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TEACHERS' EXPERIENCES
IMPLEMENTING THE
2018 MISSISSIPPI COLLEGE AND
CAREER-READINESS STANDARDS
FOR SCIENCE

A Dissertation presented
in partial fulfillment of requirements
for the degree of Doctor of Philosophy
in the department of Teacher Education
at The University of Mississippi

Lydia Lytal
May 2023

Abstract

Teachers have had to use standards to teach with since the 1980's. The CCRS has made a significant shift in how standards are written and the expectations of students in learning them. With the three-dimensional design, teachers are required to change their pedagogy in order to implement the standards with fidelity. That requires training, support, and resources for the teachers. The purpose of this study was to provide insight in the experiences of high school teachers in Mississippi as they implemented the standards. Additionally, the researcher revealed emotions related to implementation and differences related to teachers in a tested subject and teachers in a non-tested subject. To implement standards effectively, teachers needed training, support, resources, and time for reflection.

Dedication

I dedicate this research to all of my “teacher friends” that continue to fight through whatever challenges are thrown your way. Your perseverance is respectable, and your friendships are cherished.

Acknowledgments

I Thank:

My God

Without Him, life would be meaningless.

My Granddaddy, Donald Russell

For paving the way.

My mother, Gail Morton

For always leading by example, for instilling in me that nothing is impossible, for continuing to encourage me and for teaching me that doing the hard things are worth it.

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For never trying to hold me back, for never doubting me, for supporting me through all of my many ideas and for being a great husband and father.

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Chapter 1

INTRODUCTION

Reflection is an important practice, especially when attempting something new. In the field of education, reflection identifies areas of needed improvement along with areas of success. Teachers need opportunities for reflection daily, and throughout their career to continue growing and adapting as it is necessary throughout an entire process, not just at the end. Thus, it helps them see their need to confront challenges that come with learning new instructional practices (Brand, 2020). A teacher's self-reflection is often a personal matter and is kept to themselves, but sharing experiences, thoughts, trial and error can inform others about what to do if they are faced with the same situation. Often teachers are not given the opportunities to share their experiences and therefore their administrators are not providing the correct supports that teachers need (Davis et al., 2006). This study gave some science teachers in Mississippi the opportunity to reflect and share their experiences as they implement the Mississippi College and Career Readiness Science Standards.

This chapter gives the background of the study, statement of the problem, purpose of the study, and research questions. Following these topics, a brief review of the methodology is given along with assumptions, limitations, and important terms.

Background of the Study

In the early 1980s, there was evidence that American education was falling behind other countries (National Commission on Excellence in Education, 1983). This was especially apparent regarding science literacy (Mead & Mates, 2009). Due to this, science standards in

every state became a requirement beginning in 1983. Hence, each state's department of education developed their own standards. Benchmarks were developed to track the progression of student growth and curriculum frameworks were developed to provide guidance for implementing the standards. As developers made several attempts to redevelop science standards across the United States, the need for consistency was evident. The Next Generation Science Standards (NGSS) were developed with the intent of focusing on what should be taught in science, how it should be taught, how sciences can connect to other sciences, and science literacy (National Research Council, 2012). Currently 44 states have adopted NGSS or have developed their own standards based off the same frameworks used to develop NGSS (National Science Teaching Association, 2022).

Unlike previous standards, the NGSS standards focus on the learning process instead of strictly focusing on science content. They also include engineering standards which is new. Not all college science teacher education programs teach engineering in their curriculum; therefore, many teachers are being asked to teach something they have not been trained to do. This implies that many teachers need professional development training to teach these standards with fidelity. Reiser (2013) affirmed this by stating, "tools including new curriculum materials and new assessments will be important supports to help the K-12 system move in these directions, but without a strong focus on aligned professional development, adopting NGSS and providing these resources will not be sufficient." (p. 2). Reiser (2013) also noted that a shift in the way science teachers teach will be needed for effective implementation.

NGSS is not only about what should be taught, but also about how science should be taught. The NGSS standards, which employ a hands-on approach, help students make connections between science content to develop a well-rounded knowledge of science. This is

accomplished through a three-dimensional approach. The first dimension is the *science and engineering practices* (SEP). The National Research Council (2012) defined the SEPs as the “behaviors that scientists engage in as they investigate and build models and theories about the natural world and the key set of engineering practices used as they design and build models and systems” (p. 30). The next dimension is the *crosscutting concepts* (CCC), which are defined as “concepts that bridge disciplinary boundaries, having explanatory value throughout much of science and engineering” (NRS, 2012, p.30). The third dimension is the *disciplinary core ideas* (DCI), the core knowledge that students should learn so they can build upon it as they advance in science. Together these three dimensions are used to teach an in-depth understanding of science content, while developing key skills like communication, collaboration, inquiry, problem solving, and flexibility which will benefit the student throughout their lives (Next Generation Science Standards, 2013).

Statement of the Problem

After the College and Career Readiness Science Standards for Mississippi were released, professional development and implementation began for some teachers and schools. Implementation without proper professional development began for other teachers. No matter what type of training the teacher had, if any, implementation started very soon after adoption took place. Science classes in fifth grade, eighth grade, and the biology course in high school were required to give the end of year required assessment the first year the new standards were implemented. Teachers in this study referred to it as the “state test”. There was no trial year given before the assessment was required (Sampsell, & McKinney, 2017). During the second year of implementation, the COVID-19 pandemic began and drastically slowed the implementation of the new standards as they were designed to be taught (Macia, Iveland, Rego,

& White, 2022). Teachers had to quickly learn how to teach online and the use of students learning through hands-on experiences decreased (Marple & Le Fevre, 2021). Teachers worried about their student's wellbeing and were concerned that the students' home environment would hinder their ability to be successful in their classes (Andrews & Green, 2021).

Change is not always welcomed by teachers, but their perception of it tends to be positive if strong enough support from administration is given, along with ample time to implement the standards (Cheng, 2012, McGee et al., 2013) There is a limited amount of research conducted to determine what the experiences of implementing science standards are, how teachers perceive the change, and challenges teachers may face during their experience.

Purpose of the Study

The purpose of this phenomenological study was to add to the limited amount of research to understand the experiences, perceptions, and challenges associated with implementation of the 2018 Mississippi College and Career Readiness Standards for Science among secondary education teachers in Mississippi. Research has indicated that the challenges of implementing a new or reformed curriculum include but are not limited to lack of training, lack of resources, and lack of administrative support (Cheung & Wong, 2012; Alshammari, 2013; Marques & Xavier, 2020). This study was important because it gave teachers in Mississippi an opportunity to reflect on their experience implementing the 2018 College and Career Readiness Standards for Science and provide support for future teachers when standards are updated. Challenges were identified which can help administrators, policy makers, and mentors, know how to support teachers (Davis et al., 2006). While there is research on implementing educational standards and the issues that result, there is very little around implementing educational standards in Mississippi, and more specifically, the 2018 CCRS. The current literature does not include challenges that a global

pandemic might have presented when implementing a new set of teaching standards. There is also currently no research on these standards in Mississippi or the previous standards released in 2010. This study aimed to fill that gap as it explored experiences with implementation from the teacher's perspective. This study did not address the perspectives of the administrators or the students. Additionally, it did not address how effective the standards are for students.

Research Question

The research question for this study was: "What are Mississippi teachers' perceptions and experiences of implementing the 2018 College and Career Readiness Standards for Science?" This question was intentionally broad to allow the teachers freedom to speak about all aspects of implementation.

Significance of the Study

Teachers face challenges when they go through change or reform. Smith and Nadelson (2017) suggested these challenges should be shared and examined. "Careful consideration and examination of teacher perceptions, knowledge, and practice associated with a reform effort is fundamental to the development of the strategies and support necessary for the successful implementation of a reform initiative" (Smith & Nadelson, 2017, p. 196). During this examination, teachers need opportunities to voice their concerns. Giving teachers a sense that their voice is needed is one way that administrators can support their teachers (Haar, 2007). Therefore, this study was significant in providing that voice as experiences of implementing new standards was examined.

Penuel, Harris, & DeBarger (2015) suggested that data about implementing curriculum standards is needed to know if reforms are taking hold and how to design strong supports. The data from this study can be used in that way to inform a school's administration on what type of

supports their teachers need. Youngs and King (2002) found that a strong professional community was established when school administrators allowed teachers to make significant decisions about their professional development needs. Teacher support is important and necessary, especially in a time when teachers are leaving the profession and fewer college students are majoring in education. This study gave teachers a voice so that school administrators and policy makers can understand the teacher's perspective. The results of this study could be used to inform the Mississippi Department of Education (MDE) on where the teachers stand with the implementation of the standards to help MDE know how to plan professional learning opportunities. Nationally, this data could give other states insight on implementing new standards from the teacher's view when they decide to adopt new science standards. Ultimately, the goal was to reveal areas that teachers may need help in or to understand areas that are thriving so that resources from the state and local schools can be used wisely.

Methodology

A qualitative research design was used to conduct this study due to the exploratory nature of the research question. Merriam & Tisdell (2016) describes qualitative research as that which tries to “understand how people interpret their experiences, how they construct their worlds, and what meaning they attribute to their experiences” (p.6). Social constructivism is the theoretical framework that guides this study and aligns with this definition of qualitative research. Social constructivism implies that knowledge is constructed from human activity and is a social endeavor. This framework also aligns well with interpretivism. Interpretivism implies that reality is subjective, socially constructed, and is made up of multiple perspectives (Rogers, 2020, Merriam & Tisdell, 2016). Each teacher's individual constructed knowledge will determine how

the person acts or responds to reality. This framework was a necessary guide for this study to fulfill the afore mentioned definition given by Marriem & Tisdell (2016).

To conduct the study, participants had to be identified. Creswell & Poth (2018) suggest that participants should be purposefully chosen when conducting a phenomenological study. There were nine participants chosen based on how long they have taught, their school accreditation, school size, and what subject they taught.

In qualitative research, the source of data is words; therefore, the main data collection method was through interviews. Participants were asked to participate in an interview with semi-structured, in-depth questions. Probes were used with the questions to extract as much information as possible from the interviewee. After interviews were transcribed, codes were determined using In Vivo coding and emotive coding. Axial coding was used to categorize the codes to show connections between them to form themes. Confidentiality was maintained throughout the study and all participants participated on a volunteer basis. Member checking was also provided to the participants after the interview was conducted. Bracketing was used to identify preconceived beliefs and opinions about the implementation of CCRS and was used to help identify bias in this study (Greening, 2019). I identified bias through my “role of the researcher” statement and moved forward in this study with a neutral approach as questions were created and probes were formed during the interview.

Conclusion

The Mississippi College and Career Readiness Science Standards are unlike any that Mississippi teachers have used before. They are based off a three-dimensional design that includes science and engineering practices, cross-cutting concepts, and disciplinary core ideas. They challenge teachers to teach in different ways than what they are used to. It requires that

teachers change their mindset and reflect often to address challenges and successes. The purpose of this study is to explore the experiences teachers had while implementing these standards. Using interviews teachers will be given a voice about their experiences and can help identify areas in which teachers may need additional support.

Definitions of Terms

1. *Mississippi College and Career Readiness Standards for Science*-A new vision for teaching and learning science in Mississippi using three dimensions: Science and engineering practices, crosscutting concepts, and disciplinary core ideas (MDE, 2018).
2. *Next Generation Science Standards*-Kindergarten through 12th grade science content standards that set the expectations for what students should be able to know and do (Next Generation Science Standards, 2013).
3. *Curriculum*-Complete programs that comprehensively support the content goals of a science class over large pieces of instructional time. It includes all the necessary components for instruction, such as lessons and assessments (Next Generation Science Standards, 2013).
4. *Standards*-Instructional goals or benchmarks for student proficiency (Next Generation Science Standards, 2013).

Chapter 2

REVIEW OF THE LITERATURE

Introduction

A curriculum is a structure designed for a specific purpose that eases incorporating a seemingly impossible learning task (Young, 2014). In addition, there are benchmarks, also called standards, that serve as goals for students to meet throughout the learning task. In education, the curriculum is the teaching tool used to meet the goals of the standards. When implementing new standards, some institutions decide to take a slow approach and provide training while other institutions decide to take a fast approach and provide training and support as needed. There is a large pool of literature about curriculum and standards-based learning, but the pool gets much smaller when exploring teachers' experiences of implementing new standards.

This chapter begins by identifying challenges of implementing standards in general including a deeper explanation for the three challenges identified the most in the literature. Next, this chapter moves toward the focus of this study as it investigates literature about implementing science standards in the United States, implementing standards in states near Mississippi, and then ends by investing literature that is focused on the Mississippi College and Career Readiness Standards for Science.

Challenges of Implementing Standards

There have been several reasons given in literature regarding challenges teachers experience when implementing new content standards. The current literature revealed that the strongest challenge of implementation is the lack of teacher support through training (Cheung &

Wong, 2012), resources (Chaudhary, 2015; Marques & Xavier, 2020), and administration (Alshammari, 2013; Arif & Sulistianah, 2019; Wang, 2010). Teachers' understanding of the standards was also important to successful implementation since teachers play a vital role (Suyanto, 2017; Irons, Carlson, Lowery-Moore, & Farrow, 2007). The teachers in a study by Suyanto (2017) were not ready for implementation because they were not prepared through training. They experienced a five-day training, but they expressed that it was not enough to make everyone (teachers, principals, and supervisors) understand the concepts of new standards. Furthermore, not all teachers got the opportunity to attend the five-day training session. Only 30% of the teachers at the school got to attend and only 23% of them reported they understood the standards confirming the need for additional training.

Curriculum fidelity is defined as “implementing the curriculum faithfully and keeping in step with its purpose and design” (Pandey, 2018, p. 67). This definition is also applicable to implementing new standards. Time plays a factor in implementing content standards with fidelity. Teachers feel like they are not given enough time to adjust to new content standards before implementing them fully which leads to infidelity in teaching the standards (Burks, Beziat, Danley, Davis, Lowery, & Lucas, 2015; McGee, Polly, & Wang., 2013). Other teachers have reported that a lack of experience, time, and resources was a constraint to their ability to teach with fidelity (Thomson & Gregory, 2013). Participants from Wang (2010) strongly emphasized the important role of teacher training in the fidelity of implementing new standards by stating, “If policy-makers intend for teachers to adhere to the proposed policies, the most useful way of assisting would be by virtue of in-service training” (p. 133). When teachers are expected to teach in ways they are not properly trained to teach, infidelity will occur. The lack of fidelity in implementation can negatively affect students because they will not experience the

vertical alignment of the standards that is intended to prepare the student for the next grade level (Pandey, 2018).

Professional Development

Teachers face challenges learning just like students do (Davis, Petish, & Smithey, 2006), and their lack of knowledge is often directly related to the lack of continued training (Marques & Xavier, 2020). Once teachers have graduated college, that training typically comes through professional development (PD) sessions that can be designed for all teachers in the school or specific to a particular subject or need (Banilower, 2018). Professional development is vital to teachers in terms of understanding content and increasing perceptions of pedagogical and content preparedness toward standards-based teaching for all teachers (Banilower, Heck, & Weiss, 2007; Davis et al., 2006). Teachers are also more likely to use a new strategy when they have received training on its use (Banilower, Heck, & Weiss, 2007).

Learning opportunities for teachers are needed whether the school provides it, or the teacher seeks out the opportunities provided outside of school (Apsari, 2018; Marques & Xavier, 2020). There are challenges with either scenario. Schwartz (2020) concluded that teachers experience difficulties related to seeking out their own professional development (PD) sessions because many teachers must use their personal days and their own money to attend them. Often this results in teachers not getting the training they need. Training programs are often very expensive and unavailable to some teachers (Wang, 2010) even if the school provides the training. The cost of training programs often forces the administration to choose certain teachers over other teachers to receive the training. Schwartz (2020) also indicated that even if the school allowed funds or leave time for the teachers, the school's administration might dictate how it is spent and still not allow all teachers to receive the training.

Administrators should allow teachers to have a voice in what type of professional development they receive because some public-school teachers feel “powerless” and express a lot of “pressure” in implementing new standards (Abadie & Bista, 2018). The teachers have specific areas they need to focus on to alleviate those feelings; therefore, understanding each teachers’ experiences with implementing standards can be beneficial to developing PD (Abrami, Poulsen, & Chambers, 2004). Implementation could occur faster if administrators chose professional development that builds on practices that teachers commonly use in their current classroom (Smith & Nadelson, 2017). For many schools, a science curriculum coordinator serves as the teacher’s voice to advocate for the teacher’s needs, aids administrators in choosing professional development training sessions, or serve as the ones choosing, designing, and implementing the PD session (Whitworth & Chiu, 2015). These district science leaders play a vital role in supporting teachers as they provide ongoing leadership and learning opportunities to support change.

When adopting new standards, teachers need to feel confident in them to ensure accurate implementation and need to have the perception that they can be successful (Pandey, 2018; Brand, 2020; Abrami, Poulsen, & Chambers, 2004). This sense of confidence is often gained or accomplished through training even though some teachers do not have the energy to implement or learn anything new due to their other responsibilities in the school (Knight, 2009). In addition, the PD can affect implementation in a negative way if it is not adequate to meet teachers’ needs or is interpreted improperly by teachers (Jenkins & Agamba, 2013). Abadie & Bista (2018) noted that their teachers felt their PD sessions were a “joke” because they were not aligned to the teacher’s needs. Often teachers do not have time or the desire to attend PD because it adds to their workload (Cheung & Wong, 2012). This is true particularly for secondary education

science teachers. Compared to elementary and special education teachers, secondary education science teachers were significantly less supportive of PD than other teachers (Torff, 2010). In other studies, the age of the teacher along with the level of experience (Torff, 2018; Chval, Abell, Pareja, Musikul, & Ritzka, 2008) were the best predictors of teachers' attitudes about PD due to the variety of expectations. Teachers with six to ten years of experience wanted to play the role of the students in PD, while teachers with sixteen to twenty years of experience wanted to be treated as an adult and be shown the lesson from the teacher's perspective. The more experienced teachers also found PD to be more effective when it is sustained over time instead of a one-time session. All teachers, no matter their age or experience, wanted PD to be specific to their grade level, content, and classroom practice.

Since the Next Generation Science Standards requires a shift in learning and teaching, professional development sessions must also shift. Teachers identify that an important part of effective implementation of the standards is the ability to collaborate and plan with other teachers (Richman, Haines, & Fello, 2019). Through the collaborative piece of the professional development session in this study, teachers benefited across grade level teams and teams with special educators. These teachers felt that it not only benefited their teaching, but also the students' learning outcomes. Allen & Penuel (2015) also found that opportunities for collaboration given in professional development sessions helped teachers work through incongruencies between perceptions and goals of the teachers as they implemented the Next Generation Science Standards.

Administration

Guiding teachers to use standards effectively can be a challenge for administrators due to the teachers' mindset and beliefs. Pak, Polikoff, Desimon, & Garcia (2020) determined that

implementation was ineffective if teachers did not believe the new standards were best for the students. Implementation is also ineffective if teachers feel like the old system is sufficient (Cheung & Wong, 2012), or if they feel forced to change (Pak et al., 2020). In a study by Knight (2009), teachers report that they are often asked to make changes in a way that they feel doesn't make a difference. For teachers to be motivated to implement a new teaching practice, they must feel it will "increase student achievement, make content more accessible, improve the quality of classroom conversation, make students happier, increase the level of learning, or have some other significant positive impact (Knight, 2009, p. 509)." Not only do teachers need to feel like the change will make a difference, they also need to be able to recognize when there is a need for reform. School administration views this recognition as a major factor in the success of implementation (Cheung & Wong, 2012). Arif & Sulistianah (2019) found that the lack of recognition of the need for reform was the third highest problem with curriculum and standards implementation.

The school's administration can change the negative mindset of teachers. The teachers studied in Pak et al. (2020) changed their mindset when they received needed resources from the administration. The school district revamped its infrastructure and hired more instructional coaches to help teachers learn. Cheung & Wong (2012) suggested that principals should make better use of grants to hire more teacher assistants to lighten the workload of the teacher because change adds a massive amount to the teacher's already heavy workload.

Support from the school administration is indicated by teachers to be a large part of successful implementation (Cheung & Wong, 2012; Padney, 2018; Penuel Harris, & DeBarger, 2015). Successful implementation is shared between all participants in an institution (Arif & Sulistianah, 2019) as all individuals in the school system are expected to know their role in

implementation (Ogar & When, 2015). The principal or curriculum coordinator's role is to be aware of how they present change to their teachers and are responsible for ensuring that the teachers uphold the new changes in their everyday practice (Wang, 2010). Other educational leaders in the school help the teachers realize the vision of the science curriculum and standards by promoting strategies and identifying resources (Penuel et al., 2015). Teachers found it helpful when a guide was developed for principals to help them learn about the new changes (Penuel et al., 2015). The guides also aided in facilitating conversations with the principals which allowed for a more conducive work environment. A study by Iveland, Tyler, Britton, Nguyen, & Schneider (2017) evaluated administrators' involvement in learning the Next Generation Science Standards. The results showed a direct relationship between the time the administrators spent learning the standards and the support teachers felt. When surveyed, 66% of teachers felt supported, motivated, and encouraged as science became a priority at their school after their administrator studied to understand the science standards. Though principals with a science background show different leadership practices, it is not necessary for the principal to have a background in science to be an effective part of transforming science instruction (Lochmiller, 2014).

Resources

Educational resources are a critical component of teaching science standards (Zinger, Sanholtz, & Ringstaff, 2020). Merriam-Webster Dictionary (2012) defines resources as a "source of supply, support, or information". Many schools with students living in low-income households do not have the teaching materials that are aligned to new standards or have qualified teachers due to the high turnover rate (Penuel et al., 2015; Gagnon & Mattingly, 2015). Additionally, rural elementary schools face challenges of providing resources due to the location

and time constraints of teaching multiple disciplines in elementary grades (Zinger, Sanholtz, & Ringstaff, 2020). Teaching materials are vital to teachers as they organize and plan instruction and can result in a low readiness to implement new standards due to a lack of resources (Penuel et al., 2014; Suynato 2017). In the study by Pak et al., (2020), the mindset of the teachers changed when they received the needed resources from their administrators. Alshammari (2013) suggested that administrators can show support to teachers by ensuring that they have materials, books, training, and financial resources they need. It is also necessary for schools to provide adequate facilities for successful implementation (Apsari, 2018). High school teachers report having adequate facilities and supplies for teaching science more than elementary teachers do (Banilower, 2019). To achieve the goal of implementing new standards with fidelity, the teachers will have to adjust how they teach (pedagogy) and be given the needed resources to do so (Anderson & Helms, 2001). This may require a realignment of resources the school already has or a strong investment of financial resources to develop support materials for teachers and students (Wilson, 2013; Smith & Nadelson, 2017).

Experiences Implementing Standards Nationally

In the early 1980s, the American education system was falling behind other countries. In an effort to close the gap, science standards in every state became a requirement with each state's department of education developing their own standards. Benchmarks and curriculum frameworks were developed to track the progression of student growth and to provide guidance for implementing the standards. Though designing standards was a step in the right direction, there wasn't much consistency in the standards from state to state. The Next Generation Science Standards (NGSS) were then developed with the intent of focusing on what should be taught in science, how it should be taught, connections between sciences, and science literacy (National

Research Council, 2012). With the push for STEM (science, technology, engineering, math) related jobs increasing, implementing the NGSS became the plan to give students in the United States a chance to be competitive in science careers (Hoeng & Bencze, 2017).

If a state chose to adopt NGSS, they could not change the standards from how they were written (National Research Council [NRC], 2012). Therefore, some states, like Mississippi, designed their own standards based off the components of the framework that NGSS was designed from, *A Framework for K-12 Science Education*. Other documents used to write the Mississippi standards include the National Assessment of Education Progress (NAEP), Trends in International Mathematics and Science Study (TIMSS) and ACT College and Career Readiness (CCR) benchmarks. The standards were designed by a team of kindergarten through college level educators. In 2018, Mississippi released the College and Career Readiness Standards for science (CCRS) using the same three-dimensional approach that NGSS used. Just like Reiser (2013) suggested for NGSS implementation, these standards also require a shift in the way science teachers traditionally teach which requires proper training and time (Cheng, 2012).

These standards are unique to any that have been taught before and it has been a challenge for many teachers to implement them (Windschit & Stroupe, 2017). Engineering components are usually not included in college level courses; therefore, teachers need proper training through professional development to learn the engineering practices and be confident in teaching them (Windschit & Stroupe, 2017). If teachers are not given those training opportunities, they will not be prepared or confident in their ability to teach those components of the standards. In one study, teachers gave a confidence rating of 4% in their preparedness to teach engineering concepts (Banilower, Smith, Weiss, Malzahn, Campbell, & Weiss, 2013). Some teachers feared that they would lose control of their classroom environment when shifting

to the role of the classroom facilitator to lead engineer practices (Brand, 2020). In a study by Haag & Megowan (2015), some teachers felt that NGSS was beyond the knowledge and training of teachers. These teachers felt they needed the most training in engineering because most teachers lacked a background in engineering. In other studies, teachers had to change their negative mindset to an open and positive one to implement the engineering aspects of NGSS (Brand, 2020).

NGSS is the current set of suggested standards for each state to use. States have the option to adopt the standards as they are written or develop their own standards. Currently, 20 states have adopted NGSS and 24 states have developed their own standards based off of the same frameworks used to develop NGSS (National Science Teaching Association, 2022). The framework for NGSS is made up of three dimensions: science and engineering practices, crosscutting concepts, and disciplinary core ideas. These dimensions are to be taught together throughout each science course instead of individual components.

The first dimension is the Science and Engineering Practices (SEPs). The National Research Council (2012) defines the SEPs as the “behaviors that scientists engage in as they investigate and build models and theories about the natural world and the key set of engineering practices used as they design and build models and systems” (p. 30). The NRC (2012) also uses the term practices instead of “skills” because scientific investigation requires knowledge and skill. They are a major shift from inquiry focused standards to a design that supports scientific thought and action (NGSS Lead States, 2013). The eight practices are:

- Asking Questions (science) and Defining Problems (engineering)
- Developing and Using Models
- Planning and Carrying Out Investigations

- Analyzing and Interpreting Data
- Using Math and Computational Thinking
- Constructing and Explanation (science) and Designing a Solution (engineering)
- Engaging in an Argument from Evidence
- Obtaining, Evaluating, and Communicating Information

Teachers have had difficulty implementing all eight standards. Haag & Megowan (2015) concluded that high school teachers were more motivated to use all eight of the SEPs than middle school teachers. Smith & Nadelson (2017) showed that teachers engage in some practices more than others, which suggests that the teachers could benefit from professional development tailored to address the practices that were previously not part of their instruction. A study from Prihati, Sukarmin, & Suryana (2019) revealed that teachers implemented the SEPs that concern collecting and analyzing data the least and implemented the use of students' prior knowledge the most. These same teachers said that time is the most constraint in implementing instructional practices engaging the SEPs. Nationally, resources to learn NGSS and to implement NGSS are a challenge because not many schools have materials that are aligned to these standards, especially in schools with students from low-income households (Penuel, Harris, & DeBarger, 2015). Though there are challenges, it is imperative that students are taught the Science and Engineering Practices because students that become fluent in the practices in school will have a greater chance of being successful in their workplace (Cunningham & Carlsen, 2014).

The second dimension is the Crosscutting Concepts (CCC). National Research Council (2012) describes the crosscutting concepts as “concepts that bridge disciplinary boundaries, having explanatory value through much of science and engineering” (p. 83). These concepts are similar to the “unifying concepts” or “themes” that are seen in other standards documents. They

are taught in each grade level and unify the dimensions of science so that students may make connections across each of the science disciplines. The seven crosscutting concepts are:

- Patterns
- Cause and effect
- Scale, proportion, and quantity
- Systems and system models
- Energy and matter: flow, cycles, and conservation
- Structure and function
- Stability and change

The third dimension is the Disciplinary Core Ideas (DCI). These core ideas are the basis of the content strands of the standards. They are taught at each grade level and students' knowledge is expected to be increased in these four areas with each new science course they take:

- Physical science
- Life science
- Earth and Space Science
- Engineering and Technology

NGSS calls for large shifts in teaching that require extensive professional development specifically focused on performance expectations. Penuel, Harris, & DeBarger (2015) noted "Implementing the standards will demand significant changes for everyone in schools and districts: students, teachers, and school and district leaders" (p. 48). Simply asking teachers to align NGSS to their current lessons is not enough to prepare teachers (Windschit & Stroupe, 2017). Teachers lack professional development, a culture of support for science education, and

instructional resources to help implement new curriculum (Smith & Nadelson, 2017). Another study by Dickinson, Thacker, & Michaels (2020) found that teachers may lack in institutional and organizational support needed to successfully implement NGSS. After administrators took time to learn NGSS, they understood that teachers need flexibility to integrate with other subjects and assessments in the science classroom should not always be expected to be in traditional form (Iveland et al., 2017). Not only is it beneficial to teachers for administrators to learn NGSS, understanding and consideration of their teachers' perceptions, knowledge, strategies, belief systems, and culture is central to developing strategies and supplements needed for successful implementation (Smith & Nadelson, 2017; Van Driel, Beijaard & Verloop, 2001). Implementing NGSS requires attention from many people in the school and does not rely solely on the teacher.

States near Mississippi

States near Mississippi that have been researched regarding their implementation of standards are Louisiana and Georgia. When Louisiana implemented the Common Core State Standards (CCSS), there was a drastic difference between teacher's experiences with implementation between public and private schools in the state (Abadie & Bista 2018). The private schools were allowed to choose their implementation plan and they chose to implement one subject and a few grade levels at a time. This was different from the public schools that were told to implement all subjects and grades at one time based on district-created curriculum plans. Public school teachers expressed a high level of anxiety and frustration while the private school teachers were satisfied with their experiences and had a positive mindset. Some public-school teachers described their PD as a "joke" while the private school teachers were pleased with their PD since they were able to analyze and digest one subject at a time. It is not a secret that change

is necessary to keep up with a society that is constantly evolving, but the way implementation is addressed makes a difference in the experiences of the teachers (Abadie & Bista, 2018).

Georgia recently developed the Georgia Standards of Excellence using the same framework that NGSS was developed from. The participants acknowledged the need for a shift in the teacher's role of the "information giver" to a facilitator in the classroom. The participants were given minimal support about the standards or how to implement them, affirming the need for more professional development. They agreed that the Crosscutting Concepts were the hardest to incorporate because they do not often enter the conversation naturally. The teachers expressed a variation in levels of support, but all reported to have an overall positive experience implementing the Georgia Standards of Excellence (Kraeling, 2021).

Mississippi Science Standards

States can choose to adopt NGSS as they are written or write their own standards based off of the components of the framework that NGSS was designed from, a *Framework for K-12 Science Education* (NRC, 2012). Mississippi chose to write their own and created the 2018 College and Career Readiness Standards for Science (CCRS). A team of kindergarten through college level teachers began writing the framework in 2016. The 2017-2018 school year was used as a pilot year to test out the standards with a few schools, and it was fully implemented in all public schools during the 2018-2019 school year. The design team used resources from the science standards of other states including South Carolina, Alabama, Massachusetts, and Virginia. Other resources used to develop the frameworks were National Assessment of Educational Progress (NAEP), ACT College and Career Readiness Benchmarks, Trends in International Mathematics and Science Study (TIMSS), and National Research Council: A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas

(2012). NRC (2012) was the major document used for reference. The ACT benchmarks were used as a resource to add science literacy to the new frameworks. The team of curriculum writers decided to retire 10 courses from the previous standards and many of the courses were reformatted to increase rigor by adding research and reading into the course objectives. Teachers were asked to play a role in developing the state assessment for the new framework, including writing the state assessment questions. The new assessments were in place during the 2018-2019 school year which was also the first full year of implementation (Sampsell & McKinney, 2017).

The CCRS is designed to be student-centered instead of teacher centered as it balances science content with the learning process. The goals of the standards reflect what students should know and be able to do (Sampsell & McKinney, 2017). The manner or methods in which a teacher should help students obtain these goals is not dictated in the document. Like the Next Generation Science Standards, CCRS is based on subject specific core ideas (DCI), concepts that can connect each of the disciplines of science (CCC), and practices that allow the student to use and display their knowledge (SEP). Knowledge and reasoning skills are not often integrated into the teaching process (Prihati, Sukarmin, & Suryana, 2019), so the CCRS standards reflect the knowledge and skills that students need for success in college and careers that allow students to compete in the global economy (Mississippi Department of Education, 2018). The skills are taught using the Science and Engineering practices (SEPs). “The standards are intended to drive relevant and rigorous instruction that emphasizes student mastery of both disciplinary core ideas (concepts) and application of science and engineering practices (skills) to support student readiness for citizenship, college, and careers.” (MDE, 2018, P.11) The SEPs are intended to be woven throughout the disciplinary core ideas instead of taught as a separate unit. This was one

aspect of the standards that was very difficult to accomplish when teaching had to be moved online very quickly during the COVID pandemic.

Mississippi Department of Education (2018) also addresses expectations for the teachers. “Mississippi’s teachers are encouraged to embrace the growth mindset and constantly seek to upgrade classroom approaches by experimenting and adopting methods that excite students to learn and become functional, autonomous learners and contributors.” (MDE, 2018, P.16). The original support documents and resources for learning the new standards were provided to the teachers through the Mississippi Department of Education Website. The resources included crosswalks, materials from a workshop in 2017, resource guides, parent guides, and webinars. School districts could also request professional development offered by the state’s Professional Development Coordinator for a fee.

To be most effective in supporting teachers, educational leaders need data about implementation to know how it is working in their school and how to design supports for teachers (Penuel et al., 2015). Teachers can provide that data through studies like this one as they practice self-reflection. Schon (1983) describes a reflective practice as one where professionals become aware of their knowledge base and learn from their experience. Each teachers’ experiences are unique, so their reflection on these experiences helps them see their need for learning and their need to address challenges associated with change (Brand, 2020). There is currently no research conducted on the CCRS standards, the implementation of the CCRS standards in Mississippi, or teachers’ experiences implementing the standards needed to inform educational leaders in the schools, school districts, and the Mississippi Department of Education. This study focused on the teachers’ experiences implementing the CCRS standards in Mississippi.

Chapter Three

METHODOLOGY

Introduction

In this chapter, a detailed explanation of the qualitative research methodology that was applied in this study is given. This includes an overview of the researcher's background, theoretical frameworks, and design rationale. A description of how the participants were selected, how the data was collected, and how the data was analyzed will be provided. Finally, the trustworthiness of the study is addressed.

Intent and Research Question

The intent of this phenomenological study was to examine general knowledge and experiences implementing the 2018 College and Career Readiness Science standards (CCRS) for secondary science teachers in Mississippi. The research question that guided this study is:

“What are Mississippi teachers’ perceptions and experiences of implementing the 2018 College and Career Science Standards?”

The question is purposely broad to allow the researcher the opportunity to focus on the participants perceptions and experiences implementing the three-dimensional science standards. These standards are a new phenomenon and are unlike any standards the teachers in Mississippi used in the past.

Rationale for Design

A qualitative methodology was used for the design of this study because of the exploratory nature of the research question. According to Marshall, Rossman, & Blanco (2022),

a qualitative approach is fundamentally interpretive and assumes that multiple realities exist. Qualitative studies occur in natural settings instead of a laboratory and are grounded in the lived experiences of people. Butina (2015) claimed that “qualitative methods are used when you want to find out what people do, know, think, feel by observing, interviewing and analyzing documents” (p. 191). Interviews were utilized in this study to discover teachers’ experiences. Qualitative research also uses coding methods to help interpret the meaning of the data. This study used three forms of coding to identify themes. I used these characteristics of qualitative research to design of this study.

Phenomenological Approach

A phenomenological approach was necessary for this study because phenomenology explores, describes, and analyzes the meaning of individual lived experience (Marshall et al., 2022). The research question for this study is suitable for this approach because it seeks to explore the lived experiences of science teachers. The phenomena that this study explored is the participants’ experiences of the implementation of the 2018 CCRS standards. This study’s approach, more specifically, was hermeneutical phenomenology. Sloan and Bowe (2014) clarified this approach stating, “phenomenology describes how one orients to lived experience, and hermeneutics describes how one interprets the ‘texts’ of lived experience” (p. 1296). In this study, “texts” refers to the interview transcript. This method was used to interpret data from the lived experiences instead of simply providing descriptions like transcendental phenomenology would (Manen, 2011). Hermeneutical phenomenology aims to focus on understanding the meaning of experiences by way of looking for themes and looking at the data with an interpretive lens. This is a complex way of looking at phenomenological studies because the participants’ existence and relation to the world around them plays a factor (Sloan & Bowe, 2014). Reflection

by the participant and the researcher also plays a role in interpreting meanings. The researcher can reflect on their own prior experiences and/or provide empathy to aid in data analysis. This approach and study were appropriate because there is little existing research about implementing the 2018 CCRS in science (Hsieh & Shannon, 2005).

Epistemology

This study was conducted through an inductive, interpretivist lens. Through this lens “research is inherently shaped by the researcher, who brings their own subjective view of observed phenomena based on their personal experience. Generated knowledge is not an absolute truth, but relative to the time, context, and culture that it emerged from” (Rogers, 2020, p. 1). Through this lens, themes and meanings emerged from the research process which included interviewing. The interview questions were broad so the meaning of the situation can be constructed (Creswell & Poth, 2018). Transcripts from these interviews were read multiple times to identify significant themes between the participants to construct meaning of their experiences.

A benefit of using an interpretivist approach is that it can address the complexity and meaning of a situation (Black, 2006). This benefit affirms the hermeneutical phenomenology design for this study. Phenomenology is also one of the prominent approaches to interpretivist research (Ryan, 2018). Interpretivism involves interactions of the participants with themselves along with others and the environment around them. Interpretivism implies that reality is subjective, socially constructed, and is made up of multiple perspectives (Merriam & Tisdell, 2016; Rogers, 2020). This implication is the link to the theoretical framework of social constructivism.

Framework

In qualitative research, a framework is used to shape the design of the study. This study used social constructivism as the framework. Social constructivism implies that knowledge is constructed from human activity using connections with others in a social environment (Hirtle, 1996). Individuals create meaning through their interactions, interpretations, and experiences. A person takes the reality of their interpretation of their experiences to construct knowledge. The new constructed knowledge will determine how the person acts or responds to reality. In this study, reality is the implementation of CCRS. Social constructivism allows for teachers to have different perceptions of implementing the standards as they use their personal feelings, perceptions, and past experiences. This framework further enforces the uses of hermeneutical phenomenology as the design since the participants' relation to the environment around them plays a factor.

Interpretivism and social constructivism work well together in this study because interpretivism implies that each person interprets experiences differently and social constructivism implies that knowledge about a reality is constructed based on individualized experiences. These frameworks used together suggest that multiple realities can exist. The hermeneutical approach will attempt to form meaning through the multiple realities that the participants experience. These frameworks align with a phenomenological approach to data collection because the phenomenological interview “focuses on the deep, lived meanings that events have for individuals, assuming that these meanings guide actions and interactions” (Marshall et al., 2022, p. 167).

Role and Background of Researcher

In a phenomenological study, the main role of the researcher is to collect and analyze data. The researcher did this by selecting participants, interviewing participants, transcribing interviews, coding transcriptions, and interpreting meaning from the analysis of the data. It is important that the researcher identify bias and be transparent about their background to maintain credibility. In phenomenological studies, “researchers can never be completely separate from their own values and beliefs, so these will inevitably inform the way in which they collect, interpret and analyze data” (Ryan, 2018, p. 17). The positionality of the researchers plays a role in an interpretivist study.

Identifying the researcher’s positionality is essential for phenomenological research as it is important for the researcher to identify and set aside any bias or preconceived notions in order to accurately report and interpret the data. To do this, a technique called epoché bracketing was utilized. It is the process in which the researcher gains clarity from their own preconceptions (Marshall et al., 2022). During bracketing, the researcher identifies their beliefs, preconceptions, opinions, and personal experiences with the phenomena (Greening, 2019). After each interview, the researcher personally reflects on my their experiences, and then set those reflections aside to focus on the experience of the participant. Bracketing is a continuous process throughout the study so the researcher may continue to take a fresh perspective toward the phenomena (Creswell & Poth, 2018). Bracketing off the researcher’s experiences and positionality with CCRS ensures the data collection and analysis is not influenced by the researcher (Chan, Fung, Chien, 2013). This is important because phenomenological interviewing allows a focus on the researcher’s personal experience combined with those of the participants. I will share my background of my lived experiences as it has shaped how I view the phenomenon.

I began teaching in 2010, I taught introduction to biology, biology, and earth science to 9th through 12th graders. Since then, I moved to another school and have taught biology 2, anatomy and physiology, and advanced placement biology. When I came into teaching, the 2010 standards had just been implemented. I did not feel overwhelmed with them like other teachers because these standards were the only ones I had known. In 2018, when the CCRS standards were introduced, I was not provided any training on them since I did not teach a state tested class. I knew there was no one to help me, so I gave up trying to learn them and just taught the content that I knew needed to be taught. No one asked or expected me to change anything that I was doing to implement the new standards. The focus for administration seemed to be on the state test scores since those scores determine the accreditation grade of the school.

Currently, I teach biology 1, biology 2, and methods of teaching biology courses at a university. I teach the students in the methods course how to use the CCRS standards. They feel confident with the standards when they leave my course but are very confused when they complete their observation or internship hours in middle and high schools. They always ask if they should write their lesson plans with the CCRS and teach with the SEPs, or should they just do test prep lessons like the high school teacher they are observing is doing. There is an obvious disconnect between the intentions of the curriculum and what the teachers are actually doing in their classroom. It is unknown through research why this disconnect is occurring.

My purpose for this study is to expose teachers' perspectives and experiences from those that have tried to implement the CCRS curriculum. Their experiences may never get recognized any other way. All teachers are important and need a chance to reflect and tell their stories. A teacher at a local high school said, "We never got a chance to face the standards head on before COVID hit. Now we don't get chances to unpack our baggage from the previous year to try to

face this (CCRS) again” (Kathy White, personal communication, July 6, 2021). I want this study to give them their chance to “unpack their baggage” so the teachers can clear their head and the Mississippi Department of Education (MDE) can understand what challenges teachers have faced since the implementation began. This knowledge could help MDE know how to direct and support teachers in implementing the standards now or with future standards, so the gap can be closed.

As a teacher that has experienced implementing the CCRS standards, I will bring my personal perspective to this study. My passion for equity in professional development opportunities and teacher support is what drives this research study. When I work with teachers who are trying to implement the CCRS standards, I reflect on my own feelings I had when the curriculum was initially introduced. Personally, I was very hesitant to try to learn new standards. I was concerned about the unknown and how that unknown would change what and how I taught. There was not any professional development provided that eased my concerns and hesitations. Though I did not teach these standards very long before moving to higher education, I did not feel that I changed much of what I did prior to the new standards being released. I know that was mostly because I did not know how to change. I did not want to change due to the fear of failure. My knowledge of the standards was constructed through my own research on the Internet and my colleagues and I forming our own thoughts and meanings of the standards. Many teachers share those same feelings of fear of failure, doubt, and hesitation to learning something new and some do not. I acknowledge that my personal experiences have shaped and influenced this study and the interpretation of the data in the future, but I will bracket out those experiences as much as possible to focus on those of the participants.

Process and Procedures for Conducting the Study

This section will address the process and procedures for conducting this study. It includes selection and recruitment of participants, data collection, ethical consideration, and data analysis.

Participants

Though there is no set rule on how many participants are needed in a phenomenological study, Padilla-Diaz (2015) suggested that 3-15 participants be used; therefore, I aimed for 8-12. Though there were more that agreed to be in the study, nine teachers qualified from seven different schools. Creswell & Poth (2018) suggested purposefully choosing participants in a phenomenological study to ensure the participants are knowledgeable about or have experience with the phenomena. I chose schools of various accreditation levels and sizes. To understand more about experiences implementing standards from multiple perspectives, I tried to choose an equal number of teachers that taught a class with a state assessment connected to it as those that did not teach classes with state assessments. The criteria used to select the participants reflected the social constructivist framework as well. Creswell & Poth (2018) stated that social constructivism develops subjective meanings of experiences in the world in which participants live and work, implying that the school, demographics, and subject they teach can influence their experiences. The other requirement for these teachers was that they must have been teaching science in a 9-12 grade classroom before these 2018 standards were released to ensure they were familiar with the previous science standards. Pseudonyms were used for names to protect the participant's identity. Data was collected online through Zoom using broad, open-ended questions. The participants had an option to use Zoom or meet face-to-face. They all chose Zoom for convenience since most of the interviews took place right after school or during the teacher's planning period.

Recruitment of Participants

After defending the prospectus, being approved by the dissertation committee and the Institutional Review Board (IRB) of the University of Mississippi, the next step in answering the research question was selecting the participants. I sent a recruitment email to the science teachers at many different schools. This recruitment letter offered a short explanation of the study. If they were interested in participating, they responded with their name, subject they taught, school, school size and school accreditation level. This information helped me choose who the participants would be. A summary of the participants is provided in table 3.1.

Participant Narratives

Participant 1 Shelly has been teaching for seven years with the last three in her current school teaching biology and advanced placement biology. She is thankful for her master's degree in biology because she knows the content of the standards well. When the standards were released, she was teaching in a school that had recently been taken control of by the state due to poor test scores. She was sent to many trainings. She was even sent to one of them twice. She has not received additional training since moving to her current school. She was thankful for the opportunity to talk to someone about her experiences.

Participant 2 Chris has been teaching for 15 years with the majority of it being in one school. He has taught many subjects in the science field, but he has spent the majoring of his teaching career teaching chemistry, advanced placement chemistry, and physics. A bachelor's degree is the highest he has achieved, but he has a National Board certification and Advanced Placement certification. Chris has never received any training on the current science standards and doesn't study them much. His main focus in teaching is to make sure his students are prepared to enter

college level science classes and feels very fortunate that he doesn't have to focus on preparing students for a state mandated test.

Participant 3 Liz has been teaching for 15 years and has spent the majority of them in her current school. Until this year, she has always taught biology which is tied to a state mandated end of year assessment. She is currently teaching anatomy and physiology, chemistry, and zoology and loves the change. She received training on the standards when they were first released but hasn't received any training since the initial release of the standards.

Participant 4 Becky has been teaching for six years. She started her teaching career teaching Algebra, but quickly moved to science where she currently teaches genetics, chemistry, and advanced placement chemistry. She has a master's degree in accounting and is National Board certified. She taught Algebra (state tested subject) when the newest math standards were released and taught the aforementioned non-tested subjects when the new science standards were released. She was given many training opportunities when math standards were released but has been offered no trainings when the science standards were released. The absence of the test has "revamped her love of teaching". She was very thankful for the opportunity to talk about her experiences implementing CCRS.

Participant 5 Ava has been teaching biology and advanced placement biology for nine years in her current school. The highest degree she has achieved is a master's degree. She has had to learn the new standards on her own since her school district did not provide any training for her. Until this year, she hasn't had a planning period in two years. She enjoyed the opportunity to talk about her experiences. She said it was exciting and helped her discover some of her own feelings and experiences that she hasn't thought of before.

Participant 6 Deanna has taught for 17 years and has been at her current school for the last five teaching biology, foundations to biology, botany, and genetics. She has a specialist degree and was afforded the opportunity to serve on the assessment writing team in 2019. She describes that opportunity as life changing. She was thankful for the opportunity to talk about her experiences and hopes they will encourage others when they also experience a change in standards.

Participant 7 Nancy has been teaching chemistry and advanced placement chemistry in the same school for 21 years. A master's degree is the highest that she has achieved. She didn't know that the state was getting new standards, but claimed it was easy for her to adjust because she is accustomed to the advanced placement standards. She wasn't given any training when the standards were introduced but isn't concerned since administration has other things to focus on. She was very thankful for getting to talk about her experiences. She said it was fun, enlightening, and has made her think about her lessons for next week a little more.

Participant 8 Susan has been teaching high school for 40 years. She spent the first 30 years teaching in a private school and the last 10 in one public school district. She describes those experiences teaching as drastically different. She currently teaches anatomy and physiology but taught biology when the standards were first released. She has a specialist degree and is National Board Certified. She recently served as an interim science curriculum coach and viewed that job as one that guides teachers as they learn and teach with the standards.

Participant 9 Stephanie has been teaching biology for 15 years and has spent the last four in her current school. She has a master's degree in public health and came to teaching through an alternate route program. She feels confident about her content knowledge but sometimes struggles to understand the educational terminology used in the standards. She claims teachers that teach a state tested subject are quickly getting burned out.

Table 3.1 Participant Demographics.

Pseudonym	Gender	Years taught	Years taught at current school	Current subject taught	Highest Degree
Shelly	Female	7	3	Biology, AP Biology	Master's
Chris	Male	15	12	Chemistry, Physics, AP Chemistry	Bachelor's, National Board Certification
Liz	Female	15	12	Anatomy & Physiology, Chemistry, Zoology	Bachelor's
Becky	Female	6	6	Chemistry, Genetics, AP Chemistry	Master's, National Board Certification
Ava	Female	9	9	Biology, AP Biology	Master's
Deanna	Female	17	5	Biology, Foundations to Biology, Botany, Genetics	Specialist
Nancy	Female	21	21	Chemistry, AP Chemistry	Bachelor's
Susan	Female	40	10	Anatomy and Physiology	Specialist, National Board Certification
Stephanie	Female	15	4	Biology	Master's

Data Collection

Creswell & Poth (2018) suggested that the main source of data should come from interviews. Patton (2015) stated, “The main way that qualitative researchers seek to understand the perceptions, feelings, experiences, and knowledge of people is through in-depth, intensive

interviewing (p. 27). For this reason, each participant was asked to participate in one interview that consisted of semi-structured, in-depth questions. Semi-structured interviews consist of open-ended questions that are not in any predetermined order (Merriam & Tisdell, 2016). This process allows the researcher flexibility when conducting the interview. Morris (2018) defined semi-structured interviews as “involving a researcher asking open-ended questions and following up on the responses of the interviewee in an endeavor to extract as much information as possible from them” (p. 3). Probes were formed during the interview that followed questions to draw out more data from the participant. Probes are questions or comments that follow questions and are impossible to specify ahead of time because of their dependency on the question (Merriam & Tisdell, 2016). Using the social constructivist framework, probes are necessary and cannot be predetermined because each participant represents a different experience implementing the CCRS standards. All interviews were scheduled in advance and were recorded so the interviewer could easily replay them for transcription. Analysis of the data began after each interview was completed.

Data Analysis

Cresswell & Poth (2018) described a way of analyzing data as “the data analysis spiral” where the research moves in analytic circles rather than using a fixed linear approach. Patton (2015) noted, “qualitative analysis transforms data into findings. No formula exists for that transformation” (p.521). I used the main parts of the data analysis spiral which are: managing and organizing the data, reading and memoing emergent ideas, describing and classifying codes into themes, developing and accessing interpretations, and representing and visualizing the data. I managed the data by using NVivo software. This software aided in organizing codes and creating themes.

Initially, the interview transcripts were read from beginning to end like reading a story to begin the process of horizontalization. Merriam & Tisdell (2016) described this process of horizontalization as “the process of laying out all the data for examination and treating the data as having equal weight at the initial data analysis stage” (p. 27). The second time they were read, the first coding cycle began. Codes were developed as more transcripts are read. Saldana (2013) described a code as being “a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language based or visual data” (p. 3). Some codes were combined while others were split into subcategories after all the codes were formed. These codes were derived directly from the text and were not predetermined (Hsieh & Shannon, 2005).

Zero coding cycle. After the initial pass through, it was determined that participants unknowingly answered multiple questions at one time. For example, a teacher could have been talking about administrative support, but also mentioned what they think a strength of the standards is without me asking about that. The answers to each question needed to be organized before analyzing, so this served as a zero coding cycle.

First coding cycle. Due to this study’s interpretive nature and social constructive framework, three types of codes were used to look for themes in the data. The first is in vivo coding. This elemental coding method is often called literal coding because it uses the participants exact words (Saldana, 2013). In vivo coding was used to identifying words or short phrases to enhance and deepen the meaning of the data. These words or short phrases were formed as they emerged from reading the interview and were reanalyzed after each interview. As this first coding cycle was completed after each interview, the codes were reanalyzed and lumped together or split.

Second coding cycle. Many words related to interpretivism are connected to emotions. Some examples of these are feeling, story, emotion, judgement, and insecurity. Since interpretivism is so closely related to emotions, the second type of coding that was used to develop themes was emotional coding. Merriam-Webster defines emotion as “a conscious mental reaction (as anger or fear) subjectively experiences as strong feeling usually directed toward a specific object and typically accompanied by physiological and behavioral changes in the body” (Merriam-Webster, 2012). Saldana (2013) explained that emotional coding labels the subjective quality of human experiences. It also labels emotions recalled and/or experienced by the participants.

Third coding cycle. Once all the in vivo codes were formed, axial coding was utilized. Saldana (2013) describes this as grouping similarly coded data to reduce the number of initial codes. This coding cycle was used to categorize the in vivo codes and start to make connections between them. Simmons (2017) describes axial coding as a way to create linkages between data. Though axial coding is typically used in grounded theory studies, it was used in this study to refine, align, and categorize the themes (Williams & Moser, 2019).

Ethical Considerations

I used pseudonyms for the participants and schools to maintain confidentiality. Any confidential information that the participant shared was not shared with the public, and all data was kept in a secure location that can only be accessed by the researcher. The participants were assured that their participation was voluntary and that they could stop at any point. The purpose and the use of the data was discussed to avoid deceiving the participants. The participants were also given the option to review the transcripts before they are finalized to give them a chance to

verify that their responses to interview questions are worded the way they want. The participants were not required to review the transcripts, nor did they choose the option to.

Control of Threats to Trustworthiness

Guba and Lincoln (1981) recognized that all research must have some type of truth value, applicability, consistency, and neutrality to be considered worth conducting. These values are evaluated differently in quantitative research and qualitative research (Whittemore, Chase, & Mandle, 2001). Truth values are measured in terms of trustworthiness of the study. Guba and Lincoln (1985) identify multiple ways trustworthiness can be achieved. The first is through ensuring credibility. In qualitative research, credibility ensures that the study collects data that it intends to answer research questions (Shenton, 2004). Researcher bias is one of the most common threats to credibility that can be addressed. In this study, I identified my bias in my positionality statement and set it aside from the study using bracketing. I did this by identifying my beliefs, preconceptions, opinions, and personal experiences with the phenomena in my positionality statement setting them apart from the participants' experiences, so it does not influence the analysis of the data. I addressed my bias by phrasing my questions in a way that would not lead the participant in a certain direction. I used open-ended questions that allowed the participants to elaborate on their answers.

Another way to ensure credibility is through crystallization which is not only ensuring a variety of data sources but ensuring that sense-making through the data is rich (Ellingson, 2009). Crystallization confirms that multiple truth can exist and can be socially constructed (Vik & Bute, 2009). One way I achieved crystallization through the data sources was by using a wide range of informants to ensure a rich picture of teachers' experiences with CCRS is given. I also gave attention to the complexity of interpretation through using multiple coding cycles and

addressed credibility in reactivity by staying mindful of how my presence influences the environment and participant being interviewed.

Another way to increase trustworthiness in a study is through confirmability which is the ability of the research to present the participants responses and not that of the researcher (Tobin & Begley, 2004). I ensured confirmability after the data was collected by using the participants' words when coding instead of using a predetermined set of codes. I also presented all data from the participants even if it does not support what I initially thought the data would determine. This study was conducted ethically by showing respect to my participants in their dignity and privacy, not subjecting them to harm in any way, and ensuring confidentiality. I provided member checking for the participants after the interview was conducted by allowing them an opportunity to review the transcript from their interview. This was done to ensure the data collected is represented in an acceptable manner for the participants.

Limitations and Delimitations

As a phenomenological study, the first limitation of this study is the small number of participants. This represents the experiences of a few people and not all teachers in Mississippi that have experienced teaching Mississippi science standards. Another limiting factor is that all participants may not be candid in their responses. It is difficult to verify what the participants say during the interview. If the participants are not candid in their response, it may alter the themes generated. Some participants may only discuss what they think the researcher wants to hear instead of their honest perspectives.

A delimitation of this study is this data does not represent every school district in the state of Mississippi. It only focused on a few schools with the criteria for the participants being they

teach at the secondary education level, and they began teaching in 2017 or earlier. This study is also a representation of the teacher's perceptions of implementation instead of observable data.

Summary of the Chapter

The purpose of this study was to explore the lived experiences of science teachers in Mississippi as they implemented the 2018 College and Career Readiness Standards. This study's design reflects an interpretive and social constructivist view. Chapter three described the qualitative research methods needed to conduct this phenomenological study. This process includes selection of participants, data collection methods, analysis procedures, and a timeline for the study.

Chapter 4

RESULTS

Introduction

The purpose of this study was to learn about teacher's experiences as they have implemented the 2018 College and Career Readiness Standards for science. The design was a qualitative and phenomenological design with interviews being the method of data collection. The research question that guided this study is: "What are Mississippi teachers' perceptions and experiences of implementing the 2018 College and Career Readiness Standards for Science?"

The participants were purposefully selected based on the school in which they taught, subject they taught, and number of years they have taught. There were nine teachers chosen, representing seven different schools. There was one male and eight females, and the number of years taught ranged between seven and forty. The schools ranged from 1A to 6A in size, and school accreditation letter grades of "C" through "A" were represented. Four teachers teach biology, and five teachers teach other non-tested subjects including chemistry, advanced placement chemistry, anatomy and physiology, zoology, genetics, foundations to biology, and advanced placement biology. The demographics of the participants are summarized in Table 3.1.

Each participant was interviewed once, online through Zoom. The participant chose the time and the day the interview was conducted. Each interview was transcribed and analyzed through three rounds of coding. Through this analysis, four themes emerged from the data. In this chapter, the four themes will be discussed in detail, and then an analysis of the themes will be given.

Data Analysis

After the interviews were completed, the data was transcribed using the exact words the participants said. The researcher made four pass-throughs of the data to code it. The zero code was used to align the answers with each question because some participants unintentionally answered questions before I got to them. The first official round of coding was in vivo coding, and 19 codes were created. The second round was emotive coding, and 14 codes were created. The last was axial coding and was used to combine, delete, and rearrange codes to make connects between them. There were four themes that emerged from the in vivo codes: 1) *Personal Knowledge of Standards Related to the Strengths and Weakness, Opinions, and Use of the Three Dimensions of the Standards*, 2) *Professional Development Related to Training During Implementation and Desires for Training*, 3) *Levels of Support Related to Colleagues, Administrators, and Resources* and 4) *Opportunities for Reflection Related to the Standards and Impacts of COVID*. The codes created during emotive coding applied to all four themes.

Theme 1: Personal Knowledge of Standards Related to the Strengths and Weakness, Opinions, and Use of the Three Dimensions of the Standards.

A theme that was evident throughout the data that influenced the experiences of implementation is the teachers' personal level of knowledge they had of the standards. This theme includes evidence of their knowledge through their identification of the strengths and weakness of the standards and their use of SEPs and CCCs in their lessons.

Strengths and Weaknesses of Standards

With increased knowledge comes increased opinions about the strengths and weaknesses of the standards. The most identified weakness between the participants were the gaps in the standards and topics that were removed. Shelly was frustrated when she said, "Some things were

taken out of my grade and then added to a younger grade. Ok, so you mean to tell me they're going to remember something in ninth grade that they learned several years prior? They're not." This also serves as an example of the gaps in the standards that teachers are identifying. Susan was also frustrated when she talked about gaps in the standards. She said, "There is no human body content anywhere! They know nothing about their bodies and that is just sad." Shelly confirmed Susan's claim when she said, "One thing that is gone is anatomy and physiology(A&P). Unless they specifically take A&P as a course, they don't learn anything about their body their entire high school career." Ava noticed the gaps as well. She claims that information about cells, water, and chemistry has drastically been reduced from the biology content strands. She assumes that information is put somewhere else, but like Shelly, she isn't hopeful that students will remember it by the time they get to biology. Liz confirmed Ava's suspicions when she said, "the cell is introduced in the fifth and sixth grade and not mentioned again until biology. That is a big part of their state test so I think the cell is something they should learn about every year." Stephanie also identified the gaps as the greatest weakness, specifically, the gaps created in the middle school standards.

Liz and Stephanie felt that a major strength of the standards is that they put a bigger emphasis on the real-world, hands-on, application type of information. Becky also likes the application to real world issues. She said, "It's not just memorize and regurgitate anymore. Students have to actually get out of their comfort zone and be able to analyze the data and know how a change in one thing can affect another." Deanna liked how clearly the standards are stated. Shelly also like the clarity of them and felt they are not "over complicated".

Use of All Dimensions of the Standards

Though the standards are made up of three parts, all participants referred to their knowledge of the standards as it relates to the content which is just one of the three parts. This could be due to the type of training they received, if any. When the researcher asked the participants to identify times that they have taught science and engineering practices in their classroom, all but two participants could not recall what science and engineering practices are. The researcher provided a list, and all participants could recall specific ways that they have taught some of them in their class. No teacher claimed to teach all science and engineering practices (SEPs) in their classroom. The same scenario occurred when the researcher asked the participant to identify specific ways that they taught the crosscutting concepts. Teachers had to spend more time thinking and could not think of many examples related to the crosscutting concepts (CCCs). The participants that initially didn't know what SEPs and CCCs claimed that they teach with them but call them a different name. No teacher could tell me what different name they used. Most teachers referred to them as the labs or the hands-on things they do when they teach. Even the teachers that know a lot about the standards have their own reservations about using all three parts. Deanna has knowledge of the SEPs and CCCs but claims she doesn't focus on these parts of the standards often. She said:

As educators sometimes we have control issues. I've done the engineering design labs but turning them loose and letting them figure it out terrifies me. The students loved it, and they really impressed me. I wish I could do these types of activities more often, but you know, control issues.

Stephanie also had reservations about teaching SEPs because some of her classes' behavior is unpredictable. She is not willing to hand over some control to certain classes she has. Ava has

reservations as well because she knows that doing the SEPs cost money and she doesn't have much given to her from her school each year.

Knowledge of Standards Related to Use of Standards

The participants' level of knowledge had a direct effect on their use of the standards. Liz knows the standards very well and, therefore, knows the value in them. She said, "I have them on my desk all the time. They are my guide. I can see it. It's visible and I'm checking it off as I go to make sure I have covered everything." Once Deanna went to training and worked with the assessment writing team, she understood the value in them. She said:

The standards are not just thrown out there to give you a template or a skeleton, they are what is expected of the student to know. It doesn't matter what is in the textbook or in the labs. You have to start with the standards. Everything else is supplemental.

Chris is also an example of the direct relationship of knowledge and use. He said, "I don't really study the standards. You know, I just look at them when I put them on lesson plans to document what we are doing. I don't look at them any other time." He doesn't claim to know much about the current standards and doesn't use them much.

Background of Teacher Influences Knowledge

When teachers try to learn and increase their knowledge of the standards, the teacher's background influenced what parts they needed to focus on when learning. Stephanie and Shelly came into education through an alternate route program and have master's degree in a science content field. They both stated they are very confident in their level of knowledge and ability to teach content, but don't have much knowledge in educational terminology. Becky has a degree in accounting and came to science with a math background. She received an endorsement to teach chemistry by taking the Praxis in chemistry. Not only did she have to learn science, she also had

to learn how to teach science. That was a major additional challenge for her. Becky, Shelly, Chris, Ava, and Nancy are certified to teach advanced placement courses. Many of them claimed that it was easier to learn the 3-D design of the standards since it was similar to the national standards that the AP community uses.

Theme 2: Professional Development Related to Training During Implementation and Desires for Training

Professional development (PD) is the training sessions that teachers attend to learn many things. These sessions can occur at a professional conference or simply hosted by the participant's school. Sometimes the sessions will be led by fellow teachers or a professional that has insight about what is being introduced. Formal training, in this study, refers to training either at a workshop or at school that involves someone from MDE or other professional organizations. Informal training refers to the opportunities to learn about the standards without attending a conference. Informal training usually occurs in the school setting within professional learning community (PLC) groups. There isn't a formal definition of "good PD" because good is a subjective term as it relates to experiences and emotions.

Not only is training beneficial at the beginning, but it is also needed after implementation begins. Some teachers skipped over parts of the content strands that they did not have much knowledge in or were not comfortable teaching. Many participants acknowledged that teaching all of the standards in their grade level is very important to the science classes that follow. Liz stated, "You absolutely 100% have to teach standards in the grade that they're supposed to be taught, and you have to teach it well, or the students are going to miss something." In the standards, there may be two or more years between when topics are to be taught; therefore, a teacher can't skip parts they are not comfortable with. Ava states, "The things that I feel like I

can fully explain are the ones that I'm going to be teaching the best." In order to explain and teach things well without skipping over parts, the teacher needs training in content knowledge and pedagogical content knowledge. Those types of training may look different in how they are presented, but both are equally as important.

Ranges of Professional Development Opportunities

The participants in this study represent a wide range of experiences when it comes to the initial PD, continued PD after the release, and the variation of needs related to PD. These training experiences played a part in constructing the teacher's knowledge of the standards. Some teachers like Chris and Nancy didn't receive any training while others like Shelly went to many training sessions. Some of the participants rely on the standards to inform them of what to teach while others don't use them in any form. One item that remains constant with all participants is that training should be an important part of releasing new standards so they can know how to teach the standards with fidelity.

When the standards were initially released there were not any state-mandated training sessions that teachers were required to attend. It was left up to the school district to send their teachers to PD. Not all teachers in this study were given training opportunities. Nancy wasn't even aware that new standards were going to be released. Except for Ava, the participants that teach biology are the only ones that were sent to a formal training when the standards were released. Other teachers that taught subjects without a state test were not given any training in a formal way. Some schools like the one Susan teaches in didn't send their teachers to trainings but gave them time with her colleagues to dissect the standards. Since the initial release of the standards and the initial PD trainings, all participants reported that they have not been given additional training opportunities unless they personally sought after them or asked permission.

Desires for Professional Development

The participants expressed a wide range of desires for PD. Nancy, Becky, and Chris (chemistry teachers) don't have a strong desire to attend any trainings because they can't find any they feel would be beneficial. These teachers along with Liz would like to attend training that is specific to what they teach. Nancy states:

I want someone who has done it to train me. It would be a great situation where we had chemistry teachers together and asked questions like: What does this look like in your room? How are you doing this? What does this look like? I think this would be huge for the people who are literally in the trenches. I think it would be phenomenal to know what other teachers are doing.

Nancy would like to attend a training led by chemistry teachers that will sit down with each standard and say, "This is how we normally teach stoichiometry, and here is what it looks like with the new standards." Liz said, "I would like to hear from real teachers from all over Mississippi and share how they teach each standard. I want to know how they implement and how they taught it with different types of classes." Stephanie confirmed that different classes must be taught in different ways based on the academic and behavioral levels of the students. She gave the example that the activities she normally does can't be done with her 4th period class due to their misbehavior. Becky can't find any PD she would like to attend because she feels they are state test driven or simply not beneficial for her.

Variety of Professional Development Trainings

A factor that effected their experiences with teaching the standards was the type of training they attended. All teachers that reported attending a training by MDE reported that it was not beneficial. One teacher described training from MDE as "somebody from Jackson

talking about stuff they haven't even done yet." Shelly described the trainings from MDE as "generic" as they mostly gave information about how to read the new standards. They also did not desire consultants. Stephanie described the consultants as "generic" and felt that what they were telling her was something they say to everybody. Nancy didn't like the educational consultants either because sometimes the consultants were elementary teachers. She didn't feel like their suggestions were suitable for high school classes. She expressed frustration that there aren't any consultants in chemistry. She said, "Who is coming from chemistry to tell us how to unpack those standards? No one." She isn't against consultants coming to help them, but she wants it to be someone who has taught science in a high school classroom. Shelly found that the consultant company her district used was a little helpful, but their time with her was split between two teachers over three days and she didn't feel like she had enough time to get all of her questions answered. She explained that the consultant helped the most with clarifying expectations and terms used in the standards.

Teachers described the most beneficial trainings were those from The University of Mississippi, Mississippi Professional Educators (MPE), and Advanced Placement (AP). Liz has been to more than one training at The University of Mississippi and she said they were very beneficial because the leader took an in-depth look at the standards in all three dimensions of them. Liz said it was a training at The University of Mississippi where she learned that she should be doing performance-based tasks on her assessments. She credits that change in assessment to her student's success on the state test. Shelly and Deanna noted that training provided by MPE was their most beneficial training because (like the one Liz went to at The University of Mississippi) they went in depth with each of the standards. Shelly said:

They went through it standard by standard and was like, ‘Hey, this is what each of these words mean.’ For example, it used to be that you had to create a dihybrid cross and be able to analyze it. Now the students don’t create it, they just analyze it. So, when the standards say analyze and use, that means they’ve already got it for the students, they just need to be able to read it.

Deanna loved the training from MPE because she made a connection to the team that writes the questions for the state test. She said, “It changed my life. I cannot express to you how it changed the entire projection of my career.” Not only did she get to write test questions, but she got an inside look at what is happening at the state level and what the expectations are. The teachers that teach advanced placement courses related their ideal PD to that of the required training they received to teach the course. Chris said:

The AP training I went to was good because we went to the chemistry lab at Millsaps, and we worked in groups to share ideas and learn how to do the labs that we were going to have to do with our students. It was the best PD I have ever been to.

Nancy, Becky, and Susan felt that their experiences with the AP standards helped them tremendously. Nancy said:

I would have to say that AP Biology prepared me for the change in standards since AP standards change every four or five years. It wasn’t weird when the Mississippi standards changed. In fact, I would say the new standards look more like what I am accustomed to since the wording is more in line with what the National College Board uses to make the AP standards.

Becky felt that knowing the AP standards helped her understand the CCRS standards because she could see how the high school classes fed into the college level courses. She felt knowing that bit of the big picture helped her teach the CCRS standards better.

Theme 3: Levels of Support Related to Colleagues, Administrators, and Resources

The second theme that emerged from the data is the various levels and forms of support the teachers received and continue to receive related to the implementation of the standards. The participants described supports in the form of teamwork of colleagues, administrators in their school, and resources needed to teach their class. There were six out of the nine participants that directly addressed the benefit of having support from colleagues and working in teams. In some schools these teams are called professional learning communities (PLCs). Nancy said one way her PLC is beneficial is that it helps bring the many ideas and backgrounds of her teachers together. She said:

Within my school we have teachers that teach the same subject but do not agree on the standards. They don't agree on what should be taught or how in depth you should go.

That is hard. We may also have a teacher that is set in her ways and is very comfortable with what she does. And then we have new teachers that come in with their own ideas, and it is kind of hard to address all of these. So, our PLC is important. Change can't be forced, but we can definitely talk about it, understand each other more, and expose each other to different ideas and points of view."

Liz referenced the importance of team support 12 times during her interview. Students from her school score well on the state test and she claims that it is due to her giving performance-based assessment. Additionally, due to her teachers supporting each other, many other teachers in her

school have students that perform well too. When the researcher asked her what that looks like in her school she said:

We have a PLC group that consist of 3rd grade through 12th grade science teachers. All are included in the same emails, and all are included in the resources we send out. We constantly have a group chat going on where we are constantly bouncing ideas off each other and sharing resources. Since fifth and eighth grade sciences are the ones tested, we look at what is needed in third and fourth grade to get ready for fifth grade and we look at sixth and seventh grade to get ready for the eighth-grade test, and then all those combined to prepare for the biology test. That may mean we teach more than what is written in the standards. We certainly don't teach less though.

She recognizes that this scenario is easier to do in a small school than in a large school where the classrooms and grades are separated in different buildings. She also related colleague support to professional development sessions where resources are shared, and new connections are made between teachers from other schools. That networking opportunity is why she liked the PD given by The University of Mississippi so much. She said, "we want our students to collaborate with each other by designing and working in teams, so I believe that's what we as teachers need to do as well." When Shelly started using the CCRS standards she was "thrown in" to the state tested biology class in a low-performing school without ever teaching biology before. Her colleague teacher had never taught biology either, so they did a lot of collaboration and read through all the standards together to try to understand them. Most of the resources she currently still uses in class is something they created through their teamwork or is something spun off an idea they had. She doesn't teach with that teacher or that school district anymore, but they continue to stay

in contact and share resources and ideas. She claims she would not have made it through that year without the support from her fellow teacher.

Susan, Stephanie, and Nancy also described the importance of their PLC team support.

Susan said:

I came to public school after teaching at a private school for many years. If I didn't have a fantastic team, then it would have been much more difficult for me when I started teaching in this school and when these standards were released. I am so blessed in that way.

Like Liz, Stephanie has access to a vertical alignment spreadsheet that describes what students should know in each grade. She is thankful for that, but she didn't help make it and wishes that she could regularly meet with teachers in the grades before biology to show them how to support her. Unlike Liz, she is at a large school and that type of collaboration is difficult to achieve. Though support from fellow teachers in this way is not strong in her school, she recognizes the need and benefit of it. Nancy loves the support she receives from her PLC group and from conferences. She said:

The best thing I do in my classroom I got from somebody else through a conference or a conversation with a fellow science teacher. I still have science friends from other schools along with those down the hall that share resources and ideas that have helped me teach these standards well.

Not all teachers noted support from teachers strictly in their subject area. Shelly and Deanna noted the necessity of general education and special education teacher team support. She said:

I have a really good special education teacher I work with that really gets to know her students. So, we talk about standards, and she identifies the specific areas that her students are going to struggle in, or she identifies standards that her students are not prepared for. Without her support, it would be an epic disaster.

Deanna is in a different scenario where there isn't much support from a special education teacher and wishes for improvement in that area. She said:

I am not a special education teacher. I can teach content, but I need support to help bridge that gap with my special education students. The resource teacher and the general education teacher should be working as a team helping each other.

She recognizes there are things she can personally do to help their team "get there".

Aside from teachers wanting support for themselves, some teachers may have the desire to give support. Deanna wishes she could offer support to help her fellow biology teachers at the other school in their district. Her school is a "B" school while the other school in the district is an "F" school. She has tried to offer her support, but it is not well accepted. She feels like she is on her own island within her school. She is confident about how well the science teachers in her school support each other, but it is not spread throughout the district. She has put forth many efforts to meet with them, but they usually give an excuse as to why they aren't going to do that right now. She feels confident in the teacher's abilities to teach the standards at her school but notes that changes within the district's administration will need to be made to gain unity in the district before she can say that about the other school. Her school district has had four different superintendents in the last five years and claims that consistency in the district administration will need to improve before some of the other issues like unity can be addressed. She is hopeful the current superintendent has them on the right track. Becky is in the opposite situation as

Deanna but also feels a sense of loneliness within her district. She would love to reach out and collaborate with the teachers in the other school in her district but is intimidated by them. They have been teaching chemistry for a long time and she doesn't feel like she knows enough to be in the same conversation with them. She hopes that one day she will be closer to their level of expertise and feel that she can use them as a resource.

Support From School Administrators

Teachers in this study also experienced various levels of support from their administrators. These administrators include building principals, curriculum coordinators, and superintendents. Most teachers described the initial support from administration in a negative way. When I asked about guidance they received from their administrators when the standards were first released, most of them answered with "none". Shelly, Chris, Ava, Deanna, and Nancy all said that their administrators didn't bother them much as long as their test scores were good, or if the administrator didn't get any complaints about them. That is frustrating to some, but others are fine with it. Ava found it frustrating because they aren't consistent. She said:

Until this year, I don't know that I've ever had a real observation, and then recently I had one with six people. That was like from nothing to extreme. That was a few weeks ago and still no feedback. I probably won't get any. But that's how it works. Nothing, nothing, nothing and then oh, let's make a big show.

Deanna feels that the administrators take for granted that teachers simply just know what to do when that is not always the case. Even veteran teachers need teaching, so she admits that any training or help she has gotten about implementing the standards, she has sought out the opportunities herself.

Some teachers appreciate the hands-off approach from the administrators. Ava states:
Our principal is great. He treats us like we are adults and can make good decisions in our classrooms. He gives us the ability to do what we need to do, but I feel confident that if I told him I need help, then he would try to point me in the right direction.

Susan notes her appreciation for her administrators because they yield to the science teachers when speaking about the standards. Shelly claims she could teach underwater basket weaving and the administrators would let her because they trust that what she is teaching is in the standards and she is doing what she is supposed to do. Chris stated, “They don’t really know what I’m teaching. And, you know, they don’t worry about it because there isn’t a chemistry state assessment.” He laughed and said, “And I’m glad there’s not. I don’t want that. I enjoy my freedom.”

Some participants claimed that the principals’ hands-off approach is because they simply don’t have any knowledge of the standards or know how to help. Nancy explained:

I think my principals, care. I just think they don’t know much about what I teach. I think their attention is always somewhere else. When they make comments on my lesson plans, no one has ever made a comment about engineering practices. I don’t know that they even know those exist. Honestly, I don’t know who in my district would be able to read and interpret them to even know if I’m teaching the standards correctly. They just want to see that the standard I wrote on my lesson plan is what I am teaching.

Shelly noted that none of her administrators have a science background. Like Nancy, she doesn’t feel that they know enough about her standards to offer any kind of support. She also feels that their attention isn’t on science. English and math test scores count more towards a school’s accreditation, so the biology and US history classes don’t get as much attention. Chris also feels

the lack of support is due to their lack of knowledge. He said, “They’re not chemistry people. They’re not any kind of science. One of our principals has never even taught in a classroom. He doesn’t know what we need. They’re focused on test scores and benchmark data.” While most participants could not think of a specific way that their administrators supported them in implementing the standards, all said that they feel like their administrators would support them if they asked to go to training to help them learn about the standards.

Support From Resources

Teachers described support in the form of resources as well. Stephanie described how helpful it was that her district is full of resources. She claimed that if there is something she says she needs to teach these standards better, then there is someone in the district that will write a grant and get it for her. That was not the case for all the other teachers in this study. One resource that other teachers needed was lab equipment. Shelly was frustrated at the behavior of her students that have broken the faucets in the lab. She wants updated lab equipment along with some virtual labs, textbooks, and programs. Becky feels embarrassed when she talks to other science teachers due to her lack of lab equipment. She said:

When other teachers ask what kind of labs I do I have to tell them none involving heat.

We don’t even have access to gas in the lab and I teach chemistry. I have to explain that I have to show videos of other people doing the lab or spend a lot of time figuring out some alternative. It seems like there is a lack of resources for the non-tested teachers. All the funds go to the state tested teachers. I am coming from a state tested class to a non-state tested class so I can attest to this first-hand.

Ava also explained that she doesn't do many labs due to a lack of funding. The \$2 lab fee that her school charges each student isn't enough to fund any labs. She tries to do demonstrations for the students instead of full labs.

The other area that teachers are lacking in is content materials like textbooks. Susan and Ava complained that they are outdated and not aligned with the standards, therefore, the teacher has to spend a lot of time picking out the important parts of the book or rearranging and combining information from different chapters to match the information required from the standards. Susan wished for interactive activities aligned with the textbook since her school supplies each of her students with technology and felt that the textbooks are too big. She held up the textbook and said, "Why would any student want to carry this thing around. Look how big it is. I can barely pick it up." Liz doesn't use a textbook much but felt she would benefit from state assessment resources from MDE. She would like for MDE to give the teachers more practice questions every year. She said:

I don't understand why they don't give us more practice materials because the past questions are retired. You would think they could give us something. Maybe like a quarter of the test or 20 questions just to give us an idea of how they are setting up test items. I think that would be very helpful and a really great support for us to have.

Theme 4: Opportunities for Reflection Related to the Standards and Impacts of COVID

In this study, reflection is a time for teachers to think about aspects involved with the implementation of the CCRS standards. This time allows teachers to reflect upon their own understanding and practice to identify their strengths and weaknesses as well as understand where they have been and where they should go next (Heller, Daehler, Wong, Shinohara, & Miratrix, 2012). The participants also identified events that helped them learn the standards and

the emotions related to implementing something new. Opportunities for reflection are critical in the growth of a teacher. This interview afforded some teachers the opportunity to reflect upon their experiences; an opportunity that some didn't realize they needed. Ava said, "You know I didn't realize I had such a problem with the standards until I started talking about them."

Teachers like Deanna and Nancy that take responsibility in their learning love to reflect, but don't often have the time. Nancy said, "This interview has been fun. Actually, it has been enlightening. It has made me think about everything. It made me think about next week's lesson plans. I need to go look at those and see what I can improve." Ava felt the opportunity to talk about her experiences was exciting and helped her discover some of her own feelings and experiences that she hasn't thought of before. Deanna, Becky, and Shelly also expressed gratitude for the opportunity to share their thoughts and experiences related to the journey of implementing the current science standards.

This Study as a Time of Reflection

Participating in the interview for this study gave a lot of teachers a chance to reflect on the last few years. Many of them felt that this year was the first school year that has felt "normal". Chris said, "This school year has been the most normal year since the pandemic. For the past two years we've had to do virtual or a mixture. This year is finally 100% traditional instruction." Nancy thought back over the years of non-traditional instruction through the pandemic and remembered the frustration she felt. She said, "Some kids are home, some are at school, some are on your roll, but they never came to school. There was no way that science and engineering practices or cross cutting concepts were being taught during that time." Teachers are seeing the effects that the pandemic had on students, not only because teaching had to change so much, but also because teachers had to be so lenient on the students during that time. Susan said,

“We are seeing the weakness of the forgiveness from teachers. The reading skills, the study skill, the motivational skills, they’re all lacking. Our kids are just different after the pandemic.” After the pandemic Chris cut out lab reports. He claims that it is due to laziness on his part and not being able to do labs with online instruction. He plans on adding them back in as he has been rethinking how he wants to do labs since instruction is back to the traditional format.

Recognition of Personal Strengths and Weaknesses

Time of reflections allow teachers to look at their strengths and weaknesses. Becky recognizes that she struggles teaching genetics using these standards. Genetics is written to be taught as a higher-level science course, but most of her students are not higher-level students. She is constantly thinking of ways that she can find balance in this course. She wants to push these students, but she struggles because they don’t seem to be interested. Most of the time, her solution is to choose the standards she thinks they have a chance at understanding and don’t teach the rest. Nancy had the same struggles. She wrote the new standards on lesson plans but taught the old ones. Susan has recognized her strengths by reflecting on her teaching. She said:

I have learned the less I do and the more the students do is what is best for them. That is really hard for a teacher. I’ve had to constantly think about what I am doing and what they are doing but watching them learn from each other with my guidance is incredible.

Stephanie had to reflect on her teaching when she was trying to engage the students in scientific argumentation. She said:

Scientific argumentation is part of these standards. I want my students to be able to do it, but I had to think of a way. I had to first teach debate skills so they don’t sit there and yell at each other. I’ve done it a few times with my students.

Teachers need time to reflect, and time to adjust their teaching plan to try to make it better. If Stephanie chose not to spend time reflecting on her initial experiences trying to lead her students in scientific argumentation, she likely would have given up on the idea and missed a key opportunity to teach her students how to be more scientifically literate through argumentation.

Emotions Related to Implementation Ranging from Frustration to Joy

There were many emotions related to implementing the new science standards. Many have been mentioned as they relate to the themes but there were several that teachers strongly expressed that were not related to one of the four themes. Liz stated:

It is really annoying when we have to get a new set of standards. We do our best to learn how to play the game and get fluent in the standards and then boom, they change them on us. That is the frustration.

Deanna expressed frustration about meeting the expectations of teaching the standards when there are other events during the school day. She said, “We started in August, and I’m supposed to run through all of the standards and go to assemblies and other school events in one semester is hard. We start day one and go as fast as we can.”

The frustrations and enjoyments are different depending on if the teacher taught a tested subject or not. If the teacher taught a tested subject, the frustrations mostly revolved around data collection, consultants, and the lack of students’ knowledge retention. Liz was scared about state assessments related to the new standards and expressed her own insecurities about assessing her students. Ava was frustrated about how her district did snapshots. Some schools call these benchmark test. These are periodic assessments that are given to students to check if they are learning. She said, “I think they’re kind of dumb, honestly. They don’t build on each other so it doesn’t show how the student progressed through the year.” Stephanie and Shelly were frustrated

with how little the students remembered about what they learned in previous years. They know the students were taught it, but they don't remember it when they get to biology.

There were very few frustrated type emotions given by teachers that did not have a state test. Their emotions mostly revolved around joy and freedom. Liz said, "I am not tested anymore. It is wonderful. It has been a really good year. I am having a lot of fun." Becky said, "I have thoroughly enjoyed leaving the state tested class and coming into the non-tested science classes. It has given me the love of teaching back. I have a little bit of my freedom back." Chris enjoys teaching lab twice a week. He said, "I'm pretty fortunate that I have never taught a state tested class. I get to do whatever I want to do including the fun stuff like labs."

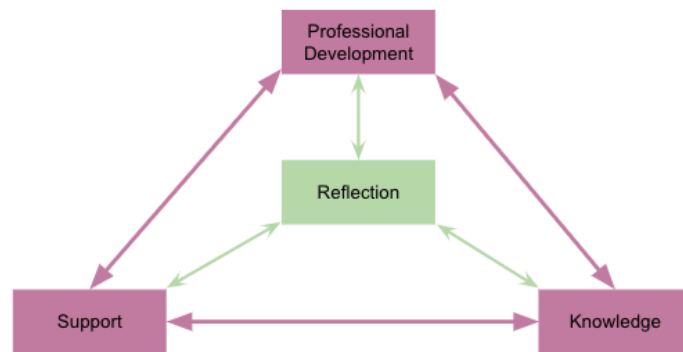
Since some of the state-tested teachers don't get to experience these types of emotions, some of them are experiencing stress and burn out. Shelly said, "I'm getting burned out teaching this subject. It is the same thing twice a year. It feels like same song and dance multiple times a day and multiple times a year. I feel like a robot on repeat." Stephanie recommends shuffling the teachers around to prevent burn out. She suggested that the state tested teacher team up with another teacher and let that teacher observe them for a year to learn how to teach a state tested class. Other emotions expressed and referenced to in the description of themes included concernment, loneliness, hopefulness, and respect.

Analysis of Themes

The themes formed from the data are cohesive and supportive of one another. The first three themes, 1) *Personal Knowledge of Standards Related to the Strengths and Weakness, Opinions, and Use of the Three Dimensions of the Standards*, 2) *Professional Development Related to Training During Implementation and Desires for Training*, 3) *Levels of Support Related to Colleagues, Administrators, and Resources*, are reliant on each other and it is difficult

to discuss one without including the influence the others give towards it. The fourth theme, *Opportunities for Reflection Related to the Standards and Impacts of COVID*, is the central action that the teacher must do or be given opportunities for to understand and identify the role that the first three themes has played in their experiences of implementing new standards. These connections are demonstrated in Figure 4.1.

Figure 4.1. Analysis of Themes.



Professional Development and Knowledge. This connection in the themes was the strongest. The professional development that teachers received influenced the level of knowledge they had about the standards. The teachers that did not have any formal training or time with their colleagues to learn about the standards had a basic level of knowledge. Deanna had the most intimate form of professional development where she was taught how to analyze each word of the content strands to for assessment questions in the state assessment. That is where she learned the value of the standards and learned how to use them to teach instead of strictly using a textbook. Nancy wasn't given any training but was given time during professional development days at school to meet with her science team. They only focused on the changes to the content strands and, therefore, missed out on learning about the SEPs and CCCs. Inadvertently, the level of knowledge the participant had influenced their desire for professional development. The

participants that did not have a lot of knowledge of the standards had less desire to know more about them. Chris used the standards the least of all the participants. He also has not received any training and doesn't desire to go to any because he doesn't feel there are any out there that he could benefit from. He views his purpose in teaching is to prepare students for college science courses. He feels he is doing a great job at that. He doesn't have a state test to review data with, so he assesses his effectiveness through former students that come back and thank him for making sure they were prepared. He bases his performance on anecdotal feedback.

Professional Development and Support. Supports that teachers received or lack while implementing the standards were from administrators, colleagues, and resources. All of these play a role in professional development training. The administrators choose what kind of learning opportunities the teachers receive. Shelly was told which trainings she would attend, while Susan's administrator didn't send her anywhere but allowed time with her science team to unpack the standards. Nancy admitted that she didn't really want to go to any training but knew her administration would support her if she found somewhere she wanted to go. Professional development trainings are where some teachers reported they meet colleagues that provide support. Stephanie attends the Mississippi Science Teachers Association conference every year. She claims to learn a lot in sessions, but also learn a lot from fellow science teachers. She said, "It's good to talk to other people that are teaching the same things as you. It is helpful to know that they are facing the same struggles and we try to help each other out." Professional development opportunities are also a place where teachers can gain support through resources. Each new relationship built with another teacher at PDs can be a resource. Additionally, it is recognized as a place where teachers can get resources for activities and assessments for their classes. These types of resources often cost money, but sometimes they are given away free at

professional development sessions. The lack of any of these types of supports at schools will lead the teacher to seek out their own PD opportunities. Becky was not given any training to learn the new standards, so she sought after opportunities on her own. She requested to attend the Mississippi and National Science Teaching Association conferences and was granted permission to go. Additionally, the lack of the right kind of support can influence the type of PD the teachers need. Nancy, Becky, and Chris lack in resources specific to their subject and desire opportunities to learn more about chemistry from someone that has taught chemistry before.

Support and Knowledge. As a teacher learns more about standards, they can identify areas where they need more support. Ava expressed that she had the knowledge to teach the SEPs but teaching them was difficult without many resources. Her students only pay a \$2 lab fee and that was not enough to do many of the hands-on parts of the SEPs. Shelly experiences the same problem. She said, “I can show a video of what we could do if we had more money. I then spend five hours trying to get everything together, and then I just run out of time. Very frustrating.” Increasing knowledge can also identify weaknesses and gaps, which can identify how colleagues can support each other. Liz, along with many of the other teachers, identified gaps in the standards, especially in the middle school years. She works with her colleagues to make sure that those gaps are recognized and completed. The teachers’ levels of support through administration, colleagues, and resources have a large impact on increasing their knowledge of the standards. The teachers who described the most support teach the standards with fidelity.

Reflection. Reflection is the action from the teacher that can be used to enhance their experiences implementing the standards. They need time to think and evaluate their experiences with professional development, their supports, and their level of knowledge to help identify the barriers associated with learning the standards. Teachers should reflect upon their professional

development desires and opportunities. This was evident when many of the participants described the type of PD that was helpful and the types they desired. Most desired PD specific to their subject, taught by teachers in their field, taught with hands-on approaches, and PD that looks at each of the standards and gives ideas of how to teach them. Teachers should reflect upon their knowledge of the standards and ask themselves if they truly know how to teach these standards with the three-dimensional design. They must identify their strengths and weaknesses to know how to improve. Through our time of reflection during the interview, Stephanie recognized that she struggles learning “educational terms” used in the standards document since she came to education through an alternate route pathway. When teachers make that identification will allow them to know what support they need and how they can support others. Deanna knows her strength is understanding the standards and the connection between them and the test. She feels she can support other schools in her district if they need help. When teachers meet as a PLC to plan, they can reflect as a whole group. Nancy meets with her PLC group often. They often think about the labs they have done and what they could do to make them better and make sure the students are better prepared for the advanced placement chemistry course. Stephanie identified that she struggles teaching ecology because it is boring to her. She said, “Maybe it is because there’s nothing interesting to do. I just show a video and we talk about it. I don’t know what kind of activity to do. I’ve been searching and thinking a lot, but nothing interesting comes up.” In figure 4.1, the arrows extending from the reflection area are doubled sided because it is opportunities from the other themes that provide the opportunities for the teacher to reflect.

Summary of the Chapter

This chapter described the results of the study. An introduction was given followed by the description of the four themes: *1) Personal Knowledge of Standards Related to the Strengths and Weakness, Opinions, and Use of the Three Dimensions of the Standards, 2) Professional Development Related to Training During Implementation and Desires for Training, 3) Levels of Support Related to Colleagues, Administrators, and Resources and 4) Opportunities for Reflection Related to the Standards and Impacts of COVID*. The chapter concluded with an analysis of the themes as they work together in describing teachers' experiences implementing new standards. An image created by the researcher is included that shows the connections of the themes in Figure 4.1.

Chapter 5

DISCUSSION AND IMPLICATIONS

Introduction

In 2018 Mississippi released the College and Career Readiness Standards (CCRS) for science. These standards are the current mandated standards to be taught at all grade levels in public schools. These standards are not like any standards teachers and students in Mississippi have seen before. They are focused on application instead of rote memorization and they include engineering standards that haven't been included before. The purpose of this study was to understand the experiences, perceptions, and challenges associated with implementation of the 2018 Mississippi College and Career Readiness Standards for Science among secondary education science teachers in Mississippi.

The research question for this study is: "What are Mississippi teachers' perceptions and experiences of implementing the 2018 College and Career Readiness Standards for Science?" Data used to answer this question was collected through one interview with each participant. Each interview was an average of 45 minutes long and asked questions that focused on support, experiences, knowledge, implementation, and recommendations. This chapter will give a summary of the design of the study, discussion of findings, limitations of the study, implications, and a conclusion.

Summary of the study

The literature was reviewed before the study was designed. The review began by looking at challenges of implementing standards in various types of fields. The literature consistently presented three challenges more than others, so a deeper look into challenges associated with training, administration, and resources was given. As the literature review moved toward the focus of the study, it discussed studies about implementing science standards in the United States. It described what the Next Generation Science Standards are and explained that the Mississippi standards are built from the same framework. Next, the literature review focused on implementing standards in states near Mississippi, then concluded by describing the small amount of literature that is focused on the Mississippi College and Career Readiness Standards for Science.

A qualitative design was used for this study because of the exploratory nature of the research question. Since the lived experiences of teachers were being analyzed, a phenomenological method was used. Qualitative studies are fundamentally interpretive, so an interpretive ontological perspective was utilized in designing the study and interpreting the data. This view assumes that reality is subjective, and every individual can have a different interpretation of an experience (Merriam & Tisdell, 2016). The findings were analyzed through the social constructivism framework. It implies that the knowledge and meaning the teachers have about the standards are constructed through social interactions, interpretations, and experiences.

Data were collected via online interviews through Zoom. The semi-structured interview questions were left broad on purpose to allow opportunities for teachers to speak freely. These questions are listed in Appendix B. After each interview was conducted, In Vivo codes were

derived and used to form four themes. They are 1) *Personal Knowledge of Standards Related to the Strengths and Weakness, Opinions, and Use of the Three Dimensions of the Standards*, 2) *Professional Development Related to Training During Implementation and Desires for Training*, 3) *Levels of Support Related to Colleagues, Administrators, and Resources* and 4) *Opportunities for Reflection Related to the Standards and Impacts of COVID*. A codebook describing these themes is given in Appendix C. In addition, emotive coding was used to analyze emotions associated with implementation and axial coding was used to form themes.

Discussion of Findings

The first theme, *Personal Knowledge of Standards Related to the Strengths and Weakness, Opinions, and Use of the Three Dimensions of the Standards*, evaluated their knowledge of the standards through their identification of weaknesses and strengths of the standards, their use of the SEPs and CCCs in their classroom, and their views and struggles of CCRS. Similar to the feelings of other teachers (Brand, 2020), some participants in this study had knowledge of the standards but feared that they would lose control when they shifted to the role of the classroom facilitator. The biggest weakness of the CCRS standards as identified by the teachers in this study are the noticeable gaps in content through the years, particularly in middle school. Teachers struggle to fill those gaps because students don't retain what they learn from year to year. Smith & Nadelson (2017) showed that teachers engage in some practices more than others. Most teachers used some of the SEPs in their lessons regularly, but the intentional use of the CCCs was lacking. There were no teachers that claimed they used all the SEPs on a regular basis. Almost all teachers did not recognize the names, science and engineering practices and crosscutting concepts. This is similar to the teachers in Haag & Megowan (2015) that felt that NGSS (standards similar to CCRS) was beyond the current knowledge of the teachers.

The second theme, *Professional Development Related to Training During Implementation and Desires for Training*, described the teachers' experiences with professional development when CCRS was first released, professional development that has been provided since the initial year, types of professional development given, and the type of professional development that teachers felt was most beneficial. Banilower, Heck, & Weiss (2007) show that professional development is vital to teachers in understanding content, but some teachers did not receive any training through professional development, while some teachers received a lot. This is no surprise as literature has indicated that a school's administration might dictate who gets to attend training (Schwartz, 2020). None of the teachers received continued training on the standards unless they sought opportunities on their own. The professional development that looked at the individual standards and explained what is meant by the words in the content strands was most beneficial. Some teachers don't feel that professional development is beneficial to them because there are not any trainings available in their subject area.

Remaining true to an interpretivist nature, each of the participants in this study had different experiences when it came to PD. These participants represent a wide range of experiences when it comes to the initial PD, continued PD after the release, and the variation of PD needs. Remaining true to the constructivist nature, these training experiences have played a part in constructing the teacher's knowledge of the standards and how they will be assessed. For example, Liz learned about performance-based assessments at one of the PD sessions she attended and it changed how she taught and assessed the standards.

The third theme, *Levels of Support Related to Colleagues, Administrators, and Resources*, addressed anything the teachers felt that supported or did not support them through implementation. This included support from colleagues, administrators, and resources. A study

by Richman, Haines, & Fello (2019) also concluded the support from colleagues through collaboration and planning was a very important part of implementing standards. Some teachers meet with professional learning communities that are formed in their school and claim that it is the most beneficial thing they do, as it provides collaborative opportunities while they were learning something new (Allen & Penuel, 2015). Others that don't have a PLC or close colleagues to talk to desire that type of support. All participants said that administrators did not directly provide any support when the standards were initially introduced, but they knew their principals would provide it if they asked for it. The third part of this theme was about resources. This includes money, pedagogical aids, and building structures. Alshammari (2013) suggested that providing the needed resources for teachers is a way that administrators can support their teachers.

The fourth theme, *Opportunities for Reflection Related to the Standards and Impacts of COVID*, identified the benefit of reflection by discussion of their personal strengths and weaknesses, use of standards, and their reflection on the years of teaching during the COVID-19 pandemic. The interview for this study was a perfect time of reflection. Many teachers thanked me for giving them an opportunity to discuss their experiences. One described it as “enlightening” and made her think about her current lesson plans while describing it as “fun” and “exciting.” Many described this school year as the first “normal” year they have had in a long time. They need opportunities to evaluate their thoughts, lessons, and future plans, but often they simply don't have the time or opportunity. Each teacher's experiences are unique. Taking the time to reflect on these unique experiences helps teachers see areas they need to learn in and acknowledge their need to address challenges associated with change (Brand, 2020).

Limitations

As a qualitative study, limitations are inevitable. The first limitation to this study is the small number of participants. The small number only represents the experiences of a few teachers in Mississippi. The use of interviews to collect data was also a limitation. There was only one interview given to each participant. Multiple interviews could have yielded different responses. Though pseudonyms were used, and participants were assured they would remain anonymous, participants may not have been candid in their responses. Some participants may not have given as much detail in their responses or presented responses they think the researcher wanted to hear. They may have also had reservations about their answers in fear of being identified. The final limitation to this study is the recall accuracy of the participants. Some interview questions asked about events that occurred many years ago, so the data is reliant on the accuracy of the participants to remember events that aren't recent.

Implications

For Teachers

Implementing standards is a human endeavor. Teachers feel many emotions like joy, freedom, inadequacy, frustration, insecurity, stress, burn out. They will be faced with challenges where they don't feel equipped or supported and want to leave the profession. During those times the teacher must be their own advocate and build resilience. Resilient teachers are more likely to overcome adversity and change (Castro, Kelly, & Shih, 2010). Resilience refers to the "ability to adjust to varied situations and increase one's competence in the face of adverse conditions" (Bobek, 2002, p. 202). Standards, for example, are going to change every five to eight years and with that will come some of the same challenges and emotions the teachers expressed in this study. It is important for the teacher to remain a life-long learner so they can adjust to the

situation and build resiliency. They need to constantly strive to stay ahead and educate themselves as much as possible, even if the teacher doesn't have their administration forcing them to be educated (Apsari, 2018; Marques & Xavier, 2020). Liz said teaching the standards is not as hard now as it used to be because she knows more about them now. If insecurities or frustrations arise around a certain occasion, student, or learning objective, the teacher should seek out opportunities to learn how to handle the situation. It can get easier when the knowledge and support are present.

Since emotions are heavily attached to the teaching field and challenges are constant, the teacher needs to make sure that they are equipped to handle the emotions and challenges. The teacher does not need be ashamed to seek therapy if they need help. Castro, Kelly, & Shih (2010) claim that seeking help is part of the process of building resiliency. There is currently a massive teacher shortage in the United States, and it is partly due to teacher burn out and emotional exhaustion (Rumschlag, 2017). Teachers need to do the necessary actions of being their own advocate and seeking help when needed to ensure they can stay in a field they love for as long as possible.

For Teacher Educators and Teacher Educator Programs

Teacher educator programs have a large responsibility to prepare teachers. There are so many aspects of teaching that are learned “on the job” instead of in a college classroom, but the education programs should try to give as close to “on the job” training as possible. Pre-service teachers need to be exposed to the classroom setting as much as possible so they can learn how other teachers combat problems in their classroom. Zeichner (2010) claims that giving more field experience in education courses will create expanded learning opportunities and will better prepare them to be successful in the field of education. Many teachers in this study wanted

training opportunities from veteran teachers in their field because learning from someone experienced is valuable. When preservice teachers observe veteran teachers they learn classroom discipline, pedagogy, positive/negative influences the teacher can have on students' behavior. Eventually, they begin to notice how all of those aspects influence student learning (Anderson, Barksdale, & Hite, 2005; Jenkins, 2014). This type of training should start in the teacher education program as early as possible so many of the different aspects of teaching can be observed.

Participants in this study claimed that working with a team and having supportive colleagues is vital to implementing new standards. Teachers need the collaborative teamwork skills before they enter the teaching field. They should be taught how to work in a team and be a good team member. Tschannen-Moran & Barr (2004) and Cybulski, Hoy, & Sweetland (2005) conducted studies that found that positive collaborative work between teachers in a team had a positive impact on student achievement. This idea of collective efficacy was first introduced as "the belief in one's capability as a team to organize and execute a course of action" (Bandura, 1997). When this idea was studied in education with pre-service students, it had a positive effect on group discussion behaviors that resulted in higher cognitive skills (Wang and Lin, 2007). Atasoy & Cakiroglu (2018) found that pre-service students liked working in groups because they learned more efficiently, learned how to exchange opinions, and developed a sense of responsibility. These are all skills that would benefit a group and, in turn, benefit students if the teachers could learn them while they are still in a teacher education program.

Just like pre-service teachers need opportunities to learn how to work in a group, they also need opportunities to reflect on their lesson plans and look at their work critically to find their weaknesses in order to grow. Reflective thinking is a valuable tool for the growth of the

teacher. Pre-service teachers often act according to the reflective thinking (Gurol, 2011). There are multiple ways of accomplishing this in pre-service teacher education programs. Oner & Web (2011) used web-based portfolios. Gelfuso (2016) used videos to create reflective opportunities. Support from teachers along with these self-assessment tools within a classroom can lead to higher levels of reflection (Dawson, 2006; Samuels & Betts, 2007).

For Administrators

In other studies, the school administration played a large part of successful implementation (Cheung & Wong, 2012; Padney, 2018; Penuel Harris, & DeBarger, 2015). Teachers in this study all had the same response that administrators did not actively support them when the new standards were released, but they had mixed responses about how that made them feel. Some viewed it as the administrators didn't care, but some viewed it as the administrator showing their trust in the teacher to teach what they are supposed to teach. No matter how the teacher felt about the support from their administrator, there is a disconnect between the principal and what is happening in the classroom. Nancy and Chris brought up the fact that their administrator wouldn't know how to help them teach the standards if they did try because they aren't knowledgeable of science. They also felt the administrator's focus was not on science. There needs to be someone that bridges the gap for teachers. A possible bridge builder could be a science curriculum coordinator. This person can serve many roles including but not limited to, serving as a liaison between the teacher and administrator, choosing, designing, or implementing the professional development, and can serve as an advocate for what science teachers do (Whitworth & Chiu, 2015). Iveland et al. (2017), found that administrators understood the teachers' needs once they took time to learn the new standards. Other roles that could help bridge the gap are lead teacher or department heads.

Teachers in this study often mentioned time as a barrier to the things they needed to do. They needed time to search for more resources for teaching, time to find alternate labs when they didn't have much money, time to find a demonstration to take the place of labs, time to collaborate, time to learn, and time to reflect. Administrators need to be conscious of the teachers planning time. They should assure that teachers have adequate planning time allowed and try not to fill it with unnecessary responsibilities. This could be a way to reduce the frustration and stress level of teachers. One of the teachers stated she hasn't had a regular planning period in two years because she has to cover other teachers' classes due to the shortage of substitute teachers. Duncan (2022) suggests that school districts be creative in building a pool of substitute teachers so that scenarios like this do not happen. Examples are to partner with community-based organization to identify and train community members or to use federal relief funds to recruit and retain substitute teachers.

For the Department of Education

Teachers know that updating standards is inevitable (Wang, Moore, Roehrig, & Park, (2011). Teachers need to be trained each time there is a large change in standards (Bunch, 2013). The teachers in this study gave some specific types of training that helped them or that they felt would help them if they never received training. It may be helpful to teachers if they are given an opportunity to voice their wishes for training the next time standards are updated (Abadie & Bista, 2018). Teacher autonomy is needed especially in developing professional development trainings (Kennedy, 2014; Haar, 2007). It may also be helpful for teachers to know why they are being updated and who writes the standards. Only one teacher knew that it is other teachers that currently are in the classroom are on the committee that writes the standards. The rest of the teachers did not know or assumed it was someone from the Department of Education. Lastly, it

would be helpful if non-tested subjects were included when professional development is being developed. Some teachers said the trainings they have been to aren't very beneficial, because it is only about the state test and not specific to their subject. If the goal is for all students to be scientifically literate and for all teachers to teach the standards with fidelity, then all teachers need to be a priority. According to the participants in this study, the state tested teachers receive the most training due to their classes being the ones that count toward school accreditation. While most teachers understood the reasoning, some still didn't think it was fair. The individual schools choose who goes to training, so it could be helpful if the administration at each school was encouraged to send all science teachers as long as the training was designed to teach the standards and not the state test.

For Future Studies

Since this study is a small glimpse into the experiences of nine teachers, there are many opportunities for further research. A future study could involve looking into the experiences of middle school and elementary teachers. This study focused on high school teachers, but the results may be different based on the grade level the teacher teaches. Another future study could look into the administrator's role when standards are implemented. The participants expressed that their administrators don't know what they teach and wouldn't be able to help them if they tried. They also said that administrators are not focused on standards, but more focused on test scores. Looking into a way to make the teachers' and administrators' visions, needs, and expectations more aligned may be helpful. Another study could look at another state with a similar scenario as Mississippi and compare the teachers' experiences. Lastly, the teachers in this study discussed the social and emotional interactions they have every day as teachers. The social and emotional learning of students is currently being studied, but there is not much research on

the social and emotional aspects of teaching. Looking at this area for teachers and seeing how it impacts stress, burnout and retention could be significant.

Conclusion

There are challenges and barriers to overcome with any type of implementation. Education is not excluded. It is not enough to just ask teachers to align new standards to their current lessons (Windschit & Stroupe, 2017). There are certain factors like training, support, and time that need to be in place for the standards to be used with fidelity. This study examined high school science teachers' experiences in Mississippi as they implemented a new set of standards that were released in 2018. Soon after the standards were released, the world was faced with a pandemic that threw some unexpected challenges at teachers. Though many of the pandemic-related challenges have dissolved now, it is worth learning about what teachers have been through to use the CCRS standards in their classroom.

The ranges of the lived experiences of these teachers were wide. Within these ranges were emotions related to their experiences. Though each teacher had different circumstances, they expressed specific needs and desires related to implementation of standards. The first is related to training. This includes formal professional development sessions and learning opportunities through a Professional Learning Community (PLC). They have specific desires in how the training is presented to them and for what the training is going to teach them. The second is related to support. It includes but is not limited to support from colleagues, administrators, and resources. Support must be present from all three of those areas for effective implementation of the standards. Through training and support, the teacher's knowledge of the standards increases. Furthermore, it is during times of reflection that a teacher can grow and identify their needs and desires.

There will be a new set of science standards released again in Mississippi one day. Penuel et al. (2015) described that educational leaders need data about implementation to understand it and design supports for teachers. It is hopeful that this study will reveal the areas that need to be evaluated to help the teachers implement them more effectively and, in turn, increase student learning.

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LIST OF APPENDICES

Appendix A
Recruitment Email

November 1, 2022

Dear (Participant's Name),

Hi, I am Lydia Lytal and I am a graduate student from the University of Mississippi. I am conducting a study and would appreciate it if you would agree to let me interview you about your experiences implementing the 2018 Mississippi Science Standards. This interview will help us learn about teacher experiences implementing the Mississippi Science Standards and how we can better support them. Your participation is completely voluntary, you can quit the study at any point, and all participants will remain anonymous.

Thank you for your time and consideration.

Sincerely,

Lydia Lytal

Appendix B

Interview Protocol

- Before the interview begins, introduce yourself to the participant and make them feel at ease with you. Make sure the participant is comfortable with your recording the interview.
- To begin, press the record button and begin with the background/demographic questions.
- Move to content questions. Use probes if needed.
 - Examples of probes are:
 - “Tell me about what you mean by that?”
 - “Can you tell me more about....”
 - “Just to be clear.....”
 - “I want to make sure I’m understanding correctly. Do you mean....?”
- After the interview, stop recording and upload the recorded transcripts.
- Content questions 8-13 are adapted from Kraeling, 2021.

Background Questions

Questions to gain background information about the participants teaching history. Ask about the bullet points under question 1 if the participant doesn’t volunteer that information in their narrative.

1. Tell me about your journey as a beginning teacher to now.
 - How long have you been a teacher?
 - How long have you taught science?
 - How long have you taught in your current school district
 - What grade level do you teach?
 - What subject do you teach?
 - What other grade levels or subjects have you taught before the ones you teach now?
 - What is the highest degree you have achieved?

Interview Questions

Questions to guide the collection of data on teachers’ experiences.

General Questions

1. In general, how would you describe your experiences teaching this school year?
2. What does a typical day in your classroom look like?

Support Questions

3. Tell me about your experiences learning and teaching the CCRS standards for science since they were introduced in 2018?
4. How are your experiences with CCRS similar or different than the previous 2010 science standards? (Ask this only if they taught science prior to 2018.)

5. What kind of support/training did you receive when the CCRS were released for the 2018 school year, if any?

6. What kind of continued supports do you receive, if any?

7. What support/training/resources have you received to help you understand the crosscutting concepts, science and engineering practices, and/or changes in the content?

8. What guidance have you received regarding the implementation of the standards from administration, if any?

Experiences

9. Tell me about an experience you have had with implementing science and engineering practices in your classroom.

10. Tell me about a time you implemented crosscutting concepts (patterns, scales, etc.) intentionally in your classroom.

Understanding Standards

11. Tell me how you feel about the disciplinary core idea content standards as they are written in the CCRS.

12. Have you unpacked the standards as a district, school, or individual? If so, describe that process. What did you learn from that experience?

Strengths of CCRS

13. What are some positive aspects and strengths of the CCRS? What are some concerns you have about the CCRS?

Implementation

14. What aspects of implementing CCRS do you feel the most confidence in?

15. What aspects of implementing CCRS do you feel you need improvement?

Recommendations

16. Is there anything you feel you need that could help you teach with CCRS more effectively?

17. Is there anything else you would like to add about your experiences implementing the CCRS?

Appendix C

Codebook

Theme	Code	Description	Example
Theme 1	Use of SEPs and CCCs	The teacher describes times that they have used the SEPs and CCCs in their lessons.	“I used developing and using models when I taught the molecular geometry theory and the VSEPR theory. It shows how the molecules look once the bonding occurs because the different faces that the atoms form, and the way their electrons interact with each other. It's hard to see that 3-D shape in a book.”
	Struggles with CCRS	The teachers stated characteristics of the standards that were difficult for them to teach.	“With these standards, the students are supposed to be able to do a lot more instead of just know content. I'm used to being the 'sage of the stage' and I've had to learn how to pull back from that.”
	Strengths/weakness of standards	The teacher states anything related to their opinion of the strengths and/or weaknesses of the standards.	“I think the standards are doing really well with cross cutting concepts and the SEPs. I feel like we put a bigger emphasis on real world hands on and applying this to every facet of our life.”
	Knowledge of standards	The teacher indicates that they know about the standard or don't know about them. This ranges from how much they know about them to knowledge of how they are organized.	“The standards are really pushing them a little bit more and getting them out of the comfort zone of memorize and restate”
Theme 2	Professional Development Opportunities	The teacher states what opportunities they received to be trained on the standards. This includes when they were first released or the years following.	“Around the time the standards came out, I was able to go to the state and national science teaching conferences and that is about it.”

	Professional Development needs/desires	The teacher states if they desire more training and what kind they feel would be the most beneficial. This ranged from zero desire for any professional development to specific needs.	“I would like a more application-based PD where we can learn about things that we've seen work for students in other places. We always need fresh ideas”
	Advanced Placement standards and training	The teacher compares the CCRS standards to that of advanced placement courses. This includes training and standards.	“Teaching AP Chemistry was a big help, because it kind of helped me understand how things fed into college level classes from my chemistry standards. I need to understand why students need to know this so that I can teach it better.”
Theme 3	Colleague Support	The teacher states the benefit of teamwork and learning from other teachers.	“Science teachers are the best people around, in my opinion, and we just collaborate. It is so helpful having people to bounce ideas off of, and share resources with.”
	Administration	The teacher states anything related to the role that administration has played in implementing the standards	“I guess my test scores have always been pretty good, so my principals haven't offered to send me or do any kind of training because they're like, oh, you know this, you're fine.”
	Resources	The teacher states or alludes to the use and number of resources they have. This ranges from zero resources to an abundant amount. Resources refers to anything that aids the teacher in teaching the standards.	“I would love some updated lab equipment. I also need updated textbooks, but not the physical books. Those are way too heavy.”
Theme 4	Moments of Reflection	The teacher uses the interview for moments of reflection on their	I used to be big on lab reports and I just have really gotten lazy on that. I make my AP kids write lab reports, but I quit doing it. I guess

		own thoughts and practices.	after saying it now I feel like I probably got tired of doing them. I need to start it back.”
	Thoughts on three dimensions	The teacher states any thoughts or reflections related to the three dimensions	“I feel like when they can put those science and engineering practices to use, and they can apply it to the information then they can understand more. ”
	COVID	The teacher states anything related to COVID. This includes pre-covid and post-covid reflections.	“It seems like every year since COVID, they've got some new struggle that I haven't seen in the past.”

VITA

Lydia Lytal

lydialytal@gmail.com

Education

PhD University of Mississippi
Secondary Science Education
2019-2023
Advisor: Dr. Joel Amidon

M. Ed Blue Mountain Christian University
Secondary Science Education
2016-2018

B. S. Blue Mountain Christian University
Secondary Science Education
2006-2010

Teaching Experience

INSTRUCTOR | BLUE MOUNTAIN CHRISTIAN UNIVERSITY | 2019-PRESENT

- Teach Biology 1 and 2 for non-majors, Biology 1 and 2 for majors, Microbiology Methods of teaching science in secondary education, and History/Philosophy of Science.
- Teach these courses online and in-person.
- Teach the biology courses in the semester, summer, and winter terms.
- Advise freshman students and science education majors.

ADJUNCT INSTRUCTOR | NORTHEAST MISSISSIPPI COMMUNITY COLLEGE | 2020-PRESENT

- Teach Survey of Anatomy and Physiology and General Biology 1 in the online or in-person format

SCIENCE TEACHER | NORTH PONTOTOC HIGH SCHOOL | 2011-2019

- Taught Anatomy and Physiology, Advanced Placement Biology, Earth and Space Science, Biology 2, and ACT Prep

SCIENCE TEACHER | LAFAYETTE HIGH SCHOOL | 2010-2011

- Taught Biology 1, Earth and Space Science, Introduction to Biology.

Service

- Chair of the Science Education Department of the Mississippi Academy of Sciences 2023-2024
- Vice-Chair of the Science Education Department of the Mississippi Academy of Sciences 2022-2023
- Serve on the BMCU alumni faculty board 2021-present
- Serve on the BMCU Freshman Year Experience team 2022-present
- Science representative for the North Pontotoc Library Advisory Committee 2017-2019
- Pontotoc County SREB-LDC Literacy Design Collaborative initiative team 2016-2019
- North Pontotoc PBIS team member 2017-2019
- Member of the Pontotoc County Innovative Schools team 2018-2019
- Member of the Pontotoc County Superintendent's Advisory Board 2018-2019
- North Pontotoc Senior Beta Club Sponsor 2015 to 2019
- North Pontotoc Science Club Sponsor 2010-2019
- Colorguard instructor for North Pontotoc middle school and high school band 2012 to 2017

Presentations

- Lytal, L. (October, 2022). *Teaching Experimental Design with Pill Bugs*. A presentation at the annual conference of the Mississippi Science Teachers Association. Biloxi, MS
- Lytal, L. (April, 2022). *Sometimes Change is a Good Thing*. A presentation at the annual Conference of the Mississippi Academy of Sciences. Biloxi, MS
- Lytal, L., Morton, G. (February, 2020). *Claim, Evidence, Reasoning*. A presentation at the annual conference of the NASA Mississippi Space Grant Consortium. Oxford, MS
- Lytal, L. (October, 2019). *Let's Taco About It*. A presentation at the annual conference of the Mississippi Science Teachers Association. Biloxi, MS
- Lytal, L., Morton, G. (October, 2017). *Shake Your Bones*. A presentation at the Mississippi Museum of Natural Science family night. Jackson, MS
- Lytal, L., Kirkland, T. (October, 2016). *How to Achieve National Board Certification*. A presentation at the annual conference of the Mississippi Science Teachers Association. Jackson, MS
- Lytal, L., Morton, G. (February, 2016). *Art in Science*. A presentation at the annual conference of the NASA Mississippi Space Grant Consortium. Oxford, MS

Lytal, L., Morton, G. (October, 2015). *Art in Science*. A presentation at the annual conference of the Mississippi Science Teachers Association. Jackson, MS

Invited Talks

Lytal, L. (February, 2023) *My Journey Through Grad School*. A presentation for the Blue Mountain Christian University Math and Science club.

Lytal, L. (February, 2022). *Tips and Tricks to Teaching Online*. A presentation for the Science Education Division of the Mississippi Academy of Sciences.

Lytal, L. (November, 2022). *How I Became a Teacher and Other Life Lessons*. A presentation for Blue Mountain Christian University Math and Science club.

Lytal, L. (2021) National Science Teaching Association chat panel discussion through Twitter.

Lytal, L. (January, 2018). *Technology in Education*. A presentation for the Blue Mountain Christian University Student Intern Initiation.

Publications

Lytal, L., Whitworth, B.A., Morton, G. (2021). No Bones About Art. *Science Scope*. 45(1). 60-67.

McClellan, G.S., Adams, G., Gupta, K., Helal, R., Lytal, L., McLaughlin, E.C., Middleton, L., Pfrenger, W., Sweeney, E.Y., Wallace, L., & Wiggins, E.T. (under review). Students' perceptions of factors contributing to academic success: An action research study. *Journal of Contemporary Research in Education*.