ST) instrument: Drafting a theory-based measurement. *Education Sciences*, *9*(4), 247. https://doi.org/10.3390/educsci9040247

Harnisch, D. L., Creswell, J. W., & Guetterman, T. C. (2017). Mixed methods specialists in action: Linking mixed methods research to learning and classroom assessment. *Handbook on measurement, assessment, and evaluation in higher education* (pp. 128—144). Routledge.

Harper-Hill, K., Beamish, W., Hay, S., Whelan, M., Kerr, J., Zelenko, O., & Villalba, C. (2020). Teacher engagement in professional learning: What makes the difference to teacher practice?. *Studies in Continuing Education*, 1-14. https://doi.org/10.1080/0158037X.2020.1781611

Hatch, J. A. (2002). *Doing qualitative research in education settings*. Suny Press.

Havik, T., & Westergård, E. (2020). Do teachers matter? Students' perceptions of classroom interactions and student engagement. *Scandinavian Journal of Educational Research, 64*(4), 488—507. https://doi.org/10.1080/00313831.2019.1577754

Hayes, K. N., Wheaton, M., & Tucker, D. (2019). Understanding teacher instructional change: The case of integrating NGSS and stewardship in professional development. *Environmental Education Research*, *25*(1), 115—134. https://doi.org/10.1080/13504622.2017.1396289

Herman, K. C., Hickmon-Rosa, J. E., & Reinke, W. M. (2018). Empirically derived profiles of teacher stress, burnout, self-efficacy, and coping and associated student outcomes. *Journal of Positive Behavior Interventions*, *20*(2), 90—100. https://doi.org/10.1177/1098300717732066

Herman, K. C., Reinke, W. M., & Eddy, C. L. (2020). Advances in understanding and intervening in teacher stress and coping: The Coping-Competence-Context

Theory. *Journal of School Psychology*, *78*, 69—74. https://doi.org/10.1016/j.jsp.2020.01.001

Herro, D., & Quigley, C. (2017). Exploring teachers' perceptions of STEAM teaching through professional development: Implications for teacher educators. *Professional Development in Education*, *43*(3), 416—438. https://doi.org/10.1080/19415257.2016.1205507

Hilton, C., & Saunders, J. (2019, July). Supporting generalist elementary school teachers. In *43rd Annual Meeting of the International Group for the Psychology of Mathematics Education VOLUME 4 Oral Communications and Poster*. https://www.coursehero.com/file/92890804/PME43Volume-4-proceedings-oc-pppdf/

Hirsch, S. E., Lloyd, J. W., & Kennedy, M. J. (2019). Professional development in practice: Improving novice teachers' use of universal classroom management. *The Elementary School Journal*, *120*(1), 61—87. https://doi.org/10.1086/704492

Holdren, J. P. (2019). Jim McCarthy's achievements at the intersection of science with public policy. *Journal of Marine Research*, *77*(2), 9—15. https://doi.org/10.1357/002224019828474313

Holland, H. (2005). Teaching teacher: Professional development to improve student achievement. AERA Research Points, Volume 3, Issue 1, Summer 2005. *American Educational Research Association (AERA)*. https://files.eric.ed.gov/fulltext/ED491587.pdf

Holloway, I. (1997). *Basic concepts for qualitative research*. Wiley-Blackwell Science.

https://doi.org/10.4324/9780203846544

Holthuis, N., Deutscher, R., Schultz, S. E., & Jamshidi, A. (2018). The new NGSS classroom: A curriculum framework for project-based science learning. *American Educator*, *42*(2), 23—27. https://www.aft.org/sites/default/files/ae_summer2018_holthuis.pdf

Huang, S., Yin, H., & Lv, L. (2019). Job characteristics and teacher well-being: The mediation of teacher self-monitoring and teacher self-efficacy. *Educational Psychology*, *39*(3), 313—331. https://doi.org/10.1080/01443410.2018.1543855

Huang, X., Zhang, J., & Hudson, L. (2019). Impact of math self-efficacy, math anxiety, and growth mindset on math and science career interest for middle school students: The gender moderating effect. *European Journal of Psychology of Education*, *34*(3), 621—640. https://doi.org/10.1007/s10212-018-0403-z

Ihrig, L. M., Lane, E., Mahatmya, D., & Assouline, S. G. (2018). STEM excellence and leadership program: Increasing the level of STEM challenge and engagement for high-achieving students in economically disadvantaged rural communities. *Journal for the Education of the Gifted*, *41*(1), 24—42. https://doi.org/10.1177/0162353217745158

Al Jabri, M. J. H., Silvennoinen, H., & Griffiths, D. (2018). Teachers' professional development in Oman: Challenges, efforts, and solutions. *International Journal of Learning, Teaching and Educational Research*, *17*(5), 82—103.

Janesick, V. J. (2010). "*Stretching" exercises for qualitative researchers* Sage.

Johnson, R. B., & Christensen, L. (2019). *Educational research: Quantitative,* *qualitative, and mixed approaches*. Sage publications.

Johnson, T. N., & Dabney, K. P. (2018). Voices from the field: Constraints encountered early-career elementary science teachers. *School Science and Mathematics, 118*(6), 244-256. https://doi.org/10.1111/ssm.12290

Kaderavek, J. N., Paprzycki, P., Czerniak, C. M., Hapgood, S., Mentzer, G., Molitor, S., & Mendenhall, R. (2020). Longitudinal impact of early childhood science instruction on 5th-grade science achievement. *International Journal of Science Education*, *42*(7), 1124—1143. https://doi.org/10.1080/09500693.2020.1749908

Ketelhut, D. J., Hestness, E., & Mills, K. (2019). *Embedding computational thinking in the elementary classroom: An extended collaborative teacher learning experience*. https://doi.org/10.22318/cscl2019.869

Klassen, A. C., Creswell, J., Clark, V. L. P., Smith, K. C., & Meissner, H. I. (2012). Best practices in mixed methods for quality of life research. *Quality of Life Research*, *21*(3), 377—380. https://doi.org/10.1007/s11136-012-0122-x

Knowles, J. G. (2017). *Impacts of professional development in integrated STEM education on teacher self-efficacy, outcome expectancy, and STEM career awareness* (Doctoral dissertation, Purdue University).

Kolb, D. A. (2014). *Experiential learning: Experience as the source of learning and development*. FT Press. https://www.researchgate.net/publication/315793484_Experiential_Learning_Experience_as_the_source_of_Learning_and_Development_Second_Edition

Kruse, J., Henning, J., Wilcox, J., Carmen, K., Patel, N., & Seebach, C. (2021).

Investigating the correlations between preservice elementary teachers' self-efficacy and science teaching practices. *Journal of Science Teacher Education*, *32*(4), 469-479. https://doi.org/10.1080/1046560x.2020.1861767

Kunnari, I., Ilomäki, L., & Toom, A. (2018). Successful teacher teams in change: The role of collective efficacy and resilience. *International Journal of Teaching and Learning in Higher Education*. https://doi.org/10.4324/9781315123431-1

Kvale, S., & Brinkman, S. (2009). Interview quality. *Interviews: Learning the craft of qualitative research interviewing*, 161—175.

Larry, T., & Wendt, J. L. (2021). The predictive relationship between gender, ethnicity, science self-efficacy, teacher interpersonal behaviors, and science achievement of students in a diverse urban high school. *Learning Environments Research*, 1—17. https://doi.org/10.1007/s10984-021-09354-1

Lazarides, R., Buchholz, J., & Rubach, C. (2018). Teacher enthusiasm and self-efficacy, student-perceived mastery goal orientation, and student motivation in mathematics classrooms. *Teaching and Teacher Education*, *69*, 1-10. https://doi.org/10.1016/j.tate.2017.08.017

Lewis, F., Edmonds, J., & Fogg-Rogers, L. (2021). Engineering science education: The impact of a paired peer approach on subject knowledge confidence and self-efficacy levels of student teachers. *International Journal of Science Education*, 1-30. https://doi.org/10.1080/09500693.2021.1887544

Lindlof, T. R., & Taylor, B. C. (2017). *Qualitative communication research methods*. Sage publications.

Lodico, M. G., Spaulding, D. T., & Voegtle, K. H. (2010). *Methods in educational research: From theory to practice* (Vol. 28). John Wiley & Sons.

Liu, Y., & Liao, W. (2019). Professional development and teacher efficacy: Evidence from the 2013 TALIS. *School Effectiveness and School Improvement*, *30*(4), 487—509. https://doi.org/10.1080/09243453.2019.1612454

Loach, K. A. (2021). Science in elementary education: Teacher self-efficacy, preparation, and student achievement. *Journal of Research in Education*, *30*(1), 1—28. https://doi.org/10.32469/10355/8325

Loeser, J. W. (2018). Differentiated instruction. *Differentiated Instruction -- Research Starters Education*, 1. http://connection.ebscohost.com/c/essays/27170109/differentiated-instruction

Lindholm, M. (2018). *Promoting curiosity?* Science & Education, 27(9/10), 987—1002. https://doi.org/10.1016/j.tate.2021.103351

Ma, K., & Cavanagh, M. S. (2018). Is the classroom ready?: Pre-service teachers' self-efficacy for their first professional experience placement. *Australian Journal of Teacher Education (Online)*, *43*(7), 134—151. https://doi.org/10.14221/ajte.2018v43n7.8

Mahasneh, A. M., & Alwan, A. F. (2018). The effect of project-based learning on student-teacher self-efficacy and achievement. *International Journal of Instruction*, *11*(3), 511—524. https://doi.org/10.12973/iji.2018.11335a

Mangiante, E. S. (2018). Planning for reform-based science: Case studies of two urban elementary teachers. *Research in Science Education*, *48*(1), 207–232. https://doi-org.ezp.waldenulibrary.org/10.1007/s11165-016-9566-2

McMahon, M., & Patton, W. (2002). Using qualitative assessment in career counseling. *International Journal for Educational and Vocational Guidance*, *2*(1), 51—66. https://www.springer.com/journal/10775

McKellar, S. E., Cortina, K. S., & Ryan, A. M. (2020). Teaching practices and student engagement in early adolescence: A longitudinal study using the classroom assessment scoring system. *Teaching and Teacher Education, 89*, 102936. https://doi.org/10.1016/j.tate.2019.102936

McNeill, K. L., Lowenhaupt, R., Cherbow, K., & Lowell, B. R. (2021). Professional development to support principals' vision of science instruction: Building from their prior experiences to support the science practices. *Journal of Research in Science Teaching*. https://doi.org/10.1002/tea.21719

Mensah, F., & Jackson, I. (2018). Whiteness as property in science teacher education. *Teachers College Record, 120*(1), 1—38.

Menon, D. (2020). Influence of the sources of science teaching self-efficacy in preservice elementary teachers' identity development. *Journal of Science Teacher Education*, *31*(4), 460—481. https://doi.org/10.1080/1046560x.2020.1718863

Merriam, S. (1998). *Qualitative research and case study applications in education*. Jossey-Bass, Inc.

Merriam, S. B. (2002). Introduction to qualitative research. *Qualitative research in practice: Examples for discussion and analysis*, *1*(1), 1—17.

Merriam, S. B. (2009). *Qualitative research: A guide to design and implementation*.

Jossey-Bass.

Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation*. (4th ed.). Jossey Bass

Mertler, C., & Charles, C. M. (2008). Analyzing research data and presenting findings. *Introduction to Educational Research, 147*, *167*.

Michigan Department of Education. (2021). *M-STEP: Michigan Student Test of Educational Progress*. https://www.michigan.gov/mde/0,4615,7-140-22709_70117---,00.html

MI School Data. (2021). *Michigan School Data Dashboard*. Https://Www.Mischooldata.Org/Dashboard-Home/. https://www.mischooldata.org/dashboard-home/

Michigan Department of Education. (2021). *Michigan Academic Standards*. https://www.michigan.gov/mde/0,4615,7-140-28753---,00.html

Michigan Science Standards. (2021). *Michigan Science Standards.* https://www.michigan.gov/documents/mde/K-12_Science_Performance_Expectations_v5_496901_7.pdf

Miles, M. B., & Huberman, A. M. (1984). Drawing valid meaning from qualitative data: Toward a shared craft. *Educational Researcher 13*(5), 20—30. https://www.jstor.org/stable/1174243

Miller, A. D., Ramirez, E. M., & Murdock, T. B. (2017). The influence of teachers' self-efficacy on perceptions: Perceived teacher competence and respect and student effort and achievement. *Teaching and Teacher Education*, *64*, 260—269.

Miller, E., Manz, E., Russ, R., Stroupe, D., & Berland, L. (2018). Addressing the epistemic elephant in the room: Epistemic agency and the next generation science standards. *Journal of Research in Science Teaching*, *55*(7), 1053—1075. https://doi.org/10.1002/tea.21459

Mohtar, L. E., Halim, L., Rahman, N. A., Maat, S. M., Iksan, Z. H., & Osman, K. (2019). A model of interest in stem careers among secondary school students. *Journal of Baltic Science Education*, *18*(3), 404. https://dx.doi.org/10.33225/jbse/19.18.404

Mohd Shahali, E. H., Halim, L., Rasul, M. S., Osman, K., & Mohamad Arsad, N. (2019). Students' interest towards STEM: A longitudinal study. *Research in Science & Technological Education*, *37*(1), 71—89. https://doi.org/10.1080/02635143.2018.1489789

Morrell, P. D., Park Rogers, M. A., Pyle, E. J., Roehrig, G., & Veal, W. R. (2020). Preparing teachers of science for 2020 and beyond: Highlighting changes to the NSTA/ASTE standards for science teacher preparation. *Journal of Science Teacher Education.* 31(1), 1-7. https://doi.org/10.1080/1046560x.2019.1705536

Mosoge, M. J., Challens, B. H., & Xaba, M. I. (2018). Perceived collective teacher efficacy in low-performing schools. *South African Journal of Education*, *38*(2), 1—9. https://doi.org/10.15700/saje.v38n2a1153

Mostafa, T., Echazarra, A., & Guillou, H. (2018). *The science of teaching science: An exploration of science teaching practices in PISA.* 2015. https://doi.org/10.1787/f5bd9e57-en

Moustakas, C. (1994). *Phenomenological research methods*. Sage.

Mulder, D. (1970, January 1). *Would you want to be a student in your own class?* Would You Want to Be a Student in Your Own Class? Retrieved May 6, 2022, from http://iteach-and-ilearn.blogspot.com/2015/09/would-you-want-to-be-student-in-your.html. https://doi.org/10.4324/9781315689326-2

Naidoo, K., & Naidoo, L. J. (2021). Designing teaching and reflection experiences to develop candidates' science teaching self-efficacy. *Research in Science & Technological Education*, 1—21. https://doi.org/10.1080/02635143.2021.1895098

Next Generation Science Standards. (2021). *Next Generation Science Standards, For States, By States*. https://www.nextgenscience.org/

Noell, G. H., Burns, J. M., & Gansle, K. A. (2019). Linking student achievement to teacher preparation: Emergent challenges in implementing the value-added assessment. *Journal of Teacher Education*, *70*(2), 128—138. https://doi.org/10.1177/0022487118800708

Norris, C. M., Morris, J. E., & Lummis, G. W. (2018). Preservice teachers' self-efficacy to teach primary science based on 'science learner' typology. *International Journal of Science Education*, *40*(18), 2292-2308. https://doi.org/10.1080/09500693.2018.1528645

Novak, E., & Wisdom, S. (2018). Effects of 3D printing project-based learning on preservice elementary teachers' science attitudes, science content knowledge, and anxiety about teaching science. *Journal of Science Education and Technology*, *27*(5), 412—432. https://doi.org/10.1007/s10956-018-9733-5

Osborne, J. F., Borko, H., Fishman, E., Gomez Zaccwerelli, F., Berson, E., Busch, K. C., ... & Tseng, A. (2019). Impacts of a practice-based professional development program on elementary teachers' facilitation of and student engagement with scientific argumentation. *American Educational Research Journal*, *56*(4), 1067—1112.

Osman, D. J., & Warner, J. R. (2020). Measuring teacher motivation: The missing link between professional development and practice. *Teaching and Teacher Education*, *92*, 103064. https://doi.org/10.1016/j.tate.2020.103064

Pak, K., & Desimone, L. M. (2019). Developing principals' data-driven decision-making capacity: Lessons from one urban district. *Phi Delta Kappan*, *100*(7), 37—42. https://doi.org/10.1177/0031721719841337

Palmer, K., & Noltemeyer, A. (2019). Professional development in schools: Predictors of effectiveness and implications for statewide PBIS trainings. *Teacher Development, 23*(5), 511—528. https://doi.org/10.1080/21683603.2018.1425169

Pianta, R., Hamre, B., Downer, J., Burchinal, M., Williford, A., Locasale-Crouch, J., ... & Scott-Little, C. (2017). Early childhood professional development: Coaching and coursework effects on indicators of children's school readiness. *Early Education and Development*, *28*(8), 956—975. https://doi.org/10.1080/10409289.2017.1319783

Polizzi, S. J., Zhu, Y., Reid, J. W., Ofem, B., Salisbury, S., Beeth, M., ... & Rushton, G. T. (2021). Science and mathematics teacher communities of practice: Social influences on discipline-based identity and self-efficacy beliefs. *International*

Journal of STEM Education, *8*(1), 1—18. https://doi.org/10.1186/s40594-021-00275-2

Polly, D., Wang, C., Lambert, R., Martin, C., McGee, J. R., Pugalee, D., & Lehew, A. (2017). Supporting kindergarten teachers' mathematics instruction and student achievement through a curriculum-based professional development program. *Early Childhood Education Journal*, *45*(1), 121—131. https://doi.org/10.1080/13664530.2017.1308427

Poulou, M. S., Reddy, L. A., & Dudek, C. M. (2019). Relation of teacher self-efficacy and classroom practices: A preliminary investigation. *School Psychology International*, *40*(1), 25—48. https://doi.org/10.1177/0143034318798045

Prewett, S. L., Bergin, D. A., & Huang, F. L. (2019). Student and teacher perceptions on student-teacher relationship quality: A middle school perspective. *School Psychology International*, *40*(1), 66—87. https://doi.org/10.1177/0143034318807743

Priester, J. L. (2020). Next-generation science standards-aligned curriculum's impact on students' academic scores and attitude towards science. *Doctoral Dissertations and Projects*. 2343. https://digitalcommons.liberty.edu/doctoral/2343.

Putwain, D. W., & von der Embse, N. P. (2019). Teacher self-efficacy moderates the relations between imposed pressure from imposed curriculum changes and teacher stress. *Educational Psychology*, *39*(1), 51—64. https://psycnet.apa.org/doi/10.1080/01443410.2018.1500681

Radloff, J., & Capobianco, B. M. (2019). Investigating elementary teachers' tensions and mitigating strategies related to integrating engineering design-based science instruction. *Research in Science Education*, 1—20. https://doi.org/10.1007/s11165-019-9844-x

Ravitch, S. M., & Carl, N. M. (2020). *Qualitative research*. Sage.

Reilly, D., Neumann, D. L., & Andrews, G. (2019). Gender differences in reading and writing achievement: Evidence from the National Assessment of Educational Progress (NAEP). *American Psychologist*, *74*(4), 445. https://doi.org/10.1037/amp0000356

Rhew, E., Piro, J. S., Goolkasian, P., & Cosentino, P. (2018). The effects of a growth mindset on self-efficacy and motivation. *Cogent Education*, *5*(1), 1492337. https://doi.org/10.1080/2331186x.2018.1492337

Rubin, D. B. (2005). Causal inference using potential outcomes: Design, modeling, decisions. *Journal of the American Statistical Association*, *100*(469), 322—331. https://doi.org/10.1198/016214504000001880

Saldana, J. (2021). *The coding manual for qualitative researchers*. Sage

Sands, P., Yadav, A., & Good, J. (2018). Computational thinking in K-12: In-service teacher perceptions of computational thinking. *Computational thinking in the STEM disciplines* (pp. 151—164). Springer, Cham. https://doi.org/10.1007/978-3-319-93566-9_8

Sarı, U., Alıcı, M., & Şen, Ö. F. (2018). The effect of STEM instruction on attitude, career perception, and career interest in a problem-based learning environment and student opinions. *The Electronic Journal for Research in Science &*

Mathematics Education, *22*(1). https://doi.org/10.21891/jeseh.275649

Sawlane, R., & Shaikh, M. S. (2018). Skills development in students through inquiry as a teaching-learning strategy. *AMIERJ Journal*, 7(14). https://www.researchgate.net/profile/Rakhi-Sawlane/publication/352449996_AMIERJ_Volume-VII_Special_Issue-XIV_SKILL_DEVELOPMENT_IN_STUDENTS_THROUGH_INQUIRY_AS_A_TEACHING_LEARNING_STRATEGY/links/60ca07c9a6fdcc01d477d4e3/AMIERJ-Volume-VII-Special-Issue-XIV-SKILL-DEVELOPMENT-IN-STUDENTS-THROUGH-INQUIRY-AS-A-TEACHING-LEARNING-STRATEGY.pdf

Schmidt, M., & Allsup, R. E. (2019). John Dewey and teacher education. *Oxford Research Encyclopedia of Education*. https://doi.org/10.1093/acrefore/9780190264093.013.475

Schwab, S., Sharma, U., & Loreman, T. (2018). Were we included? Secondary students' perception of inclusion climate in their schools. *Teaching and Teacher Education*, *75*, 31-39. https://doi.org/10.1016/j.tate.2018.05.016

Seals, C., Mehta, S., Berzina-Pitcher, I., & Graves-Wolf, L. (2017). Enhancing teacher efficacy for urban STEM teachers facing challenges to their teaching. *Journal of Urban Learning, Teaching, and Research*, *13*, 135—146). https://files.eric.ed.gov/fulltext/EJ1150083.pdf

Sheu, H. B., Lent, R. W., Miller, M. J., Penn, L. T., Cusick, M. E., & Truong, N. N. (2018). Sources of self-efficacy and outcome expectations in science, technology, engineering, and mathematics domains: A meta-analysis. *Journal of Vocational Behavior, 109*, 118—136. https://doi.org/10.1016/j.jvb.2018.10.003

Sibabagariang, P. P., & S. Pandia, W. S. (2021). Teaching approach and teacher self-efficacy during early childhood distance learning. JPUD – Jurnal Pendidikan Usia Dimi, 15(1), 41—59. https://doi.org/10.21009/jpud.151.03

Sökmen, Y. (2021). The role of self-efficacy in the relationship between the learning environment and student engagement. *Educational Studies*, *47*(1), 19--37. https://doi.org/10.1080/03055698.2019.1665986

Sprott, R. A. (2019). Factors that foster and deter advanced teachers' professional development. *Teaching and Teacher Education*, *77*, 321—331. https://doi.org/10.1016/j.tate.2018.11.001

Sukma, E., Ramadhan, S., & Indriyani, V. (2020, March). Integration of environmental education in elementary schools. In *Journal of Physics: Conference Series* (Vol. 1481, No. 1, p. 012136). IOP Publishing. http://dx.doi.org/10.1088/1742-6596/1481/1/012136

Tallman, T. O. (2019). How middle grades teachers experience a collaborative culture: An interpretative phenomenological analysis. *RMLE Online*, *42*(8), 1—16. https://doi.org/10.1080/19404476.2019.1668103

Teig, N., Scherer, R., & Nilsen, T. (2019). I know I can, but do I have the time? The role of teachers' self-efficacy and perceived time constraints in implementing cognitive-activation strategies in science. *Frontiers in Psychology*, *10*, 1697. https://doi.org/10.3389/fpsyg.2019.01697

The power of believing that you can improve: Carol Dweck. YouTube. (2014, December 17). Retrieved April 12, 2022, from https://youtu.be/_X0mgOOSpLU

Thurm, D., & Barzel, B. (2020). Effects of a professional development program for teaching mathematics with technology on teachers' beliefs, self-efficacy, and practices. *ZDM: Mathematics Education*, *52*(7), 1411—1422. http://dx.doi.org/10.1007/s11858-020-01158-6

Tsui, C. (2018). Teacher efficacy: A case study of faculty beliefs in an English-medium instruction teacher training program. *Taiwan Journal of TESOL*, *15*(1), 101—128. https://doi.org/10.1002/9781118784235.eelt0219

U.S. Department of Education. (2021). *Science, Technology, Engineering, and Math Including Computer Science*. https://www.ed.gov/ste

Uzuntiryaki-Kondakci, E., Kirbulut, Z. D., Sarici, E., & Oktay, O. (2020). Emotion regulation as a mediator of the influence of science teacher emotions on teacher efficacy beliefs. *Educational Studies*, 1—19. https://doi.org/10.1080/03055698.2020.1793300

Van Manen, M. (1990). Beyond assumptions: Shifting the limits of action research. *Theory into practice*, *29*(3), 152—157. https://doi.org/10.1080/00405849009543448

van Rooij, E. C. M., Fokkens-Bruinsma, M., & Goedhart, M. (2019). Preparing science undergraduates for a teaching careers: Sources of their teacher self-efficacy. *The Teacher Educator*, *54*(3), 270—294. https://doi.org/10.1080/08878730.2019.1606374

Webb-Williams, J. (2018). Science self-efficacy in the primary classroom: Using mixed methods to investigate sources of self-efficacy. *Research in Science Education*, *48*(5), 939-961. https://doi.org/10.1007/s11165-016-9592-0

White, K., & Rotermund, S. (2019). Elementary and secondary mathematics and science education. Science & Engineering Indicators 2020. NSB-2019-6. *National Science Foundation*. https://ncses.nsf.gov/pubs/nsb20196/

Wiebe, E., Unfried, A., & Faber, M. (2018). The relationship of STEM attitudes and careers interest. *EURASIA Journal of Mathematics, Science, and Technology Education*, *14*(10). https://doi.org/10.29333/ejmste/92286

Williford, A. P., Carter, L. M., Maier, M. F., Hamre, B. K., Cash, A., Pianta, R. C., & Downer, J. T. (2017). Teacher engagement in core components of an effective, early childhood professional development course: Links to changes in teacher–child interactions. *Journal of Early Childhood Teacher Education*, *38*(1), 102—118. https://doi-org.ezp.waldenulibrary.org/10.1080/10901027.2016.1269028

Wilson, R. T., Watson, E., Kaelin, M., & Huebner, W. (2018). Early preparation and inspiration for STEM careers: Preliminary report of the epidemiology challenge randomized intervention, 2014-2015. *Public Health Reports*, *133*(1), 64—74. https://doi.org/10.1177/0033354917746983

Workman, J. (2021). Income inequality and student achievement: trends among the US States (1992–2019). *Educational Review*, 1—23. https://doi.org/10.1080/00131911.2021.1974349

Worthington, M. (2013). Differences between phenomenological research and a basic qualitative research design. *Retrieved from*, *1149861*.

Yeager, D. S., & Dweck, C. S. (2020). What can be learned from growth mindset controversies? *American Psychologist*, *75*(9), 1269. https://psycnet.apa.org/doi/10.1037/amp0000794

Yin, R. K. (2009). Case study research: Design and methods (Vol. 5). Sage. https://doi.org/10.33524/cjar.v14i1.73

Young, A. M., Wendel, P. J., Esson, J. M., & Plank, K. M. (2018). Motivational decline and recovery in higher education STEM courses. *International Journal of Science Education*, *40*(9), 1016-1033. https://doi.org/10.1080/09500693.2018.1460773

Zhang, L., Carter Jr, R. A., Zhang, J., Hunt, T. L., Emerling, C. R., Yang, S., & Xu, F. (2021). Teacher perceptions of effective professional development: Insights for design. *Professional Development in Education*, 1—14. https://doi.org/10.1080/19415257.2021.1879236

Zimmerman, B. J. (2000). Self-efficacy: An essential motive to learn. *Contemporary Educational Psychology*, *25*(1), 82—91. https://doi.org/10.1006/ceps.1999.1016

Appendix A: The Project

A PowerPoint presentation will guide the activities of the 3-day professional development project. The PowerPoint will include topics, transitions, and engage teachers throughout the sessions. The PowerPoint, a schedule, and facilitator notes are included in this Appendix:

Day 1- Professional Development Session Schedule

Time	Activities	Methods & Materials
8:30 am – 9:00 am	Sign-in, binder/dividers, and materials pick-up, continental breakfast	Participants sign in at a table and receive an Agenda, binder/dividers, materials, and continental breakfast
9:00 am – 9:15 am	Welcome, introductions, tent cards activity, overview of day 1, norms	Facilitator led with participants' input via PowerPoint, handouts
9:15 am – 10:00 am	Self-Efficacy Pretest and sharing, growth mindset video clip, and verbal mantra	Facilitator led with participants' input via PowerPoint, Self-Efficacy Pretest, growth mindset video clip, and verbal mantra
10:00 am – 10:30 am	Article & discussion: “Would You Want to be a Student in Your Own Classroom?”	Facilitator led with participants' input via PowerPoint, article
	10 Minute Break	
10:40 am – 11:40 am	What is the MSS? Where do I find MSS strategies & resources?	Facilitator led with participants' input via PowerPoint, handouts

11:40 am – 12:00 pm	MSS website scavenger hunt	Facilitator led with participants input via PowerPoint, handouts
12:00 pm – 1:00 pm	Lunch	Lunch is provided
1:00 pm – 2:00 pm	What is phenomena-based instruction?	Facilitator led via PowerPoint and handouts
	10 Minute Break	
2:15 pm – 3:15 pm	Phenomenon search and find activity and sharing	Facilitator led with participants input via PowerPoint, handouts
3:15pm – 3:30pm	Exit ticket	Facilitator led with participants input via PowerPoint, handouts

Day 1- Facilitator Notes

- Participants enter to soft music and are greeted. They will sign in, receive a 3-ring binder with daily dividers, and materials. They will then enjoy a continental breakfast.
- Participants will make tent cards with their names and a drawing of their favorite food. Each person will introduce themselves and share their favorite food.
- The facilitator will share professional development norms and give an overview of the 3-day professional development. Norms will also be posted to ensure visibility.
- Teachers will then take an Elementary Science Self-Efficacy Pretest. They will be invited to share the results and hopes for future self-efficacy perceptions.
- Participants will watch a growth mindset video clip. They will discuss the video and engage in a growth mindset verbal mantra.

- Facilitator-led article review and discussion: "Would You Want to be a Student in Your Own Classroom?"
- Facilitator will give participants a 10-minute Break.
- Facilitator will share a complete overview of MSS including where to find resources and strategies. Participants use computers to find MSS on the website and participate in a website scavenger hunt.
- Facilitator will give participants a 1-hour Lunch Break.
- Facilitator will delve into phenomena-based instruction that is at the core of MSS lessons.
- Facilitator will give participants a 10 minute Break.
- Participants will then be partnered with another teacher to complete a digital phenomenon search and find activity. This activity will help participants identify and locate phenomena on various websites that correlates to science topics. Each group will share the results of the phenomenon search and find activity with the group.
- Each group will share at least two phenomena that they were able to locate during the phenomena search and find with the whole group.
- Participants will add all handouts and lesson plans to their binder before leaving for the day.
- The day will end with an exit ticket. Participants will answer the following:
    - What engaged you the most today?
    - What other strategies would you help you feel confident to engage students in elementary science?"

Day 2- Professional Development Session Schedule

Time	Activities	Methods & Materials
8:30 am – 9:00 am	Sign-in, materials pick-up, continental breakfast	Participants sign-in at table and receive an Agenda, binder/dividers, materials, and continental breakfast
9:00 am – 9:30 am	Welcome, icebreaker	Facilitator led with participants input via PowerPoint
9:30 am – 10:00 am	Growth mindset video clip, and verbal mantra	Facilitator led with participants input via PowerPoint, growth mindset video clip, and verbal mantra
10:00 am – 10:30 am	Review of Day 1 exit tickets, overview of Day 2, norms	Facilitator led with participants input via PowerPoint
	10 Minute Break	
10:40 am – 11:30 am	Solution-oriented conversations: Time management with a colleague followed by sharing	Facilitator led with participants input via PowerPoint, handouts
11:30 am –12:00 pm	Time management resources & strategies	Facilitator led with participants input via PowerPoint, handouts
12:00 pm – 1:00 pm	Lunch	Lunch is provided
1:00 pm – 2:00 pm	The importance of engaging science strategies: Video clips, hands-on activities, website resources, and strategies	Facilitator led via PowerPoint and handouts
2:00 pm – 2:15 pm	Engaging science strategies and standards matching activity	Facilitator led with participants input via PowerPoint, handouts

10 Minute Break

2:25 pm – 3:20 pm	Engaging science strategies lesson plan search	Facilitator led via PowerPoint, participant input, and handouts
3:20 pm – 3:30 pm	Exit ticket	Facilitator led via PowerPoint, participant input, and handouts

Day 2- Facilitator Notes

- Participants enter to soft music and are greeted. They will sign in, pick up materials, and enjoy a continental breakfast.
- Facilitator will welcome participants and lead an Icebreaker “Find a Person Who…”
- Participants will watch a growth mindset video clip. They will discuss the video as a whole-group and engage in a growth mindset verbal mantra.
- Facilitator will read Day 1 exit tickets aloud, give an overview of Day 2, and Norms. Norms will also be will be posted to ensure visibility.
- Facilitator will give participants a 10-minute Break.
- Facilitator will pair participants according to grade levels for solution-oriented conversations about time management and teaching science with fidelity. Participants will share results with the whole-group.
- Facilitator will share time management resources and strategies with participants.
- Facilitator will give participants a 1-hour Lunch Break.
- Facilitator will share the importance of engaging science strategies including a video clip, hands-on materials, website resources, and instructional strategies.

- Participants will complete an engaging strategies and standards matching activity. They will share results with the whole group.
- Facilitator will give participants a 10-minute Break.
- Participants will complete an engaging strategies lesson search to find plans for the upcoming school year.
- Participants will add all handouts and lesson plans to their binder before leaving for the day.
- The day will end with an exit ticket. Participants will answer the following:
  - What engaged you the most today?
  - What other strategies would help you feel confident to engage students in elementary science?"

Day 3- Professional Development Session Schedule

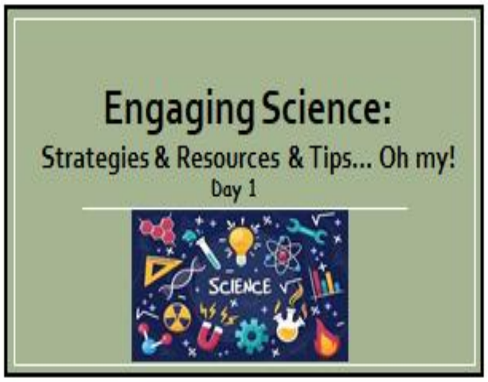
Time	Activities	Methods & Materials
8:30 am – 9:00 am	Sign-in, materials pick-up, continental breakfast	Participants sign-in at table and receive an Agenda, binder/dividers, materials, and continental breakfast
9:00 am – 9:30 am	Welcome, icebreaker, growth mindset video clip and verbal mantra	Facilitator led with participants input via PowerPoint, growth mindset video clip, and verbal mantra
9:30 am – 9:45 am	Review of Day 2 exit tickets, Overview of Day 3, norms	Facilitator led with participants input via PowerPoint

9:45 am – 10:30 am	Science engagement: Review of day 1 and day 2	Facilitator led with participants input via PowerPoint, handouts
	10 Minute Break	
10:40 am – 10:50 am	Science engagement scavenger hunt activity	Facilitator led with participants input via PowerPoint, handouts
10:50 am – 12:00 pm	Engaging, phenomena-based science lesson planning- Part 1	Participant small group planning with facilitator input
12:00 pm – 1:00 pm	Lunch	Lunch is provided
1:00 pm – 1:30 pm	Engaging, phenomena-based science lesson planning- Part 2	Participant small group planning with facilitator input
1:30 pm – 2:15 pm	Engaging, phenomena-based science lesson plan sharing	Facilitator led with participants input via PowerPoint, handouts
	10 Minute Break	
2:25 pm – 3:00 pm	Final celebrations	Facilitator led via PowerPoint, participant input
3:00 pm – 3:30 pm	Exit ticket, Self-Efficacy Posttest, final evaluation	Facilitator led with participants input via PowerPoint, handouts

Day 3- Facilitator Notes

- Participants enter to soft music and greeted by the facilitator. They will sign in, pick up materials, and enjoy a continental breakfast.
- Facilitator will welcome participants and lead an icebreaker called, “Summer Me.”

- Participants will watch a growth mindset video clip. They will discuss the video and engage a whole-group growth mindset verbal mantra.
- Facilitator will read Day 2 exit tickets aloud, give an overview of the Day 3, and review norms. Norms will be posted to ensure visibility.
- Facilitator led session, Science Engagement: Review of Day 1 and Day 2.
- Facilitator will lead participants in a science engagement scavenger hunt for prizes.
- Facilitator will give participants a 10 minute Break.
- Facilitator will lead participants in Science Engagement: Review of Day 1 and Day 2.
- Participants will collaborate with another teacher in the group to develop two complete lesson plans to be used during the school year. Lesson plans must include the standard, phenomena, engaging strategies, engaging technology, and/or a hands-on activity.
- Facilitator will give participants a 1-hour Lunch Break.
- Participants will continue planning lessons before sharing with the whole group.
- Facilitator will give participants a 10 minute Break.
- Participants will have final celebrations and openly share, “lessons learned” during the 3-day professional development or an implementation plan for the 2022-2023 school year.
- Participants will add all handouts and lesson plans to their binder before leaving.
- The day will end with an exit ticket, Science Self-Efficacy Posttest, and final evaluation.


Engaging Science:
Strategies & Resources & Tips… Oh my!
Day 1
SCIENCE

1


INTRODUCTIONS
YOUR NAME HERE
Write your name and draw a picture of your favorite food.

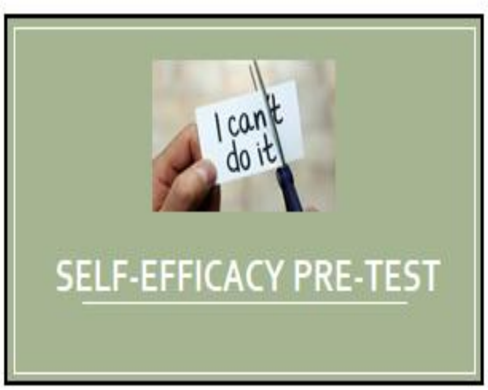
2


Agenda
Welcome
Introductions
Day 1 Overview/Agenda
Norms
Self-Efficacy & Growth Mindset
"Would You Want to be a Student in Your Own Classroom?"
MSS
Phenomena-Based Instruction
Exit Ticket

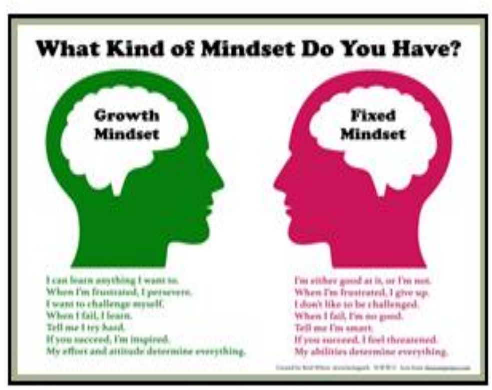
3


NORMS
Demonstrate mutual respect.
Be mentally and physically present.
Respect others expertise/credibility; share floor time with humility
Science is Elementary

4

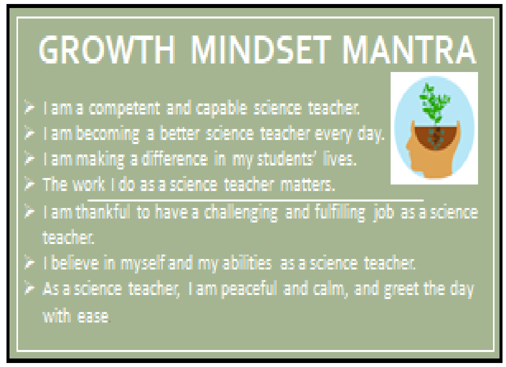

I can't do it
SELF-EFFICACY PRE-TEST

5


What Kind of Mindset Do You Have?
Growth Mindset
Fixed Mindset
I can learn anything I want to.
When I'm frustrated, I persevere.
I want to challenge myself.
When I fail, I learn.
Tell me I try hard.
If you succeed, I'm inspired.
My effort and attitude determine everything.
I'm either good at it, or I'm not.
When I'm frustrated, I give up.
I don't like to be challenged.
When I fail, I'm no good.
Tell me I'm smart.
If you succeed, I feel threatened.
My abilities determine everything.

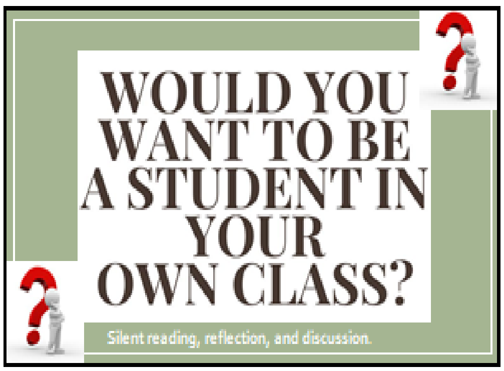
Growth Mindset Video Clip
• https://youtu.be/_XomqOOSpLU
"Failure is an opportunity to grow"
GROWTH MINDSET
"Challenges help me to grow"
"Feedback is constructive"
"I like to try new things"
"Failure is the limit of my abilities"
FIXED MINDSET
"I'm either good at it or I'm not"
"My potential is predetermined"
"When I'm frustrated, I give up"
"I stick to what I know"

7



GROWTH MINDSET MANTRA
I am a competent and capable science teacher.
I am becoming a better science teacher every day.
I am making a difference in my students' lives.
The work I do as a science teacher matters.
I am thankful to have a challenging and fulfilling job as a science teacher.
I believe in myself and my abilities as a science teacher.
As a science teacher, I am peaceful and calm, and greet the day with ease

8



WOULD YOU WANT TO BE A STUDENT IN YOUR OWN CLASS?
Silent reading, reflection, and discussion.

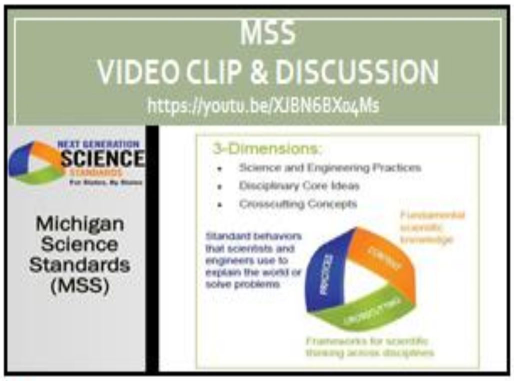
9

10- Minute Break
Pause

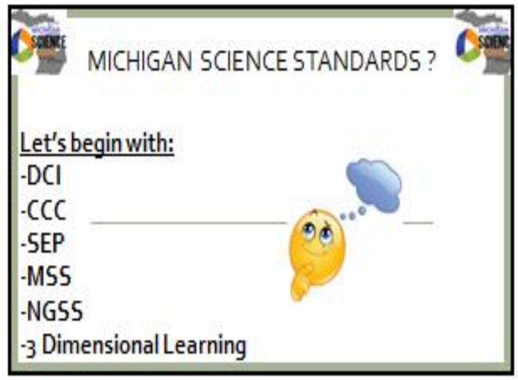
10

WHAT'S SO NEW ABOUT THE MICHIGAN SCIENCE STANDARDS (MSS)?
MICHIGAN
SCIENCE

What are the Michigan Science Standards?
The MSS are standards with a purpose. The K-12 science content standards cover every grade and every scientific discipline, setting expectations for what students should know and be able to do in science.
A major difference between the MSS and previous science standards is "three-dimensional" (3D) learning. 3D learning refers to the thoughtful and deliberate integration of three distinct dimensions: Scientific and Engineering Practices (SEPs), Disciplinary Core Ideas (DCIs), and Crosscutting Concepts (CCCs).
Through 3D learning, the MSS emphasize that science is not just a series of isolated facts. This awareness enables students to view science more as an interrelated world of inquiry and phenomena rather than a static set of science disciplines.
The MSS represent a fundamental shift in science education and require a different approach to teaching science than has been done in the past. Looking ahead, teachers can use a range of strategies to engage students and create opportunities to demonstrate their thinking and learning.


MSS
VIDEO CLIP & DISCUSSION
https://youtu.be/XJBN6BXo4Ms
NEXT GENERATION SCIENCE STANDARDS
Michigan Science Standards (MSS)
3-Dimensions:
• Science and Engineering Practices
• Disciplinary Core Ideas
• Crosscutting Concepts
Fundamental scientific knowledge
Standard behaviors that scientists and engineers use to explain the world or solve problems
Frameworks for scientific thinking across disciplines

13


MICHIGAN SCIENCE STANDARDS ?
Let's begin with:
-DCI
-CCC
-SEP
-MSS
-NGSS
-3 Dimensional Learning

14


Michigan Science Standards (MSS)?
1. ***Focus on explaining PHENOMENA or designing solutions to problems
2. 3-Dimensional Learning
*Organized around disciplinary core ideas (DCI)
*Central role of scientific and engineering practices (SEP)
*Use of crosscutting concepts (CCC)
3. Coherence: building and applying ideas across time

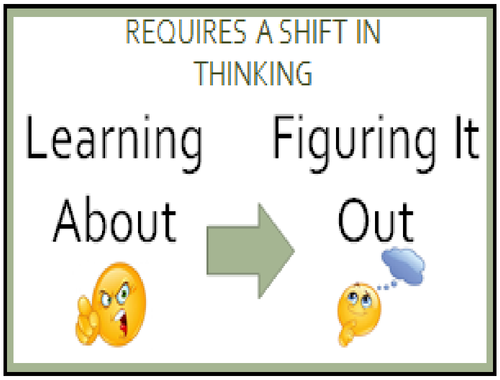
15


MSS RESOURCES & STRATEGIES
✓ https://www.michigan.gov/-/media/Project/Websites/mde/Literacy/Content-Standards/Science_Standards.pdf?rev=7obad7cocbco48ceabbc548669b2d76a
✓ https://www.nextgenscience.org/lead-state-michigan
✓ https://www.msta-mich.org/page/standardslinks

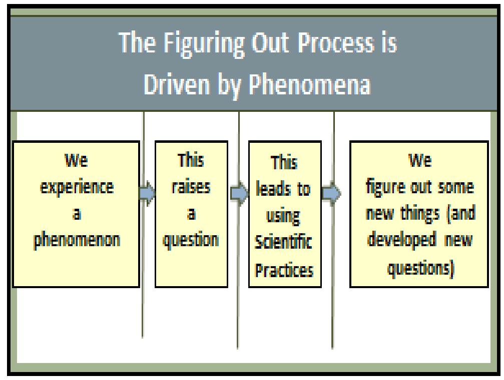
16


MSS Website Scavenger Hunt
Scavenger Hunts

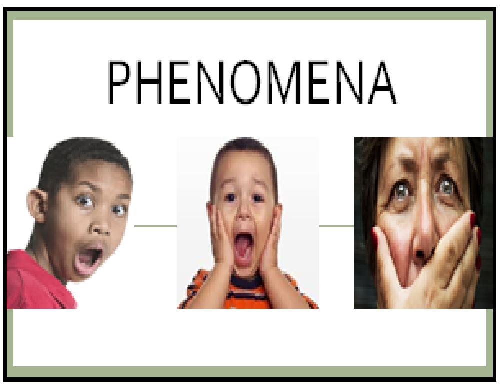

Lunch Break
LUNCH TIME
•Please return by 1 p.m.


REQUIRES A SHIFT IN THINKING
Learning About
Figuring It Out

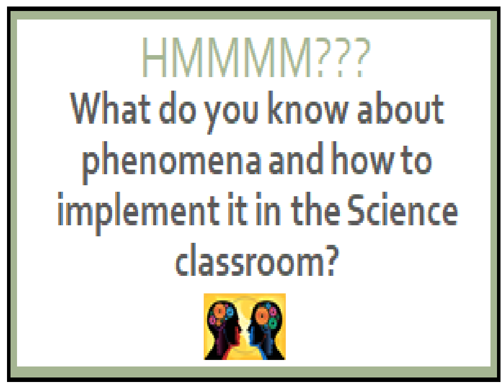
19


The Figuring Out Process is Driven by Phenomena
We experience a phenomenon
This raises a question
This leads to using Scientific Practices
We figure out some new things (and developed new questions)

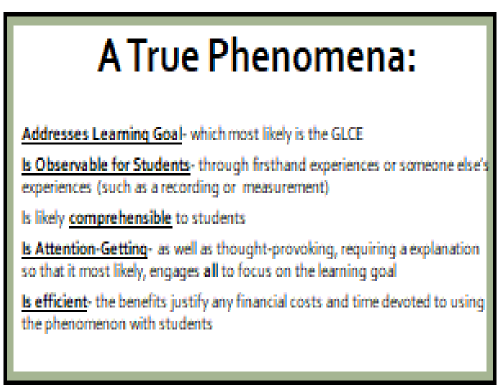
20

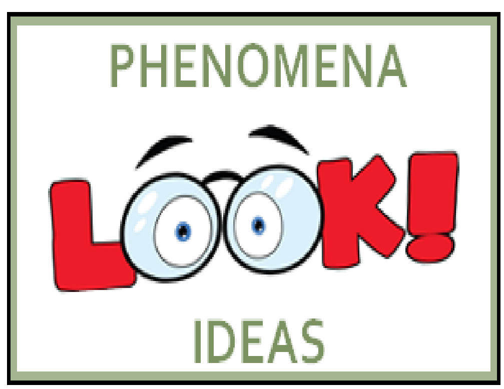

PHENOMENA

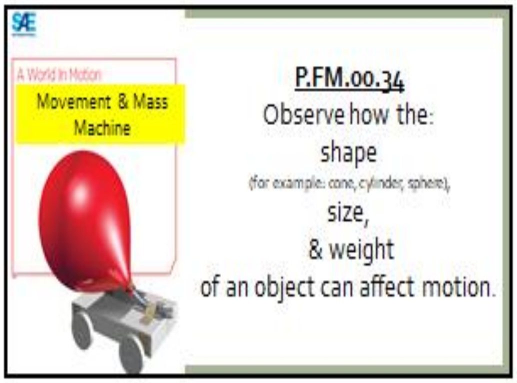
21


HMMMM???
What do you know about phenomena and how to implement it in the Science classroom?

22


A True Phenomena:
Addresses Learning Goal- which most likely is the GLCE
Is Observable for Students- through firsthand experiences or someone else's experiences (such as a recording or measurement)
Is likely comprehensible to students
Is Attention-Getting- as well as thought-provoking, requiring a explanation so that it most likely, engages all to focus on the learning goal
Is efficient- the benefits justify any financial costs and time devoted to using the phenomenon with students


PHENOMENA
LOOK!
IDEAS


A World in Motion
Movement & Mass Machine
P.FM.00.34
Observe how the:
shape
(for example: cone, cylinder, sphere),
size,
& weight
of an object can affect motion.

25


How can we design a place for our pet fish to live?

26


Worm Invasion!

27


What is making her sick?

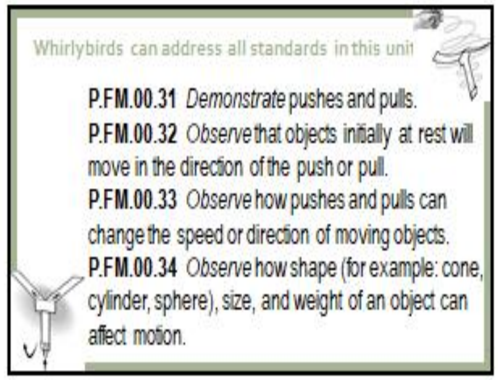
28


WATCH
&
DO

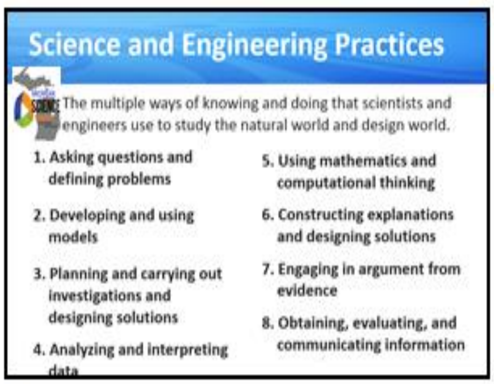

What do we need to know to figure out
Why our whirly bird is moving down?


SCIENCE
TIE IT TO THE
STANDARD/LEARNING GOAL:

31


Whirlybirds can address all standards in this unit
P.FM.00.31 Demonstrate pushes and pulls.
P.FM.00.32 Observe that objects initially at rest will move in the direction of the push or pull.
P.FM.00.33 Observe how pushes and pulls can change the speed or direction of moving objects.
P.FM.00.34 Observe how shape (for example: cone, cylinder, sphere), size, and weight of an object can affect motion.

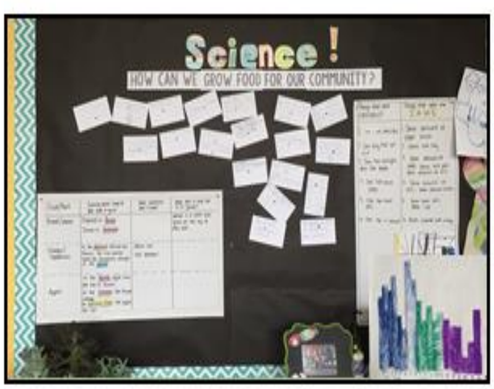
32

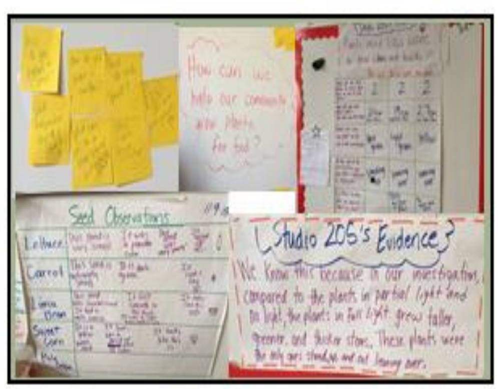

Science and Engineering Practices
The multiple ways of knowing and doing that scientists and engineers use to study the natural world and design world.
1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations and designing solutions
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

33


"Asking Questions" with Talk Moves
I agree with your answer because...
I disagree with your answer because...
My strategy is like yours because...
My strategy is different because...
Could you explain it another way?
I don't understand...
How do you know your answer is right?
What is another strategy we could use to check?

34


Science!
HOW CAN WE GROW FOOD FOR OUR COMMUNITY?


Seed Observations
Lettuce
Carrot
Studio 205's Evidence


Questions?
➢Questions about three-dimensional learning
➢Questions about Cross cutting concepts?
➢Questions on Scientific and Engineering Practices?

37


10- Minute Break
TIME FOR A BREAK

38


PHENONMENA SEARCH
&
FIND

39


PHENONMENA SEARCH
&
FIND
TIME TO SHARE

40


EXIT
TICKET
ADMIT ONE

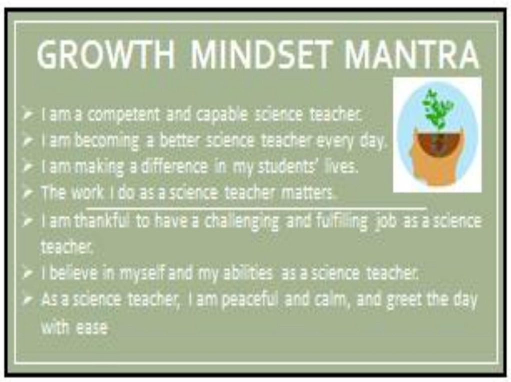

Engaging Science:
Strategies & Resources & Tips… Oh my!
Day 2
SCIENCE


i,m
Here
WELCOME & ICE BREAKER
Find a person who…

43


Growth Mindset Video Clip
GROWTH MINDSET
FIXED MINDSET

44


GROWTH MINDSET MANTRA
I am a competent and capable science teacher.
I am becoming a better science teacher every day.
I am making a difference in my students' lives.
The work I do as a science teacher matters.
I am thankful to have a challenging and fulfilling job as a science teacher.
I believe in myself and my abilities as a science teacher.
As a science teacher, I am peaceful and calm, and greet the day with ease

45


Agenda
Welcome
Ice Breaker
Growth Mindset Video and Mantra
Review of Day 1 Exit Ticket
Day 2 Overview/Agenda
Norms
Solution-Oriented Conversations with a Colleague (Time Management) & Sharing
Time Management Resources & Strategies
The Importance of Engaging Science Instruction
Engaging Science Strategies Activity & Lesson Plan Search
Exit Ticket
SCIENCE WONDERFUL

46


NORMS
•Demonstrate mutual respect.
•Be mentally and physically present.
•Respect others expertise/credibility; share floor time with humility
Science is Elementary


10- Minute Break
Pause

Solution-Oriented Conversations with a Colleague: Time Management

Objective: Collaborate with a colleague to problem-solve ways to ensure that instructional minutes for elementary science are met.

- ✓Have a growth mindset and focus on solutions, not the problem.
- ✓Develop a chart to share with the group.

Problem	Solution

49

Elementary Science Time Management: Strategies

- Tip #1: Plan, plan, plan.
- Tip #2: Gather all of the materials ahead of time.
- Tip #3: Plan your work and work your plan.
- Tip #4: Just say "NO" by setting boundaries.
- Tip #5: Set a timer for every lesson.
- Tip #6: Pursue making science "fun" with a vengeance!
- Tip #7: Be flexible.

50

Elementary Science Time Management: Strategies

- Tip #1: Plan, plan, plan.
- Tip #2: Gather all of the materials ahead of time.
- Tip #3: Plan your work and work your plan.
- Tip #4: Just say "NO" by setting boundaries.
- Tip #5: Set a timer for every lesson.
- Tip #6: Pursue making science "fun" with a vengeance!
- Tip #7: Be flexible.

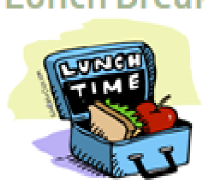
51

Elementary Science Time Management: Resources

- Free Musical Timer: https://youtu.be/HA7Bx1Y14CU
- Free Star Wars Timer: https://youtu.be/jwkl_-BZaU
- Free Aquarium Timer: https://youtu.be/odz6sDTJKz4
- Free Science Theme: https://youtu.be/dkXrQQxlBxk

52

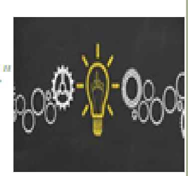
Lunch Break



- Please return by 1 p.m.

The Importance of Engaging Science: Strategies

- Let's read: https://www.edutopia.org/article/focusing-science-elementary-students-year
- Tip #1: Use phenomena.
- Tip #2: Integrate art.
- Tip #3: Use the "Tableau Routine."
- Tip #4: Be hands-on.
- Tip #5: Allow curiosity.
- Tip #6: Integrate music.
- Tip #7: STEAM it.



More strategies: https://static.nsta.org/pdfs/samples/PB243Xweb.pdf


The Importance of Engaging Science:
Video Clips
• Free Captivating Photos/Videos:
https://www.sciencephoto.com/motion
• Discovery Education:
https://www.discoveryeducation.com/programs/science/
• Free NASA Videos:
https://spaceplace.nasa.gov/menu/videos/
• Free National Geographic:
https://kids.nationalgeographic.com/videos/topic/spectacular-scienceTip #5: Set a timer for every lesson.

55


Engaging Science Strategies & Standards Matching Activity
➢ Work with a partner to match a science strategy to an MSS.
➢ The first team to finish wins a prize!
➢ Be ready to share the strategies that you selected when the timer goes off
READY
SET
GO!

56

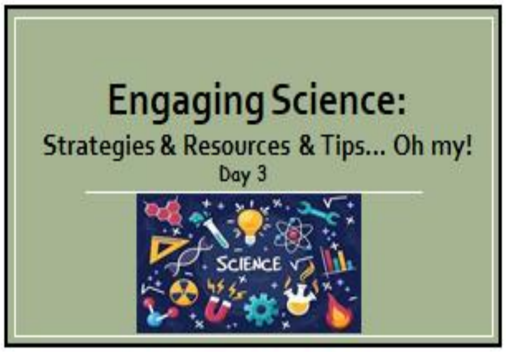

10- Minute Break
TIME FOR A BREAK

57


Engaging Science Lesson Plan Search
➢ Work with a colleague to find engaging science lesson plans for the upcoming school year.

58


EXIT
TICKET
ADMIT ONE

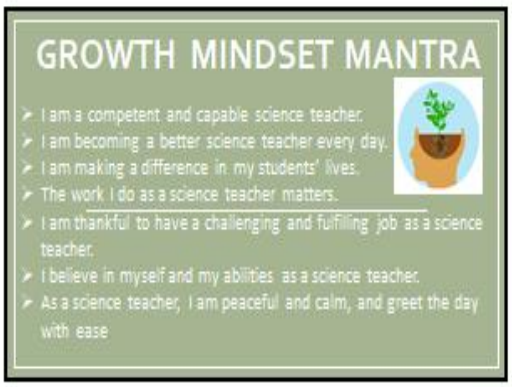

Engaging Science:
Strategies & Resources & Tips… Oh my!
Day 3
SCIENCE


SUMMER
WELCOME & ICE BREAKER
Summer me…

61


Growth Mindset Video Clip
"Failure is an opportunity to grow"
GROWTH MINDSET
"Challenges help me to grow"
"Feedback is constructive"
"I like to try new things"
"Failure is the limit of my abilities"
FIXED MINDSET
"I'm either good at it or I'm not"
"My potential is predetermined"
"When I'm frustrated, I give up"
"I stick to what I know"

62


GROWTH MINDSET MANTRA
➢ I am a competent and capable science teacher.
➢ I am becoming a better science teacher every day.
➢ I am making a difference in my students' lives.
➢ The work I do as a science teacher matters.
➢ I am thankful to have a challenging and fulfilling job as a science teacher.
➢ I believe in myself and my abilities as a science teacher.
➢ As a science teacher, I am peaceful and calm, and greet the day with ease

63


Agenda
- Welcome
- Ice Breaker
- Growth Mindset Video and Mantra
- Review of Day 2 Exit Ticket
- Day 3 Overview/Agenda of the Day
- Norms
- Science Engagement: Review of Day 1 & Day 2
- Science Engagement: Review of Day 1 & Day 2 Game
- Engaging, Phenomena-Based Science Lesson Planning
- Engaging, Phenomena-Based Science Lesson Sharing
- Final Celebrations
- Exit Ticket
SCIENCE IS WONDERFUL

64


NORMS
•Demonstrate mutual respect.
•Be mentally and physically present.
•Respect others expertise/credibility; share floor time with humility
Science is Elementary


Science Engagement
Time for review
What have we learned?

The Importance of Engaging Science: Strategies

- Let's read: https://www.edutopia.org/article/focusing-science-elementary-students-year
- Tip #1: Use phenomena.
- Tip #2: Integrate art.
- Tip #3: Use the "Tableau Routine."
- Tip #4: Be hands-on.
- Tip #5: Allow curiosity.
- Tip #6: Integrate music.
- Tip #7: STEAM it.

More strategies: https://static.nsta.org/pdfs/samples/PB243Xweb.pdf

67

The Importance of Engaging Science: Video Clips

- Free Captivating Photos/Videos: https://www.sciencephoto.com/motion
- Discovery Education: https://www.discoveryeducation.com/programs/science/
- Free NASA Videos: https://spaceplace.nasa.gov/menu/videos/
- Free National Geographic: https://kids.nationalgeographic.com/videos/topic/spectacular-scienceTip #5: Set a timer for every lesson.

68

The Importance of Engaging Science: Websites

- Science Investigations: https://www.teachingexpertise.com/classroom-ideas/science-videos-for-kids/Tip #2: Gather all of the materials ahead of time
- Science Instructional Ideas: https://www.teachingexpertise.com/
- Elementary Curriculum Ideas: https://mysteryscience.com/

69

10- Minute Break

70

Science Engagement: Review

Game Time

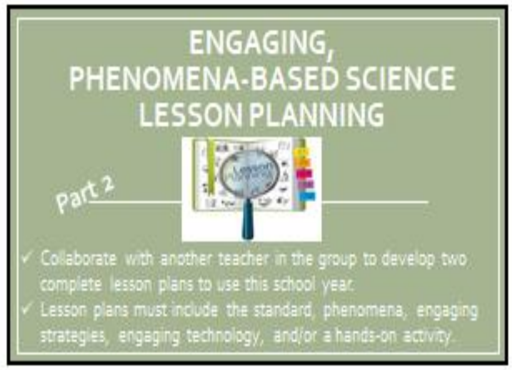
ENGAGING, PHENOMENA-BASED SCIENCE LESSON PLANNING

Part 1

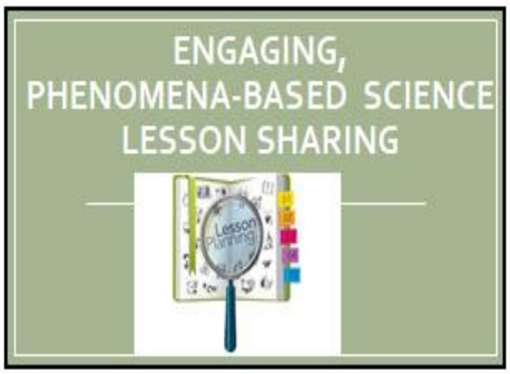
- ✓ Collaborate with another teacher in the group to develop two complete lesson plans to use this school year.
- ✓ Lesson plans must include the standard, phenomena, engaging strategies, engaging technology, and/or a hands-on activity.


Lunch Break
LUNCH TIME
•Please return by 1 p.m.

73


ENGAGING,
PHENOMENA-BASED SCIENCE
LESSON PLANNING
Part 2
✓ Collaborate with another teacher in the group to develop two complete lesson plans to use this school year.
✓ Lesson plans must include the standard, phenomena, engaging strategies, engaging technology, and/or a hands-on activity.

74


ENGAGING,
PHENOMENA-BASED SCIENCE
LESSON SHARING

75

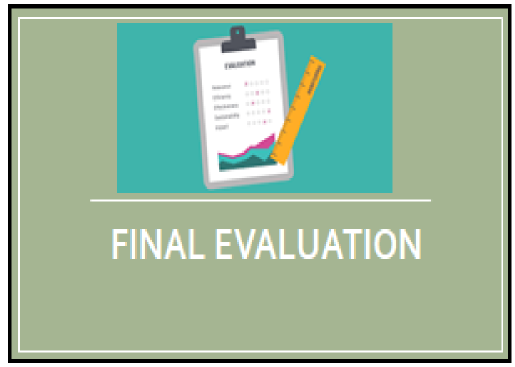

10- Minute Break
TIME FOR A
BREAK

76


Celebration Time
SHARE EITHER A "LESSON LEARNED" OR AN IMPLEMENTATION IDEA


EXIT
TICKET
ADMIT ONE


I can't do it
SELF-EFFICACY POST-TEST


FINAL EVALUATION

Elementary Science Teacher Self-Efficacy Pretest and Posttest

Name (optional): ____

Directions: Circle a response by each statement that matches how you feel as an elementary science teacher. When finished use the rubric at the bottom to score your responses. The higher the score the higher your self-efficacy for teaching science.

1. I feel that my skills as a science educator are equal with the skills of other science teachers:
   Strongly Agree Agree Disagree Strongly Disagree
2. As a science teacher, I have several good qualities.
   Strongly Agree Agree Disagree Strongly Disagree
3. As a science teacher, I am prone to feel like a failure.
   Strongly Agree Agree Disagree Strongly Disagree
4. As a science teacher, I don't do as well as other science teachers.
   Strongly Agree Agree Disagree Strongly Disagree
5. As a science teacher, I do not have much to be proud of.
   Strongly Agree Agree Disagree Strongly Disagree
6. As a science teacher, I take a positive attitude toward myself.
   Strongly Agree Agree Disagree Strongly Disagree
7. As a science teacher, on the whole, I am satisfied with my potential to grow as an educator.
   Strongly Agree Agree Disagree Strongly Disagree
8. As a science teacher, I often feel useless.
   Strongly Agree Agree Disagree Strongly Disagree
9. As a science teacher, I think that I am no good at all.
   Strongly Agree Agree Disagree Strongly Disagree
10. As a science teacher, I respect my work.
    Strongly Agree Agree Disagree Strongly Disagree

Rubric

(maximum score 30):

Strongly Agree= 0 Agree=1 Disagree=2 Strongly Disagree=3

3-Day Professional Development Summative Evaluation Form

Name (optional): ____

1. Tell us your overall thoughts about the 3-day professional development series?

2. What did you like most about the 3-day professional development series?

3. What did you like least about the 3-day professional development series?

4. What did you learn from the 3-day professsional development series?

5. What will you implement in your science instruction, immediately?

6. What other professional developments would be beneficial to you?

7. Additional comments or concerns:

We appreciate your participation in this 3-day professional development series. Thank you

Appendix B: Interview Questions

1. How long have you been teaching?
2. Which sector(s) have you taught/teach?
3. Which grade level(s) have you taught/teach?
4. How long have you been teaching science?
5. Please describe the science trainings you have had.
6. What do you think are the reasons for low student achievement in science?
7. What method(s) do you use when teaching science that you think engage students?
8. Please describe your strengths when teaching science?
9. Please describe any weakness may have when teaching science?
10. What do you think are the challenges to engaging students in learning science?
11. What specific challenges if any, do you face when teaching science?
12. What concerns if any, do you have when teaching science?
13. How do you think you could address the concern(s) that you have when teaching science?
14. How confident are you when teaching science?
15. What causes you to feel confident when teaching science?
16. What causes you to feel unconfident when teaching science?
17. What form of science training would be most beneficial to help you engage students?
18. What supports would you like to have that you think would help improve science instruction?

Appendix C: Research Questions Matched to Interview Questions

- How long have you been teaching?
- Which sector(s) have you taught/teach?
- Which grade level(s) have you taught/teach?

Interview Questions Part 2: Participant Science Teaching Profile

RQ1: How do local elementary teachers describe their methods of teaching science to engage students?

- What method(s) do you use when teaching science that you think engage students?
- Please describe your strengths when teaching science?
- Please describe the science training you have had.

RQ2: How do local elementary teachers describe challenges to engaging students in learning science?

- What do you think are the challenges to engaging students in learning science?
- What specific challenges if any, do you face when teaching science?
- What concerns if any, do you have when teaching science?
- How do you think you could address the concern(s) that you have when teaching science?

RQ3: How do local elementary teachers describe their self-efficacy for engaging students in learning science?

- How long have you been teaching science?
- How confident are you when teaching science?
- What causes you to feel confident when teaching science?
- What causes you to feel unconfident when teaching science?
- Please describe any weakness may have when teaching science?

RQ4: What supports do local elementary teachers think they need to help improve their science instruction?

- What supports if any, would you like to have that you think would help improve science instruction?
- What do you think are the reasons for low student engagement in science?
- What form of science training would be most beneficial to help you engage students?

Appendix D: Sample Interview Transcript

Stacie Smith: Hello. Thanks for being here today and for your support to date.

Participant: Hello Ms. Smith. How are you?

Stacie Smith: I am well. Thanks again for joining me today. Are you ready to begin?

Participant: I am ready. Let's begin.

Stacie Smith: How long have you been teaching?

Participant: 17 years and still loving it.

Stacie Smith: Thank you. What sectors have you taught?

Participants: Just science and math.

Stacie Smith: Thanks. What grade levels have you taught and what grade level, are you currently teaching?

Participant: I have taught grades K, 2, 1, and 4. I am currently teaching grade 3.

Stacie Smith: Thank you. How long have you been teaching science?

Participant: All 17 years have been teaching science.

Stacie Smith: Thanks. Describe any science training that you have had.

Participant: I have not been required or offered any science training because the focus is always on mathematics and reading.

Stacie Smith: Thanks. What do you think are the reasons for low student achievement in science?

Participant: Teachers have to focus on other subject areas to keep our jobs. Reading and mathematics are the focus at this school that is why achievement is very low in science.

Stacie Smith: Thank you. What methods do you use when teaching science that you think engage students?

Participant: I was able to find a wonderful collection of videos from a teacher group that I joined. Videos make science instruction 10 times easier.

Stacie Smith: Please describe your strengths when teaching science.

Participant: I am willing to learn. During the reading and math professional developments, I pay attention when others do not. If I hear a strategy that might help in science or social studies, I try to save the strategy for later use.

Stacie Smith: Describe any weaknesses that you may have when teaching science.

Participant: Well, I guess that even though the video set works well, my weakness is a lack of resources or strategies to keep the kid's attention in science.

Stacie Smith: Thank you. What do you think are the challenges to engaging students in science learning?

Participant: Students need more to do in science class. There are so many methods for teaching science but no one in this building is using very many strategies.

Stacie Smith: Thank you. What specific challenges, if any, do you face when teaching science?

Participant: The specific challenges I face is wanting more training but not getting it here at the school.

Stacie Smith: Thank you. What concerns, if any, do you have when teaching science?

Participant: I should not have to join a teacher group outside of the school to get science material that is interesting.

Stacie Smith: How do you think you could address the concerns that you have about teaching science?

Participant: To address this the school should provide an updated curriculum with technology to match.

Stacie Smith: Thank you. How confident are you when teaching science?

Participant: I am not too confident because I know that there are so many new ways to teach science that I am not using in my classroom

Stacie Smith: What makes you feel confident when teaching science?

Participant: I feel confident when I have done my best to prepare a lesson.

Stacie Smith: What causes you to not feel confident when teaching science?

Participant: I feel unconfident when the lesson I did my best to prepare is not interesting to students.

Stacie Smith: Thank you. What form of science training will be most beneficial to help you engage students in science?

Participant: I want to have fun in my science classroom and teaching MSS. I need training to help me get there.

Stacie Smith: This is the last question, what supports, would you like to have that you think would help improve science instruction?

Participant: I should not have to join a teacher group outside of the school to have more science resources. I would like a PD that teaches me how to keep science a fun subject for students.

Stacie Smith: That concludes our interview. Thanks again for your time. I will bring you a gift card for your participation within a week. Do you know of any other science teachers in the building who might be willing to participate?

Participant: None that I can think of right now. I will ask around.

Stacie Smith: Thank you. Please keep me posted.