Do I Enact What I Learn?: Examining Novice Science Teachers Approximations of Practice

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DO I ENACT WHAT I LEARN?: EXAMINING NOVICE SCIENCE TEACHERS

APPROXIMATIONS OF PRACTICE

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ABSTRACT

The purpose of this study was to examine novice secondary science teachers’ enactment of their teaching philosophies in their lesson planning and teaching. The framework was based on three theories: approximations of practice, teachers’ knowledge of content and students (KCS), and experiential learning. The design for this research used a qualitative case study design. The participants were three novice science teachers in a large school district in the Southwestern United States. Data sources included teaching philosophies, three semi-structured interviews, lesson plans, and observations. Three research questions were: what are novice science teachers’ major philosophies at the entry level of teaching; what factors influence novice science teachers’ enactment of their philosophies about teaching secondary science; and how do novice science teachers implement lesson planning into their own teaching practices in a secondary science classroom? The findings suggest that novice science teachers were able to enact their teaching philosophies in their lesson plans and instructional practices, but were not able to negotiate the challenge of resistant students. The findings help to address changes that may need to be considered in the design of the teacher education program and the science methods course. Thus, this study contributes to the research on science teacher.

Key words: science teacher education, novice science teachers, teaching philosophy
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DEDICATION

To Mama Sadie, my one and only. To my late father, a promise kept. To my family – patience, persistence, perseverance, and an iron will. To all my students past, present, and future you are why I do what I do.
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CHAPTER ONE

INTRODUCTION

This dissertation aims to examine the novice science teachers’ enactment of their teaching philosophies in lesson planning and the secondary science classroom. An overview of the dissertation will begin with the discussion of science teacher education under the current educational context. An overview of the importance of novice science teachers’ enactment of their teaching philosophies, both in lesson planning and in their instructional practices will be addressed. For example, Grossman, Compton, Igra, Ronfeldt, Shahan, and Williamson (2009) found that novice professionals are provided with fewer opportunities to engage in interactive practices that allow them to enact various components of their professional practices. Gaps between the applications of educational theories in teaching practices will be addressed as well. For example, Feiman-Nemser (2001) researched a lack of coherence, or disconnect, between the educational theories being taught as part of teacher preparation programs and the challenges student teachers have in applying theoretical knowledge in their field experiences.

This chapter will examine the purpose of this dissertation and provide information on the gap between theory and practice. In the second section of the chapter, the theoretical framework of enactment, teachers’ knowledge of content and students (KCS), and experiential learning theory will be briefly discussed as the lens that will be used for this dissertation. These three theories will be more closely examined in Chapter Two.

Science teacher education under the current educational context

The U.S. Department of Education released a report on the nation-wide areas where critical teacher shortages exist. STEM field teachers make up a significant portion of the areas
with critical shortages (Cross, 2016). A solution to teacher shortages led to the creation of Alternative Routes to Licensure (ARL) programs for teacher preparation. In these programs, individuals who hold an undergraduate degree in a content field may gain a license to teach after completing a specific number of educations credits as required by each states’ Department of Education (Lewis-Spector, 2016). Sass (2014) pointed out various ARL programs for professions, such as dental assistants, which helped to fill positions in critical needs areas with individuals who have an undergraduate degree in a content area related to the profession. Teacher shortages in K-12 education exist at urban and suburban schools but urban, at-risk, low-performing schools appear to face a greater challenge attracting and retaining highly qualified teachers (Ng, 2003). Attracting and retaining well trained ARL teachers who choose to remain at urban, at-risk schools may help the students attending these schools to successfully graduate and enter college.

Education tends to be viewed as a means to increase earning potential. Life time earnings increase with increasing education, especially in STEM fields (Carnevale, Rose, & Cheah, 2009). People are becoming heavily reliant on science and digital technology for a wide variety of purposes which creates the need for skilled workers who can keep current technology going or improve upon existing technologies. STEM education will become increasingly important to society and the global economy as the need for technologically savvy and scientifically literate workers increases.

STEM education becomes increasingly important to the future workforce because they may be the workers who will be responsible for using, maintaining, or creating different technologies. Their education and life time earning potential may depend on having properly trained and knowledgeable STEM teachers in our schools providing extracurricular programs,
such as biotechnology, coding, or robotics. Research conducted by Nadelson, Seifert, and Hendricks (2015) found that pressure has been placed on STEM field teachers to improve their content knowledge and content practices due to the release of the Common Core State Standards (CCSS) and the Next Generation Science Standards (NGSS). Their research addresses the need to ensure that STEM content teachers are trained so that they understand the core STEM practices as outlined in NGSS. They concluded that by increasing students’ understanding of STEM content areas, students may develop particular orientations and practices that are aligned with future careers in many of the high demand STEM fields.

The NGSS were created to bring about more inquiry-based learning opportunities in K-12 science classrooms (National Research Council, 2013). The NGSS are standards for teachers to help students meet specific performance standards and it incorporates crosscutting concepts which are designed to help students explore the interconnectedness of the four domains of science: Physical Science, Life Science, Earth and Space Science, and Engineering Design. These crosscutting concepts are designed to increase students’ scientific literacy while moving teachers away from telling students information towards facilitating the learning process.

According to the National Science Teacher Association (NSTA) in 2003, students will need to understand major concepts in science, how evidence is obtained and used to support those concepts, and what processes of examination allow scientific information to become scientifically acceptable as explanations for natural phenomena through inquiry-driven teaching. The NSTA (2003) suggests that teacher preparation programs provide preservice science teachers with the opportunities to work with classroom students using what they are learning in their preparations courses to demonstrate their understanding and their ability to teach effectively and enact reform-minded teaching strategies.
Novice science teachers’ enactment of their teaching philosophies

Novice science teachers formulate their teaching philosophies based on their beliefs about and experiences with teaching and learning. They use their beliefs and experiences as filters to make sense of education theories, new forms of knowledge, and new experiences when they enter their teacher preparation programs (Feiman-Nemser, 2001). Teacher preparation programs should produce science teachers who are reform-minded and prepared to effectively teach students by incorporating the reforms for science instruction outlined in the NGSS. Feiman-Nemser (2001) brings up the point that, if the public wants schools that engage students in powerful learning opportunities, teacher preparation programs will need to offer more powerful learning opportunities for novice science teachers. Researchers found that by focusing on core practices, novice science teachers were able to enact their practices within their teaching disciplines with more confidence and success which translates into better learning outcomes for science students (Feiman-Nemser, 2001; Grossman et al., 2009; McDonald, Kazemi, & Kavanagh, 2013).

Deemphasizing the product of professional practice and focusing more on the processes necessary to enact professional practice may provide richer preparation experiences for novice professionals (Grossman et al., 2009). For example, Gardiner and Salmon (2014) and Grossman et al. (2009) found that when novice teachers were provided with opportunities to practice different aspects of their teaching, they understood how to carry out effective instructional practices and they were able to enact these practices because the focus of the preparation was on process rather than products. These teachers were taught ways in which educational theory was used to create effective instructional practices for teaching which translates into better learning outcomes for K-12 students.
It is critical to the effectiveness of classroom instruction that teachers are able to take the educational theories that novice science teachers learn about in their teacher preparation programs and apply that information to teaching (Deygers & Kanobana, 2016; Rasmussen & Rash-Christensen, 2015). Through connecting coursework to professional practice, student teachers are better prepared for their field experiences so they feel less disconnected from the coursework (Rasmussen & Rash-Christensen, 2015). Specifically, breaking down teaching theories and principles for teacher candidates provided opportunities for understanding the practical application in the classroom while closing the gap between theory and practice (Mehrani, 2014). Stressing the process of learning to teach to facilitate the construction of knowledge about teaching in a science methods course, instead of the product of course work may be more important to novice science teachers’ enactment of their teaching philosophies (Smagorisky, 2009).

This dissertation examines novice science teachers’ teaching philosophies and the ways in which they are enacting their philosophies in their lesson planning and teaching practices in the secondary science classroom. The research questions that are answered by this dissertation are what are major philosophies held by novice science teachers at the entry level of teaching (practicum II – student teaching during their first semester in their own classroom); what factors influence novice science teachers’ enactment of their philosophies about teaching secondary science; and how novice science teachers implement lesson planning, through the science methods course, into their own teaching practices in a secondary science classroom?
Learning to teach science is a process that incorporates the science content with the methodology required to teach science in the classroom. Preparation programs focus on preparing teachers to teach students through focusing solely on what they learn. Novice science teachers would need the training through their practicum, content, and science methods courses in order to enact these practices in their classrooms; in this way novice teachers should learn about both pedagogy and student learning. There is research that examines the gap between theory and practice and illuminates what may be hindering novice science teachers’ abilities to enact not only the educational theory that they learned but their teaching philosophies based on that theory (Feiman-Nemser, 2001; McDonald et al., 2013; Rasmussen & Rash-Christensen, 2015). Understanding the most current research in education and learning may help novice science teachers build a repertoire of techniques and strategies for enacting their teaching philosophies in their instructional practices, thus engaging in effective instructional practices.

Novice science teachers may understand what is required to teach the content, however the teaching philosophies they create reflect the teacher they would like to be in the classroom, not the teacher they actually are in the classroom (Hegarty, 2015). Novice teachers base their teaching philosophies on prior experiences, referring to previous professors, and the experiences of their educational interactions (Feiman-Nemser, 2001; Witcher, Sewall, Arnold, & Travers, 2001). However, it may be challenging for novice science teachers to apply the research to the realities of their instructional practices without sufficient guidance and training. Often, novice science teachers may be facing pressure from veteran teachers, departments, or administration to conform to the existing teaching culture at their school so they may choose to abandon their training and field experiences in order to conform (Smagorinsky, 2009). They may also face
students who appear resistant to learning the science content because the novice science teachers may not have enough knowledge of their students or experiences to draw from in order to overcome students’ apparent resistance to learning (Hill, Ball, & Schilling, 2008).

Research that examines the challenges of enacting teaching philosophies provides insight into the need to address the potential causes for the break-down in enactment that novice teachers experience (Brown, Friedrichsen, & Abell, 2013; Feiman-Nemser, 2001; Hegarty, 2015; Witcher et al., 2001). It may be possible to identify factors that may be contributing to this breakdown by examining the learning activities novice science teachers are engaging in during their science methods course and how they inform teaching practices upon entering the science classroom. The research reviewed focused on general preparation courses, not on specific methods courses, such as the science methods courses.

In research on science education, there is a lack of understanding of how novice science teachers develop, design, implement, and enact effective classroom instruction based on current educational theories and science methods coursework (Larkin, 2012). Science methods courses train novice science teachers to use different instructional approaches to facilitate conceptual change in science students. In order to enhance the science teacher education program, researchers might need to examine novice science teachers’ teaching philosophies and experiences in the science methods course that may be informing enactment of their teaching philosophies in their lesson planning and teaching practices.

**Purpose of the dissertation and the outcomes of the research**

Built on the understanding of needs and problems in science teacher education, the purpose of this dissertation study was to examine novice science teachers’ enactment of their teaching philosophies in their lesson planning and instructional practices. The concluded
research helps to inform the design of the science teacher education program and the science methods course to examine how novice science teachers construct their knowledge and develop their practice utilizing the theories they have learned in their preparation programs.

Specifically, the study helps bring about a shift in the focus of science methods courses from student learning outcomes to student learning processes by increasing our understanding of how novice science teachers engaged their learning to teach in the process of creating their own knowledge. Further, more emphasis can be placed on the processes involved in developing, designing, implementing, and enacting effective classroom instruction in field experiences, instead of emphasizing the products of learning outcomes for novice science teachers enrolled in their science methods courses.

Teaching philosophies are personal statements regarding novice science teachers’ beliefs about teaching students and how students learn, thus reflecting the vision of the type of teacher they would like to be (Hegarty, 2015). The teaching philosophies that were examined for this dissertation did not contain information that described how the novice science teachers would enact their philosophies in their classroom because they were written to obtain an assignment grade rather than being written as a source of reflection and professional growth. The expected and unexpected results of this research were addressed in the findings of the dissertation study.

**Significance of the study**

The purpose of this study was to examine novice science teachers’ enactment of their teaching philosophies in their lesson plans and classroom teaching. The research questions guided the focus of the study as the researcher examined the process of enactment of novice science teachers’ teaching philosophies. The research questions that were answered by this study were what are novice science teachers’ major philosophies at the entry level of teaching; what
factors influence novice science teachers’ enactment of their philosophies about teaching secondary science; and how novice science teachers implement lesson planning, through the science methods course, into their own teaching practices in a secondary science classroom.

This study contributes to science teacher education research and practices, particularly science teacher education curriculum and methods course design. This study may facilitate discussions among teacher educators to address possible revisions to the science methods course to ensure that the coursework focuses less on the novice science teachers’ learning products and more on the processes of teaching science to secondary science students. Methods course instructors outside of science may reexamine their courses as a result of this research. The research findings helped to fill gaps in the literature that address enactment of teaching philosophies by novice science teachers in their science classroom practices.

**Researcher’s narrative**

The researcher is currently a secondary science teacher in an at-risk high school, located in the same Southwestern school district as the participants, and adjunct faculty in the Life Sciences Department at a community college. She has mentored novice science teachers, been involved in new teacher orientations, and helped to design, write and update science curriculum and science safety manuals for the school district. She was the recipient of the National Association of Biology Teachers 2017 Biology Teacher of the Year Award for the State of Nevada. The researcher has watched the struggles and frustrations of the novice science teachers she has mentored because they felt that they were not prepared to teach by their teaching program. While many of them had strong content and pedagogical knowledge, they were disconnected from the theoretical constructs and how to enact them in their science teaching. These experiences helped her to conduct the research to develop her interest in researching the
ways in which novice science teachers enact their teaching philosophies in their science classrooms.

Definition of Terms

Alternative Routes to Licensure (ARL) Teachers: The term “ARL teachers” refers to individuals who already hold an undergraduate degree in a content area and make the decision to become teachers, whether they are changing careers or are retired from the workforce (U.S. Department of Education, 2004). ARL programs were designed to put teachers into classroom within the first year of their program rather than waiting until the end of a traditional teacher preparation program (Ludlow, 2011; Ng, 2003; U.S. Department of Education, 2004). In addition, each ARL program may vary from state to state regarding the preparation program, courses required, amount of field experience, and the length of time the ARL candidates spend in student teaching (Lewis-Spector, 2016; Ludlow, 2011). For the purpose of this study, the novice science teachers will be referred as novice science teachers since they have completed the ARL course work and are finishing or have finished the coursework for their Master of Education.

Teaching Philosophy. Teaching philosophies are written statements about one’s beliefs, attitudes, and dispositions about education and teaching (Washah, 2013; Witcher et al., 2001). Teaching philosophies may change over time as teachers accumulate experiences, are influenced by colleagues, or engage in self-reflection of their instructional practices. Initially, many novice science teachers may have an idea of the type of teacher they see themselves as but may not be able to articulate this well due to a lack of insight into teaching science, which may come with experience in the classroom (Washah, 2013).
Approximation of Practice. Approximations of practice refers to opportunities that novice practitioners have for engaging in aspects of practice that are more or less proximal to their professional practice (Grossman et al., 2009). Approximations involve enactment of complex components of a particular practice. This entails that the practitioner is able to understand specific practices and strategies while providing opportunities to implement different aspects of practice in order to understand what it means to effectively enact those practices (Gardiner & Salmon, 2014; Hammerness, 2012a).

KCS. Hill et al. (2008) proposed a definition for KCS that includes the teachers’ content knowledge and knowledge of “how students think about, know, or learn this particular content” (p. 275). KCS requires that teachers are able to anticipate areas in the content where students will have difficulties. The ability to do this requires that the teacher have a deep knowledge of students, in general, and their own students in particular. Having a deep understanding of the content being taught may not be enough to ensure students success in science.

Hill et al.’s (2008) definition of KCS relies on empirical evidence that helps teachers understand how students learn and how to determine the prior knowledge the students may have. Novice science teachers may not have the accumulated knowledge or experience, at entry level, to be able to anticipate content areas that may present challenges for the teacher to teach or the students to learn. Providing information and support to novice science teachers through their science methods course may help to prepare them for the challenges of teaching science in the secondary science classroom.

Experiential Learning. Experiential learning is a transformational process that occurs in learners. Learners combine prior knowledge and experiences as a reference point to compare new experiences and knowledge which will be incorporated into their schema to transform their
understanding (Manolis, Burns, Assundani, & Chinta, 2013). Experiential learning takes into account subjective and conscious experiences which the learner uses to change ideas based on new information and experiences (Kolb, 1984).

Learner-Centered Teaching. Learner-centered teaching provides opportunities for students to construct their own knowledge by teaching critical thinking and problem solving skills, and by making their learning meaningful and relevant to the students as learners (Feiman-Nemser, 2001). NGSS requires science teachers to teach students science using learner-centered techniques. Students are to be taught how to think critically, investigate and solve authentic problems, use evidence-based reasoning, and engage in discourse regarding solution to problems (National Research Council, 2013).

Summary

Examining the enactment that novice science teachers’ carry out as they engage in their instructional practice may contribute to the current body of research into teacher preparation programs. The findings contribute to the preparation of teachers by helping understand the process of applying theoretical knowledge in novice science teachers’ teaching philosophies to their instructional practice. The review of current literature on the topic of approximation of practice demonstrated that there is a need to research this area in order to understand how novice science teachers apply educational theory to classroom practices. Preliminary findings of researchers suggest that teacher preparation programs are preparing teachers to enter the classroom but may be failing to teach how educational theories can be applied to real-world classroom teaching (Gardiner & Salmon, 2014; Hammerness, 2012a; Mehrani, 2014). A comprehensive examination of the literature revealed other factors that are contributing to this theory to practice gap that appears to be affecting novice teachers’ instructional practice.
With examination of the research questions, the findings of this dissertation contributed to the current body of research on novice science teachers’ process of enactment of their teaching philosophies. The findings demonstrated that current science methods course curriculum may need to be revised so that novice science teachers are better prepared to enact their teaching philosophies and have a better understanding of the practical application of educational theories to their instructional practices. Moreover, the study may also trigger science teacher educators and mentors to create opportunities for novice teachers to enact their philosophies and to learn how to overcome student resistance to learning science content. Chapter two discusses the theoretical framework and literature review which is the lens used for this dissertation.
CHAPTER TWO
THEORETICAL FRAMEWORK AND LITERATURE REVIEW

The discussion of a theoretical framework in Chapter Two is to help guide the design of the study, examine the data collected, guide the data analysis, and provide the interpretive framework for drawing conclusions from the data analysis (Creswell & Poth, 2018). The theoretical framework is the blueprint that provides the structural support that defines this study (Grant & Osanloo, 2014). The framework is discussed first and is based on three theories: a) approximations of practice, one of three components of pedagogy of practices; b) KCS, knowing how and what students know; and c) experiential learning. Definitions, critical attributes, relationship, and contributions of these theories to the dissertation are discussed. Table 1 illustrates the theories used for this study and their links to the research questions. Table 2 illustrates the critical attributes of each theory and the link to this dissertation.

These three theories established a contextual framework, with which the researcher investigated the process of enactment of novice science teachers’ teaching philosophies and identified information learned in the science methods course that may be informing their instructional practice. Approximations of practice and KCS addressed RQ2 and RQ3 because several factors influenced how novice science teachers enacted their teaching philosophies in their lesson planning and instructional practices which were components of their instructional practice and require specific, complex actions on the part of the novice science teacher.

Examining novice science teachers’ approximations of practice and KCS provided insight into the process of enactment (i.e. doing, carrying out) of their teaching philosophies through lesson planning and instructional practices. Experiential learning theory addressed the overarching research questions in that the learning taking place in the science methods course
drew upon prior knowledge and experience and require critical self-reflection from the novice science teachers. This theory was applied to research questions 1 and 3 because novice science teachers gained experience in the science methods course which may have help to change their understanding of their teaching philosophies and instructional practices. Table 1 illustrates the relationship between the theories and the research questions.

**Table 1.** Relationships between Theory and Research Questions.

<table>
<thead>
<tr>
<th>Theory</th>
<th>Research Questions</th>
</tr>
</thead>
</table>
| **Approximation of Practice** | **RQ2:** What factors influence novice science teachers’ enactment of their teaching philosophies about teaching secondary science?  
**RQ3:** How do novice science teachers implement lesson planning, through the science methods course, into their own teaching practices in a secondary science classroom? |
| **KCS**                       | **RQ2:** What factors influence novice science teachers’ enactment of their teaching philosophies about teaching secondary science?  
**RQ3:** How do novice science teachers implement lesson planning, through the science methods course, into their own teaching practices in a secondary science classroom?           |
| **Experiential Learning Theory** | **RQ1:** What are novice science teachers’ major philosophies at the entry level of teaching?  
**RQ3:** How do novice science teachers implement lesson planning, through the science methods course, into to their own teaching practices in a secondary science classroom? |

The literature review summarized current research on the topics of approximations of practice focusing on enactment, theory to practice gaps, and teaching philosophies. The purpose of the literature review was to help the researcher generate research questions, generate themes
for coding data based on similar studies conducted by other researchers, data analysis, to help generate questions for the purpose of future research, and to determine if the research being conducted will help to fill in any gaps in knowledge that existed on a specific research problem (Yin, 2014). Additionally, the literature review helps to connect this study to previous studies. Table 3 will list the themes and relevant authors’ research that was used for the literature review.

**Theoretical Framework**

*Approximation of Practice in Field Experiences.*

Grossman et al. (2009) proposed several important concepts of teacher education practice and research through a comprehensive case study that compared three different professional preparation programs: three seminary, three clinical psychology, and two teacher preparation programs. These three conceptions include: approximation of practice, representations of practice, and decomposition or practice. While these terms are interrelated, approximations of practice significantly contributes to my dissertation that will examine novice science teachers’ teaching philosophy as they are enacted in their lesson planning and teaching practices; thus the other two concepts are not presented in this chapter.

Teaching instructional practice is a complex process involving the learner’s prior knowledge and experiences and unpredictable situations and circumstances that may require split-second judgments to be made by the novice science teacher. Being able to represent professional practices and make them visible (i.e. representations of practice), breaking down the components of practice for the purpose of teaching and learning (decomposition of practice), and providing opportunities for novices to enact those practices which are relevant to their instructional practices (approximation of practice) are important for novice science teachers to facilitate enactment of their professional practice (Grossman et al., 2009). Approximations of
practice was defined as “opportunities for novices to engage in practices that are more or less proximal to the practices of a profession” (Grossman et al., 2009, p. 2058).

Approximations of practice involve enacting complex components of teaching so novice teachers can understand how to apply educational theories to specific practices and learn strategies for teaching. Being able to translate and apply theories into the classroom will enable novice science teachers to engage in more rigorous and challenging instruction for their students by enacting their teaching philosophies. Lack of authenticity and the focus on specific aspects of practice is a criticism of applying approximations of practice to teacher preparation programs, specifically the methods courses.

Feiman-Nemser (2001) refers to the weak relationship between what is learned in teacher preparation programs and what is actually taking place during field experiences as a lack of coherence. While many novice teachers look at student teaching as being the most valuable aspect of their programs, they are not afforded the opportunity to practice any reform minded teaching. The researcher points to cooperating teachers as one factor that prevents student teachers from enacting their practice because the cooperating teachers feel that the professors are disconnected from the realities of teaching, therefore they are doing the teaching candidates a disservice. Feiman-Nemser (2001) proposed a framework that would stimulate thinking about the continuum of professional practice currently used to prepare teachers to teach.

Often novice teachers will form their knowledge of teaching around the experiences they have had in their educational careers as students (McDonald et al., 2013). Feiman-Nemser (2001) states that teacher education pedagogy is being mirrored in K-12 education, therefore teacher educators are not practicing the very ideas they are teaching their novice teachers. Many preparation programs are so abstract that they fail to challenge novice teachers’ ideas and beliefs
about teaching and learning or in these programs deep understanding is not fostered in novice teachers because courses are superficial so deep understanding of the content is not learned or reinforced in meaningful ways (Feiman-Nemser, 2001).

Feiman-Nemser (2001) calls for programs that are innovative. Feiman-Nemser (2001) identifies these innovative practices that are being used in teacher preparation programs for facilitating the development of novice teachers with broad, innovative visions of good teaching, and an understanding of how to enact their teaching practices in a way that will bring about effective teaching and learning. The researcher does qualify this by identifying strong support for novice teachers as critical in preventing novice teachers from abandoning everything they have been taught in favor of strategies or activities that they perceive as safer and easier to teach (Feiman-Nemser, 2001).

The problem with enactment occurs when novice teachers are unable to put effective teaching and learning into practice because they are unable to translate and apply the theories from coursework into the classroom (Gardiner & Salmon, 2014). Providing opportunities that allow novice teachers to implement different aspects of effective teaching so they can understand how to effectively enact their teaching practices in the classroom may facilitate higher quality teaching and better learning outcomes for students.

Several studies used the approximation of practice to examine learning to teach processes and outcomes (Feiman-Nemser, 2001; Gardiner & Salmon, 2014; Grossman et al., 2009; McDonald et al., 2013). These studies suggest that this theory is a useful framework that guide researchers to explore the enactment process and outcomes. Approximation of practice was useful for examining novice science teachers’ teaching philosophies as they were enacted in lesson planning and into their own teaching practices in the secondary science classroom.
Therefore, the researcher of this dissertation study used this theory to guide the research design and helped her identify the themes of the findings for research questions 2 and 3.

**KCS – Teachers’ Knowledge of Content and Students**

Shulman (1986) proposed that teachers’ pedagogical content knowledge (PCK) was separate from the content knowledge of specific content area by making the content understandable and comprehensible for student learning to take place. PCK focuses on teachers’ understanding of the presentation of the content, while paying attention to specific ideas or concepts that may be problematic for students to grasp. Hill et al. (2008) built upon Shulman’s original lines of reasoning for PCK by adding teachers’ knowledge of their students, including the ability to recognize the knowledge that students bring or fail to bring with them to the classroom.

The first years of teaching are the apprenticeship period for novice science teachers where they are implementing what they have learned in their preparation programs, specifically their science methods course, to their classroom teaching (Berry & Van Driel, 2012). During this period of time, novice science teachers can see their students working on assignments, engaging in discussions about laboratory data, or working collaboratively on a project. They are able to see and hear these things, but they may not know the prior knowledge that their students are tapping in to nor are they able to determine exactly what or how their students are thinking about as they construct their knowledge about science.

Preparing novice science teachers to teach science may not be enough to ensure the success of students in science classrooms. Ensuring that novice science teachers have knowledge of their content and knowledge of their students is an area that has not been well studied but may be useful to better preparing novice teachers for the challenges of their
classrooms (Hill et al., 2008). Novice science teachers lack the experience and knowledge built from years of student-teacher interactions because they are in the early, formative years of their teaching careers. They have to figure out their students as they teach, trying to keep one thinking step ahead of their students’ learning, in order to anticipate their students’ reaction to their learning (Hill et al., 2008). KCS was one useful framework for examining RQ2 and RQ 3 due to the novice science teachers’ lack of understanding about what prior science knowledge their students bring with them into the science classroom. The researcher used KCS to guide her examination of factors that may affect enactment of novice science teachers’ teaching philosophies in their lesson plans and instructional practices.

*Experiential Learning Theory*

Kolb (1984) defines experiential learning as “the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience” (p. 41). This definition puts an emphasis on the learning process instead of emphasizing the outcomes of learning and views knowledge as fluid and continually changing with increased experiences (Kolb, 1984). Experiential learning theory’s contribution to my dissertation will allow me to examine the ways in which the teacher learning activities in a science methods course transforms novice science teachers’ understanding of how to teach science content, through the implementation of lesson planning, into their own teaching practices in a secondary science classroom.

Dewey (2001, 2013), Lewin (1939), and Piaget (1952) viewed learning as cyclical and viewed concrete experiences or phenomena as the driving force behind learning. All three looked at the process of reflecting on experiences as necessary to constructing knowledge based on observations. While only Lewin and Piaget addressed the abstract nature of knowledge
construction directly, Dewey viewed learning as a complex process requiring predictions to be made, which in turn required the learner to reflect upon experiences and be able to think and reason abstractly (Dewey, 2001; Kolb, 1984). All three individuals emphasized the use of judgments based on observation, knowledge, and experiences. Following these theories, this dissertation involves the learning activities that novice science teachers experience in the science methods course and these activities may help to facilitate changes in understanding their teaching philosophies and practices in their science classrooms.

Experiential learning is an acknowledgement of non-institutional learning. While some scholars feel that experiential learning theory negates the experiences of children by focusing exclusively on adult learners, experiential learning theory is still a useful framework for learner-centered education in adult educational institutions (Kolb & Kolb, 2005, 2009). Experiential learning theory is important to the field of adult education because adults bring with them many different experiences, what some would call wisdom, and they add to those experiences through academic preparation to become classroom teachers. Experience and learning requires critical self-reflection on what has been learned through interactions with the world in order to make meaning of those experiences. To ignore these experiences when preparing novice science teachers would be to ignore experience as a different way of knowing and learning.

Several studies used experiential learning theory to examine learning to teach process and outcomes (Dewey, 2001, 2013; Deygers & Kanobana, 2016; Fowler, 2008; Green & Ballard, 2011; Kolb, 1984; Kolb & Kolb, 2005, 2009; Lewin, 1939; Piaget, 1952). These studies suggest that this theory is a useful framework to examine the ways in which experiences may facilitate critical self-reflection in novice science teachers as they construct their teaching philosophies. Teaching philosophies provide an opportunity for novice teachers to critically self-reflect on
their beliefs about teaching and how students learn. This study will examine novice science teachers’ teaching philosophies to determine how the experiences with learning activities in a secondary science methods class informs their lesson planning and enactment of their philosophies in their instructional practices. Therefore, I used this theory to guide the research design and to help me identify the themes of the findings for research questions 1 and 3.

Critical self-reflection on prior experience and knowledge are components of experiential learning. This theory relates to approximations of practice because it requires the learner to utilize prior knowledge, experiences, and skills to be able to carry out an action – enactment. This study looked at how the learning activities in a science methods course informed the enactment of novice science teachers’ teaching philosophies in their lesson planning and instructional practice in the secondary science classroom. These theories served as the lens with which to view the study’s findings and implications. The relevance of the theory to the study is illustrated in Table 2.
Table 2. Relevance of Theoretical Framework.

<table>
<thead>
<tr>
<th>Theory</th>
<th>Critical Attributes</th>
<th>Links to study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approximation of practice (Gardiner &amp; Salmon, 2014; Grossman, Compton, Igra, Ronfeldt, Shahan, &amp; Williamson, 2009)</td>
<td>• Enact components of instructional practice</td>
<td>• Enactment of teaching philosophies</td>
</tr>
<tr>
<td></td>
<td>• Transfer and application of content to practice</td>
<td>• Utilize prior knowledge and experiences</td>
</tr>
<tr>
<td></td>
<td>• Use of judgment for unpredictable situations</td>
<td>• Incorporate science methods course to instructional practices</td>
</tr>
<tr>
<td></td>
<td>• Instructional practice</td>
<td>• Building relationships during course of enacting components of instructional practices</td>
</tr>
<tr>
<td>Teachers’ Knowledge of Content and Students – KCS (Hill, Ball, &amp; Schilling, (2008))</td>
<td>• Teachers’ ability to design effective instruction</td>
<td>• Know things about students in particular domains</td>
</tr>
<tr>
<td></td>
<td>• Teachers’ skill at motivating students’ learning</td>
<td>• Teaching strategies to novice science teachers to overcome student resistance to learning science</td>
</tr>
<tr>
<td></td>
<td>• Critical evaluation</td>
<td>• Prior experiences and knowledge examined to create future plans</td>
</tr>
<tr>
<td></td>
<td>• Predictive and operative thinking</td>
<td>• Evaluate actions, choices, and philosophies</td>
</tr>
<tr>
<td></td>
<td>• Instrumental learning</td>
<td>• Manipulate things and examine the results</td>
</tr>
<tr>
<td></td>
<td>• Communicative learning</td>
<td>• Understanding the meaning of others</td>
</tr>
</tbody>
</table>

**Literature Review**

Databases such as Google Scholar, EBSCHOhost, ERIC, and references cited in research articles used for the literature review were conducted by the researcher using a computer. Databases were searched for peer reviewed articles, beginning with the years 2013 to 2018. Reference lists from research articles were examined to identify the relevant pieces of research.
that would add to the researcher’s understanding of the literature. Keyword searches were conducted using different words and word combinations in order to conduct as comprehensive and exhaustive search as possible. The following word or word combinations were used during database searches: enactment, approximation of practice, experiential learning, novice science teacher, methods course and science methods course, theory to practice gap, alternative routes to teaching licensure, teaching philosophy, pedagogical content knowledge, and science teacher philosophy.

Approximately 245 articles were examined during the process of this literature review. Of the 245 articles that were reviewed for relevance to this dissertation only 225 were reviewed and 70 deemed relevant based on the nature of the research questions, the researchers’ literature reviews, their findings, and conclusions. There were eight articles that were deemed relevant to this study were read and annotated. The decision to incorporate the eight sources in this literature review was based on the nature of the literature reviewed, how recent the study was, and the applicability of the study to the themes of this literature review. These different research studies provided a broad spectrum of information with a deep, comprehensive examination of current issues, studies, and critiques of some studies. This review of the literature provided a comprehensive summary of the relevant works that are applicable to the dissertation.

The literature review presented relevant research on enactment, theory to practice gaps, and teaching philosophies in order to understand the findings and how they pertained to the research questions. The literature review presented information on these topics that incorporated different aspects of the theories discussed above and contained a discussion on the research conducted regarding enactment and ways in which enactment may be facilitated in instructional practices. The literature review examined how teacher preparation programs were creating a
theory to practice gap between course work and instructional practices for novice teachers and how researchers have attempted to address this issue. Table 3 outlines the themes to be discussed in the literature review and the authors of the studies cited in the literature review.

Table 3. Themes of the Literature Review and the Authors.

<table>
<thead>
<tr>
<th>Themes</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory to Practice Gap</td>
<td>Deygers &amp; Kanobana, (2016); Kormos &amp; Gifford, (2014)</td>
</tr>
<tr>
<td>Teaching Philosophies</td>
<td>Marbach-Ad, Schaefer, &amp; Thompson, (2012); Wiesenberg &amp; Stacey, (2013); Witcher, Sewall, Arnold, &amp; Travers, (2001)</td>
</tr>
</tbody>
</table>

For the each theme, articles were read to determine which articles would provide the greatest value to this literature review, articles were vetted based on their value and applicability to this dissertation, and an annotated bibliography was created on the articles deemed most appropriate for this dissertation. Each article was reviewed individually, then compared to determine their value in providing context for the reader to understand the rationale for this dissertation.

Approximations of Practice – Enactment

Three articles were reviewed for this theme and annotated bibliographies created for articles deemed most appropriate for establishing a context for the reader. The first study of approximations of practice is Grossman et al.’s (2009) innovative examination of learning to serve in clergy, psychology, and teacher preparation programs. They utilized the comparative case study to examine professional education in the three different fields. Three teacher education programs, three seminaries, and three clinical psychology programs were compared to
determine what each program did to prepare the students for the realities of their practice. The study consisted of eighteen seminary students in three schools and forty-two seminary faculty, twenty-nine clinical psychology students in three schools and twenty-nine clinical psychology faculty, and forty-one novice teachers in two schools and twenty-six teacher preparation faculty. This was a qualitative study that involved interviews, focus groups, and field observations. The researchers’ intention for carrying out this study was to develop a framework for describing and analyzing different educational preparation programs.

Grossman et al. (2009) identified three pedagogies of practice: representations of practice (the ways practice is represented and made visible to novices), decompositions of practice (breaking down practice into its constituent components for teaching and learning), and approximations of practice (opportunities to enact practices that are related to the profession). The researchers found that all three components of practice overlap at different points but they also underscore each other. They provide the example that approximations of practice engage the student in a specific part of the practice so that they are breaking down a part of the practice through enactment of that practice. Grossman et al. (2009) found that novices must break down components of the practice in order to plan for the use of that component.

Grossman et al. (2009) found that teacher preparation programs prepare novice teachers for preactive practices i.e. learning to teach through the use of simulated lesson planning, unit planning, and planning for classroom management. The most significant finding of this study is that novice teachers are provided less opportunities to engage in enactment of interactive practices that would allow novice teachers to practice how to develop contingency plans if something does not go as planned, how to interact with or respond to challenging or resistant
students, how to respond to student questions, or how to implement a class discussion (Grossman et al. 2009).

Research has already identified the emphasis of product over process in methods courses as one possible source that hinders enactment. Based on the findings, it appeared that the methods courses focused more on the product or learning outcomes for the novice teachers and less on the processes needed for successful enactment of novice teacher’s lesson planning and implementation. Grossman et al.’s research helped with this dissertation because the researcher was able to identify learning activities in the science methods course were designed to emphasize the production of a learning outcome rather than emphasizing teaching and learning processes that informed the enactment of novice science teachers’ teaching philosophies in their lesson planning and instructional practices in the science classroom.

The second study by Gardiner and Salmon (2014) examined year one of a three year faculty research residency (FRR) model that was designed to inform university course redesign through school-university partnerships. The project consisted of 120 participants in the first year and was situated in a high-need urban school that partnered with a university to help both the preservice teachers and university professors understand how to successfully bridge this gap between theory and practice. Their research used a descriptive narrative report on the data they collected in the first year of implementation of their FRR. The FRR was designed and implemented for a large college of education that offers undergraduate and graduate degrees in education. Gardiner and Salmon (2014) used practice-based theory to examine how the practices taught by teacher educators are enacted by the teaching candidates in the field and to identify and examine the difficulties the teaching candidates have with enactment. The researchers’ intentions were to use the data from this study to eventually create alignment across the
curriculum for teacher preparation courses by ensuring that teacher education faculty understand how successful enactment takes place in teaching and can teach the teacher candidates how to carry this out by carefully restructuring course curriculum and the learning activities in the courses.

Gardiner and Salmon (2014) found that the problem of enactment occurred when novice teachers were unable to put effective teaching and learning into practice because they were unable to translate and apply the theories from coursework into the classroom. Approximations involve enacting complex components of teaching so novice teachers can understand specific practices and strategies for teaching, such as leading a group discussion or conducting a laboratory investigation (Gardiner & Salmon, 2014; Grossman et al., 2009). This provides the opportunity for novice teachers to implement different aspects of teaching so they can understand how to effectively enact their teaching practices in the classroom.

Gardiner and Salmon’s research demonstrated that education faculty tend to be too removed from the realities of the K-12 classroom and are not able to enact educational theories therefore they are unprepared to teach their students how to do this. Without understanding the contexts of the current school and classroom environments, or lacking any K-12 teaching experiences, university teacher educators may be out of touch with what is actually happening when novice teachers are placed in field experiences. Being out of touch with the realities of today’s science classrooms may contribute to the continuing gap between the teaching theories found in coursework and the practical application of theories in classroom practices.

Modeling enactment for teacher candidates, by science teacher educators, may help close the theory to practice gap for novice science teachers because they can see the process in action. While the researchers focused on learning activities created for the research residencies for
university faculty in teacher education programs, they did not clearly discuss how their research would inform the teaching practices of the faculty regarding the enactment of classroom practices, such as lesson planning, for effective instruction of teacher candidates. The creation of effective lesson plans which reflect enactable components of educational theories and teaching philosophies are important skills effective novice teachers would need modeled for them by teacher educators.

Science methods courses are designed to build upon the fundamentals of curriculum and teaching theories through engagement in learning activities that will teach novice science teachers how to implement and enact best practices for effective classroom teaching. Gardiner and Salmon’s research helped to inform the researcher’s examination of the ways in which the science methods course informed the enactment of novice science teachers’ teaching philosophies in their lesson planning and instructional practices in their science classrooms.

The third study conducted by McDonald et al. (2013) examined one aspect of Grossman et al.’s (2009) work on professional practices, focusing on core practices of K-12 teachers as they examine professional judgment and the creation of social communities. They examined ways that teacher educators use pedagogy to teach teacher candidates how to enact their core teaching practices as a way to improve student learning outcomes in K-12 classrooms. Their research targeted the gap between the theoretical knowledge and the enactment of theory into teachers’ classroom practices. By using core practices, they argue, teaching candidates will be able to mesh their teaching knowledge with their ability to enact their practices within their teaching disciplines.

The researchers studied sixty-five preservice primary teachers who were in the first year of their degree. The preservice teachers were enrolled in a course that focused on developing
pedagogies of enactment. For twelve weeks the preservice teachers attended two sessions of two hours each week so that they completed a total of forty-eight hours of coursework. Focus skills were introduced each week and the preservice teachers were provided time to practice these core skills before being video recorded presenting these practices. Groups of twelve preservice teachers were partnered with a faculty member to continue building upon rehearsed skills. After each presentation, peer feedback was carried out and self-analysis of the recorded skills practiced were carried out. Further data was collected in the form of copies of weekly feedback, two questionnaires completed at the beginning and end of the twelve weeks, Likert scale questions were given to the preservice teachers, and they were asked to rate the overall value of the program using a five-point scale in both surveys.

McDonald et al. (2013) found that capturing the teacher candidates’ enactment on video, for example, allowed them to share this with teacher educators. The last part of their strategy to teach candidates how to enact their practices required the candidates to analyze their enactment to learn from what they saw.

The researchers suggest that a common language and learning framework be established for teacher preparation programs to help with scholarship and practitioners’ knowledge so that implementation can take place across all educational settings. However, without incorporating specific content areas, such as science, mathematics, or English, there will be limited opportunities for cross-disciplinary collaboration in teacher preparation programs (McDonald et al., 2013). The researchers’ findings are broadly applicable to the standard preparation of teachers but fail to adequately account for the consideration of best practices for specific content areas. A common language and learning framework may help to standardize teacher preparation programs and close the theory to practice gap in general, but it does not account for the
incorporation of subject content knowledge required to teach specific disciplines in such a way that the gap between theory and practice does not become a chasm.

To summarize, Grossman et al.’s (2009) study helped to understand the factors that may hinder novice science teachers’ ability to enact their teaching philosophies due to them failing to understand the difference between the learning and teaching outcomes of their methods course and the learning and teaching process they would enact in their secondary science classroom as a result of their science methods course. McDonald et al.’s (2013) research was similar to that of Gardiner and Salmon’s in that both looked at the enactment of professional practices by teacher educators. Gardiner and Salmon’s (2014) study addressed learning activities that would facilitate teacher educators’ ability to enact educational theories in their courses in order to be able to model this practice for their teacher candidates. McDonald et al. (2013) examined the ways that teacher educators use pedagogy to teach enactment of core practices to teacher candidates to improve their students’ learning outcomes. Their research was about the process teacher candidates would need to understand rather than leaning outcomes of the course. These three studies helped the researcher to develop research questions 2 and 3. Studying the learning activities that novice science teachers engage in, while enrolled in the science methods course, were an important factor that might have informed the enactment of their teaching philosophies through the process of lesson planning and teaching practices in their secondary science classrooms.

Theory to Practice Gap

Four articles were reviewed for this theme and annotated bibliographies created for articles deemed most appropriate for establishing a context for the reader. The first study by Deygers and Kanobana’s (2016) was a qualitative case study conducted on Flemish preservice
teachers and contained self-assessments that were designed by the researchers for the participants in their study. They were interested in looking at components of training that may be influential in preservice teachers’ beliefs and practices. The premise of their study was based on other research studies that indicated that experience was more effective than theory for changing prospective teachers’ beliefs about teaching. They examined a teacher training program at a Flemish University which consisted of coursework mainly designed to teach theory. The study obtained data from five preservice teachers enrolled in a twenty hour Dutch for Academic Purposes (DAP) workshop, eighteen inservice teachers who were trained as facilitators for the DAP workshop, and the head of the teacher training program for the university providing the workshop. Five focus groups, an online questionnaire, and interviews were conducted.

The experience of teaching in the classroom did more to change the practices and beliefs of the preservice teachers in the study than any of the theoretical knowledge they encounter in their course work (Deygers & Kanobana, 2016). The experiences and the reflection on those experiences led the preservice teachers to change their thoughts regarding student learning and teaching. Their final conclusion was that providing preservice teachers with hands-on experiences were more meaningful and provided tools and empowerment which created more successful teachers. The researchers in no way advocate for the dismissal of educational theories from the current teacher preparation programs, but their findings suggest that preservice teachers derive greater, meaningful benefit from the hands-on classroom experiences they were provided in the study, even if the duration of that experience was less than twenty hours. The research demonstrates that without providing experiences that allow preservice teachers opportunities to see these theories applied to teaching, how they may be enacted in the classroom, and to
experiences what it takes to enact these theories then teaching educational theory becomes meaningless.

The limitation to Deygers and Kanobana’s (2016) study was the use of self-reported data by the students who were enrolled in a workshop designed to prepare preservice teachers to teach Dutch as a second language. Self-reporting assumes that the individual will provide an accurate assessment of actual behavior (Kormos & Gifford, 2014). The accuracy and validity of the information reported is entirely subjective and dependent upon variables outside of the researcher’s control, such as the personal feelings or attitudes of the respondent to the questions or types of information being requested for the self-report. The researchers did not include any discussion of the variables that they took into account, to maintain construct validity, during data collection. Additionally, the way in which the preservice teachers taught the workshop meant that they were not being given time to critically self-reflect on their practice. Without being able to critically self-reflect on one’s practices, it becomes questionable whether one is able to truly assess one’s ability to translate theory into one’s instructional practice.

Deygers and Kanobana’s research was useful for the dissertation because they examined the influential nature of the training components that may inform preservice teachers’ beliefs and practices. Teaching philosophies are based upon one’s beliefs about teaching and student learning and the theories that support those beliefs. This dissertation looked at the way in which the teacher learning activities in the science methods course informed novice science teachers’ teaching philosophies and how they enacted their philosophies in their lesson planning and instructional practices.

This dissertation related to novice science teachers’ understanding of the process of enactment as it pertained to their instructional practices, as reflected in their lesson planning and
teaching practices in their secondary science classroom. Feiman-Nemser’s research helped to generate research questions 1 and 3 because critical self-reflection and analysis of one’s teaching practices and experiences may be a factor that helped novice science teachers’ enact those practices that were effective for facilitating student learning in the secondary science classroom.

Rasmussen and Rash-Christensen (2015) carried out a study designed to pay attention to connecting coursework directly to practice for preservice teachers. They focused on solutions to the problem of linking theory to practice in teacher education. They were interested in understanding how the preparation of teachers could lead to more effective classroom teachers and what factors were responsible for weak or absent application of education theories to teaching practices. The study was a longitudinal study consisting of research and development projects in the first two years of a four year education program. They observed college teachers, practice teachers, and student teachers to identify their relation to the different types of knowledge they were expected to represent as they engaged in their different roles during the course of this study at four participating colleges. Student teachers documented their experiences, created portfolios or wrote practicum reports. Meetings were held between the college teacher, practice teacher, and student teacher. Focus group interviews were conducted with an unspecified number of participants at the four colleges. A total of thirty-two students, eight from each college, were followed through the two years of the study.

Rasmussen and Rash-Christensen found that using empirical approaches and problem-oriented approaches was successful for preparing student teachers for their field experiences. The problem-oriented and empirical approaches of this study were aligned with the student teachers’ internship reports after they completed their internships. Meetings between the college teachers, practice teachers, and student teachers proved to be important because it provided an
opportunity for the student teachers to present the data that they were collecting and opened discussions about it. These meetings provided opportunities for connecting the theory, data, and practice in meaningful ways for the student teachers. They found that this study demonstrated that the gap between college teaching and practice teaching was narrowed. They attributed the narrowing of the gap to the fact that coursework had to be connected to and revolve around the same topic or problem.

Rasmussen and Rash-Christensen were unclear in describing the specific roles that the college teacher, practice teacher, and student teacher had during the two year study. The majority of the decisions and planning fell on the shoulders of the student teacher. The college teachers and practice teachers roles were not defined and it appeared they took on more of a supporting role than a guiding or mentoring role. Even though there were specific topics or problems that the student teachers had to focus on, the variation in the kind of theoretical knowledge and the goals for teaching expertise was great. This variation made it difficult to understand if the theoretical knowledge and application of that knowledge was occurring consistently across all four colleges. It appeared that there was no consistency in the learning goals for the student teachers that would present a strong link between their study design and findings.

Many of the college teachers were reluctant and hesitant and found it difficult to reference and use theoretical knowledge during the meetings. The researchers attribute it to the college teachers’ holding back because they did not want to appear as if they were clever than the practice teachers or the student teachers. It is just as likely that this situation could be attributed to the power relations between the college teachers, practice teachers and student
teachers. It is also just as likely that the nature of conflicting knowledge bases of the college
teachers, practice teachers, and student teachers is the main cause of this (Mehrani, 2014).

Connecting course work to teaching practices so that novice teachers are prepared to
enter the classroom was important for producing high quality, effective teachers. The
experiences and content in the science methods course helped novice science teachers in
determining the ways in which they utilized and applied education theories in their classrooms.
Rasmussen and Rash-Christensen’s research helped this researcher answer her research questions 1 and 3.

Mehrani’s (2014) study explored strategies that would bridge the gap between research
and classroom practices. The research looked to find strategies that could be used to improve the
relationship between researchers and practitioners in an Iranian English Language teaching
program. Mehrani used a qualitative research design which collected data from focus group
discussions between researchers and practitioners. There were six participants in this study.
Their experiences in teaching ranged from five years to twelve years in both public and private
schools. The participants had published research papers and had presented their research. Two
participants had written published chapters for books and one had twice presented at different
symposia. The discussion groups focused on different topics or issues and were conducted by a
skilled interviewer.

Mehrani’s findings indicated that, as students in teacher preparation programs, teacher
candidates are presented research to read but are not being shown how to break down the
research and analyze it so that they are able to obtain useful information that they can apply in
the classroom. This further distances the practitioners from the researchers. Mehrani (2014)
puts forth the suggestion that a system be created that will reward teachers who become
consumers of research but also contribute to the research through classroom research projects and other types of research that will facilitate the implementation of educational theory to practical applications in the classroom.

Mehrani (2014) was studying teaching and education at one level while teachers were interested in studies at a different level. The questions that classroom teachers are interested in researching are not the same questions that researchers are interested in studying. Mehrani did not discuss if any attempt was made during the study to determine if the teacher candidates were required to apply the research they were examining in their preparation program to their instructional practices or if they were only using the research for course assignments. Further, the study focused on practitioner-researchers who had managed to bridge the gap between theory and practice with varying degrees of success. The study did not adequately discuss whether or not teacher candidates or classroom teachers were successful in bridging the gap in their instructional practices, instead focusing on discussions regarding encouraging teachers to become evidence-based practitioners who partner with researchers to address questions teachers are interested in researching.

To summarize, being able to understand how educational theories inform the practices of novice science teachers is important in identifying the ways in which these theories are enacted and implemented in the secondary science classroom. Novice science teachers use educational philosophies as foundations for their teaching philosophies, which in turn are enacted in their lesson planning and classroom practices. As shown in the literature (Deygers & Kanobana, 2016; Feiman-Nemser, 2001; Mehrani, 2014; Rasmussen & Rash-Christensen, 2015) the inability of novice science teachers to close the gap between their understanding of educational theory and classroom practices may hinder their ability to become effective and successful
teachers who are versed in the strategies that allow them to apply current research to their instructional practice. These four research studies help the researcher to address research questions 2 and 3.

**Teaching Philosophy**

Three studies were examined for this section. The first study discussed involves the teaching philosophies of university teachers. The second study examines the changes of teaching philosophies as university faculty transition from teaching face-to-face courses to teaching online courses and the impacts teaching philosophies. The third study examines the effect of field-based teaching experiences on changing preservice teachers’ teaching philosophies.

Teaching philosophies are based on beliefs about teaching and learning, may be influenced by others or new experiences, and are reflective of the times we live in (Witcher et al., 2001). The researcher discusses two points of view that have emerged in public schools regarding teaching philosophies and how a survey constructed by one of the researchers has helped to provide teacher educators with a starting point for reflecting on their beliefs and utilizing the survey for their teacher candidates.

Witcher et al. (2001) discuss the use of the Witcher-Travers Survey of Educational Beliefs, developed in 1995 to examine the evolution of teaching beliefs though several developmental stages. The test instrument is a five-point Likert Scale test consisting of forty questions. If participants’ beliefs were high, they were considered to have progressive viewpoints while lower scores identified participants as more aligned with transmissive viewpoints. The transmissive viewpoint states that the past views on education and learning should be held on to because it worked in the past and will continue to work into the future. The progressive viewpoint uses past experiences and practices as a means to critically examine what
can and should be changed now and into the future. The researchers were able to use the results of the survey to determine a connection between the beliefs held by teachers and their teaching philosophies.

The Witcher-Travers Survey’s implications for teaching and teacher preparation addressed how the survey can help identify personal teaching philosophies. It did not discuss what teacher educators can do with that information to bring about changes in their philosophies, nor did it discuss how the survey could be used to help teacher candidates to transform their own teaching philosophies in order for them to become more effective classroom teachers. Additionally it did not address the ways this information could be used to train teacher candidates in strategies to enact their philosophies in their instructional practices. A clearly articulated teaching philosophy will provide support for classroom teachers when called on to explain their rationale for specific instructional choices they put in their lesson plans (Witcher et al., 2001).

When novice science teachers enter their classrooms, there are many factors that will continually influence their teaching philosophies. They may find that their philosophies do not match those of the school administration or the administration’s vision for the school. This may influence them to reexamine their philosophies. Additionally, many novice science teachers are influenced by mentor teachers or their departments to adjust their teaching philosophies to conform to the philosophy held by the majority of the department. Conforming to the teaching philosophies of the majority of the science teachers in the department is more often a survival mechanism that novice science teachers adopt (Witcher et al., 2001).

For this dissertation study, it was important to identify novice science teachers’ teaching philosophies at the entry level of teaching in order to identify the experiences that helped to
inform the development of their teaching philosophies. The importance of the learning activities that novice science teachers experienced in their science methods course may be instrumental in helping to inform their philosophies through lesson planning and enactment of their philosophies in a secondary science classroom. Witcher et al.’s (2001) study helped to address research questions 1 and 3.

The second research study examined the effects of professional development on faculty members’ teaching philosophies at a research university used to shape the goals and activities of the Teaching and Learning Center located in the College of Chemical and Life Science. Marbach-Ad et al. (2012) examined the faculty’s philosophies based on their teaching styles as observed in the faculty’s classrooms. The Higher Education Research Institution (HERI) Faculty Survey was administer to fifty-eight faculty members to identify themes found in responses regarding instructors’ teaching philosophies. The researchers were attempting to identify the instructors’ teaching philosophies and educational goals, the teaching practices that the instructors were using, and the instructor’s perceived challenges in balancing their professional responsibilities (Marbach-Ad et al., 2012).

The researchers found that the faulty still relied on lecturing and stressed factual knowledge over application of knowledge which they attributed to higher education faculty’s lack of formal training in the most current, effective teaching techniques. Witcher et al. (2001) felt that lack of formal training may be preventing the faculty from incorporating new techniques for teaching and learning into their classrooms, which confirms Marbach-Ad et al.’s (2012) findings. Marbach-Ad et al. found that when the faculty were trained in new teaching techniques by paralleling the practice of science and provided with the most current research in science education, the faculty were more comfortable and better prepared to implement new strategies in
their teaching. In addition to university faculty lacking any formal training in teaching techniques, universities still favor research over teaching which further reinforces the difficulties and challenges faced by faculty in their teaching practices (Marbach-Ad et al., 2012; McDonald et al., 2013).

Teacher preparation programs work with teacher candidates to help them develop a teaching philosophy that will allow them to become effective classroom teachers. Based on Marbach-Ad et al.’s (2012) study, if university faculty are not clear with their own teaching philosophies, they may be hard pressed to properly guide their students to develop a cohesive, implementable teaching philosophy and the preparation necessary for teaching philosophies to be enacted in the classroom. The instructional practices, methodologies, and educational theories that teacher candidates are supposed to learn and utilize in their professional practice are the very factors that university faculty are disregarding in their professional practice, according to Marbach-Ad et al. (2012). Ensuring that university faculty are practicing what they preach may better prepare future teachers’ understanding of how to engage in and enact effective teaching through the modeling of their professors.

This study focused on university science faculty and the process of training them to develop innovative teaching practices by reevaluating their teaching philosophies as a way to improve undergraduate science courses. Marbach-Ad et al.’s research provided a frame of reference for answering research questions 1 and 3 by applying their findings to novice science teachers to determine what their teaching philosophies were at the entry level and how their teaching philosophies informed their lesson planning and instructional practices.

A case study approach was used by Wiesenber and Stacey (2013) to compare faculty in two universities, one in Canada and one in Australia, who were transitioning from teaching from
face-to-face classes to virtual classrooms. There were twelve Canadian participants and ten Australian participants. Both groups of faculty taught discipline-specific and general education courses. The Canadian teachers were teaching at the graduate level while the Australian teachers taught mostly undergraduate courses. Questionnaires were used to obtain data about teaching philosophies. They modified a questionnaire that was designed for face-to-face teaching so that it could be used to gauge online teaching as well.

Wiesenberg and Stacey (2013) found that teaching preference was no different when faculty were asked about face-to-face teaching and online teaching. This brings into question the accuracy of the results that stated that there was no difference in preferences for the different teaching formats. The researchers also found that the Canadian teachers voluntarily adopted online courses, whereas the Australian group were compelled to teach online courses.

The teaching preferences for online versus face-to-face classes did not differ, according to the researchers. They found that this did not fall in line with previous literature that demonstrated considerably different approaches to teaching face-to-face classes versus online classes. The researchers found that there were changes in the philosophies of the faculty regarding teaching face-to-face and online. Those faculty with the most online teaching experiences found that their teaching philosophies regarding face-to-face teaching changed with regard to setting due dates for assignments and responding to students through online discussions.

The study attempted to provide evidence for what Wiesenberg and Stacey (2013) found to be mostly anecdotal evidence in the literature. The study examined how professional development support for transitioning from face-to-face courses to online courses can change teaching philosophies. The research did not demonstrate that the Canadian or the Australian
teachers were using their prior teaching philosophies or had difficulty adjusting their teaching philosophies, thus driving the development of the professional development program. They did demonstrate that the more exposure teachers had to teaching online courses, the more their philosophies changed and adjusted to the demands of online teaching without any interventions. More research would be needed that would examine the challenges for teachers enacting their teaching philosophies when they are teaching an online course for the first time in their teaching careers.

The researchers state that their results were contradictory because the Canadian teachers were early adopters of online learning and were willing to volunteer for the study. The Australian teachers were ambivalent about online teaching and were compelled to participate in the survey. The compulsion of the Australian teachers may have been the reason the researchers obtained discrepant and contradictory results. The surveys collected self-reported data so it may be possible that the data reported in the initial survey of the Australian teachers reflected their ambivalence rather than their actual feelings, beliefs, and perceptions regarding face to face versus online classrooms. The positive attitudes of the Canadian teachers may have contributed to the results obtained because they had expressed a willingness to participate and that may have transferred over to more favorable responses on the survey.

In summary, these three studies helped me to understand how teaching philosophies undergo change when teacher educators were put in different classroom settings. As shown in the literature (Witcher et al., 2001; Marbach-Ad et al., 2012; Wiesenber & Stacey, 2013) teaching philosophies are malleable constructs that change in accordance with the knowledge and experiences that novice teachers have been exposed to. Their research helped me to identify changes in novice science teachers’ teaching philosophies and the ways in which their
philosophies were implemented in their lesson planning and instructional practices, which
directly relates to research questions 1 and 3.

**Summary**

The literature review helped to identify, examine, and discuss current research on
enactment, theory to practice gaps, KCS, and teaching philosophies and how these informed
novice science teachers’ philosophy of lesson planning and teaching secondary science. The
relevant terms that were used in this literature review were defined so that the reader was aware
of how these terms were used in this dissertation based on how other researchers have used and
applied these terms. Approximations of practice, KCS, and experiential learning theory provide
the framework for this study.

The literature review demonstrated that is there is a gap in the literature regarding science
methods courses taught in higher education and their impact on informing novice science
teachers’ teaching philosophies and enactment of them in lesson planning and instructional
practices. The main body of research regarding science methods courses examined professional
development geared toward generating understanding or changing misconceptions about specific
scientific concepts as an instructional tool for novice or veteran science teachers to implement in
their classrooms. There was also a gap in research that specifically examined the enactment of
teaching philosophies through lesson planning and instructional practices. The literature review
discussed enactment and teaching philosophies as separate from each other because there
appeared to be few studies that specifically researched how teachers were taught to implement
their philosophies in lesson planning and classroom practices. Additionally, some of the
research in the literature review was not specifically concerned with issues effecting novice
science teachers because there was little research specifically focused on the science content area, teaching secondary science, or university level science methods courses.

Examining novice science teachers’ teaching philosophies upon their entry into teaching helped to identify any changes to their teaching philosophies based on factors influencing them. Some of the content in the science methods course influenced novice science teachers’ teaching philosophies. It may be just as likely that a combination of additional factors may be influencing their philosophies. This study helped identify additional factors influencing novice science teachers’ teaching philosophies through the examination of learning activities in the science methods course. The literature review helped this study examine how science methods courses informed science teachers’ teaching philosophies as they enacted them in their lesson planning and instructional practices.
CHAPTER THREE

METHODOLOGY

Chapter Three outlines the methodological decisions of the research design for this dissertation. The rationale for the dissertation is discussed first and included the rationale for selecting the specific methods and design of the research. The purpose of the research and the research questions is discussed next. Included in this chapter is the human subject form, a discussion of the participants that were chosen for this study, and information regarding site selection is discussed last. The next section includes the data sources (written teaching philosophies, semi-structured interviews, lesson plans, and observational information), data collection, and data analysis methods. The last section addresses the process used to maintain the privacy and confidentiality of the participants, the pros and cons of this research design, the connection to theory and methodology, and a summary that concludes this chapter.

Rationale for Qualitative Methods

The design for this research used a qualitative research design, specifically the case study design. The use of multiple-case studies in qualitative research designs has been used in a variety of different areas of research, from educational research to medical research. Yin (2014) defined a multiple-case study as one in which one or more cases are used to organize the study. The case or cases become the focal point for the organization of the researcher’s study. Creswell and Poth (2018) referred to the multiple-case study as a collective case study. They defined this study as one in which one issue or concern is illustrated by the researcher through the selection of one or more cases that best illustrate the issue under study. In addition, both studies pointed out that the researcher may purposefully select multiple cases to compare similar perspectives on
an issue being studied or to compare differing perspectives on an issue being studied. For the purpose of this dissertation, the researcher aligned the study to Yin’s (2014) and Creswell and Poth’s (2018) definitions to take a collective look at the similarities in each case and then focus on separate issues that arose with each case so as to address them adequately.

In science education research, Nehm and Reilly (2007) conducted a study using two classes of second-semester biology majors to examine their understanding of evolution by natural selection using different instructional strategies. Learning activities were designed for the experimental class to determine if the redesigned instructional strategy brought about a transformed understanding of content when the two classes’ data were compared. Turkle, Breazeal, Dasté, and Scassellati (2006) used a multiple-case study of children’s interactions with artificial intelligence to study how they would interact with two robots, Kismet and Cog. Based on these examples of multiple-case studies used to study a wide variety of topics, using this study design for this dissertation is an appropriate one because this study investigates the process, interactions, and actions of novice science teachers’ enactment of their teaching philosophies in their lesson plans and instructional practices (Creswell & Poth, 2018; Yin, 2014).

Following the definitions of multiple case research designs (Creswell & Poth, 2018; Yin, 2014) and the application of the methods in the literature, this study was focused on the alignment of novice science teachers’ teaching philosophies with their lesson plans and instructional practices. This study examined how novice science teachers were enacting their philosophies regarding teaching and student learning in their classrooms during note-taking, hands-on activities, and laboratory investigations. The study investigated the application and enactment of the theoretical knowledge and philosophical rationale of novice science teachers as
they made instructional choices and decisions during lesson planning and enactment of the lesson plans, specifically hands-on science activities and laboratory investigation.

Below are the three research questions:

**RQ1:** What are novice science teachers’ major philosophies at the entry level of teaching?

**RQ2:** What factors influence novice science teachers’ enactment of their philosophies about teaching secondary science?

**RQ3:** How do novice science teachers implement lesson planning into their own teaching practices in a secondary science classroom?

**Participants and Context of Study**

**Context of Study**

The participants of the study were three novice science teachers who taught at two urban, at-risk, and designated low-performing schools located in the Southwestern part of the United States. The schools were designated as urban, at-risk, and low-performing by the school district. The novice science teachers were enrolled in the same science methods course as part of the ARL program in a Southwestern university in the United States. This study included ARL novice science teachers because the researcher was able to examine the non-educational and educational experiences and influences that effected the development of novice science teachers’ philosophies, further enacting their philosophies, and compared similarities and differences across cases.

The ARL program was a year and a half, non-traditional teacher preparation program which requires candidates to take courses, do field observations, and pass the Praxis II
examination in order to be eligible for a provisional ARL license to teach through a fast track to licensure. Novice teachers had to be concurrently enrolled in three courses in the first semester of the ARL program. These courses were designed to help ARL candidates develop an understanding of student learning, teaching practices and philosophies, and content knowledge.

Lesson planning, shadowing a teacher in their classroom, and self-reflection were the core assignments for Secondary School Practicum (SSP) and Secondary Process and Instruction (SPI) were designed to allow students to become self-reflective. Both SSP and SPI required that lessons be taught and critiqued as a means to improve instructional design and practice. Student generated data was utilized in SPI for the purpose of understanding student learning and using the data to objectively inform instruction and expand their understanding of the components of effective teaching.

In addition to taking a practicum and the content methods class, the ARL students took a general methods class and a classroom management class. The researcher taught the classroom management on-line class, for the spring 2015 semester at the same university where this study was conducted. In this course, the students posted online discussions about the different classroom management strategies they were reading about and were observing during their classroom observations in practicum.

ARL students had to engage in one semester of student teaching in their first year in the classroom and therefore they had to be enrolled in Secondary Supervised Student Teaching concurrently with Secondary Supervised Student Teaching Seminar. The student teaching allowed novice teachers the opportunity to display their knowledge and skills for teaching through mentorship in the classroom. The student teaching provided support, reflective opportunities, and connecting with school and supervisory personnel.
Novice science teachers may be enrolled in the content methods course in their first year of teaching. Thus the science methods course was one of the major courses that prepared participants to learn to teach science in secondary classes. The focus of the dissertation was the ways in which the science methods course informed the enactment of the novice science teachers’ teaching philosophies in their lesson planning and instructional practices, i.e. the strategies and methods used to teach students.

According to the course syllabus, the course was designed to teach both novice teachers how to write lesson plans that were aligned to the Next Generation Science Standards (NGSS), utilize assessments and the data they generate to guide instruction and instructional choices, differentiate, evaluate, and modify lessons to meet learning objectives of each lesson and the needs of their students, incorporate technology into their lesson planning, and be reflective practitioners who use evidence-based practices to guide their teaching and assessments. For the purpose of this dissertation, the focus was placed on the ARL novice science teachers because they were already in their own classrooms while simultaneously enrolled in SPI.

Coursework consisted of novice science teachers writing a teaching philosophy which included their ideas about teaching secondary science lessons, the methods they would utilize to achieve their objectives of each lesson, a method for assessing their success in meeting their objectives, and any other related ideas or rationale for their views on how science should be taught, and how they believed students learned in general and learned science in particular. The novice teachers used the teaching philosophy as a guide for enacting their philosophies in their lesson planning and teaching to allow them the opportunities for self-reflection.

Novice science teachers were required to write lesson plans that included differentiated lessons and assessments for students with diverse learning needs, and a section in which the
candidates reflected on the lesson they would teach. Novice science teachers were required to create a peer teaching lesson and assessment that would allow candidates and their peers to critically assess, analyze, and reflect on the lesson in order to improve their lesson planning and their practice using immediate feedback and the experience of teaching this lesson.

The final project for the course involved candidates’ developing a unit plan of instruction. This was a plan that covered a unit of science content. The rationale for this project was to have the novice teachers create a cohesive, integrated, and connected series of lesson plans that covered an entire unit of instruction. This unit plan included objectives of a lesson, activities, resources, materials, laboratories, technology and inquiry components, and varied assessment methods in order to determine if objectives were met. The novice science teachers drew from their experiences in this course and in their classrooms in order to complete this assignment. During the pilot study observations, the instructor continually reminded the novice science teachers that enacting what they were putting in their lesson plans was very important to being successful at teaching the scientific concepts.

Site

The type of school setting in which the observations took place was not under the researcher’s control. The school district partnered with the ARL program at the university to place the novice science teachers. The novice science teachers were placed at schools which were designated at-risk, under performing, urban schools (Eckert, 2013). It is not uncommon for novice teachers, regardless of the type of preparation program, to be placed in these types of schools. Goldhaber, Liddle, and Theobald (2013) found that while neither traditional teacher preparation programs nor alternative route to licensure programs prepare teachers for specific types of school settings, there was evidence that certain programs may have different focuses for
preparation, depending on the schools teachers may be placed at. Teachers teaching in at-risk, urban schools have to contend with students that may have gang affiliations, engage in teen violence, come from single-parent households, and grandparents raising grandchildren, teen pregnancy, and high absenteeism, transience, and drop-out rates among students (Eckert, 2013; Goldhaber et al., 2013).

Sample

Convenience sampling was used in order to access volunteers among the novice science teachers for the pilot study and this research because they were available and willing to participate in the study (Creswell & Poth, 2018; Etikan, Musa, & Alkassim, 2016). Access to the novice science teachers in the science methods course in fall 2016 was obtained by the researcher after meeting with the instructor of the course to explain the nature of the pilot research project. The researcher needed to obtain the instructor’s permission to access to their classroom in order to speak with the novice science teachers to find participants who were willing to volunteer.

The researcher selected novice science teachers to observe in the classroom based on the alignment of the teaching philosophy to the activity or laboratory lesson plans or the lack of alignment of the teaching philosophy to the lesson plans. Selecting for well aligned and poorly aligned lesson plans will allow the researcher to present extremes in this study. Using several cases to illustrate several perspectives was appropriate for a multiple case study (Creswell & Poth, 2018). Purposeful sampling of the cases yielded enough different perspectives and a dichotomy of perspectives to provide the researcher with an in depth view of the issues facing novice science teachers’ enactment of their teaching philosophies.
The dissertation study consisted of the three novice secondary science teachers, who were enrolled in the science methods course during the fall 2016 semester and participated in the pilot study. From these participants, the researcher looked for data within the cases that replicate each other or presented stark contrasts and that would best answer the specific problem posed by her research questions (Creswell & Poth, 2018; Yin, 2014). There was replication between two of the novice high school science teachers based on the similarity of content they were teaching at the time of the study. The third participant taught middle school science so the content she was teaching could not be compared to the other cases. The contrasts that were identified in the three cases were a result of the different experiences that the novice science teachers had both personally, academically, and professionally.

The novice science teachers had the same science methods course which was taught by the same instructor. Two of the novice teachers were planning to graduate in the spring 2018 and the third graduated in the summer 2017. While their experiences may be similar, the way in which these experiences informed their enactment of their teaching philosophies in their lesson planning and instructional practices was quite different.

Adrianne. Adrianne is a second year science teacher at Sunny High School, teaching 9th grade biology in her first and second years of teaching and is the head cheerleading coach. She obtained a degree in biology and minored in psychology. After she graduated with her bachelor’s degree from a university in the Southwestern United States, Adrianne wanted to become a physician’s assistant and enrolled in a program of study to complete her training. Adrianne had to put her education on hold due to pregnancy. To support herself and her son, Adrianne obtained a position with a casino. She began to examine careers that would allow her to use her education to do something she felt would be more meaningful. Adrianne moved to a
new state with her son and looked into the ARL program at another university in the Southwestern United States and enrolled in their program. Adrianne was hired to teach at Sunny High School after her first year in the ARL program. Adrianne and Isaac teach in the same department as Sunny High School and share the same mentor (A-PSI, 2016).

**Fey.** Fey is a second year science teacher at Orion Middle School. She lived in the Southwestern United States but moved with her husband to the central Mid-Western United States. Fey earned a bachelor’s degree in biology and chemistry from a university in the Southwestern United States and worked as a biochemist at a central Mid-Western university for many years. Her research duties included running a research lab and conducting flow cytometry, protein isolation, and data analysis. Fey worked with graduate students working on medical research. Fey became a young widow in need of a strong support network, which led her to return to her home state in the Southwest. She enrolled in the ARL program at the university she earned her bachelor’s degree. She was hired at Orion Middle School to teach 7th grade science in her first year of teaching and 6th grade science in her second year of teaching (F-PSI, 2016).

**Isaac.** Isaac is a second year science teacher at Sunny High School and teaches with Adrianne. In his first year of teaching, Isaac taught 9th grade biology and in his second year teaches 9th grade biology honors. Isaac graduated from a Midwestern university in the United States with a bachelor’s degree in kinesiology. The biology classes he took during his undergraduate degree cemented his passion for science, working with children, and desire to teach biology. He took athletic training courses so that he could coach students both academically and athletically. He moved to a new state, following his family, and enrolled in a university in the Southwestern United States to obtain a teaching license through the university’s
ARL program. He was hired to teach at Sunny High School in 2016 and to be the head volleyball coach (I-PSI, 2017).

**Researcher’s Role**

The researcher has been teaching in a school district in the Southwestern part of the United States for the past 16 years. This is the same school district as the study’s participants. She has taught high school science at urban, under-resourced, designated at-risk schools for her entire teaching career. She has 9 years of experience teaching majors and non-majors biology courses at a community college in the same area of the country. The researcher has worked to designed science curriculum and has worked with practicum students learning to become science teachers. Additionally, she has mentored novice teachers in her content area and outside her content area to help them in various areas and aspects of teaching, instructional design, and classroom management.

She has mentored novice science teachers through their first three to five years of teaching, helping them to understand the population of students in the school and to understand how to utilize data to adjust or further develop their instructional decisions. From this researcher’s experiences working with practicum students and mentoring novice science teachers, it has been observed that the gap between theoretical knowledge and classroom application of theory and enactment of teaching philosophies have been challenging for them. The greatest challenge these novice science teachers have had is enacting what they already know about teaching, but in the setting of a laboratory investigation. An additional challenge for these novice teachers is the disconnect they find when they are faced with the realities of the classroom. Novice and veteran teachers find that the research being conducted at the university
level is carried out for the benefit of the university; asking questions that classroom teachers would not ask because they are of no value in helping them to become effective teachers or teaching educational learning theories that do not reflect the realities of the classrooms the novice teacher are placed in (Mehrani, 2014). Thus there is a feeling of disconnectedness between the theory being taught in the teacher preparation programs and the application of that theory to the teaching practices in the classroom.

Addressing the disconnect that novice science teachers face is important to producing quality science teachers who understand the real-world application of theoretical concepts to the realities of the classroom environment and are able to enact their philosophies successfully (Feiman-Nemser, 2001; Grossman et al., 2009). From this researcher’s experience, helping these novice science teachers overcome this challenge requires them to critically reflect on their philosophies and personal and professional experiences.

Many novice science teachers lack formal laboratory experiences and lack an understanding of how to set the stage for their students to prepare them for hands-on laboratory investigations. Many novice science teachers are teaching the way in which they were taught science; i.e. cook-book science where steps are followed exactly and everyone arrives at the same results. This teacher-centered teaching style contrasts sharply with the mandates outlined in NGSS requiring science be taught as student-centered, not teacher-centered. In addition, many of the novice science teachers felt unprepared to help students understand or explain differences in findings when investigations were carried out, whether they were cook-book investigations with a prescribed set of steps or they were inquiry labs where students were allowed to test their own idea using a guiding question to help them draw conclusions. The novice science teachers appeared to lack knowledge to that would allow them to help students
learn to think about their own science knowledge or they lacked the experiences that would allow them to determine content that would cause students to resist instruction due to the difficulty of concepts (Hill et al., 2008).

The researcher’s role in this dissertation study spanned several roles. The researcher met with the novice science teacher enrolled in the science methods course to seek willing volunteers to participate in the pilot study in 2016 and contacted them by email in fall 2017 to determine their interest in this dissertation study. The researcher conducted and transcribed interviews, analyzed, organized, and coded all the data. Case studies required that the researcher be willing and able to place strong demands on their intellect, emotions, ego, and knowledge, to set aside their biases and point of view in order to critically analyze the data, and to understand that qualitative data analysis had no routine procedures set in place and must therefore create procedures for each step of data collection and analysis (Yin, 2014). In short, the researcher had to take on many roles and wear many hats and therefore be flexible as she transitioned between roles.

In order to remain as unbiased as possible, it was incumbent upon the researcher to acknowledge her cultural perspectives, personal and professional biases, and beliefs as these were the factors that might skew the analysis and damage the validity of the research and credibility of the researcher. Yin (2014) and Creswell and Poth (2018) discussed the researcher in terms of fairness, trustworthiness, and sensitivity to evidence that was contrary to the researcher’s intent but still must be acknowledged, explained, and discussed. The researcher acted as an observer, limited contact with participants to the semi-structured interviews and teaching observations of participants in their classrooms so as not to influence the candidates which might bias the data being collected.
The only interaction the researcher had after speaking with the novice science teachers and addressing concerns and questions was setting up interview and observation dates and contacting participants to cross-check the interview transcripts via email. The participants were able to contact the researcher through email if they had any unanswered concerns or questions at any time during the dissertation study. The researcher did not interact with novice science teachers’ students during the teaching observation. By remaining in the role of a direct observer, the researcher was unable to manipulate events going on in the candidates’ classrooms and had no influence over those events; thus ensuring the validity of the data and the research ethics (Yin, 2014). This enabled the researcher to present an authentic description of the events as they occurred naturally in the course of the teachers teaching science to their students.

**Data Sources**

The multiple-case study design was an appropriate one for this dissertation because it allowed the researcher to reconstruct the personal perspectives of the novice science teachers in order to understand what may have influenced their understanding about teaching science (Gelo, Braakmann, & Benetka, 2008). Additionally, a multiple-case study allowed the researcher to draw comparisons between and across the different cases because the contexts for each case were different (Baxter & Jack, 2008). Perhaps the largest advantage of this study was the reliability and robustness of the evidence (Baxter & Jack, 2008; Creswell & Poth, 2018; Yin, 2014).

The case study design allowed a richer description of real-life events and decisions being made by the novice science teachers (Creswell & Poth, 2018; Yin, 2014). This dissertation described novice science teachers’ teaching activities and their processes of decision making about designing and implementing lessons, based on their philosophies that already existed or were being developed as they gained experience as science teachers. In addition to providing a
richer description, case study designs are preferred when the main research question seeks to answer “how” or “why” questions about a phenomena, the research cannot control the behavior of the participants in the study, or the study has a contemporary focus rather than an historical one (Yin, 2014). A variety of rich data sources were obtained utilizing qualitative data collection methods.

Yin (2014) and Creswell and Poth (2018) provide examples of data sources rather than provide a working definition of what is considered data in qualitative research. They provide examples of data sources and types of data that may help to answer research questions in qualitative research. Data sources that were used in this research included novice science teachers’ teaching philosophies, lesson plans, three semi-structured interviews, and direct observations of the participants teaching lessons, activities, and laboratories in their classrooms. Table 4 lists the data sources that addressed each question. Rationales for using these data sources are listed in Table 5.

Table 4. Data sources and research question.

<table>
<thead>
<tr>
<th>Data Sources</th>
<th>RQ1</th>
<th>RQ2</th>
<th>RQ3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching philosophy</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Semi-structured interviews (PSI, I #1 &amp; I #2)</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Lesson plans</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Classroom observation</td>
<td>X</td>
<td>X</td>
<td>X</td>
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</tbody>
</table>
Table 5. Data sources and research purpose.

<table>
<thead>
<tr>
<th>Data Sources</th>
<th>Purpose for Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teaching Philosophy</td>
<td>Novice teachers’ teaching philosophies were analyzed for categories of philosophies to determine teaching viewpoints.</td>
</tr>
<tr>
<td>Semi-structured Interviews</td>
<td>The interviews provided evidence for how initial philosophies were related to the science methods course content and the process candidates’ used for lesson planning and teaching lessons.</td>
</tr>
<tr>
<td>Lesson Plans</td>
<td>Lesson plans provided evidence for candidates’ beginning enactment of their philosophies at the planning stage.</td>
</tr>
<tr>
<td>Teaching Observation</td>
<td>Classroom observations provided evidence for the novice science teachers’ process of enactment of their philosophies in lesson planning and instructional practices.</td>
</tr>
</tbody>
</table>

Using multiple sources of data for this dissertation provided a more convincing and accurate interpretation when addressing a broad range of issues (Yin, 2014). Moreover, multiple sources of data strengthened and supported the dissertation’s findings and lent more credibility to any generalizations that were made from these data (Creswell & Poth, 2018; Yin, 2014). The teaching philosophies allowed the novice science teachers to conceptualize their beliefs about teaching and learning and interrelate specific beliefs with respect to teaching science (Wiesenber & Stacey, 2013).

**Teaching Philosophy**

Marbach-Ad et al. (2012) identified seven themes that emerged from their study of teaching philosophies from faculty members in a Teaching and Learning College. Several themes of this dissertation were identified by the researcher through an analysis of the teaching philosophies collected during the pilot study. The themes that were similar to Marbach-Ad et al.’s (2012) findings were critical thinking skill development, student engagement, connection (relevance) to students’ everyday lives, and using and identifying students’ prior knowledge. Snyder (2012) examined novice teachers’ teaching philosophies to determine if their
understanding of effective teaching was transformed by a teacher preparation program designed for career-changing students. This study looked at disorienting dilemmas the students were faced with as they were learning new information, enacting this by implementing it in their practice, gaining new perspectives on what it means to become a teacher, and becoming reflective practitioners (Snyder, 2012). Witcher et al.’s (2001) study helped the researcher identify the novice science teachers’ viewpoints in their teaching philosophies regarding teaching science as progressive (critically reflecting as a way to examine future changes) or transmissive.

The science methods course required that novice science teachers submit a teaching philosophy that explained their rationale for teaching science. The novice science teachers included their ideas about teaching science objectives, the methods that the candidates employed to teach their students the objectives, and the ways in which they would assess their students to determine if they had met the objectives. The methods course syllabus also recommended that the philosophy paper included ideas on how children learned science, what they believed it meant to have scientific understanding in general, and the ways in which good teaching would foster and support their students’ scientific understanding of the concepts or principles of science.

**Lesson Plans**

Lesson plan data was used to determine if the teaching philosophies were being enacted in the novice science teachers’ lesson plans by using the themes from the philosophies to identify the enactment in the lesson plans. The lesson plans provided further data to determine if the novice science teachers were able to not only enact their teaching philosophies but also determine if they were able to successfully integrate the knowledge gained from their methods.
course into their lesson plans. In addition, the lesson plans provided insight into the novice science teachers’ ability to apply the theories they had learned in their coursework, i.e. bridge the gap between theory and application.

Lesson plan data allowed the researcher to further provide evidence of those influences that facilitated the novice science teachers’ enactment of their philosophies. The learning activities that the novice science teachers’ were engaging in as part of their science methods course informed their instructional choices and classroom practices as they enacted different aspects of their teaching philosophies. The categories of data used helped the researcher identify similarities or differences in teaching philosophies and how they were enacted. Tables 1 and 2 provide brief explanations of the data sources, the research questions they helped to address, and the purpose those sources had in helping to answer the research questions.

Lesson plans were used by the novice science teachers to enact the theories and practices from the science methods course and teaching philosophies into their teaching. Park and Chen’s (2012) study of high school biology teachers’ integration of their pedagogical content knowledge (PCK) into their classroom teaching was conducted using semi-structured interviews, lesson plans, and classroom observations. When examining lesson plans for themes, the researchers were looking for the participants’ understanding of student knowledge and instructional practices, knowledge of science curriculum and assessment of science learning, and knowledge of student assessment of learning (Park & Chen, 2012).

Based the lesson plans that were analyzed for this dissertation, similar themes emerged as well. In addition to the above themes, this researcher conducted classroom observations to identify the enactment of the candidates’ teaching philosophies during their classroom teaching.
This was in line with research conducted by Santoyo and Zhang (2016) that examined teacher candidates’ enactment of the knowledge obtained in their course work during their clinical practice.

Lesson plans were collected and analyzed to identify how the novice science teachers’ teaching philosophies were enacted in their lesson plans. Examining the enactment of their philosophies in their lesson plans helped to determine if the breakdown of their practice facilitated their teaching (Grossman et al., 2009). To further identify in what ways the teaching philosophies were being enacted, the researcher conducted classroom observations of the novice science teachers as they were teaching to determine how they were enacting their philosophies. The criteria that were used to determine if the novice science teachers were enacting their teaching philosophies were taken from the constructs listed in Table 3.

**Semi-Structured Interview**

The use of interview data allowed the researcher to present the data from the novice science teachers’ point of view. Creswell and Poth (2018) discuss interviews as pieces of data that provide personal perspectives and the opportunity for the novice science teacher to share their lived experiences and reflect on how those experiences have transformed their understanding of teaching science. In addition, the interviews enhanced the thick description of the data and provided context as the narrative unfolded (Ponterotto, 2006).

Examining the teaching philosophies of the novice science teachers upon entry into the science methods course provided insight into the influences informing their philosophies and how they planned on enacting those philosophies in their classrooms. Further, the interview data provided more detailed explanations regarding enactment of the novice science teachers’
teaching philosophies by allowing the researcher the opportunity to ask probing questions and provide the novice science teachers the opportunity to expound on their philosophies. Comparing the pilot study interviews with the interviews conducted in their second year of teaching allowed the researcher to uncover additional factors that might have informed alterations to the novice science teachers’ teaching philosophies.

Yin (2014) discusses the reason a researcher would use interview data for qualitative research if the researcher’s questions are seeking to address how something is or works, or address why something is the way it is or why it does/does not work in a particular way. Interview data allowed the researcher to tell a narrative from the perspective of one or more individuals utilizing a set of questions. The researcher interacted and engaged in dialog with the novice science teachers, telling their stories from their perspective (Creswell & Poth, 2018).

This dissertation study started at the beginning of the novice science teachers second year of teaching. The study utilized the teaching philosophies collected in fall 2016, during the pilot study to generate interview questions. In the first phase, teaching philosophies of the novice teachers were reread, coded, and used to generate interview questions. Yin (2014) identifies good interview questions as those that are created before the interview, based on the researcher’s background knowledge and research. He goes further by pointing out that the researcher ask questions that are impromptu but still remain true to the research questions, always keeping the intent of the research in mind, hence the use of the teaching philosophies to guide the creation of the interview questions.

Semi structured interviews were conducted with each consented novice science teacher to examine statements and concepts discussed in the teaching philosophies in greater depth to
explore the influence of their experiences in the classroom on their philosophies. Each interview lasted 20-30 minutes to prevent fatigue and to ensure that the answers were valid (Creswell & Poth, 2018). The pilot study interview (PSI) was conducted to determine the novice science teachers teaching philosophies at entry level. The next interview (I#1) was conducted at the beginning of their second year of teaching and the final interview (I#2) was conducted later in the first semester of their second year of teaching.

The PSI was conducted in the fall 2016 semester with the three novice science teachers to determine their major teaching philosophies at entry level, as first year novice science teachers. The pilot study interview provided the researcher the opportunity to obtain any clarification or insights into statements made in the teaching philosophies that she felt might help her to better understand the thoughts and intentions of the novice science teacher. It also allowed her to provide the novice science teachers the opportunity to discuss the learning opportunities afforded to them in their methods course work and reflect on these experiences as first year science teachers. The first interview for this study was designed to identify any influences that may have caused them to reflect on their teaching philosophies after completing their first year of teaching. This interview allowed the researcher to identify the factors that potentially influenced the novice science teachers’ enactment of their teaching philosophy as they reflect back on different experiences in their first year of teaching. In addition, this interview allowed the researcher the opportunity to gather information to determine changes in their philosophy and that provided insight those changes.

A second interview was conducted after the classroom observations to examine the novice science teachers’ enactment and application of theory to practice. The second interview provided novice science teachers’ the opportunity to reflect back on their lesson and discuss the
factors that may have helped or hindered the enactment of their lesson plan. The researcher was able to discuss some of her observations with the novice science teachers’ in order to gain insight regarding their perspective of their teaching. In addition to providing the novice science teachers the opportunity to reflect on the lessons that were observed, the second interview allowed them to discuss any additional influences that informed their practices or changed their teaching philosophy. This interview allowed the researcher to provide the novice science teachers the opportunity to discuss areas of strength or weakness as science teachers and to reflect on their rationale for their choices.

Understanding the background knowledge of the novice science teacher is important because it allowed the researcher to contextualize their responses (Creswell & Poth, 2018). The prior knowledge and experiences of these novice science teachers form a reference point from which they draw from when comparing new experiences to the previous ones (Dewey, 2013). In addition, understanding how the science methods course influenced their teaching philosophy and enactment can be better explored through questions that provided time for critical self-reflection. Brookfield (2000) and Mezirow (1996, 1997, 1998) discussed the importance of critical self-reflection as a way for learners to make meaning out of their knowledge so that they can begin to think in new ways and incorporate other information as they construct their understanding of new experiences.

Based on the experience of the researcher and information gathered from the research, there exists theory to practice gaps in novice science teachers’ understanding of teaching science. Questions were asked that directly addressed how they would enact their philosophies and apply the theories they learned about in their preparation program. These questions helped to paint a picture of the processes they were using to apply their practical, theoretical, and content
knowledge, and enact their philosophies in the classroom (see Appendix A). Feiman-Nemser (2009) and Buchmann (1983) acknowledge the importance of teaching a habit of inquiry in preservice teachers with the intended consequence of ensuring that they carry this into their classrooms to bridge the gap between the theory taught in their course work and their classroom practices.

Observations

Observational data allowed the researcher to observe the enactment of the teaching philosophy in action in the classroom. A second interview after the observations helped the researcher identify any challenges the novice science teacher faced with the application of educational theories and their teaching philosophies to their content and lesson structure. The observation recorded the researcher’s impressions of the learning environment, the interactions of the students and novice science teacher, and reactions and behaviors of students and novice science teachers as they interacted with each other during the lesson (Creswell & Poth, 2018). The observational data served as the basis for creating questions for the follow up interview after the lesson plan and observational data were compared to determine if they were aligned.

Qualitative research lends itself to the study of phenomena through observations and allows for more descriptive accounts of the phenomena being observed (Bradley, Curry, & Devers, 2007; Gelo et al., 2008). Observing novice science teachers teaching in their classrooms provided the context for describing the enactment of their teaching philosophies. The selection of the qualitative research form was appropriate for examining socially and psychologically constructed behaviors and events from the point of view of the participants in this study (Gelo et al., 2008).
Examining their teaching philosophies and interviewing novice science teachers provided the opportunity for them to expound on their philosophies and discuss experiences they had in the methods course and in their classrooms that contributed to transforming their understanding of teaching science. Experiences are socially constructed through the interaction of a person with the world around them, which may lead to an alteration of their learning experience (Bandura, 1977, 1982, 2001; Brookfield, 2000).

Appendix B contains the observation protocol the researcher will use for this study. The protocol was based on themes that emerged from the teaching philosophies collected during the pilot study and lesson plans collected for this study. The observations allowed the researcher to see novice science teachers teaching and enacting their teaching philosophies as they interact with the students in their classrooms. The researcher was able to experience the process of enactment and the application of theory into practice, took notes on personal impressions, interactions, and reactions of the students and novice science teacher as the lesson unfolded. The narrative created by the researcher from the interviews and observations provided insight and historical context into the personal decision making processes of the novice science teachers as they told their stories about their teaching experiences (Creswell & Poth, 2018).

Data Collection

The researcher sent an email out to the novice science teachers who volunteered to participate in the pilot study and explained that she was interested in their participation in her research for her dissertation, discussed the nature of the research, and address any questions or concerns they had. The researcher explained the consenting process for human subject research, types of data that would be collected, what would be done with the data that was collected, the
time needed from candidates for the interview process and cross-checking the interview
transcript, and the manner in which candidates’ identities and data would be protected and
stored. The Internal Review Board (IRB) approval letter may be found in Appendix C. The
consenting letter that was provided to the participants when the researcher met the novice science
teachers at a preapproved public area on the university campus appears in Appendix D. The
email that was sent to the pilot study participants to request their participation in the dissertation
study, the information about the nature of the research, and researcher contact information
appears in Appendix E. All of the data for this research was collected, transcribed, coded, and
analyzed by the researcher throughout the fall 2017 semester.

Teaching Philosophies

Teaching philosophies were emailed to the researcher, by the novice science teachers,
during the pilot study and analyzed for the themes that guided the pilot study interview
questions. The teaching philosophies were used to identify components included in the design
of the lesson plans. Prior to the start of the first interview for this study, the teaching
philosophies were handed to the novice science teachers during the first interview of this study
so that they could refresh their memories regarding what they wrote the previous year.

Questions of validity of the teaching philosophies may arise with the researcher. The
researcher needed to identify her biases as a teacher who was still teaching science at the high
school level. She needed to be continually aware that her teaching philosophy should not be
disclosed to the novice science teachers she was interacting with so as not to influence the
responses of the novice science teachers. The researcher kept in mind that these teaching
philosophies were also course assignments that were graded by the instructor and could have
contained responses to specific components that fulfilled the science methods instructor’s requirements.

**Lesson Plans**

Each novice science teacher was asked to email 5 lesson plans to the researcher. The lesson plans were read, coded, and analyzed to determine if their philosophies were being enacted in their lesson plans. The researcher chose one lesson plans that contained a component of note-taking and some type of hands-on activity or laboratory to observe how the novice science teachers would enact their teaching philosophies in their instructional practices. The observational, in conjunction with lesson plans and their teaching philosophies, were used to generate questions for their final interview.

**Semi-structured Interview**

Two interviews were conducted for this study; one early in the semester after the teaching philosophies were reexamined, coded and interview questions generated, and one after the observations which allowed the researcher to corroborate certain findings by asking questions that allowed the novice science teacher to provide their perspective or add new meaning, insight, or information (Creswell & Poth, 2018; Yin, 2014). The first interviews were conducted in late October 2017. The second interview was conducted after the researcher had completed observations of each novice science teacher, approximately the second and third weeks of December 2017. The researcher used a digital voice recorder during the interviews.

Interviews provided the opportunity for the researcher to establish a trusting relationship with the interviewees. The researcher kept in mind that it was important to be cordial and friendly with the interviewees in order to make them comfortable with the process. She
remained upfront and honest regarding the interview process and throughout the interview, answering any questions that arose before, during or after the interview. The researcher kept an open mind and did not react negatively to or take personally any disagreeable statements that may have been made by the interviewees. The researcher’s line of questioning helped the interviewees explore and reflect on their teaching philosophies and the ways in which their science methods course informed the enactment of their teaching philosophies in their lesson plans and teaching practices. The novice science teachers were asked to rate themselves and provide rationale for their ratings based on four of Feiman-Nemser’s (2009) categories: opportunity for student application of knowledge, opportunity for students to practice concepts, use of project-based learning, and implementation of student-directed learning.

Creswell and Poth (2018) state that it is appropriate to place time limits on interviews to prevent interviewee and researcher fatigue that may lead to poor results. The interviews were designed to last 20-30 minutes, excluding time to respond to questions or concerns before or after the interview. Most importantly, the researcher ensured that interviewees did not become fatigued during the interview process, as pointed out by Creswell and Poth (2018), since this might have elicit responses given by the interviewee in the hopes that the researcher would end the interview quickly. Additionally, the researcher let the interviewees know in advance that they were under no obligation to answer all questions asked, they were free to ask the researcher questions during the interview, and that they could terminate the interview at any time.

Interview questions contained straight-forward wording and were constructed so that misunderstandings on the part of the interviewee were minimized (Turner, 2010). Follow-up questions were asked when the researcher felt that the interviewee had moved off topic or when she felt that the interviewee did not understand the question, based on the responses of
interviewees. Additional questions were asked based on the researcher’s need to obtain more information or to clarify a response to ensure understanding on the part of the interviewee and researcher.

**Observations**

The researcher selected one lesson plan that contained an aspect of note-taking by the students and a laboratory or other type of inquiry-based classroom activity to observe the novice science teachers. Communication between the researcher and novice science teacher took place via email to determine when the lesson plan would be implemented so that the researcher could arrange to be there for the observation. The researcher observed the novice science teacher in order to identify and observe their enactment of their teaching philosophy in their classroom practices.

Classroom observations were conducted during the month of November 2017. The researcher used the novice science teachers’ email to make contact to find out the location of their school, determine a date and class period that was convenient for them to be observed, and determine the school’s protocol for guests in the classroom. The researcher utilized the observation protocol (see appendix B). The protocol allowed the research to witness the enactment of the novice science teachers’ teaching philosophy in action and to determine if enactment was taking place. The notes taken during the observations helped to generate additional questions for the second interview that was be conducted in December 2017.

The researcher remained as a strict observer during the classroom observations to ensure that her interactions did not interfere with classroom instruction and the natural progression of the lesson. The role of strict observer was the most difficult hat for this researcher to put on. As
a classroom teacher for 16 years, and a mentor to novice science teachers, the researcher had to exert the greatest amount of self-control so as not to interfere with the natural progression of the lesson as it unfolded. She had to be constantly on guard so that she did not interact, correct, or impart any content information during the process of the observations. The researcher had to remain detached but watchful of the activities and conversations taking place in the classroom. Constant vigilance had to be maintained on the part of the researcher to ensure that she did not skew results by her words or actions. This would have invalidated the data collection and the results that were obtained during the course of data analysis. The timeline for data collection and analysis is illustrated in table 6.

**Table 6.** Timeline for proposed dissertation study.

<table>
<thead>
<tr>
<th>Data Item</th>
<th>Collection Date</th>
<th>Analysis of Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Novice Science Teacher Consent</td>
<td>Mid-September 2017</td>
<td>N/A</td>
</tr>
<tr>
<td>Teaching Philosophies</td>
<td>Early September 2016</td>
<td>September 2017</td>
</tr>
<tr>
<td>Semi-Structured Interviews (3)</td>
<td></td>
<td>Late October – December 2017; January 2018</td>
</tr>
<tr>
<td><strong>Total Time: 4.5 hours</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pilot Study</td>
<td>October 2016 – November 2016</td>
<td></td>
</tr>
<tr>
<td>Dissertation Study</td>
<td>October 2017; December 2017</td>
<td></td>
</tr>
<tr>
<td>Lesson Plans</td>
<td>October – November 2017</td>
<td>October – December 2017; January 2018</td>
</tr>
<tr>
<td>Observations</td>
<td>October – November 2017</td>
<td>October – December 2017; January 2018</td>
</tr>
<tr>
<td><strong>Total Time: 9 hours</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Data Analysis

Data analysis was concurrent with the data collection process. Teaching philosophies were reexamined, coded using themes that emerged from the literature review, and interview questions generated for this study’s first interview. Lesson plans were collected, read and coded using the themes that emerged from the literature review, in addition to any relevant themes that emerged from the data as it was being coded. Additional themes that were identified in the teaching philosophies were used to generate more probing interview questions. Coding consisted of reading through the teaching philosophies and highlighting, using the high lighting tool in Word, to color code the themes identified from the literature review and any additional themes that emerged from the analysis of the teaching philosophies. The lesson plans and interview transcripts were coded using the same color coding system as that used for the teaching philosophies.

Sections of each teaching philosophy were read to identify themes and sort sections so as to condense information into manageable pieces of data. Each theme was placed into a table in which key words or phrases were entered. Coding took the form of in vivo coding, words based on the researcher’s interpretation of the data, and codes identified through the literature review (Creswell & Poth, 2018). The teaching philosophies were coded first so that the researcher was able to identify novice science teachers with teaching philosophies that illustrated differences in philosophies. Categories for themes which were identified from the pilot study and literature review were used for the teaching philosophies. Additional themes that emerged from the analysis of the teaching philosophies were incorporated into the coding already established.
The lesson plans were coded after the teaching philosophies utilizing the same coding method. The researcher was looking for lesson plans that aligned with the teaching philosophy and demonstrate clear enactment of the novice science teacher’s teaching philosophy and lesson plans that neither aligned nor demonstrated clear enactment of the novice science teacher’s teaching philosophy. Lesson plans that fell in between these two criteria were also examined as they provided further insight into factors that facilitated or adversely affected the novice science teachers’ enactment of their philosophies.

The choice of themes that were used to code the data had been obtained objectively, from the literature review, and subjectively, from the researcher herself. Creswell and Poth (2018) discussed the identification of codes as representing expected information that the researcher would find with the study, information that was not anticipated but was to be included in the study, or information obtained from the participants that was “conceptually interesting or unusual information” but compelling enough that it should be included in the study. Chena (1995) suggested that when coding, the researcher tries to understand not just the single sentence or idea conveyed in the data but the context as a way to maintain openness about the process.

Each digital recording of the semi-structured interviews was transcribed, read through while simultaneously listening to the audio recording to verify the accuracy of the transcription, and finally reread to code the data. The interviews were examined for a purposive sample of responses to determine their relevancy to the research questions and to determine if the themes that emerged from the literature review and teaching philosophies aligned (Ryan & Bernard, 2003). The researcher cross-referenced the interviews and classroom observations to identify repetition in the themes that were already identified. The researcher highlighted key phrases, themes, or noteworthy quotes from the data and included a description of why these pieces of
data were considered important for the researcher’s use in answering the research questions. She included specific rationale to justify the necessity of these data points as they pertained to each research question (Creswell & Poth, 2018).

Interviewees were asked to read through their emailed transcripts of the interviews to member-check them. This provided the interviewees the opportunity to check for accuracy of the researcher’s interpretation of the interview, to afford them the opportunity to add any additional information they felt was necessary or to clarify any comments that may have been interpreted out of context. Member-checking helped provide a more accurate interpretation of the interview and it allowed the participants the opportunity to discuss and clarify interpretations or add new contributions or perspectives (Baxter & Jack, 2008; Lincoln & Guba, 1986). This ensured validity, accuracy of the transcription, and reliability of the notes taken during the observations. Member-checking enhanced the credibility of the data because the interviewees were affirming the accuracy and completeness of the data (Creswell & Poth, 2018). They further stated that member-checking was not entirely without fault but it did decrease the probability that incorrect or inaccurate interpretations were conducted on the part of the researcher.

Double coding was used as it allowed the researcher to return to the data and recode it for comparison to determine if the initial coding and recoding compared (Baxter & Jack, 2008). Finally, all the data was triangulated in order to ensure that the phenomena being researched had been fully examined and explored using several different perspectives (Baxter & Jack, 2008). This process consisted of examining each code from the different data collected to determine if codes were consistently and accurately applied. As suggested by Yin (2014) and Creswell and Poth (2018), codes were aggregated into themes in the data base so that ideas, interpretations,
and insights could be gained from this analysis. This type of approach was appropriate for data analysis when conducting a case study.

The coding process was highly interpretive since the researcher was the one deciding on the choice of themes and codes, using the pilot study and literature review (Creswell & Poth, 2018). To ensure that the codes chosen by the researcher were reliable, a coder was recruited from the same doctoral program as the researcher. This ensured intercoder agreement and reliability because this acted as an internal check on the codes applied to the data (Creswell & Poth, 2018).

Creswell and Poth (2018) determined a set of criteria to follow in order to check for intercoder reliability. A preliminary coding system was established and applied to one teaching philosophy. Each coder independently read the philosophy to establish an independent code list. The researcher and coder compared the independent list to the list of codes prepared by the researcher to determine if the initial codes were reliable. The researcher and coder came to an agreement on the codes. These codes were applied independently to the teaching philosophies to determine the reliability and consistency of the codes. The coding was analyzed to determine its reliability and make revisions before applying the coding system to the remaining data sources.

Interpretation of the results was ongoing throughout the data collection process. Analysis, interpretation, and synthesis by the researcher occurred as each piece of data was examined. Merging of the data facilitated categorization of information into more manageable blocks of information. The interpretations of the data enabled the research to identify those data points that either helped to answer the research questions or created new questions for an entirely different line of research.
Summary

The multiple-case study examined the ways in which the learning activities in a science methods course informed novice science teachers’ enactment of their teaching philosophies as they were reflected in their lesson plans and during classroom teaching observations. The dissertation study took place during the months of October to December 2017. Consent of the novice science teachers took place at the end of October 2017. Data collection took place during the last week of October to the third week of December 2017, with the researcher remaining in contact with the novice science teachers throughout this time period. Thematic analysis, coding, transcribing, cross case analysis, and member-checking allowed the researcher to determine how enactment would look like for novice science teachers. The methodology outlined in this chapter allowed the researcher to gather the pertinent data that helped to answer the research questions and contribute to the current understanding of teacher education research.
CHAPTER FOUR

FINDINGS OF THE STUDY

The purpose of this study was to examine the ways in which the science methods course informed novice secondary science teachers’ enactment of their teaching philosophies in their lesson planning and teaching. In addition, this study examined additional factors influencing novice science teachers’ enactment of their philosophies about teaching secondary science in their lesson planning and instructional practices. Utilizing data obtained from teaching philosophies, interviews, lesson plans, and teaching observations through the lenses of approximation of practice (Gardiner & Salmon, 2014; Grossman et al., 2009; McDonald et al., 2013), KCS (Hill et al., 2008) and experiential learning theory (Dewey, 2004, 2013; Deygers & Kanobana, 2016; Fowler, 2007; Green & Ballard, 2011; Kolb, 1984, 1985; Kolb & Kolb, 2005, 2008; Lewin, 1939; Piaget 1952), findings focused on the way factors interact as enactment emerges, matures, and evolves in each of the three cases of this study. These findings are what generated the following three themes: emerging enactment, evolving enactment, and maturing enactment.

Chapter three discussed the use of cases as the focal point and organizational structure of case study methodology. Creswell and Poth (2018) discuss the use of vignettes to provide vicarious experiences for the reader as an appropriate method to begin the presentation of findings for a case study. They point out that there is no set standard for reporting findings for case studies, instead leaving it up to the researcher to decide on the most appropriate and effective way to present their findings.
Research Questions

The research questions guiding this study were:

**RQ1:** What are novice science teachers’ major philosophies at the entry level of teaching?

**RQ2:** What factors influence novice science teachers’ enactment of their philosophies about teaching secondary science?

**RQ3:** How do novice science teachers implement lesson planning into their own teaching practices in a secondary science classroom?

Data Collection and Analysis

The data collected enabled the researcher to use enactment as a lens to understand what major philosophies each novice science teacher had as they began to teach (RQ1). Each piece of data provided a glimpse of the novice science teachers’ emerging vision of themselves as teachers, their evolving beliefs and ideas about how they would teach, and the manner in which their science methods course informed their instructional practices as their enactment approached maturity (RQ2 & RQ 3). Experiential learning provided a lens for understanding how personal, academic, and professional experiences inform instructional decisions made by the novice science teachers. Using KCS as a lens enabled the researcher to examine the novice science teachers’ enactment as they drew from their knowledge of what students knew about science and how students constructed their knowledge of science.

The findings of each case were examined through four data sources: teaching philosophy papers, the novice science teachers’ interviews and lesson plans, and teaching observations. The researcher took precautions to ensure that the novice science teachers’ identities and the identities of the schools were protected by assigning pseudonyms to them and their schools. She
used a pseudonym for Fey’s district-assigned mentor. Next, the researcher provided a portrait of each case and identified each case’s unique characteristics in learning to teach science, which allowed the researcher to further discuss issues related to the ARL program and novice science teachers’ beginning journey to become effective teachers.

The first data obtained was the teaching philosophies which the researcher collected during the pilot study by requesting that the consented participants email the philosophies to her. Each teaching philosophy was examined to identify the novice science teachers’ major philosophies at the entry level. Next, the teaching philosophies were reread to identify components of enactment so that the researcher was able to create interview questions that would flesh out the ways in which the science methods may be informing their teaching philosophies. Themes generated by the teaching philosophies were organized based on words that appeared across the teaching philosophies that the researcher interpreted from the data (Creswell & Poth, 2018). Themes identified were: critical thinking, self-actualized, application, and practice.

The second step was to interview the novice science teachers to provide evidence to determine the ways in which their initial philosophies might have been related to the science methods course content. The pilot study interview allowed the researcher to obtain information regarding the personal, academic, and professional experience that the novice science teachers had that may have played a role in the formation of their teaching philosophies. This information helped to provide background knowledge of the novice science teachers so that the researcher could contextualize their responses (Creswell & Poth, 2018). The pilot study interviews were transcribed for information that would illustrate their emerging journey enacting their teaching philosophies as novice science teachers in their first year of teaching. Themes
generated from the PSI were: *struggle, frustration, sadness, excitement, dissonance, and challenge.*

The questions for Interview #1 were created from the teaching philosophies that were collected during the pilot study. Interview #1 took place at the beginning of the novice science teachers’ second year of teaching. The interview yielded data that allowed the researcher to identify changes in how they saw themselves as teachers at entry level and the teacher they saw themselves evolving into. The transcription from the pilot study interview was reread and compared to the transcript of Interview #1 as a way to begin identifying beginning enactment and any factors informing their emerging enactment. Themes generated from Interview #1 were: *self-reflection, making connections, critical thinking, application, and change.*

The third step in data collection entailed emailing the researcher five lesson plans by the novice science teachers. The lesson plans were analyzed to identify signs of enactment of their teaching philosophies. The researcher selected lesson plans in which the novice science teachers were presenting content to their students or were engaged in some type of hands-on activity or laboratory activity. In addition, the instructional choices which were included in the lesson plans allowed the researcher to begin to identify if they were able to successfully integrate the information they gained from their science methods course and then enact this knowledge into their instructional practices. The lesson plans further allowed the researcher to determine if the novice science teachers were able to apply the theories that they learned in their coursework. Themes generated from the lesson plans were: *front-loading, inquiry, application, and prior knowledge.*

The observations allowed the researcher to see what enactment might look like in their classrooms. The observation data was used to identify the changes taking place in the teaching
philosophies as the novice science teachers continued enacting them in their instructional practices. The data was used to generate questions for Interview #2 to help to identify any challenges the novice science teachers may have faced enacting their teaching philosophies in their instructional practices. Themes generated from the observations were: *front-loading, hands-on, interaction, application, inquiry, and student resistance.*

The last data collection step the researcher took entailed cross-referencing the interviews, the observations, and teaching philosophies to identify repetitive themes that appeared across the cases (Creswell & Poth, 2018; Ryan & Bernard, 2003). The novice science teachers were provided the opportunity to check the interview transcripts for accuracy of the researcher’s interpretation of the interview and to allow them to expound on responses they provided to the interview questions they were asked (Baxter & Jack, 2008; Lincoln & Guba, 1986). Finally, interpretations of the data, which was an ongoing process as teaching philosophies, interviews, lesson plans, and teaching observations were collected, helped to identify data that would address the research questions and generate themes.

Originally, the researcher identified the following themes as focal points for the findings: *front-loading content, evolving philosophy, student resistance, and dissonance or discord expressed with the way they were teaching.* The theme of change fit with the overall intent of the dissertation which was to uncover the ways in which novice science teachers enact their teaching philosophies in their lesson plans and instructional practices. Teaching philosophies helped novice science teachers develop a picture of the teacher they hope to be but through practice, experience, and reflection, the teacher they would become began to shine through. Enactment became the focal point for the themes. To demonstrate the changes, the researcher fell back on the type of teacher she was researching, i.e. science teachers. Therefore, terms that would reflect
science and that reflected the specific type of teachers studied, i.e. novice science teachers, were chosen: *emerging, evolving, and maturing*. The themes generated from the data were: *emerging enactment, evolving enactment, and maturing enactment*. Table 7 lists the themes identified from the teaching philosophies, interviews, lesson plans and observations.

**Table 7.** Themes identified from the data sources.

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<th>Teaching philosophies</th>
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**Findings of three cases**

At the start of Adrianne, Fey, and Isaac’s first year of teaching each shared what they were feeling about being novice science teachers. They were excited, they were terrified, but they were passionate in their desire to be the best teacher they could be. Adrianne: “Science is exciting but teaching it…scary?”; Fey: “Science is enthralling, I love it!”; and Isaac: “Science is fun to learn and interesting. I’m pumped.” (A-PSI, 2016; F-PSI, 2016; I-PSI, 2016). At the beginning of their second year in the classroom, Adrianne, Fey, and Isaac were still excited to be teaching science, but their excitement was tempered by the unfolding realities of teaching and professional responsibilities.
Adrianne

Theme 1: Emerging enactment.

Adrianne referenced her science methods course when she was in the ARL program regarding what she learned and in what ways she was able to implement that information.

If it taught me, [it is] ok, so yes I know you’re supposed to begin here and then tie it into what you learned yesterday and then move on to include new stuff. I get that. I’m not dunderhead enough, where I don’t understand (A-PSI, 2016).

She was concerned and upset as she related this in the interview during her first year of teaching. At the beginning of her first year Adrianne responded to the inquiry about how she was doing, “Trying to cut my teeth” (A-PSI, 2016). Adrianne felt that she was not an effective teacher. “It’s the things I’m not shown how to do that I’m kind of winging it a little bit” (A-PSI, 2016). Adrianne appeared to be sad during the PSI as she discussed her experiences in her science methods course and her difficulty in transferring what she learned to her instructional practices. “Science is supposed to be exciting. And I’m sad because I know I’m not being as effective as I could be” (A-PSI, 2016).

Establishing routines and patterns was important to Adrianne if she had any hope of being an effective teacher. She felt that if the students knew the routines of the classroom, they would become comfortable with the learning environment. “If the students are comfortable with me and the classroom, they will feel relaxed and focused” (A-PSI, 2016). Creating a rhythm to her teaching was a struggle in her first year in her classroom. “I’m struggling with getting the students to focus. But they’re settling down slowly,” (A-PSI, 2016). The rhythm she was
looking to establish was outlined by her during the PSI. “Give them information, just enough so they can take time to apply it, use it, maybe reinforce it with a video or activity,” (A-PSI, 2016). Adrianne’s teaching philosophy stressed her belief that students should be given varied instruction and time to master material while at the same time, structuring her teaching in such a way that it is student-centered (A-TP, 2016).

Adrianne wanted to have a rhythm to her teaching in which she provided some information to the students and then had them practice and work with that information. It was important that a routine was established that Adrianne and the students were comfortable with. In addition, Adrianne planned on using a video or activity that would clarify what she taught her students by presenting the same information in a different format. She stated that teaching this way would allow her to reach her goal of providing multiple chances to understand and master each concept as well as “hit them with the information in multiple and different formats,” (A-TP, 2016; A-PSI, 2016).

A sense of Adrianne’s idea of effective teaching included varying the types of instructional strategies she used to present information to the students. Her desire to do her best to teach her students and her apparent lack of confidence in her ability to be effective did not seem to change her vision of creating that predictability she called rhythm. Her emotional investment in being a teacher and her insecurity about her teaching came through in that she did not see herself as being effective. Adrianne seemed to be confusing her self-reported ineffectiveness with the struggles that come with being a novice science teacher. She may not have had enough experiences in her first year of teaching to be able to identify, with in herself, the difference between being a new teacher trying to learn their craft and being an ineffective teacher.
Adrianne felt that what she learned during her preparation program was delivered as being applicable to all learning situations. She found the science methods course, of all the courses she took, the most helpful in understanding what she needed to do to teach science, not merely unit design or one or two lessons on student-centered learning. She felt that she lacked the knowledge that would allow her to break down the instruction in a way that would facilitate student-centered learning and become the effective teacher she envisioned in her teaching philosophy (A-TP, 2016). She felt that there were things that she needed to know or be shown to her but were somehow over looked in her course work.

She had not figured out what knowledge or vision or practice might help her to be able to break down instruction. Adrianne struggled with the aspects of her instructional practice that would allow her to better establish routines for students in her first year of teaching. In her teaching, this particular aspect of her instructional practice was addressed by establishing a classroom routine. She struggled in her second year with practices for teaching and the ability to break down her instruction in a way that would allow her to effectively implement her teaching philosophy in her teaching practices.

Theme 2: Evolving enactment.

In the beginning of her second year of teaching Adrianne was able to establish a pattern to her teaching that the students followed. She had worked hard to establish her “recurrent pattern of teaching” discussed in her teaching philosophy (A-I #1, 2017). She established a pattern of instruction that began with a Do-Now question or Question of the Day to give the students a “brain boost to get them back to where we were at the beginning”, followed by a brief lecture for notes, and concluding with an activity that reinforced the concept being taught and provided the students an opportunity to practice and apply the information (A-I #1, 2017).
Observation 2 was chosen because Adrianne was beginning a new unit and in her teaching philosophy and Interview #2, she stated she wanted to “give them a little lecture, usually not much of a lecture” and then “give them an activity” (A-I #1, 2017). Adrianne was providing students’ notes on the classes of biomolecules which required students to apply what they learned about the periodic table of elements, atoms, and atomic bonding (A-LP #2, 2017). “And now I’m just reading off a PowerPoint and that to me makes me feel I’m not being a very effective teacher” (A-PSI, 2016). The students were provided with opportunities to utilize and apply prior knowledge and to practice the concepts that were covered in previous lessons. In addition, the notes that were provided to the students required that they look at the information in the PowerPoint and use that information to answer questions in a worksheet (A-O #2, 2017). This type of direct teaching appeared to create conflict between her desire to be a teacher who uses student-centered teaching and her use of direct teaching.

Adrianne was clearly stressed on the day Observation #2 took place because she felt she did not have enough practice with the interactive notes in her first year of teaching and she was concerned with all the information. “What if I screw up?” (A-O #2, 2017). After the observation, Adrianne stopped the researcher to apologize. “Last year, I was just trying to survive. I’m sorry” (A-O #2, 2017). It appeared that Adrianne had a firm handle on the content she was presenting and developed a novel solution to present the information in a manner that she was familiar with, direct teaching. She had note sheets that contained questions students had to answer from the notes. This may have been Adrianne’s way of moving toward her desire to focus on student-centered teaching, while still maintaining control over her students’ learning.

However, during the observation, Adrianne did little reading off the PowerPoint slides except when stressing, “You need to look at the bonds of glucose,” and then she began to read
three words under the picture of a glucose molecule, “Remember kids, ‘Bonds store energy’,” (A-O #2, 2017). She continued in this manner, asking students to think about what they know, followed by questioning them about the information on the slide, and encouraging them to apply their responses to another question. She asked her students how they thought organisms digested fats (A-O #2, 2017). One of the students began to answer and then shut down. Adrianne reacted to the shut-down with encouragement by saying, “Don’t say ‘I don’t know’ when you were kind of on the right track, then you took a turn off the road. Let’s hear what you were thinking and see if anyone else is thinking the same way” (A-O #2, 2017). Adrianne stated that if the students were not able to answer simple questions then “I’m not able to pull out of them where I want them to go” (A-I #1, 2017).

It seems that there is a lack of confidence in her ability to provide effective, meaningful instruction to her students. On the one hand, Adrianne felt sad that she was not being an effective teacher, yet the observations tell another story. Her ability to lead students to deducing answers or making predictions about information on a PowerPoint slide she had not shown them yet shows a sophisticated understanding of the ways that students construct knowledge about science. Her apology for being in survival mode as a first-year teacher spoke more of her lack of self-confidence than her failings as a science teacher. Again, her comments to the researcher when she was being observed appeared to be a reaction to the researcher’s presence in her room. Once Adrianne started the class, it was apparent that the students were focused and Adrianne was relaxing and forgetting about the fact that her teaching was being observed.

Theme 3: Maturing enactment.

Adrianne discussed using step-by-step process to ensure that her students understood the concepts before she had students engage in activities that required them to apply their
knowledge. She would demonstrate a step and then have her students practice that step as a way to reinforce their learning. While her students worked on the activity she could be observed walking around the room, checking on her students, and making herself available if her students experienced any difficulties. She felt that walking “around and being available for one-on-one teaching with any students that are struggling” allowed her to get to know her students, how much they knew of the content, and how they were able to apply that information (A-TP, 2016).

Adrianne stated in Interview #1 (2017) that she was using activities and labs where students had to decide on a solution. The labs have questions “were they had to state the evidence that was showing them” (A-I #2, 2017). Adrianne described in Interview #1 (2017) how she had her students use computers to do research on climate change “a bill board thing”. She called it a “museum walk” where the students “found out and then we had a little discussion at the end so that they could apply all of their knowledge, the evidence they had gathered” (A-I #2, 2017). Her students had to explain to her and each other what they had researched and evidence they found. “And that’s how I knew if they were grasping one way or another that there was evidence behind that they needed to back up what they were saying or what they were learning” (A-I #2, 2017).

Adrianne was not as concerned with the performance of the lab but that the students had an understanding of “where they messed up” and that they learn something from this: “I will try my best to have labs that students get to decide their own path to the solution” (A-TP, 2016). Her basis for these views stemmed from her experiences in her undergraduate course work where the laboratories were conducted under time constraints which Adrianne “hated in university laboratory classes” (A-TP, 2017). Adrianne was less concerned with perfection or “overloading them with information they had little time to assimilate” (A-TP, 2016). Her goal was to
encourage her students to think outside the box. I kind of leave it a little open-ended questions now instead of making them direct statements that I want them to prove or not” (A-I #1, 2017).

Adrianne used direct instruction to review the lab directions with her students in an observed lesson (A-O #1, 2017). The students were seated for the first ten minutes of class while Adrianne went over the cell microscopy lab by reading the directions on the first page of the lab packed. She checked for understanding and answered any questions the students had. Students had to read the rest of the information in the lab packet, record observations using vocabulary words, provide evidence for written observations, and draw the specimens and label them (A-LP #1, 2017; A-O #1, 2017).

Adrianne’s use of a demonstration at the beginning of the cell microscopy lab allowed her to show the acceptable way to handle, make, and stain slides (A-O #1, 2017). “I am a fan of I do, We do, You do, which should help the students by giving them first the step-by-step process and then letting them try it on their own” (A-TP, 2016). The rest of the time, the students were working at their stations and helping out each other if groups were having trouble and they saw Adrianne tied up helping with other students. She walked around the room observing each group as they began to make slides and view them under the microscope (A-O #1, 2017). For the most part, Adrianne made few corrections to the slide preparation the students were engaged in but was generous in her praise of each group’s slide preparations.

Adrianne was asked to discuss her experience (A-I #2, 2017), when she set up an activity for her students and then had them direct their own learning, she reported that she experienced push-back not because her students could not do the work nor because they did not understand what they were supposed to do, but because “I think they’re spoon fed….They want to be told
what to do.” When asked if this was her observation or was told this from teachers in her
department, Adrianne stated “this was coming from my students” (A-I #2, 2017).

The observations did not support this statement. The researcher noted that a few students
appeared disinterested no matter what their group members said or did to try to get them
working. Adrianne’s attempts to engage one of the students with the slide preparation were met
with indifference. Her physical proximity was enough to inspire the other students to get to
work. One student resisting instruction may not be uncommon to teachers but it may not
represent student resistance.

There were a few students who appeared to be off task but when redirected, they began to
work with little enthusiasm. Adrianne approached these students and said something very
quietly that got the students to start to work with more vigor and interest (A-O #2, 2017). It was
at the end of the class period that the researcher asked about the conversation that transpired with
these students. “They would rather play than learn. You know, lab day, play day. I told them to
get cracking,” (A-O #1, 2017). Aside from this incident, the students appeared to follow ‘I do,
We do, You do’ which Adrianne used to demonstrate the preparation of the microscope slides.

Adrianne had to figure out a way to make connections with students while struggling
with her desire to do right by her students. Whereas she was once focused on perfection from
her students, she came to accept her students as imperfect but was willing to try if given the
opportunity. She maintained her concern for her students’ successful learning regardless of how
others perceived her as an easy teacher. Her concern about students’ time for learning the
content and her changed views regarding the appropriateness of student responses seemed less
important in her second year of teaching. In spite of this, Adrianne was extremely frustrated
with what she reported as her students’ resistance to her attempts to teach them how to direct
their own learning. She had not been able to figure out what to do with students who expected the appropriate answers from her rather than find the answers on their own. Adrianne’s experiences in her preparation program, classroom experience, and self-reflection on her classroom practices left her feeling a greater sense of frustration rather than empowerment that would lead to success in teaching (Deygers & Kanobana, 2016).

Adrianne was asked if she struggled with implementing her teaching philosophy. “Yes, I do, sometimes. And that’s because something happens over here and I lose track” (A-I #2, 2017). Part of her struggle had to do with student behavior issues and her own forgetfulness. She stated, “I have fixed that by writing down what it is I want to say when I want to say it so I don’t miss those things” (A-I #2, 2017). Adrianne turned to a veteran science teacher and to another novice science teacher in her department when she needed help. She said that the content area teachers were supportive and “they just say keep trying and I’m like Okay”. Adrianne scripted information for herself so that she did not leave out anything that she wanted to say to the students. She attributes the need for this script because “I think it’s me, a novice teacher. I think my classroom management is a little better than last year, not as great as I wish it would be, right?” (A-I #2, 2017).

Summary

Adrianne began her first year of teaching lacking self-confidence and an overwhelming concern that she would do more harm than good as a teacher. Her concern that her students’ work was perfect changed, by her second year of teaching, into a concern that her students just tried their best to learn. Now she had come to her personal realization that “students get what they get and sometimes we have to be okay with just okay” (A-I #1, 2017). Instead of becoming frustrated with students who were not on task, Adrianne found ways to engage the students in
learning by drawing from the experiences she had in her science methods course and the help and support she received from her peers and mentor. Most significantly, Adrianne was becoming more comfortable in the classroom and with making professional connections. Adrianne’s struggle to enact her teaching philosophy is by no means at an end. Her experiences in the classroom, support of her colleagues, and her critical self-reflection had alleviated some of her frustrations about teaching and being a teacher.

Fey

Theme 1: Emerging enactment.

During her first year of teaching, Fey’s frustration was very apparent: “My kids and I…I finally got to the point with the kids, I said ‘You know what? I’m learning too’” and explained to her classes that she understood their frustrations with her because she was just as frustrated with herself (F-PSI, 2016). This confession came when Fey was discussing her science methods course. This statement stemmed from her frustration and feelings of being overwhelmed. She was asked what her students’ reaction was to this. “Very frustrated” but she laughed and said, “And we have a good dynamic now, we’re working it out” (F-PSI, 2016).

Fey expressed her frustration when she was unable to implement her teaching philosophy successfully in her lesson plans and instructional practices: “It’s excruciatingly frustrating” (F-PSI, 2016). She discussed her frustration with the developed perception that her students did not care about learning: “And I’m, that’s where my philosophy hits a wall, and I’m really frustrated” (F-I #2, 2017). Fey stated that when she became frustrated she had people she could turn to for help in her department and at the school. “I’m struggling internally, right now, with how much
of it is my fault and how much of it is what I’m trying to work with or the tools I have to work with. So I don’t know” (F-I #2, 2017). A district assigned mentor was provided for Fey.

Fey’s response to being asked about how the science methods course has been for her in relation to her teaching was forceful. “I would have liked it last semester when I’m shadowing and not this semester when I’m teaching because the content is great, there’s so much and the learning curve in that course is huge” (F-PSI, 2016). However, she confessed “trying to absorb it all” took effort on her part with all the other information she had to process (F-PSI, 2016). Fey was asked to relate how her science methods course helped her with enacting her teaching philosophy in her lesson planning during the pilot study. Fey expressed increasing frustration with her course work and stumbled in her response due to her inability to articulate the source of her frustration about her science methods course, as she searched for the wording for her answer. “I, it’s just, how to write lesson plans”, she finally blurted (F-PSI, 2016).

Fey’s lesson demonstrated her ability to incorporate multiple learning strategies into her instruction. She used a variety of methods to engage her students in their learning. Fey’s struggles with implementing the NGSS resulted more from the timing of her science methods course than it did from a lack of understanding of what she was supposed to teach. She took her science methods course while she was shadowing another teacher, not while she was teaching her own students (F-PSI, 2016). “You’re at the mercy of them, how they’re going to do it, their lesson plans, I mean” (F-PSI, 2016). Fey had never stepped into a classroom in the roll of a teacher when she shadowed a veteran teacher. She felt that having ARL science teachers take the science methods course a semester before they become “autonomous” would have provided her a “better arsenal” for teaching (F-PSI, 2016).
She credited her “survival” that first year to her principal for getting her a mentor through the school district, her department, and content area teachers that she worked with (F-I #2, 2017). She was excited and animated, during Interview #1 (2017), describing how she would teach two class periods while her mentor observed her; then for the next two periods Fey would watch her mentor, Annie, teach the same exact lesson. During her prep period and at the end of the day, Annie and Fey would sit down and debrief on the lessons. Fey found the debriefing to be the greatest help to her “It has changed everything for me” (F-I #1, 2017). Fey was able to create a teaching repertoire, with the help of her mentor and colleagues, that worked for her and her students. Fey drew from what she observed her mentor doing and inserted her style and personality to redesign her instructional practices. By observing, mimicking, and debriefing with her mentor, she was able to break down her instruction so that her students were led to create their own knowledge using small pieces of information.

Her mentor allowed Fey to do what she needed to do, as a teacher, to create the type of learning environment she envisioned. “I’m seeing what is expected in action” when she would watch her mentor, then sit down and debrief the lesson she observed in her mentor’ teaching (F-PSI, 2016). Grossman et al. (2009) noted that novice professionals need to have the hidden components of instructional practice discussed so that they understand that novices are able to blend the seen and unseen components seamlessly. Fey still struggled with the two levels of learners in her classroom but she was better prepared and understood strategies that allowed her to split the students’ learning without holding the accelerated students back. Her desire to create critical thinkers and encourage her student to construct their own knowledge was just beginning to emerge due to her mentoring and determination not to let her students down.
**Theme 2: Evolving enactment.**

Fey was asked about the part of her teaching philosophy and she stated that she wanted her students to be able to critically think and become self-actualized, in Interview #2, 2017). Fey was asked how she was going about enacting this part of her teaching philosophy. She gave students “bread crumbs” of information that were discussed as a group and as a class, followed by a demonstration of a phenomena or classroom activity, some more “bread crumbs”, finally leading up to the students discussing different ideas that would provide evidence-based explanations of the phenomena that they were shown (F-I #2, 2017).

Fey was providing information to students on water as it cycled through the Earth’s systems during Observation #1 (2017). The students were provided with a work sheet that had some recall questions and synthesis questions they had to answer as Fey went through a PowerPoint presentation with the students. The presentation was a combination of informational slides interspersed with short video clips. Before playing the video clips, Fey would ask a question and discuss it with the class. The lesson required students to utilize prior knowledge of molecules, matter, cycling of materials through a system, and heat energy when discussing the water cycle on Earth (F-O #1, 2017). Students had to “recall and apply prior knowledge of the water cycle to identify and describe the factors influencing the ‘cause and effect’ principal” (F-LP #1, 2017).

Fey was observed as she began the water cycle lesson by asking students questions to review prior knowledge. Students had to fill out the first and last page of their packets based on what they already know about energy and water. Fey asked the students to discuss the task to help clarify their understanding of what was needed to be done. She asked the class to restate the information they were to fill out on the note sheet and then to discuss what it all means to them.
(F-O #1, 2017). As the students worked through the note packet, Fey would project different parts of the notes using the ELMO. “On their copy, and while I use ELMO to project student version of the worksheet, I will write down ‘claim, evidence, reasoning’ on the white board per student consensus” (F-LP #1, 2017).

To understand the cycling of materials through the water cycle, Fey asked, “Are you drinking the same water the dinosaurs drank?” as an opener to the next video clip (F-O #1, 2017). Fey led a brief class discussion asking the students what they thought about that question, asking them “are we or aren’t we and why should we care?” (F-O #1, 2017; F-I #2, 2017). The students were encouraged to turn to their neighbors and discuss the information on the water cycle throughout the class period. Fey maintained engagement through the use of direct teaching, class discussions, using lines of questioning, was providing written notes in the form of a work packet, and used brief video clips that reinforced the content. After each video Fey would ask, “Why do we care about water and the water cycle?” or “Why do we care what dinosaurs did?” (F-O #1, 2017).

Fey continually assessed the students’ prior knowledge and introduced new concepts through questioning prior to and directly after each slide and video clip. Students had to answer questions before the video clips were played and reevaluate their responses based on the new information in the video. Fey allowed students a few minutes to discuss responses with their partners before bringing them back to share their thoughts (F-O #1, 2017). Students found the ‘dinosaur pee’ video funny. Fey laughed and responded, “I thought you would” (F-O #2, 2017).

The discussions that took place between providing notes and showing the videos included students’ applying and using prior knowledge to construct answers. Students had to understand the cycling of materials on Earth, heat energy, vocabulary words such as evaporation,
transpiration, and precipitation. Fey required her students to use their vocabulary words appropriately when constructing verbal and written responses to questions (F-LP #1, 2017; F-O #1, 2017).

Fey’s notes guided questions that aligned with each video and the discussion of the PowerPoint slides presented before and after each video. Fey utilized cold calling when asking for responses from students “to answer similar questions asked in ‘Water Cycle’” (F-LP #1, 2017). Fey used guided questions and open-ended questions with the students as they worked on the water cycle activity during Observation #2 (2017). Students had to label a diagram that traced the path of water through the water cycle and they had to identify each process that determined the movement to each point. Students were required to use their vocabulary words as they answered questions and labeled their diagrams (F-O #2, 2017).

Fey was emphatic stating in her philosophy that there was a growing need to diversify lessons and to create dynamic lessons by integrating technology. She also stated in her philosophy that she wanted the lessons to have meaning for the students (F-LP, 2016). Fey would ask the students, after each video clip was discussed, “Why do we care?” (F-O #1, 2017). She was able to “pique their interests in the subject through relatable analogies and examples” (F-TP, 2016). The video clips provided examples and relatable information and analogies for the students. The video clips were interspersed within the PowerPoint lecture so that students remained engaged with taking notes and labeling diagrams that were loaded in a folder in Canvas (F-O #1, 2017).

Fey described a rain shadow demonstration, during Interview #2 that she used as a “bread crumb”, to describe what she meant by “bread crumb”, which required her students to apply information from the water cycle to this new concept. “I had a group count bubbles on one side,
then I had a group count bubbles on the other side” of a rain shadow effect set up in her classroom (F-I #2, 2017). She had students practice graphing data, applying vocabulary when writing responses, and Fey helped the students pull it all together. “And I say what does your bubble graph look like, okay, so what do you think this is? And then they have to, they start, ‘Oo, wait! We’re making a mountain range’” (F-I #2, 2017). As Fey continued to relate this lesson during Interview #2, she became increasingly animated. Her excitement and joy was infectious, “Success, yes! Check that off my list, they figured it out by the trail of bread crumbs” (F-I #2, 2017). Now Fey was beginning to see the vision of herself as a science teacher evolving.

**Theme 3: Maturing enactment.**

Fey discussed her desire to create a blended learning environment for her students where they would utilize the technology in the classroom to engage in student-centered learning. Fey discussed the fact that her classes consist of accelerated and general education students in the same room. “It’s working fabulously with accelerated and I’ve had to digress a little bit with the general education” (F-I #2, 2017). She had to create assignments that would engage the accelerated students in her classroom while at the same time ensuring that the level of difficulty of the assignments did not set up her general education students for failure (F-I #2, 2017). She stated that she was overcoming this situation by allowing the accelerated students to move on to the next learning module, in Canvas, while working to bring the general education students up to the same point that the accelerated students were so that Fey was able to conclude each unit as a class (F-I #2, 2017).

Fey combined Chrome books, videos, PowerPoint notes, and classroom discussions to create a blended learning environment for her students (F-O #1, 2017). Fey referred to the use of
computers in teaching as “profound” because of the many different areas of teaching and learning they may be applied (F-TP, 2016). Students were observed examining diagrams of the water cycle they accessed on their Chromebooks which allowed them to complete different tasks while filling in their notes (F-O #1, 2017). Fey directed them to a folder she set up on Canvas, where the students were able to drag and drop labels onto diagrams of the different stages of the water cycle (F-O #1, 2017). This was one example of what Fey referred to as “getting them to use different parts of their brains during class” (F-I #2, 2017).

Fey liked to have the students engaged and that different activities she had her students do engaged different parts of their brains (F-TP, 2016; F-I #2, 2017). The water cycle activity required that students move around to different stations based on the dice they rolled. The students had to follow the directions on the cards at each station to determine where they moved to after rolling the dice. The work packet contained questions that students had to answer using evidence and prior knowledge. The diagrams in the packet required the students to identify images at each station and transfer that information to the appropriate area on their diagrams (F-LP #2, 2017; F-O #2, 2017). The students had color pencils, glue sticks, and scissors because some stations required students to create a small foldable that they labeled if their dice sent them to those stations on their journey through the water cycle (F-O #2, 2017).

Fey wanted to create “self-actualized learners and teach them to accept responsibility for the choices and actions they make” (F-TP, 2016). The water cycle activity displayed student-centered learning with some direct teaching to ensure that students understood the activity and what they were supposed to be doing to complete the tasks. She rarely provided any information beyond reminding students to read the information at each station or to use the evidence to justify their responses. Each station had guided questions in which students had to demonstrate
an understanding of the steps of the water cycle and where each component fit into that cycle as they traced the path of the water around the cycle (F-O #2, 2017).

Fey felt that her weakest area was implementation of student-centered learning in her classroom. “I would love to give that a go; I don’t trust my kids. I would like, I don’t know how to even do that”. Fey read about the process of getting students to direct their own learning but admitted that she was not sure exactly how to do this. She had been exposed to the concept in her science methods course she took in her preparation program where “they figure out a puzzle and they move on to the next one or they don’t because they didn’t figure it out” (F-I #2, 2017). Fey was asked what type of learning she would use to categorize the puzzles and foldables that she gives her students. “I show them a sample and say make yours look like this. So is that, they learn, okay, are they, I’m thinking…when I heard that, I’m thinking that…I am!” (F-I #2, 2017). Fey realized that she was using student-centered learning and was stunned during Interview #2 (2017) when the epiphany hit her.

Fey related her success with students working on a foldable (F-I #2, 2017). She described providing students directions for creating the foldable and providing an example of what the finished foldable should look like. She explained that she wanted the students to figure out how to get to the final foldable using the directions and looking at the finished example. Here was where she reported that she faced some resistance from the students. “’Miss, I don’t understand the direction is what I get after I’m finished explaining the direction” (F-I #2, 2017). She related that she patiently asked them to be more specific about the things they did not understand when they read the directions for the foldable. “Then I get ‘Oh’ from those students as they take the directions from the set I put on their desks and they start reading” (F-I #2, 2017).
The frustration in her voice became evident as she discussed what happened as she turned from that table of students and began to walk around the room to check on the students’ progress:

“‘Miss, I don’t know how to do this. I’ll say, ‘Well, you haven’t even tried yet. Try it. I want to see a bunch of creases on this paper before you come to me and tell me ‘I can’t do this.’’” (F-I #2, 2017).

Fey was able to make science connect for her students. She was becoming more observant of her students’ learning and getting to know her students’ abilities in greater depth. She would present a small amount of information to her students, allow them to discuss the information, engage in an activity, and then gather the students back together to ask them “Why should we care?” (F-O #1, 2017). Fey required her students to incorporate their vocabulary into their responses to this question. Fey was able to make her lessons engaging and relevant to her students by incorporating activities that put the students into the process of science as she did with the water cycle activity. Fey was continually checking on the progress of her students, making sure they understood what they were doing, and asking them to explain the process to her during the water cycle activity. Her concern for her students’ academic success was foremost in her mind. Her excitement as she discussed what she was doing in the class contrasted with the pilot study interview and her feeling of failure and frustration.

Fey was asked about her written philosophy statement where she wrote about wanting to fulfil her philosophy. She was asked to discuss how that was taking place. She stated that she was more “cognizant of the fact that…I’m not reaching some of these people” but understood that she still had a great deal of learning about teaching to do. She realized that her philosophy would keep evolving but felt that “I am growing closer to fulfilling it”. When asked to discuss some ways in which her teaching philosophy had changed between her first and second year of
teaching, Fey stated that she realized that her “way is not the only way”. She emphasized that she valued the idea that students had voices and that she realized that they would eventually find their way between “getting to C, not going through B, and so I’m learning a tolerance for that.” She stated that as long as the students got to the point she needs them to be at, “their journey was just as acceptable” (F-I #2, 2017). With the help and support of her school’s administration, her mentor, and colleagues, Fey was starting to mature in her ability to enact her teaching philosophy in her lesson planning and instructional practices.

**Summary**

Fey found that spanning that gap between learning what steps to take to teach the content versus how to implement those steps left her close to tears and feeling overwhelmed in her first year of teaching. “It’s excruciatingly frustrating” for Fey because she was led to believe that her students were not the issue and that her teaching was the issue (F-I #2, 2017). Her mentor, administration, and department were very supportive of her teaching and always willing to provide her with anything she needed to successfully teach her students. Fey confessed to her students that she was learning how best to teach them science. She spoke honestly and passionately to her students, not at them. She asked for their help in becoming a better teacher. “They’re people and we’ve got to make this work. Help, you tell me what we can do” (F-I #2, 2017). She was more relaxed in her in her role as a teacher in her second year of teaching, she had a clearer sense of purpose as a science teacher, and a stronger connection with her students as she relinquished control of their learning over to them.
Isaac

Theme 1: Emerging enactment.

Isaac was asked during the pilot interview to relate to the researcher what he expected to learn in his first year teaching. “Doing more inquiry-based teaching is something I’m learning right now, too” (I-PSI, 2016). He was passionate about using inquiry-based lessons in his classes because he was shown different ways of using inquiry lesson in his science methods course.

Observation #2 was selected because the lab was designed to be an inquiry-lab using the microscope to examine plant and animal cells (I-LP #1, 2017). At the beginning of class, Isaac reviewed the lab with the students. He used a demonstration with the students to show them how to make a wet mount and how to stain their slides. He reminded students that they would have to create scientifically acceptable drawings and label them according to what they were told and how they practiced this in a previous lesson (I-O #2, 2017).

Isaac was asked to relate the kinds of information he obtained from his science methods course during the pilot interview (2016). One of the things he said the instructor did was engaging the novice science teachers in inquiry-based activities that were aligned to NGSS. He explained “It’s mainly focusing on inquiry [in the science methods course]. Hands-on inquiry” (I-PSI, 2016). Isaac had students using tools such as microscopes, slides, cover slips, and different specimens to practice using microscopes for observations of cells in an inquiry lab.

Isaac’s lesson plan included student use and application of the vocabulary “in correct sentences”, identify cell structures and different parts of the microscope as they compared and contrasted animal and plant cells (I-LP #2, 2017). He had students beginning the lab by answering a Do-Now question, using their lab notebooks for the microscope lab, and following
the format for correctly keeping the lab notebook. Isaac identified staining the slides in his lesson plans, “There will be a demonstration by the teacher to let the students know how to do it properly” (LP #2, 2017). Isaac did the staining because he stated that he did not want the students getting stain on themselves or ruining the stain (I-LP #2, 2017).

Isaac’s strong desire to provide meaningful, challenging activities that would allow students to work with each other as they applied what they were learning were expressed in his teaching philosophy (2016). He stated that as they gained knowledge, he would be able to incorporate more hands-on activities and laboratory experiences for his students so that they might “apply the base knowledge they should have received” from his lessons which would allow him to gage if they “solidify and learn more about that topic” (I-TP, 2017).

Isaac passionately expressed his desire in his teaching philosophy to have his students think critically and engage in inquiry-based learning. Isaac was still using direct instruction as a way to build foundational knowledge in his second year of teaching. He found that even his honors students lack the fundamental content that he felt they should have, especially as honors students. Isaac believed strongly in building foundational knowledge before moving his students forward in applying and thinking critically about this knowledge. Isaac had reached a compromise between traditional approaches to teaching that may have worked for him and progressive teaching styles that incorporate a variety of teaching strategies (Witcher et al., 2001).

Theme 2: Evolving enactment.

Isaac was asked how he envisioned himself teaching in his second year because in his teaching philosophy, he had stated that the “teaching materials do not reflect how I want to teach” (I-TP, 2016). Isaac elaborated, “So I want to go paperless for the most part. One of the
biggest things I want to do is I want to do Google Classroom” (I-I #1, 2017). He expressed his desire to use Google Classroom because he believed it would “help my students” since they would be able to access notes and supplementary materials via this platform rather than Isaac handing out copies of work. Isaac felt it would make all the content materials and information available to the students at any time (I-I #2, 2017).

Isaac was asked to discuss any changes in his teaching philosophy that may have taken place since his first year of teaching. He stated that he was still teaching in a traditional manner because there was a great deal of foundational knowledge that the students were lacking, “even for honors students” (I-I #2, 2017). He was “doing a lot more inquiry teaching” than he was able to do in the previous year because he was still trying to learn how to teach. He was trying to move further away from traditional teaching, where he was providing information to the students and working hard on getting his students to the point where they could drive their own learning. “I’m going to try to incorporate more online stuff, um, and that’s the way I’d like to teach” (I-I #2, 2017). Isaac’s virtual enzyme lab was an inquiry activity which required students to read the directions for the virtual lab equipment, set up their test, run it, observe any changes to the solutions they set up, and examine the data that was collected by the virtual equipment. Isaac used some direct teaching when he reviewed the lab packet with the students while the computers were logging in. The lab was designed to be a realistic simulation of the effect temperature and pH had on enzyme function. Students had to gather data, keep a table of data, and graph the data in their lab packets after all experiments were run (I-O #3, 2017).

“What I typically try and do is to apply the information I give them with a project to do” (I-I #3, 2017). The virtual enzyme lab simulation explained the different tools students would need to manipulate in order to run the simulation and gather data on reaction rates. “They would
need to interact with the website in order to complete it” (I-LP #3, 2017). Isaac briefly reviewed the sections in the packet which directed the students to read the website information so that they would understand how to manipulate the controls in the simulation (I-LP #3, 2017; I-O #3, 2017).

Isaac’s comfort with his ability to teach science appeared to be stronger, yet he still felt he needed to use direct-instruction to build foundational knowledge for his students. There may still be a residual sense of insecurity within Isaac that was creating a conflict between his vision of himself as a science teacher and the struggle to let go of the types of teaching methods, i.e. direct instruction, that provided him a sense of comfort because of its familiarity.

**Theme 3: Maturing enactment.**

Isaac stated in his teaching philosophy that once he was able to establish a strong knowledge base for his students, he would be able to incorporate more hands-on activities and laboratories. Isaac stated, “This will have the students apply the base knowledge they should have received. It should also help them solidify and learn more about that topic” (I-TP, 2017). He also felt that students were capable of “figuring out problems if they are able to work together” but Isaac felt that it was necessary to guide his students to that level of learning. Isaac recognized the challenge of getting his students to this level but he also recognized that “it may be extremely beneficial for them to do it” (I-TP, 2016).

During Isaac’s second year of teaching he was asked to revisit his statement in his teaching philosophy regarding his desire to have his students think critically. He discussed the steps he used where he presented some information to the students; the students were given a scenario where they applied that information. Then Isaac had them begin to create some possible
solutions based on the information they were provided. He related that he expected that some of
the student responses would demonstrate more than one way to solve a problem. He found that
he was able to take his students through the steps to become critical thinkers in his second year
of teaching because of the experiences he had in his first year of teaching. He further attributed
his students’ somewhat successful first attempts to the fact that they were biology honors
students so their behavior was better. “I’ll give them a rubric of what I’m looking for but I want
to inspire their creativity a lot” (I-I #1, 2017). He went further in his explanation, “Last year the
regular biology students were so low. They couldn’t read, think…” (I-I #2, 2017).

After his first year of teaching, Isaac still appears to be unable to fully identify, within
himself, the evolution taking place in his teaching philosophy. He attributed the students’ ability
to figure out problems, in his second year, to their status as honors students rather than recognize
his maturing enactment. Isaac was incorporating more inquiry-based lessons into his second
year of teaching after reflecting back on what he had learned in his science methods course.
Isaac may be misinterpreting his lack of trust in his students for his lack of practice at making
instructional judgment calls when it comes to his professional practice (McDonald et al., 2013).
However, Isaac expressed his determination to reflect on his teaching as an ongoing process
during his teaching career. He felt that this would allow him to critically examine his practices
so that he could improve himself as a teacher.

On the day of Observation #2, Isaac looked flustered and sounded rushed. He
approached the researcher to explain that the cellular diffusion lab was going to be conducted as
a demonstration because he could not find enough equipment and could not purchase enough
supplies for students to conduct the experiment in groups (I-O #2, 2017). Isaac conducted the
demonstration of cellular transport for the students, explaining each step so that students were
able to write down the information on their worksheets. Isaac checked to see if anyone needed more time before moving on. He asked them questions on the current material and included questions that required them to use their prior knowledge from previous lessons. Isaac asked students to make predictions during the lesson on cellular transport (I-O #2, 2017). As Isaac set up the demonstration, he kept a continual dialog with the students asking them to share the predictions that they made and asked questions as he continued the set up (I-O #2, 2017).

Isaac was observed in the school’s computer lab for lesson plan #3 which required the students to determine the effect different variables had on enzyme function. Students were using simulations of equipment used to test enzyme activity in a real laboratory. Isaac called the students’ attention and explained that the lab packet was not a cook book: “You will need to think about what you’re seeing and figure out what’s going on in the simulation” (I-O #3, 2017). He reiterated that the directions for working the simulation could be considered “cook book” but that was because students may not have used this type of simulation before. There was no observed direct teaching during this virtual simulation other than the review of directions.

In his lesson plan, Isaac included that students would “define vocabulary, apply vocabulary words correctly in sentences, and if applicable, give examples of what the vocabulary word is” as they worked their way through the simulation (I-LP #3, 2017; I-O #3, 2017). Students were required to write down what they knew about enzymes prior to beginning the lab, while the computers were logging into the school’s server. Isaac walked around the computer lab making sure that the students were logging in, reading the information in the lab packet, or working on the questions. Once the computers were logged in, Isaac moved around making sure students were able to locate the appropriate website using the URL he wrote on the white board (I-O #3, 2017).
Isaac’s hands-off approach during Observation #3 contrasted sharply with Observation #1. He attributed his altered teaching during the lab to critical self-reflection and utilizing different resources. Isaac utilized the resources he had available when he found he was struggling with implementing his teaching philosophy. He spoke with other novice science teachers and sought the assistance of a veteran science teacher at his school as well as a veteran English teacher at the high school he attended. “So if I’m having an issue with like my philosophy, um, getting it across, I’ll go ask them and get some help” (I-I #2, 2017). Isaac stated that the biology teachers were close and were in continual contact “and if we have issues we always come and talk; we always meet once or twice a week, typically” (I-I #2, 2017). Based on this, and the recognized change during Observation #3, his support network was allowing Isaac to mature in his instructional practices.

He felt that the biggest issue he had with enacting his teaching philosophy had to do with application. Isaac’s teaching philosophy, lesson plans, and observations demonstrated that he was able to get his students to practice and apply concepts. Yet he still felt he was not successful with enacting student-directed learning. Isaac felt that he lacked familiarity with how to go about having students direct their own learning in his classroom because he was not able to practice student-centered teaching with his students:

I really haven’t practiced it all too much. Student-centered learning is useful, depending on the student or students that you have, it will not work because the students will be more involved into their own learning process and the majority of them have not learned it, form where I’m currently teaching at. Um, they’re just force fed down the pipeline, but that’s another story (I-I #2, 2017).
Isaac stated students “get into that habit and it takes a while to break a habit” where the teachers are providing information and the students take on the role of passive learners. He reflected on the question when asked about this weakness. Isaac stated, “I can’t rely on my students to actually do that. I can’t really practice that, which means, if I can’t practice I can’t get better at it. So I think it’s a combination of both” with regard to his inability to enact student-directed learning (I-I #2, 2017).

Isaac still returns to student resistance as justification for his inability to fully enact his teaching philosophy in his lesson plans and instructional practices. He was aware of his lack of trust in his students even as his enactment started to become mature. Isaac demonstrated a hands-off approach during Observation #3 whereas, in Observations #1 and #2 Isaac seemed to hover more around his students as they worked. His teaching philosophy stated that he wanted students to figure things out for themselves which is what they did, based on the researcher’s observations during the virtual simulation. Very few of the students asked for help if they were having difficulties with the computers connecting with the school’s server or manipulating the virtual equipment in the simulation. Instead they were seeking out assistance from each other, with the exception of a student at a malfunctioning computer.

Summary

Isaac claimed that he was struggling with the push-back from his students and his students’ lack of foundational knowledge that would allow him to take his students to a deeper level of learning and thinking about science. It may be that the resistance that Isaac perceived was due to his lack of knowledge about what and how much his students knew about science. Isaac appeared to be the most confident in his abilities as a novice science teacher. However, the lack of trust, whether in his student or himself, appeared to be dissolving in his second year of
teaching. Isaac began to move away from direct teaching by incorporating more inquiry-based learning. He attributed this move toward inquiry to self-reflection on his instructional practices, the guidance of his mentor, and the support and assistance of his peers. His move toward achieving this goal was happening at a slow pace and Isaac was comfortable with the progress.

**Summary of the Findings**

Teaching philosophies reflected stances regarding learner-centered teaching, i.e. application of knowledge, opportunity practice concepts, project-based learning, and student-centered learning (Feiman-Nemser, 2009). Adrianne, Fey, and Isaac each expressed varying levels of progressive teaching viewpoints and provided examples that demonstrated their desire to teach in a learner-centered way. Adrianne, Fey, and Isaac still used some direct teaching to build knowledge despite demonstrating progressive teaching viewpoints. Isaac relied more on direct teaching to build the foundational knowledge he felt his students were lacking so that he was able to move his students toward becoming critical thinkers. Adrianne and Fey used direct teaching but incorporated a more interactive component to it. Adrianne would ask students to use their prior knowledge to anticipate what information would be on the next slide. Fey provided time for her students to discuss information with each other and then provide responses to questions that were posed to them.

The teaching philosophy discussed each novice science teachers’ vision of how they would like to teach. Adrianne planned on pacing her teaching to the pace of her students’ learning, Fey recognized the need to diversify her lessons to meet the needs of her students while incorporating technology in her lessons, and Isaac focused on what he would need to do to teach his students critical thinking skills so that they were better prepared to learn science content. A common theme through the three philosophies was the desire to help student to become critical
thinkers through the use of learner-centered teaching. Fey appeared to be closer to enacting her philosophy of utilizing a blended-learning environment because she had integrated Canvas into her classroom practice.

Adrianne was able to engage her students in the lessons and activities she chose for her students to work on. She ensured that there was interactions involving students working in groups or individually as she moved around during activities or questioned her students as notes were prevented. Fey engaged her students by utilizing Chrome books, varying her presentation of information by including videos to introduce or reinforce information she was reviewing.

Isaac engaged his students by interacting with them as he discussed information and asking his students questions to determine their level of prior knowledge.

Adrianne was frustrated with her attempts to implement student-directed learning. She was concerned enough for her students’ success that she sought help from other biology teachers in her department. Fey had to learn to let go of her desire to control her students’ learning and allow them to take control of their own learning. Part of her journey began with a district assigned mentor and the other part of her journey allowed her to draw her students into helping her. Isaac struggled with getting his students to the academic level he felt they needed to be at. He felt it was crucial to understand the amount of foundational knowledge his students had in order for him to bring them to the next level of learning.

The teaching philosophies and interview data allowed the researcher to answer RQ1 and RQ2. First, the researcher examined the novice science teachers’ teaching philosophies at the entry level of teaching to identify the type of teacher they wanted to be (RQ1). Adrianne expressed concern about providing her students with enough time to learn at their own pace and their ability to apply their knowledge; Fey wanted to teach critical thinking skills and create self-
actualized learners; and Isaac wanted his students to think critically and apply their knowledge (A-TP, 2016; F-TP, 2016; I-TP, 2016). In addition, Adrianne, Fey, and Isaac wanted to be engaging teachers who made science fun and interesting for their students.

RQ 2 addressed the factors that may have influenced Adrianne, Fey, and Isaac’s enactment of their teaching philosophy in their lesson plans and instructional practices. The interview data allowed the researcher to uncover the influences (the science methods course, their mentors and colleagues, and their critical self-reflection) that were beginning to shape the novice science teachers’ enactment of their teaching philosophy about teaching secondary science. Adrianne became more confident about her teaching and let go of her expectation of perfection from her students. Fey turned to her students for help in teaching them how to learn and learned to relinquish control of learning over to her students. Isaac was able to engage his students in class discussions and began to utilize more inquiry-based learning activities as his trust in his students and himself began to grow.

The lesson plans, teacher observations, and interview data helped to answer RQ 2 and RQ3. Lesson plans provided the outline of what would be taught by the novice science teachers and provided the researcher a glimpse of the structure and delivery of their lessons, as well as identifying the influence their science methods course had in their choice of instruction (RQ 3). Observing the novice science teachers as they taught the lessons and then conducting interviews after the observations helped the researcher examine novice science teachers as they implemented what they learned in their science methods course in their lesson plans and instructional practices. They learned to utilize inquiry-based activities and labs and to provide support for their students as they taught them how to be critical thinkers and self-directed learners.
These data helped to elucidate the changes that appeared to be altering and reshaping the novice science teachers’ views about the type of science teacher they had the potential to become. Adrianne was a nervous teacher, afraid of doing more harm than good and in her second year, she became a teacher who was gaining confidence with her teaching and working to build positive relationships with her students as she taught them to direct their learning. Adrianne exclaimed, “I’m a lousy teacher. I suck at it!”, yet began to morph into a teacher who was becoming more confident in her abilities as a teacher and increasingly focused on her students’ success (A-PSI, 2016).

Fey learned to relinquish control of her students’ learning so that they could be guided by her in constructing their own knowledge. Where once Fey was saddened and frustrated, she was becoming hopeful, less frustrated, and more determined to do right by her students by drawing them in with poignant words: “Help me to help you” (F-I #3, 2017).

Isaac was lacking in trust both of himself and his students stating “I don’t trust my students”, but he may have misinterpreted his distrust for insecurity in his role as a teacher (I-I #3, 2017). In his second year of teaching, Isaac was beginning to trust himself and his students as he became more comfortable with his role as a teacher.
CHAPTER FIVE

DISCUSSION, IMPLICATIONS, AND FUTURE RESEARCH

Chapter 5 will discuss the findings of this study as they pertain to the types of learning activities novice science teachers were exposed to in their science methods course work, and how these activities informed the enactment of their teaching philosophies in their lesson planning and instructional practices as novice teachers. First the findings will be summarized, followed by the study’s contribution to the literature and theories, implications for teaching and the program, limitations and future research, and last the conclusions of this study. Table 8 illustrates the findings that facilitate or hinder enactment of teaching philosophies in lesson planning and instructional practice.

Table 8. Factors informing enactment of teaching philosophies.

<table>
<thead>
<tr>
<th>Findings</th>
<th>Facilitate enactment</th>
<th>Hinder enactment</th>
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<tbody>
<tr>
<td>Written teaching philosophies focused learning outcomes, but changed focus</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Use of science methods course content</td>
<td>✓</td>
<td></td>
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<tr>
<td>Support of colleagues</td>
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<tr>
<td>Overwhelmed by teaching duties</td>
<td></td>
<td>✓</td>
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<tr>
<td>Lesson planning used variety of instructional practices</td>
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<td></td>
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<tr>
<td>Lack of KCS</td>
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Summary of the Findings

The research questions provided the framework for the study’s examination of novice science teachers’ teaching philosophies in their first year of teaching, factors that inform their enactment of their teaching philosophies in their lesson planning and instructional practices as
novice teachers, and the ways in which the science methods course work informed enactment and implementation of their teaching philosophies.

The first research question sought to identify novice science teachers’ teaching philosophies at the entry level. The findings suggest that the three teachers’ written teaching philosophies were focused on student learning outcomes rather than exclusively focusing on their teaching strategies. Within the teaching philosophies were glimpses of each novice science teachers’ vision of the teacher they wanted to become. However, when interviewed during their second year of teaching regarding individual teaching philosophies, the novice science teachers discussed how they would go about enacting their philosophies in their instructional practices. Their interview statements contrast with the written philosophies which appeared too focused more on how they saw what their teaching would be like in their classrooms.

The written philosophies demonstrated the use of concepts that were taught during the novice science teachers’ preparation programs, drawing from the general preparation and the science methods course. For example, student-directed learning and teaching critical thinking skills were mentioned in the three teaching philosophies. The interview data suggested that these components of their teaching philosophies and lesson planning were informed based on the content in their science methods course. The interviews demonstrated that the novice science teachers were not only utilizing experience in their science methods course, but also utilizing their personal, academic, and professional experiences to inform their practices.

The second research question was to identify factors that influenced novice science teachers’ enactment of their teaching philosophies. Based on the findings there are several factors that influenced the enactment of instructional practices in their classrooms. First, it appears that the science methods course was a factor that influences enactment for the novice
science teachers. Second, having supportive colleagues and mentors was an additional factor that was discussed by the novice science teachers as having an influence on their instructional practices. The support network helped them to see other ways of teaching and how those ways were enacted by their mentors and colleagues; furthermore, being able to engage in self-reflection during content meetings, one-on-one discussions with colleagues, or private contemplation of instructional practices appears to have helped facilitate two things: more effective enactment in instructional practice and changes in personal teaching philosophies. Third, the novice science teachers still struggled with a feeling of being unprepared for their first year of teaching because they felt overwhelmed by demands of their teaching duties.

The third question examined implementation of lesson planning into novice science teachers’ instructional practices. Lesson planning provided a script which may be used to provide guidance for the pacing of instruction, learning objectives and content standards that the instruction would meet, learning activities the students would engage in, and the types of assessments that would be used to determine if learning was taking place. While the lesson plans that were completed by the three participants did demonstrate the use of a variety of instructional strategies and assessment types, enactment of some of the components the novice science teachers’ teaching philosophies was demonstrated.

Teaching philosophies reflect one’s beliefs about teaching and learning and the ways in which teachers plan on teaching lessons (Witcher et al., 2001). The teaching philosophies examined for this study were created as a requirement for the novice science teachers’ science methods course during their first year of teaching. The novice science teachers’ teaching philosophies reflected their desire to present instruction so that students would be actively engaged in learning science. Feiman-Nemser (2009) discussed student-centered teaching as
something that was necessary for novice teachers to learn in their teacher preparation program so that they could meet the demands of the educational reforms being implemented. The reforms included teaching that focused on concepts, provide students with opportunities to practice concepts, have students critically think about concepts, have students engage in problem solving, and learning information that is relevant to the student.

The stances that Adrianne, Fey, and Isaac held at the entry level of teaching began to change as they practiced enacting their teaching philosophies in their lesson planning and instructional practices. As they accumulated more experience teaching, each novice science teacher became more progressive in their instructional practices. Adrianne became more confident in drawing information out of her students, Fey brought her students into decisions about their learning by asking for their help, and Isaac began to step back and to trust his students while still clinging to direct teaching for a sense of security.

Each novice science teacher displayed increasing levels of success enacting their teaching philosophies in their lesson plans and instructional practices. Adrianne and Fey demonstrated the greatest maturation in their teaching philosophies and began to enact what they learned in their science methods course. Isaac demonstrated a modest maturation, which was most likely due to his sense of insecurity about teaching. They still displayed dissonance between the way they envisioned themselves as teachers and their desire to maintain teaching styles that were familiar and comforting to them, such as using direct teaching to provide information to students.

The lesson plans did not break down how the novice science teachers were going to enact their teaching philosophies, what rationale they were using when they chose particular activities, simulations, laboratories, or assessments or why they chose any particular combination of instructional medium. It was when the novice science teachers were interviewed about their
lessons and instructional choices that it became clear why each instructional decision was made, the rationale behind the decision, and how the novice science teachers were going to enact their teaching philosophies as they implemented their instructional choices.

**Contributions to Literature and Theories**

The concepts and findings from the literature review were corroborated by the findings of this study, some study findings contradicted with the literature review, while others may contribute to furthering research into factors which inform or factors that fail to inform successful enactment of instructional practices of novice science teachers. This study contributes to both the literature of novice science teachers’ learning to teach and related theories.

**Teaching philosophies.** This study found that novice science teachers faced several challenges enacting their teaching philosophies. First, making professional connections with the students appeared to challenge Adrianne, causing conflict with her desire to do the right thing for her students while getting them to buy into their learning. Second, combining two levels of students, accelerated and non-accelerated students, in one classroom negatively affected Fey’s ability to enact her teaching philosophy because she was concerned about how to design instruction so that neither group of students was penalized. Third, Isaac was aware that he needed to practice his enactment in order to become better at teaching but felt that he was not able to practice because the students were not prepared to learn at the level he wanted to teach at. Last, the three novice science teachers felt that the resistance from the students to student-centered learning was hindering their abilities to enact components, such as creating critical thinkers, in their instructional practices.
Hill et al. (2008) discussed the necessity for teachers to be able to develop knowledge of science content at the same time they are building knowledge of their students. In the cases of Adrianne, Fey, and Isaac, their content knowledge was not a barrier to their ability to enact their teaching philosophy; their lack of knowledge regarding what and how much their students knew about science prevented them from creating solutions to the students’ resistance to instruction. This raises the issue of how to build knowledge about content and students in the teacher preparation program, but more specifically in the science methods course because of the way NGSS has redesigned the presentation of science content.

Teachers’ beliefs are key to novice science teachers’ learning to teach because their teaching philosophies were constructed with previous personal and educational experiences; rather than from the classrooms and the schools they are teaching. One of the central tasks for novice science teachers is to examine their teaching beliefs including philosophies through classroom practices (Feiman-Nemser, 2001). The teaching philosophies examined for this study were created as a requirement for the novice science teachers’ science methods course. Referring to two categories by Witcher et al. (2001), it was possible to identify progressive viewpoints in two of the novice science teachers’ philosophies. Their beliefs about teaching and student learning were strong because they were using their experiences to critically examine their instructional practices as a way to become better at teaching. One of the philosophies reflected a more transmissive viewpoint, using past views regarding teaching and learning because they worked and an assumption is made that they would still work.

The researcher was able to identify the novice science teachers’ teaching philosophies as having progressive or transmissive viewpoints which confirms Witcher et al.’s (2001) findings regarding teachers’ beliefs about teaching and their teaching philosophies. The study did not
help to identify factors which might have been instrumental in altering novice science teachers’
teaching philosophies. The findings suggest that at least in the science methods course, the
instructor was practicing inquiry-based teaching and learning in a manner that aligned with the
NGSS and was transparent to the novice science teachers (Marbach-Ad et al., 2012). According
to the findings, the novice science teachers were able to understand the teaching requirements of
the NGSS because the class paralleled many of the practices found in science, such as using
claim, evidence, reasoning (Marbach-Ad et al., 2012).

Previous studies did not look at factors such as the school or classroom environments as
contributing factors that may have brought about change in teaching philosophies (Marbach-Ad
et al., 2012; Wiesenberg & Stacey, 2013; Witcher et al., 2001). This study found that classroom
environment, particularly the students’ disposition to learning, may play a role in facilitating
changes in novice science teachers’ teaching philosophies and enactment of that philosophy in
their instructional practices. Additionally, the academic level of students seemed to have a
negative effect on Fey’s ability to create self-actualized learners. Her extreme case, where
accelerated learners and non-accelerated learners were combined in one class, created a novel
situation for her. Fey allowed the accelerate learners to move ahead with the content and teach
themselves, while providing a slower pace for the non-accelerated students. Fey was able to
reflect on this situation, design what she felt was a temporary solution, and reflect on changes for
the spring semester and changes for the next school year.

The findings suggest that the delivery of instruction in the science methods course
appeared to have a greater influence on the teaching philosophies of the novice science teacher in
the study. Further, the novice science teachers’ ability to turn to mentors and other content area
teachers for support and guidance appears to be a major factor in helping to facilitate changes in
their teaching philosophies, in turn bringing about more successful enactment in their instructional practices. Novice science teachers were required to write teaching philosophies but they were not being shown, in their preparation program, how to critically examine the contents of their philosophies in a constructive manner that would facilitate enactment in their lesson planning and instructional practices. The novice science teachers may have learned the what and why of teaching science but not how to teach science, particularly regarding novice science teachers’ knowledge about students.

Based on the findings, Adrianne, Fey, and Isaac utilized their prior experiences and reflection to begin improving their teaching when they reflected back on their first year in the classroom as opposed to their second year. Each novice science teacher struggled with different aspects of enacting their teaching philosophies in their instructional practices. Adrianne struggled with application of educational theory to her instructional practices, Fey struggled with enacting that part of her teaching philosophy where she could create self-actualized learners, and Isaac struggled with enactment due to his students’ lack of foundational knowledge. Yet the findings indicate that each of these novice science teachers were learning from the previous year’s teaching experiences and using this to alter their teaching philosophies and enactment of their teaching philosophies in their classroom practices (Smagorinsky, 2009).

Teacher preparation programs require teacher candidates to examine their teaching philosophies for the different courses they are taking. They may have to write teaching philosophies for introductory teaching, classroom management, general and content methods courses. Each teaching philosophy may allow the teacher candidate the opportunity to critically self-reflect on their written philosophies and to demonstrate how the experiences in their courses altered their beliefs and perceptions about teaching and learning. There may be a need for
teacher preparation programs to ensure that teacher candidates develop a philosophy that is concise, geared toward the content they plan on teaching and students they are teaching, as well as current educational theory. Further, ensuring that the teaching philosophies are written so that they are implementable in the classroom and transfer across to lesson planning may help to facilitate consistent enactment in novice science teachers’ professional practices (Weshah, 2013).

**Approximations of practice – enactment.** Grossman et al. (2009) identified the need to uncover the hidden components of enactment as a way to help novice professionals become better at enactment in their instructional practices. Based on the findings of this study, this did not appear to be happening in the novice science teachers’ preparation program. Opportunities for the novice science teachers to work through different activities and simulations in the science methods course were helpful in learning how to incorporate that type of learning into their classrooms. The science methods course also provides the novice science teachers with opportunities to identify areas in activities that students may have difficulties and ways in which the novice science teachers would be able to adjust instruction to address those difficulties. This finding was especially important to the novice science teachers’ ability to engage their students in inquiry-based activities. The findings suggested that teaching novice science teachers how to set up inquiry-based activities and laboratory experiments that require extensive material use are hidden components of enactment that may be unintentionally overlooked.

The findings indicated that the science methods course demonstrated ways to present instruction in the novice science teachers’ classrooms and provide opportunities for novice science teachers to act like the students. There was lack of opportunities for them to engage in supervised practice in the field to ensure that they understood how to enact various components of their teaching philosophies. Findings suggest that the critical factor that appeared to hinder the
novice science teachers’ ability to enact their teaching philosophies in the classroom had more to do with a lack of understanding of how to engage in instructional strategies, such as leading group discussions, conducting hands-on or virtual laboratories, how to overcome resistant students, or how to employ strategies that would lessen the need for behavioral management so that classroom instruction is not interrupted by a few challenging students (Gardiner & Salmon, 2014; Grossman et al., 2009).

The novice science teacher participating in this study faced students who were resistant to the learning style being implemented in classrooms. Resistance to instruction may be due to the novice science teachers’ lack of understanding and practice in designing instruction or motivating students in such a way that the students cease resisting (Hill, Ball, & Schilling, 2008). The situation the novice science teachers were facing may be a systemic issue to teaching and not relegated to novice teachers. Part of the barrier these novice science teachers are facing may have to do with implementing NGSS which require that learning be student-directed.

Research has demonstrated that students have become used to teachers being the provider of all information who only require students to regurgitate information back to them on assessments (Fadhlullah & Ahmad, 2017; Grow, 1991; Rahim & Ros, 2016). The findings demonstrated that even the novice science teachers who hold to progressive teaching viewpoints are still engaging in traditional teaching practices, such as brief lecturing on science content. The difference in these findings is that these novice science teachers were providing opportunities for their students to take the information and apply it to different situations. The students were required to formulate answers based on the NGSS claim, evidence, reasoning format and to provide novel solutions based on their prior knowledge.
The findings both support and contradict some of the findings of the studies conducted by Gardiner and Salmon (2014), Grossman et al. (2009), and McDonald et al. (2013). The support in favor of breaking down core practices as a means of critical reflection to facilitate enactment was taking place, whether the novice science teachers were self-reflecting as part of their course work or they engaged in self-reflection in order to improve their professional practices (Gardiner & Salmon, 2014; Grossman et al., 2009; McDonald et al., 2013). It may be useful to novice science teachers’ successful classroom enactment of their teaching philosophies in their lesson plans if they were to have a university or district assigned mentor observe and evaluate their enactment. Providing more opportunities for novice science teachers to practice the lesson plans they are writing for their science methods course and having opportunities to debrief with a mentor after observations may alter their perceptions about teaching science and how students best learn science content. For example, Lampert et al.’s (2013) rehearsal approach may be significant to novice science teachers’ learning to teach either in the methods course or in professional development at the schools they teach.

The contradiction occurred with the particular science methods course the novice science teachers were enrolled in. While it appears that the instructor was focused on product over process, based on the interview data, he demonstrated a move toward explaining science processes in such a way that the novice science teachers were able to incorporate some of the strategies from the methods course in their lesson planning and instructional practices. A paradigm shift away from learning products toward learning processes in the science methods course may help to facilitate effective enactment of instructional practices for novice science teachers. This may be more important to ARL teaching candidates because they may be taking fewer preparation courses and having fewer opportunities for field experiences than are required

**Missing conditions for linking theories to practice.** The novice science teachers in this study were knowledgeable about educational theories as they applied to teaching science. The ability to bridge the gap between theory and practice appeared to be happening during their work with mentors and colleagues. The novice science teachers reported that their mentors and colleagues helped them understand how the theories could be successfully applied to their instructional practices. The experiences they encountered in their classrooms seemed to be of great importance to the critical self-reflection the novice science teachers engaged in privately and with mentors and colleagues. Observing veteran science teachers teach or having mentors come into the novice science teachers’ classroom to teach provided important information and experiences the novice science teachers were able to incorporate into their teaching repertoire. These hands-on experiences and training components the novice science teachers engaged in confirm the findings of Deygers and Kanobana (2016) regarding the application of educational theories to classroom practices.

The finding of this study supported the findings in the literature with regard to the types of challenges and difficulties that novice professionals have in closing the gap between the theories they learn in their preparation programs and the application of those theories in their instructional practices; nonetheless, preactive practices were still being taught in the novice science teachers’ course work (Grossman et al., 2009). Academic faculty may not be keeping abreast of the changing school and classroom environments that the novice teachers will be entering in their first years of teaching. This lack of understanding on the part of preparation programs may be continuing the trend that is keeping this theory to practice gap open. The
participants in this study were in the same program at the same university and had the same
instructor for their science methods course, demonstrating a conflict with these researchers’
findings that variation in programs contributed to the novice science teachers’ inability to close
the theory to practice gap.

The challenges that the novice science teachers had during their first year of teaching
were supported by the findings of Gardiner and Salmon (2014), who found that when novice
teachers were unable to put the knowledge and experience they had gained from their preparation
programs into practice in the classroom, there was a breakdown in their ability to enact their
teaching philosophies. The novice science teachers acted as if they were their students as they
were taken through different activities and simulations in their science methods course; this was
still just a facsimile of what the novice science teachers had to contend with in their classrooms
(Grossman et al., 2009). When the novice science teachers were mentored by veteran teachers or
district-assigned mentors, they were able to begin to close that theory to practice gap because
they were able to see those classroom practices that were hidden (Gardiner & Salmon, 2014;
Grossman et al., 2009). Providing mentorship for novice science teachers appears to be an
instrumental component to closing the theory to practice gap and to facilitating successful
enactment of their teaching philosophies in their instructional practices. Additionally, what
remained uncovered was to further investigate the aspects of the theory to practice gap in science
teaching and there is a need for this investigation to help novice science teachers identify their
specific challenges and further enhance their teaching.

Unlike the study conducted by Deygers and Kanobana (2016) in which preservice
teachers taught for a short duration of time with no self-reflection, the novice science teachers in
this study engaged in self-reflection as a means to reevaluate their teaching philosophies and
professional practices (Feiman-Nemser, 2001). The components of their training were being utilized to varying extents by the novice science teachers but it may be that their self-reflection provided the greatest opportunities to critically analyze their instructional practices in a manner that allowed them to begin to understand ways to apply educational theories to close their gaps in application. The mode of self-reflection, in isolation or with the help of a mentor or veteran content teachers, may have made a difference in the outcome of the novice science teachers’ reflections on the changes they made in their teaching philosophies or in their enactment. The findings illustrated that changes of varying degrees did take place in the novice science teachers’ teaching philosophies.

**Implications of the Study for Teaching Practice and Course Design**

The purpose of this study was to examine the ways in which learning activities in a science methods course inform novice science teachers’ enactment of their teaching philosophies in their lesson planning and instructional practices. The implications of this study may affect the way the science methods course provides opportunities for novice science teachers’ to practice applying educational theories and information to teaching science. Providing additional guidance during field experiences and the first year of classroom teaching regarding how to enact different components of their teaching philosophies in their lesson plans and instructional practices may need to be evaluated as well.

**Enactment of teaching philosophy.** Entry-level teaching philosophies may be a tool that could be used to identify changes in thought that help novice science teachers’ enactment of their teaching philosophies as they progress in their preparation programs and their careers. Several factors were identified as influencing novice science teachers’ enactment of their teaching philosophies. Providing more opportunities for novice science teachers to breakdown
their instructional practices under the guidance of a mentor may provide more successful learning outcomes for the novice science teacher which, in turn, would be reflected in their enactment of their professional practices (Feiman-Nemser, 2001; Grossman et al., 2009). Providing more practice may ensure that novice science teachers become more comfortable with their instructional choices and demonstrate an understanding of how these instructional choices help may to facilitate improved learning outcomes for their students, thus helping to close the theory to practice gap as well (Gardiner & Salmon, 2014; Grossman et al., 2009).

Mentors (regardless of who places them or how they are placed) and supportive, collaboration among content area teachers appeared to be a significant factor in facilitating changes in novice science teachers’ teaching philosophies and enactment of their instructional practices. Feiman-Nemser (2001) discussed the use of innovation in teacher preparation programs as a way to facilitate enactment of novice teachers’ teaching philosophies. The findings of this research with regard to providing support for novice science teachers in the above mentioned manners, is borne out by Feiman-Nemser’s research.

Mentors and collegial support, at least in this study, appeared to facilitate the novice science teachers’ transfer and application of various educational theories into their enactment and instructional practices. The support network the novice science teachers had in their schools appeared to encourage them to try new or innovative instructional strategies or new activities with their students. Based on the findings, the novice science teachers’ were working with colleagues just as willing to try new activities or methods for teaching. This finding appears to contradict with Feiman-Nemser (2001) regarding closed-minded cooperating teachers stifling student teachers’ ability to enact their teaching philosophies or veteran teachers trying to get novice teachers to fall in line with the school or departments’ culture. These types of supports
may be instrumental not only for facilitating enactment of teaching philosophies, but for keeping
the innovative instructional practices novice science teachers learned in their preparation
programs alive and evolving. Finding and assigning open-minded and innovative mentors for
novice science teachers may help to contribute to understanding additional factors that enable
successful enactment of novice science teachers’ teaching philosophies in their lesson planning
and instructional practices.

**Student resistance to instruction.** This study provides a finding that was unexpected
and appears to have been a factor that negatively affected the novice science teachers’ ability to
enact their teaching philosophies in their instructional practices. It appeared student resistance to
instruction had an impact on the ability of novice science teachers’ enactment of their teaching
philosophies during classroom instruction. Grossman et al.’s (2009) study found that novice
professionals were afforded little time to practice contingency plans should something not go as
planned, including challenging students, the resistance of students to learn in the classroom, or
responding to student questions. The novice science teachers felt they had an adequate grasp on
how to present information to their students, due to their science methods class, but hit a wall
when it came to their underestimation of how much foundational knowledge their students
actually received and remembered. This finding posed a significant amount of angst for the
novice science teachers and appeared to be more challenging than their inability to bridge the
gap between theory and practice; further illustrating the lack of understanding the three novice
science teachers had regarding KCS (Hill et al., 2008). However, student resistance may have
been due to the novice science teachers’ lack of knowledge of their students’ understanding of
science and their lack of confidence as novice teachers than it was to student resistance to
instruction.
Inquiry-based instruction. The inquiry-based instructional practices that were incorporated into NGSS were put in the document as a way of increasing student science literacy while moving science instruction away from teacher-centered teaching and toward learner-centered teaching. Science teachers, under NGSS, must use evidence-based reasoning in their teaching practices as a tool for facilitating critical thinking in their students (National Research Council, 2013). There may be teachers that are resistant to this type of teaching and still cling to teacher-centered teaching. As a result, students may become just as comfortable with this type of learning; rote memorization with little student input in their learning and knowledge construction.

Studies have found that teacher-centered teaching does not benefit the long-term retention of information but instead creates passive learners who rely on the teacher to construct knowledge for them (Rahim & Ros, 2016). Studies suggest that incorporating the kinds of teaching strategies outlined in NGSS, where students have to formulate an evidence-based argument when providing responses, or incorporating more open-ended learning activities while providing less direct-teaching, may help to improve science students’ ability to critically think within and outside the box of science (Fadhlullah & Ahmad, 2017; Rahim & Ros, 2016).

The novice science teachers in this study appeared to have a clear understanding of inquiry-based learning, but still engaged in some direct-teaching or teacher-centered instruction. Their rationale was that the students had little to no knowledge base or the novice science teachers failed to investigate what knowledge their students came into the classroom with from middle school. The novice science teachers felt that direct teaching was needed to build foundational knowledge in their students before they could move forward in instruction. Nevertheless, the three novice science teachers were engaging in varying degrees of active
student learning through activities, laboratory experiments, and virtual simulations. They placed their students in groups for collaborative learning and engaged in group and whole class discussions where students were required to provide evidence to substantiate their claims. Perhaps as these novice science teachers gain more experiences in their classrooms, they will move away from teacher-centered teaching and embrace student-centered teaching.

**Limitations**

A limitation to this dissertation was that there were many factors beyond the control of the researcher, such as relying on the good graces of the original pilot study participants to consent to volunteer for this study. Eight emails were sent out to the original participants but only three responded. There might be a flaw in the methodology due to the small number of participants and the fact that they already had some idea about this current study due to their previous participation in the pilot study. To overcome this potential limitation, the researcher closely examined and compared the wording of questions in the pilot study with the interview questions for this study, and took extreme care when wording questions for the first interview for this dissertation.

The most important step the researcher took to avoid having flaws in methodology was to be detailed and rigorous in her descriptions of the methodology, the choice of study method (i.e. multiple-case study), careful consideration and review of the body of literature that pertained to the research, choice of theoretical framework, and concise wording of research questions (Hyett, Kenny, & Dickson-Swift, 2014).

Validity and reliability were issues to consider but were contingent upon human nature, which was beyond the researcher’s control. Obtaining the lesson plans, via email, from the
novice science teachers necessitated building a trusting relationship with the novice science teachers and assuring them that the researcher had no interest disclosing personal information that may appear in the lesson plans or email. The researcher also had to trust that the novice science teachers email their lesson plans in a timely manner and were willing to allow the researcher into their classrooms to conduct observations of their teaching. In addition, the willingness of the school principals to allow the researcher into the school had to be obtained prior to engaging in the collection of lesson plans. These aspects of data collection were out of the researcher’s control and could have limited the quantity, and perhaps the quality, of the data available for analysis.

Close attention to detail was important to this qualitative study because this was one of many issues that render the view of qualitative studies as less credible than quantitative or mixed methods studies. Being true to the stories of the participants being studied, carefully interpreting the findings, and clearly, concisely, and accurately reporting the data would far in lending quality and credibility to this dissertation study (Hyett et al., 2014). Artistic license was taken but only so far as it could be methodologically justified by the researcher.

Qualitative studies may be used to generate theories which are substantially supported by the research. In order to generate theories, the researcher must understand the problem to be studied in order to synthesize meaningful information from the data analysis. Qualitative studies help researchers generate the types of questions that create a jumping off point for quantitative or mixed methods studies to branch off and delve deeper into the topic. Qualitative case studies help researchers examine poorly understood problems by looking at the perspectives of the individuals most closely associated with the problem (Simon & Goes, 2013).
The last item to consider was the researcher’s biases that could taint the research at any point during this dissertation. One component that the researcher was looking at was the critical self-reflection of the novice science teachers. Before she could expect this of the participants, she had to critically self-reflect on the professional biases she might have regarding various aspects of teaching that would negatively impact this dissertation. For example, she must strive to relinquish control of those aspects of human nature that cannot and should not be controlled, such as responding to emails or interview questions of the teachers’ own volition. She recognized that each teacher was an individual and taught in an individualized style, shaped by their experiences and environment. The researcher was not observing novice science teachers to critique their teaching style or their students’ knowledge base or current learning success, but to determine enactment, nothing more. The researcher had to be a detached observer, viewing the scene as it unfolded, and reporting those observations as objectively as possible. Creswell and Poth (2018) pointed out that the ethical researcher has a responsibility to scholarship and must strive to avoid deception, remain transparent and honest about all aspects of the research process, and be responsible for and accepting of the responsibility of all the work that the researcher is doing, including protecting the anonymity of the research participants.

**Researcher/participant relationship.** Building relationships with the study participants may very well have caused some limitations to the study in that the novice science teachers, by nature of being versed in scientific research, may have been too willing to cooperate with the study by attempting to anticipate the types of responses they thought the researcher might have been looking for. In the same way that self-reported data may be unreliable because the participants may be answering based on what they perceive to be the responses the researcher wants to obtain, this may be the case with this type of study.
The researcher may have been looking to build relationships in the desire to obtain factual, honest, forthright answers during interviews (Simon & Goes, 2013). She may have overlooked the fact that the research subjects were also scientists and perhaps studying the researcher as they were being interviewed, to gage the researcher’s reaction to responses to the interview questions. Does this make the interview data invalid? Perhaps not because there still must be a level of trust and brutal honesty between the researcher and the participants in the study. Additionally, it stands to reason that study participants would be just as interested in observing the researcher’s reaction to interview responses, as the researcher is in observing the study participants reactions to the interview questions.

**Validity of data sources.** Another limitation to this study would be the validity of the data sources. The researcher utilized a variety of data sources including the teaching philosophies of the novice science teachers, the lesson plans they had written for the observed lessons, and three interviews (Creswell & Poth, 2018; Yin, 2014). Each interview was kept to approximately twenty minutes to avoid causing the interviewee fatigue (Creswell & Poth, 2018). The researcher used the same questions for each participant during each interview, adding unscripted questions when it appeared that a deeper line of questioning would allow the interviewee the opportunity to add additional information.

Patterns were looked for with the data that was collected within each case and across the cases. There may be some patterns that were not detected in the data during the analysis that may have been useful in addressing rival explanations, despite member checking and using intercoder reliability checks. This might not discount any transferability regarding the findings of the study but the findings may only be transferable to novice science teachers in this particular ARL program and not novice mathematics teacher in the same ARL program, for example.
**Researcher bias.** Researcher bias may be a serious limitation to any study (Creswell & Poth, 2018; Yin, 2014). The researcher was vigilant and cognizant of how close she was to the research in that she was in the classroom teaching at her own school while simultaneously conducting her research. At each point in the study, the researcher made every attempt to keep any personal or professional biases out of the lines of questioning during interviews. She thought deeply about each question before asking it to identify any hidden biases in each question. Each novice science teacher was asked the same or similar questions. Impromptu questions during the interviews may not have been as carefully thought out but every attempt was made to choose words, inflections, and even suppress emotions so as not to taint the interviewees’ responses.

The research reread and reevaluated impromptu question while reviewing each interview transcript in the off-chance a question could be asked of another interviewee if applicable. All of this was done in an attempt to keep personal bias out of the lines of questioning. Every attempt was made by the researcher to be clear, honest, and above all transparent to the novice science teachers to ensure that the study and researcher remained ethical and engaged in responsible scholarship (Creswell & Poth, 2018).

**Suggestions for further research**

**Remaining questions.** There are some questions that remain unanswered by this study. For example, the only course the novice science teachers were asked to discuss was the science methods course. In what ways might other course work, outside of the science methods course, have had an impact on the novice science teachers’ teaching philosophies and their enactment in the classroom? Perhaps a comparison between the teaching philosophies written in other courses and the one written in their science methods course would provide more insight about enactment.
Are there any common elements between the different teaching philosophies they may have had to write in other courses? If time allowed, these other teaching philosophies might have been collected and analyzed to determine if the novice science teachers were writing teaching philosophies to fulfill course requirements to obtain a grade, or if they were being honest, forthright, and self-reflective regarding their beliefs about teaching and learning. The researcher could have examined each teaching philosophy to identify changes taking place as they novice science teachers engaged in self-reflection as they wrote the next paper for the next course. Might writing teaching philosophies for other courses have affected the novice science teachers’ writing of their specific philosophies regarding teaching science?

**Further research.** Future research that compares enactment of teaching philosophies in ARL programs in other states may help to avoid some of the limitations of this study. This study focused on novice secondary science teachers in the same preparation program. Future research may yield different data if this study were to be repeated with other university’s ARL programs that prepare secondary science teachers. Each state has different licensure requirements that may have an impact on the training and preparation of teaching candidates enrolled in ARL programs (U.S. Department of Education, 2004).

Current research that examines issues surrounding teachers tends to focus on the teachers, their preparation programs, continuing education and professional development, their pedagogy, or the instructional decisions and materials that are used in the classroom. Perhaps looking at one hidden component of enactment, overcoming student resistance, may help to elucidate strategies that could be incorporated into science methods courses specifically, and other methods courses in general, to help overcome resistant students.
In this study, the novice science teachers brought up the lack of foundational knowledge in their students as a challenge to their ability to enact their teaching philosophy (Lampert et al., 2013). Perhaps examining factors that may be hindering students’ ability to build foundational knowledge, by studying how they are being taught science and their disposition to learning science, may shed light on the types of instructional practices and choices that bring about an understanding of scientific concepts. In addition, examining teachers’ resistance to teaching inquiry-based, students-centered teaching may play a role in the instructional decisions and instructional practices of science teachers and their students’ reactions to instruction.

Observations that looked for these instances of enactment would help to validate the self-reported data. This type of case study would allow the researcher to understand the ways in which the personal and professional experiences novice science teachers have during the beginning of their teaching careers informs their ability to enact their teaching philosophy (Creswell & Poth, 2018). An ethnographic study that compares enactment between novice science teachers and veteran science teachers may help to identify experiences shared between members who have fewer years teaching science when compared to science teachers who have more than 5 years of teaching experience. Creswell and Poth (2018) discussed using ethnographic studies to identify shared experience within a culture, which in the case of this dissertation, may be defined as the culture of novice science teachers.

Future research may use teacher efficacy as a framework to examine the ways in which a novice science teachers’ degree of self-efficacy effects their ability to enact their teaching philosophy in their lesson planning and instructional practices (Bandura, 1997). Personal self-efficacy would help to identify the effect that a teacher preparation program and the degree of science content knowledge have on novice science teachers’ ability to overcome challenges that
may hinder their ability to engage in enactment (Tschannen-Moran, Hoy, & Hoy, 1998). Using the lens of domain-specific epistemology can provide a framework with which to identify any role that novice science teachers’ beliefs about teaching science may have on the fulfillment of enactment (Topcu, 2013). The theory of identity dissonance could help identify the time period that may be needed for novice science teachers to link their actual and potential enactment of their teaching philosophies in their lesson planning and instructional practices (Danielowich, 2012; Warin, Maddock, Pell, & Hargreaves, 2006).

**Conclusion**

This study set out to examine novice science teachers’ enactment of their teaching philosophies as they were in the ARL program and then investigate factors that relate to the enactment in schools. Novice science teachers appear to be capable of enacting various components of their teaching philosophies, due in part to the experiences and information they obtained from their science methods course work. Having strong support from other content area teachers appears to provide an additional component that furthers novice science teachers’ enactment. The feeling that they were not prepared by their programs to face the realities of the science classroom, while disheartening, did not appear to dampen their desire to enact their teaching philosophy or lessen their desire to teach science. The experiences gained by the novice science teachers in their first year of teaching appears to have started the process of reevaluation of their teaching philosophy and the ways in which they engage in enacting their teaching philosophies in their instructional practices.

This study adds to the body of research on enactment of teaching philosophies by helping to understand the challenges novice science teachers face enacting their teaching philosophies in the beginning years of their teaching careers. This study identified the continuing gap between
theory and practice as a contributing factor that may hinder enactment. The unexpected finding regarding student resistance to instruction appears to play a small role in novice science teachers’ successful enactment of their teaching philosophies. This study extends our understanding of KCS as it may be applied to novice science teachers’ ability to enact their teaching philosophies in their instructional practices.

Support and mentoring may provide assistance and some comfort to the novice science teachers by helping them to understand how to begin the process of closing the theory to practice gap through discourse and self-reflection. This study also uncovered the issue of classroom students and the role they play in determining whether novice science teachers’ are able to successfully enact various components of their teaching philosophies in their lesson plans and classroom practices. The role that classroom students play in successful enactment may be a subject that will need to be look into in future research.
APPENDIX A: Interview Questions

Semi-Structured Interview

Pilot Interview Questions

1. Tell me about your educational background including degrees.
2. And you’re in the ARL program at UNLV?
3. Discuss your thoughts on how you would like your science lessons to be structured now that you’re actually in your classroom for your first year of teaching?
4. Discuss how you’ll integrate some of the information and/or strategies you learned in your methods course in your lesson plans and your implementation.
5. What would help you implement your teaching philosophy better than what you feel you’re already doing?

First Interview – Pre-Observation

Adrianne

1. You stated that you wanted to have a recurrent pattern to your teaching so that the students can see and know what to expect. How have you been able to bring this about? That recurrent pattern that you spoke of?
2. You discussed student practice and providing them opportunities to apply what you were teaching them. Briefly describe how you are ensuring that this is happening.
3. How do you get your students to apply their knowledge of science?
4. You discussed that had a desire to get instant feedback to the students. Describe how you provide the feedback when you assess your students.
5. Will you briefly describe what has changed since in your teaching philosophy since you first wrote it?

Fey

1. In your teaching philosophy, you describe helping students to become more self-actualized and critical thinkers. In what ways are you going about doing this?
2. You talk in your teaching philosophy about blended learning; using both instruction and computer. Describe how you are able to blend technology into your teaching methods.
3. They’ve blended your classes with gen. ed. and accelerated?
4. Will you briefly describe what has changed since in your teaching philosophy since you first wrote it?

Isaac

1. In your teaching philosophy you talk about critical thinking skills. In what ways will you go about teaching critical thinking skills to your students?
2. How do you get your students to apply their knowledge of science?
3. How do you envision yourself teaching and what materials will you use to better reflect how you want to teach?
4. Will you briefly describe what has changed since in your teaching philosophy since you first wrote it?

Second Interview – Post-Observation

Adrienne
1. Describe to me what it would be like if I came into your room at the beginning of a unit, the first day you introduce a new topic or concept.

2. Your teaching philosophy and lesson plans discuss the desire to have your students become critical thinkers by applying what they are learning. Based on your lesson plan on cellular energy, you have your students conducting an online simulation and engaging in other activities, according to your lesson plan. Discuss how going through this unit and then having them do virtual labs and simulations help facilitate the critical thinking that you want them to do?

3. In your previous interview you discussed giving your students opportunities to apply what they are learning. What would it look like if I were to observe you while you facilitate this learning opportunity with your students?

4. What would it look like if I came into your room and you were doing that application? What would I see as you’re getting them to apply?

5. Based on your teaching philosophy and your first interview, your focus of teaching is learner-centered. Look at this paper that describes 4 areas: opportunity for student application of knowledge, opportunity for students to practice concepts, use of project-based learning, and implementation of student-directed learning. Of the 4 areas, where do you feel you are strongest?

6. What has helped you to gain that strength?

7. What area or areas do you think you are weak in? Describe why you feel that way.

8. Do you find that at times you struggle with enacting your teaching philosophy in your lesson planning and classroom practices? Describe what it is like for you.
9. Do you have somewhere that you can turn to for support or assistance when you find you are struggling? How does this help you?

Fey

1. Describe to me what it would be like if I came into your room at the beginning of a unit, the first day you introduce a new topic or concept.

2. Your lesson plans always follow that pattern, where you always introduce a phenomenon and then drop, like you said, breadcrumbs as you go. That’s the pattern the students expect every time?

3. In your previous interview you discussed giving students “bread crumbs” of information, and you mentioned it again in this interview. I observed you after you had built some foundation with the students on the water cycle when I observed you the first time. What would it look like if I were to observe you for a whole unit dropping these “bread crumbs”? What would that look like?

4. Based on your teaching philosophy and your first interview, your focus of teaching is learner-centered. Look at this paper that describes 4 areas: opportunity for student application of knowledge, opportunity for students to practice concepts, use of project-based learning, and implementation of student-directed learning. Of the 4 areas, where do you feel you are strongest?

5. What has helped you to gain that strength with project-based learning?

6. What area or areas do you think you are weak in? Describe why you feel that way.

7. Do you find that at times you struggle with enacting your teaching philosophy in your lesson planning and classroom practices? Describe what it is like for you.
8. Do you have somewhere that you can turn to for support or assistance when you find you are struggling? How does this help you?

Isaac

1. Describe to me what it would be like if I came into your room at the beginning of a unit, the first day you introduce a new topic or concept.

2. Your teaching philosophy and lesson plans discuss the desire to have your students become critical thinkers by engaging in class discussions and utilizing activities and labs. Based on your lesson plan on enzymes, you have your students conducting an on-line simulation. Discuss how this accomplishes your desire to facilitate critical thinking.

3. In your previous interview you discussed giving your students opportunities to apply what they are learning. What would it look like if I were to observe you while you facilitate this learning opportunity with your students?

4. Based on your teaching philosophy and your first interview, your focus of teaching is learner-centered. Look at this paper that describes 4 areas: opportunity for student application of knowledge, opportunity for students to practice concepts, use of project-based learning, and implementation of student-directed learning. Of the 4 areas, where do you feel you are strongest?

5. What has helped you to gain that strength with project-based learning and opportunities for students to practice concepts?

6. What area or areas do you think you are weak in? Describe why you feel that way.

7. Do you find that at times you struggle with enacting your teaching philosophy in your lesson planning and classroom practices? Describe what it is like for you.
8. Do you have somewhere that you can turn to for support or assistance when you find you are struggling? How does this help you?
APPENDIX B: Observation Protocol

Observation Protocol

School: ______________________________________________________

Novice Teacher Observed: ________________________________ (code) __________

Date and Time of Observation: __________ ____

Observer Checklist for Enactment

<table>
<thead>
<tr>
<th>Pedagogical Content Knowledge (PCK)</th>
<th>Example</th>
<th>Times Observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students provided support for scientific activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of lesson plan to guide student learning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assess student understanding of science concepts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of multiple instructional strategies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Application of theory in practice</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Orientation to Teaching Science</th>
<th>Example</th>
<th>Times Observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using scientific instructional strategies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student engagement and working in groups</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opportunity for students to explore scientific ideas/concepts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utilize student understanding of science</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encourages students’ ideas/approaches/problem solving skills</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Enactment of Philosophy</th>
<th>Example</th>
<th>Times Observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structured environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning by doing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensory engagement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connection to everyday life</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guide students toward understanding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passing on knowledge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immediate feedback to students</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX C: IRB Letter of Approval

IRBNet message from Cindy Lee-Tataseo
2 messages

Fri, Oct 20, 2017 at 12:26 PM

Cindy Lee-Tataseo <no-reply@irbnet.org>
Reply-To: Cindy Lee-Tataseo <cindy.lee-tataseo@unlv.edu>
To: Shoaan Zhang <shoaan.zhang@unlv.edu>, Helene Pollins <hap@unlv.nevada.edu>

Message from Cindy Lee-Tataseo:

Re: [1104527-2] Do I Enact What I Learn?: Examining Novice Science Teachers’ Approximations of Practice

Dr. Zhang,

Thank you for submitting the following modifications:

1. Change of participants to those that have been students in the secondary education program, have taken EDSC463/CISS63 secondary science methods class at UNLV and be teaching science in CCSD.


3. Recruitment changed by emailing participants who originally participated in the pilot study to now participate in the research study.

You may now make these changes to your study. This does not change the exempt status of this proposal.

Please let me know if you have any questions.

Regards,
Cindy Lee-Tataseo

Shoaan Zhang <shoaan_zhang@unlv.edu>
Fri, Oct 20, 2017 at 12:35 PM

To: Helene Pollins-Bard <hap@unlv.nevada.edu>

Helene,

I called her a minute ago. This letter indicates that the modification is approved. you can conduct the research as proposed.

Dr.
Shoaan Zhang, Ph. D.
Associate Professor of Teacher Education
Department of Teaching and Learning
College of Education
University of Nevada, Las Vegas
Tel: (702)696-5084
Fax:(702)696-4898

[Quoted text hidden]
APPENDIX D: Letter of Consent

INFORMED CONSENT

Department of Teaching and Learning

TITLE OF STUDY: DO I ENACT WHAT I LEARN?: EXAMINING NOVICE SCIENCE TEACHERS’ APPROXIMATIONS OF PRACTICE

INVESTIGATOR(S): Helene Pollins, Shaoan Zhang, Ph. D

For questions or concerns about the study, you may contact Helene Pollins at hap@unlv.nevada.edu or Dr. SHAOAN Zhang at shaoan.zhang@unlv.edu.

For questions regarding the rights of research subjects, any complaints or comments regarding the manner in which the study is being conducted, contact the UNLV Office of Research Integrity – Human Subjects at 702-895-2794, toll free at 877-895-2794 or via email at IRB@unlv.edu.

Purpose of the Study

You are invited to participate in a research study. The purpose of this study is to examine how NOVICE SCIENCE TEACHERS LEARNED about teaching science, through creating personal teaching philosophies and lesson planning, DURING their secondary science methods course [EDSC463/CIS563] at UNLV (FALL 2016) and how their coursework HELPED them enact their teaching philosophies IN THEIR FIRST YEAR OF TEACHING.
Participants
You are being asked to participate in the study because you fit these criteria: Secondary Science NOVICE SCIENCE TEACHER WHO WERE enrolled in a science methods course at UNLV [EDSC463/CIS563] AND ARE CURRENTLY TEACHING IN THE CLARK COUNTY SCHOOL DISTRICT.

Procedures
If you volunteer to participate in this study, you will be asked to do the following: 1) AGREEVING TO EMAIL 5 LESSON PLANS TO THE RESEARCHER; 2) TAKING PART IN TWO AUDIO RECORDED INTERVIEWS FOR APPROXIMATELY 15-20 MINUTES EACH, WHICH WILL OCCUR IN A PRIVATE PLACE MUTUALLY AGREED UPON BY YOU AND THE RESEARCHER, HELENE POLLINS; and 3) allow the researcher to observe 3 lessons in your classroom (no more than 50 minutes each), which will NOT include audio or video recording of the observation except the researchers’ observation of your instruction; additionally, the researcher will get the Facility Acknowledgement letter signed by the principal before she goes to your class for the observation and she will show you a copy of the letter so that you are ensured that the researcher is allowed to observe your teaching.

Benefits of Participation
There may not be direct benefits to you as a participant in this study. However, we hope to learn how university coursework helps to prepare novice secondary science teachers to teach science content.

Risks of Participation
There are risks involved in all research studies. This study may include only minimal risks. You may become uncomfortable with some of the questions and may choose not to answer.
**Cost /Compensation**

There will be no financial cost to you to participate in this study. The study will take 15-20 minutes for each of the two interviews and each teaching observation of three lessons will last no more than 50 minutes each, totaling 150 minutes. You will not be compensated for your time.

**Confidentiality**

All information gathered in this study will be kept as confidential as possible. No reference will be made in written or oral materials that could link you to this study. All participants will be assigned a study ID to maintain anonymity. All records will be stored in a locked facility at UNLV for 5 years after completion of the study. After the storage time the information gathered will be destroyed.

**Voluntary Participation**

Your participation in this study is voluntary. You may refuse to participate in this study or in any part of this study. You may withdraw at any time without prejudice to your relations with UNLV. You are encouraged to ask questions about this study at the beginning or any time during the research study.

**Participant Consent:**

I have read the above information and agree to participate in this study. I have been able to ask questions about the research study. I am at least 18 years of age. A copy of this form has been given to me.

___________________________________________  ________________

Signature of Participant  Date
Participant Name (Please Print)

Email Address (Please Print)

I AGREE TO BE AUDIO TAPED FOR THE PURPOSE OF THIS STUDY.

____________________________________________
Signature of Participant Date

Participant Name (Please Print)
Dear Pilot Study Participants,

This is Helene Pollins. I am contacting you because you were part of a pilot study I conducted last fall 2016 when you were in Dr. Jones’ science methods course. I am continuing the study and was wondering if you would mind if I speak with you regarding this new study. I would be willing to exchange telephone numbers or meet on the university campus to speak with you regarding conducting another interview.

Please let me know if you would be willing to continue your participation in this study. I am hoping that your participation in this research will help to better prepare science teachers instructional practices.

Thank you for your time.

Sincerely,

Helene Pollins
REFERENCES


Marbach-Ad, G., Schaefer, K. L., & Thompson, K. V. (2012). Faculty teaching philosophies, reported practices, and concerns inform the design of professional development activities of a disciplinary teaching and learning center. *Journal on Centers for Teaching & Learning, 4*, 119-137.


CURRICULUM VITAE

Helene Pollins
hap@unlv.nevada.edu TheobromaBean@gmail.com

EDUCATION
University of Nevada, Las Vegas 2014-present
Doctoral Candidate – College of Education, Science Teacher Education

University of Nevada, Las Vegas 2003
M.Ed. Curriculum & Instruction – Secondary Science Education

University of Nevada, Las Vegas 1989
Bachelor of Science – Biology
Area of Concentration – Desert Plant Biology

TEACHING EXPERIENCE
Clark County School District October 2001 – present

Eldorado High School
2009 – present
Biology, Biology H, Forensic Science 1 & 2, AP Biology

Desert Pines High School
2001 – 2009
Biology, Biology H, Forensic Science 1, AP Biology

College of Southern Nevada January 2009 – present
Biology 189 – Lecture and laboratory
Adjunct Faculty – Science Department

RELATED EXPERIENCE
New Teacher Mentor – 2002 – present
PASS Institute – 2005 to 2008
Clark County School District Textbook Committee – 2007
Regional Professional Development Program: Next Generation Science Standards cadre – 2013
AdvancED Accreditation Committee, Eldorado High School – 2015 to 2016
Silver State AP Institute 2003 –2013

PUBLICATIONS AND PAPERS

Publication Pending: “Can I manage my own classroom?”: A mixed-method study examining pre-service teachers’ self-efficacy through an asynchronous classroom management course. – 2016

CURRENT RESEARCH

166
“Can I manage my own classroom?”: A mixed-method study examining pre-service teachers’ self-efficacy through an asynchronous classroom management course. – 2016
Presented at the 29th Annual Ethnographic and Qualitative Research Conference (EQRC)
January 2017

MEMBERSHIPS
American Education Research Association 2014 to present
National Association of Biology Teachers 2017 to present

AWARDS
National Association of Biology Teachers Biology Teacher of the Year – Nevada 2017

LICENSES
State Of Nevada Teaching License Exp. October 2021
Licensed for Biology and Biological Sciences