SECONDARY SCIENCE HOMEWORK AND INSTRUCTIONAL METHODOLOGIES: AN INVESTIGATION OF THE ALIGNMENT OF HOMEWORK ASSIGNMENTS AND TEACHERS’ SELF-PROFESSED INSTRUCTIONAL METHODOLOGY

DISSERTATION
SUBMITTED TO
College of Education
ASHLAND UNIVERSITY

In Partial Fulfillment of the Requirements for
The Degree
Doctor of Education in Educational Leadership
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ASHLAND UNIVERSITY
ASHLAND, OH
2009
A Dissertation

entitled

Secondary Science Homework and Instructional Methodologies:
An Investigation of the Alignment of Homework Assignments and Teachers’ Self-Professed Instructional Methodology

by

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In Partial Fulfillment of the Requirements for

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This study utilized a mixed-method design in order to investigate the alignment of secondary science teachers’ instructional methodologies and their homework designs. Surveys were distributed to educators from a Center for Ocean Sciences Excellence Education (COSEE) database. Coding rubrics were developed to categorize the participants’ responses to a series of open-ended questions. Chi-square tests were utilized in the determination of the degree of association between the participants’ instructional methodologies and their homework designs. Overall, no statistically significant association was discovered between the two variables. Likewise, a statistically significant association for alignment, based on various demographic characteristics of the participants, was also unable to be determined.
ACKNOWLEDGEMENTS

A huge thank you to my wife and best friend, Angela, for standing beside me throughout the entire doctoral process, as well as during life’s various trials. Your endless love means the world to me. Also, thank you to my parents, Debbie and Mark, for all the love, support, and encouragement they have given me in all aspects of my life. Thank you for picking me up whenever I fell, and for giving me a push when I needed it most. An additional thank you is given to the rest of my family and friends for their support and love.

Throughout my time at Ashland University, I have had the opportunity to interact with, learn from, and get to know so many wonderful people. I would especially like to recognize Dr. W. Gregory Gerrick, Dr. Harold Wilson, Dr. Howard Walters, Dr. Herb Broda, Dr. Ann Shelly, and Dr. Mary Ellen Drushal for their encouragement, enlightenment, and their guidance. Also, Mic, Bob, Terri, and Edna, I will never forget the support we gave each other throughout the endless nights.

I would also like to extend my appreciation to Dr. Rosanne Fortner, Director of the Center for Ocean Sciences Education Excellence: Great Lakes (COSSE GL) for her consent to utilize a COSSEE GL educator database in order to find participants for this study. Also, my appreciation and gratitude to Dr. Gill Roehrig of the University of Minnesota for her consent to allow me the freedom to adapt several questions from her Teacher Belief’s Interview for the survey in this study. The author acknowledges the fiscal support of the Centers for Ocean Science Education Excellence: Great Lakes (Subcontract with the University of Michigan, issued under NSF Grant OCE-0528674; Subcontract No. 3000763399; Principal Investigator, Howard D. Walters).
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CHAPTER I

Introduction

This dissertation is a study of the alignment of homework and teaching methodologies in secondary science classrooms. Specifically, the study investigates secondary school science teachers’ self-reported instructional methodologies and beliefs and their homework practices. The introductory chapter of the dissertation includes a description of the research question as well as the significance of the study. Additionally, the limitations of the study and a brief overview of the methodology employed are discussed.

Background

Homework has been a much debated topic for generations of educators, parents, scholars, and students. An oscillation seems to exist within public opinion as to the need and relevance for homework. Major political, social, and global factors have influenced this opinion for decades. In the earliest part of the twentieth century, homework was found to be a valuable tool used to help children become more disciplined in their studies. However, in the 1940s a greater emphasis was placed on the development of children as creative thinkers and problem-solvers, and a negative reaction to homework was spawned (Cooper, 1989a, 1989b, 2001). The launch of Sputnik by the former Soviet Union in the midst of the 1950s Cold War era created a concern among the public regarding the strength of America’s educational system, and once again homework was seen as a positive educational tool (Cooper, 1989a, 1989b, 2001; Cooper, Lindsay, Nye, & Greathouse, 1998; Cooper & Valentine, 2001; Gill & Schlossman, 2003, 2004). The
popular view on homework during the 1960s was somewhat negative as it was thought to be a detriment to a child’s personal growth. During this time, opponents of homework viewed it as an instrument that decreased the amount of social interaction among students, and therefore, could not be a positive educational device (Cooper, 1989a, 1989b, 2001; Cooper & Valentine, 2001; Wildman, 1968). The 1983 publication of *A Nation at Risk* created a shift toward the need for homework to emerge yet again (Cooper, 1989a, 1989b, 2001; Cooper, Lindsay, Nye, & Greathouse, 1998; Cooper & Valentine, 2001; Gill & Schlossman, 2003, 2004; Kralovec, 2007; Palloway, Epstein, Bursuck, Jayanthi, & Cumblad, 1994). Since the publication of *A Nation at Risk*, public opinion has fluctuated regarding the need and value of homework; several books and articles have been published on both sides of the homework argument since the 1983 government publication (Bennett & Kalish, 2006; Cooper, Robinson, & Patall, 2006; Fraser, Walberg, Welch, & Hattie, 1987; Hattie, 1992; Kohn, 2006; Kralovec & Buell, 2000). Most recently, the emergence of increased outsourcing of the American job market, coupled with the growth of China and India as global economic powers has forced educators and industry to once again strengthen the argument for the use of homework.

The philosophical meanings, values, and purposes of homework have been debated and modified throughout the history of America’s educational system, however one thing has remained constant – homework continues to be given to students in schools across the country. The present study does not seek to investigate whether students should or should not be given homework, whether homework has value as an educational tool, or to determine if homework has an effect on students’ achievement. Those studies have been conducted and have been replicated many times over in various forms. The
literature acknowledges the fact that the argument continues over homework’s relevance and its possible effects as an educational tool. In fact numerous studies can be found to justify either side of the argument (positive effects see Austin, 1979; Foyle, 1984; Keith & Cool, 1992; Keith, Keith, Troutman, Bickley, Trivette, & Singh, 1993; and for negative or inconclusive effects see Barber, 1986; Bents-Hill, Boswell, Byers, Cohen, Cummings, & Leavitt, 1988; Epstein, 1983; Friesen, 1979). Given that homework has consistently been assigned throughout the course of history in America’s schools, regardless of the arguments for and against homework, it seems logical that further studies on the topic of homework should continue. The present study seeks to investigate the alignment of homework assignments with the instructional methodologies employed by secondary school science teachers.

Cooper (1989a) provided an adequate, and often cited, definition of homework in his book, *Homework*. Cooper defined homework as any task that students are assigned to accomplish during those hours they are not in class. Though Cooper did not put a limit as to where the homework assignments could be completed, such as in study hall, another class, at home, etc., he did have some exclusions to his definition: in-school guided study, home study courses, and extracurricular activities. This definition was followed by a list of distinctions in the classification of various homework assignments, such as the amount of homework given, the purpose of the homework, etc. Both Cooper (1989a, 1989b) and Cooper and Valentine’s (2001) synthesis of homework research failed to address a key aspect of homework, the one which is identified within this research study. Missing from the previously mentioned studies, and in homework studies in general, is the focus on homework assignments and their alignment with instructional methodology of the teacher.
This study assumes that the instructional methodology of a classroom teacher is at the core of all work that it is to be generated from a particular classroom. This methodological assumption is depicted in Figure 1 as the *Framework of Methodological Beliefs*. I designed this framework in order to visually depict the various aspects of instruction and how they relate to the instructional methodology of the classroom teacher.

In my model, a teacher’s instructional methodology influences and is reflected in the development of the teacher’s classroom instruction, all assessment materials (exams, quizzes and tests), and work that is done in and out of class: such as long-term projects, labs, class work, and homework. Therefore, the methodological belief(s) of the instructor are central to the design of all requisite classroom materials, projects, and assignments.

Likewise, a consistent structure, based on the teacher’s methodological beliefs should be identified in all aspects of instruction revolving around the teacher’s instructional methodological beliefs. This model assumes that a teachers’ instructional methodology, based on his or her pedagogical content knowledge and beliefs (Shulman, 1986), is the catalyst for all student activities.

An example of instruction based on the *Framework of Methodological Beliefs* can be illustrated by the following example of a high school chemistry classroom. If a high school chemistry teacher’s instructional methodological belief is to design an inquiry-based environment, then all activities for this classroom should be inquiry-based in design as well. The instruction students receive should be inquiry-based in design, likewise all work associated with the course should also be based on an inquiry design.

In this example, exams, quizzes, and tests should not be based on the memorization of facts, but should reinforce the inquiry-style that the instructor uses in the classroom. Laboratory experiments would not be designed as cookbook labs, where students follow
step-by-step instructions in a procedure that closely resembles the work of laboratory technicians. Instead, students would investigate problems using methods and techniques of their own in order to discover information in a creative process like a true scientist (Huber & Moore, 2001).

![Diagram of Methodological Beliefs Framework]

Figure 1. Framework of Methodological Beliefs

This dissertation is designed to investigate one aspect of the Methodological Beliefs Framework: homework and its alignment to secondary school science teachers’ self-professed instructional methodology. The intention is to identify secondary school science teachers’ adherence to the aforementioned perspective on instructional methodology. More specifically, is the work that secondary school science teachers send home with students designed in a manner that reinforces and facilitates the teacher’s instructional methodology in the classroom? For the purpose of the current study and the
model of instructional alignment proposed within this study, homework is identified as the work sent home with students subsequent to a lesson, not preceding the lesson.

Identification of the Problem

“If homework is just busy work, both teachers and students have wasted their time” (Epstein & Pinkow, 1988, p. 4). This statement in Epstein and Pinkow’s Model for Research on Homework identifies one of the possible flaws in poorly designed homework. Homework can not be used simply as a method of keeping students busy at home with their minds focused on instruction. Nearly all classroom teachers find themselves extending their classrooms into the homes of students through the means of homework. Through the assignment of homework, a teacher broadens the instructional scope so that schoolwork can be completed in the absence of the teacher, therefore, one can conclude that the purpose of homework is to extend student learning beyond the classroom.

If homework is truly an extension of the classroom, then homework assignments should be structured to facilitate the same methodological approach the teacher utilizes in the classroom. Work that is sent home with students and the subsequent design of that work is an illustration of the teachers’ knowledge and understandings of the curriculum and their instructional and methodological beliefs (Epstein & Van Voorhis, 2001). One would then assume that as teachers prepare for their future career endeavors, that their training programs would spend a great deal of time and effort on the instruction of how to develop properly designed homework. Unfortunately, this does not seem to be the case, with many teachers feeling as though they had very little homework design training in their teacher education programs during post-secondary coursework (Jensen, Sheridan,
Olympia, & Andrews, 1994; Pribble, 1993; Van Voorhis, 2001). The apparent lack of emphasis on a methodologically consistent design of homework in teacher training and preparation programs could create circumstances that encourage poorly designed homework that lacks purpose and relevance to the classroom.

The preceding section described my instructional theory through the proposed Methodological Beliefs Framework. With the Framework as a focal point to homework design, it is my belief that poorly designed homework is homework that is not designed with the same methodological approach that the teacher uses in the classroom. Therefore, the present study is an investigation of whether secondary school science teachers’ homework assignments are designed in a manner that is consistent with the teachers’ self-professed instructional methodology. Consistent with the earlier description of homework in accordance with the Framework of Methodological Beliefs, the homework a teacher assigns to students should be designed in a similar manner as the instructional approach taken in the classroom. Though many purposes for homework exist, this research assumes that the purpose(s) of homework assignments should not determine its design, but rather it should reflect the instructional philosophy of the teacher.

Implications and Significance

A review of the literature on homework reveals a relative lack of information and research on the design of homework and its alignment with the instructional approaches of secondary school teachers. As mentioned in the preceding section, Jensen, et al. (1994), Pribble (1993), and Van Voorhis (2001) acknowledge that many teachers feel as though they had very little homework design training in their teacher education programs.
during post-secondary coursework. Epstein and Van Voorhis (2001) also note that teachers currently in the profession, and those seeking to become professional educators, need to clearly understand the linkage between the classroom, homework, and other assessments. This study could provide information that is useful in the future design and structure of post-secondary methodology programs in science education.

The results of the study could provide useful information for secondary schools as well. The impact on secondary schools could occur in two areas in particular: staff professional development and new teacher induction programs. The need for training in the alignment of one’s instructional methodology and homework design could exist if the results of a study indicate a disagreement between teachers’ self-professed instructional methodologies and their homework assignments. Likewise, induction programs for new teachers could be altered in order to address the design of homework if the above mentioned results are evident.

A third plausible implication of this study is the overall emphasis placed on homework as an instructional tool. The purposes for homework are numerous and range from a tool for practice through reinforcement, introduction and school-family communication. Although a variety of purposes for homework exist, the instrument of homework itself should be as an instructional tool used to reinforce the classroom activities. Any instructional tool utilized by a classroom teacher should be aligned with the methodological approach of the teacher. Results from this study will indicate the level to which this occurs in the secondary school science classroom.
Overview of the Methodology

A purposive sample (Merriam, 2001) of secondary school science teachers was issued a semi-closed-ended questionnaire (Creswell, 2005). The questionnaire consisted of seven open-response questions regarding the instructional beliefs and techniques each participant utilized in the classroom. The open-response section of the survey incorporated a selection of questions from Roehring and Kruse’s (2005) teaching beliefs interview, conducted for a similar purpose. The open-response questions addressed the role of the teacher, the teaching of science, student learning, and examples of classroom activities. These open-response questions were preceded by a brief demographic query in order to determine some basic demographic data from each participant. Specifically, the age, race and gender of the participants were identified, as well as the type of undergraduate college or university attended, year of graduation, degree conferred, years of experience, and current subjects of instruction. Also included in the demographics section was information pertaining to the school at which each participant currently taught. Information such as the percentage of minority enrollment and the setting (urban, suburban, rural) of the school was obtained.

Participants

Each of the teacher participants recently had been engaged in a professional development program offered by the Center for Ocean Sciences Excellence Education (COSEE) Great Lakes. COSEE Great Lakes is a member of the National COSEE Network which consists of 11 centers located on both the east and west coasts of the United States, as well as the Great Lakes Center and the COSEE Central Gulf of Mexico. COSEE Great Lakes is the nation’s largest COSEE center, comprised of educators and
professional collaborators from eight states: Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin. (See Appendix A for a complete listing of COSEE Great Lakes’ partners and collaborators, and Appendix B for COSEE Great Lakes goals and objectives.)

Data Analysis

In order to properly answer the research question, a mixed-method (Creswell, 2003) design was employed by incorporating techniques of both qualitative and quantitative research. The qualitative responses to the open-ended items focusing on the instructional beliefs and practices of the participants were coded (Creswell, 2005) according to a predetermined coding system. The coding system was developed in order to place each of the participants’ responses into one of three categories: Traditional, Traditional +, or Inquiry. A substantial description of each of these categories, as well as the process of each category’s development is detailed in Chapter III. The descriptions of the participants’ homework assignments were also analyzed in a similar fashion, utilizing a predetermined coding system to place the responses in one of the three categories. It was then possible to determine any themes emerging in the participants’ self-professed instructional methodology and their respective homework assignments. The demographic data that was obtained from the questionnaires was simply compiled and recorded for any possible extrapolations of the data based on specific subgroups of the participants. A comprehensive explanation of the methodology employed in order to answer the research question is found in Chapter III. Likewise, the results of the analysis of data, the existent themes, and all other requisite data are discussed in much further detail in Chapter IV.
Limitations of the Study

While 57 surveys were collected, 35 of those collected included individuals that could be classified as secondary school science teachers. An extrapolation of the data, to include personal interviews and observations, was not obtained. Though this information could have provided keen insight to specific results of the study, limitations in time, as well as travel expenses, prevented the compilation of this data. Therefore, the current study is dependent upon forthcoming responses by the participants in order to substantiate the results.

The purpose of this study was to identify if an alignment of secondary school science teachers’ self-professed instructional methodology and their homework assignments exist. Given that all participants were secondary school science teachers, the data and results obtained can not be generalized across the greater population of teachers in other subject areas or grade levels. The results are also somewhat limited based on the geographic location of the participants. The participants generally represent secondary school science teachers from the Midwestern United States, particularly those areas concentrated around the Great Lakes. Specific information about the representative locations of the participants is located in Chapter III.

Summary

Throughout the history of American education, popular opinion on homework seems to fluctuate every 15-30 years, either pro-or-con, more-or-less, positive-or-negative (Cooper, 2001). Likewise, reform initiatives in secondary school science instruction seem to oscillate on a similar structure. An ebb and flow of popular instructional practices and ideas exist in science education; what was popular at one point
in time eventually becomes ostracized, only to once again become popular a number of years later (DeBoer, 2006). This study investigates the alignment of homework assignments and the self-reported instructional practices of secondary school science teachers. Qualitative analyses through a process of coding and the identification of themes was utilized in order to answer the research question. This study also sought to identify themes based on the aforementioned demographic data of the participants. The results of the study may be a useful tool to inform and guide post-secondary science education programs, professional development opportunities for science teachers, as well as policy-makers at the local, state, and federal levels.
CHAPTER II

The purpose of Chapter II is to provide a conceptual analysis of literature (Glatthorn & Joyner, 2005) relevant to the research question posed in Chapter I. In order to place the current research in the proper context, the subsequent review of the literature begins by briefly illustrating an historical perspective on homework. Additionally, an historical perspective of science instruction in the United States follows. Chapter II also provides a synthesis of current instructional methodologies in secondary school science. The amalgamation of these areas of literature provides the milieu for the current research and also validates the necessity of such research.

Review of the Literature

Given the relative lack of prior literature on teachers’ homework assignments and their instructional methodology, the design of Chapter II focuses on homework and science education individually. The review of the literature begins with a brief history of the development of homework as an instructional tool in America’s public schools. Following the historical perspective on homework, the current trends in homework design are discussed. A parallel format was followed in the review of science education literature. Initially, a brief history of science education is given, followed by a review of the current philosophies predominant in science education. The intention of this format is to identify the processes that led to the current pedagogical perspectives in both homework and science instruction. The conjunction of these two topics, homework and science instruction, is illustrated in the summary section of this chapter.
A Brief History of Homework

One would be hard-pressed to find something more synonymous with a schoolhouse than homework. Homework has long been a tradition in schooling and teachers have consistently assigned homework, a trend that is likely to continue for future generations of students (Corno, 2000). Although homework seems to have always been a part of the landscape of schooling, history depicts a flux in the opinion on the relevancy of homework. Throughout the course of nineteenth century education, the debate over homework was all but nonexistent. The lack of a debate over homework in the nineteenth century was most likely due to the relatively low number of students who received homework. During this time period, homework was reserved for those attending high school, and attending high school was not the norm during the nineteenth century (Gill & Schlossman, 2004; Reese, 1995). It does not appear that the first major attacks on homework began until the period between the 1920s and 1940s, the birth of the progressive education movement (Gill & Schlossman, 1996).

The attack on homework during the period of the 1920s to 1940s centered mainly on the fact that the traditional mode of homework design, drill, memorization, and recitation was perceived as detrimental to the development of children’s physical and mental well-being (Gill & Schlossman, 2004). During this time, the development of problem-solving strategies was seen as more appropriate for students than the aforementioned design of homework, and the previous modes of homework were brought into question (Cooper, 1989a). Toward the end of the 1940s, the first methodical analysis of homework representing a nation-wide study was conducted through the 1948 Purdue Opinion Poll (Gill & Schlossman, 2003; Gill & Schlossman, 2004). The results of the 1948 Purdue Opinion Poll accentuated the progressive movement’s philosophy that
homework was not something students took seriously, with a minimal percentage of students reporting spending much time on their work (Gill & Schlossman, 2004).

The 1950s ushered in a new battle over homework. This time the popular opinion advocated, not only the use of homework, but increased amounts of it as well. This paradigm shift in the use of homework was most largely attributed to the Soviets’ 1957 launch of the space satellite Sputnik (Cooper, 1989a, 1989b; Cooper & Valentine, 2001; Gill & Schlossman, 2004). It was believed by many that the progressive education movement had caused the United States to fall behind Russia in both science and mathematics achievement and that the United States was losing the Cold War (Gill & Schlossman, 2000). As Cooper (1989a) noted, “Americans became concerned that a lack of rigor in the educational system was leaving children unprepared to face a complex technological future and [that students were ill-prepared] to compete against our ideological adversaries” (p. 4). This idea is reiterated by Gill & Schlossman (2000) who add that public opinion at the time added the value of homework as a valuable asset in the nation’s defense policy. Popular opinion regarding the favorability of homework in our schools also was aided by the Columbia Broadcast System (CBS) special “Where We Stand,” which illuminated Sputnik’s successful launch and brought about the call for higher standards in science and mathematics education (Thorpe, 2008). Sputnik served as the antecedent to an increased focus on knowledge, and homework was believed to be the mechanism to hasten its acquisition (Cooper, 1989a; Cooper, Lindsay, Nye, & Greathouse, 1998).

Wildman (1968) wrote of the pressures children faced when dealing with homework and the added mental stress and fatigue it caused. Her opinion was one of many in the mid-to-late 1960s that introduced yet another fluctuation in the debate on
A variety of learning theories questioned the relevance of homework, the variety of methods employed in the creation of homework, and the role homework played in a turbulent society (Cooper, Lindsay, Nye, & Greathouse, 1998; Gill & Schlossman, 2004). Students, especially high school students, were facing a great deal of pressure from societal issues, such as the Vietnam War and the Civil rights movement (Gill & Schlossman, 2004), so homework was seen as another unneeded pressure (Cooper & Valentine, 2001). The theme of homework in the late sixties and early seventies was best summarized by Gill & Schlossman (2000) as almost entirely disappearing from American education.

The National Commission on Excellence in Education’s 1983 publication of *A Nation At Risk: The Imperative for Education Reform* brought about a change in educational philosophy that has been standing strong until the turn of the 21st Century. The Commission’s report plainly called for an increase in the amount of homework students received, particularly for high school students (National Commission on Excellence, 1983). Throughout the course of the 1980s and 1990s homework was widely endorsed for both academic and character-building principles and was seen as a way of strengthening the United States’ standing among its global competitors (Gill & Schlossman, 2004). The notion of homework and its previously mentioned principle of maintaining America’s global prowess continues today, however the guiding philosophy has shifted from the 1980s back-to-the basics to 21st Century skills. Homework is sure to continue to play a role in education as the new millennium continues, however its role within the curriculum may well need to be reexamined. As homework continues to be utilized as an instructional tool, it appears justifiable that educators spend time seeking
methods and strategies to improve on homework’s educational quality, not on the argument of its existence (Marzano & Pickering, 2007).

**Pedagogical Perspectives in Science Education**

The historical perspective on science education that I present in this section of Chapter II can best be defined by the words of DeBoer (2006) in his brief on the history of science education. DeBoer states:

> It is not possible here to examine in depth the historical roots of the current reform efforts in the United States, but a few historical notes will be helpful in understanding why we are where we are today. First, it is important to recognize that most of what we are trying to do is not new. (p. 8)

Similar to the previous section, this section is intended to provide a brief historical perspective of science instruction in the United States. It is important to understand the process that has shaped pedagogical philosophies in science education to better understand the present (Bybee & DeBoer, 1994; DeBoer, 2006).

**Late Nineteenth Century**

It was not until the late nineteenth and early twentieth centuries that science education became a major part of America’s school curriculum. Schools during the early nineteenth century mainly emphasized subjects such as reading, writing, and some basic arithmetic skills (DeBoer, 1991; Mance, 2008). Scholars of the time believed that a foundation in the humanities led to the most laudable educational product (DeBoer, 1991; DeBoer, 2000). The science curriculum of the nineteenth century focused on the “practical sides of science and technology, such as astronomical calculations, navigation, [measurement], and surveying” (Chiappetta, 2008, p. 22). The goal of the science
curriculum of this time was the presentation of facts regarding science, and most often in theological terms (Bybee & DeBoer, 1994).

The emphasis on a theological basis for science education gradually declined toward the end of the nineteenth century (Bybee & DeBoer, 1994). In 1895, the Committee of Twelve recommended a comprehensive science program consisting of nature study (K-8), physical geography (grade 9), biological sciences (grade 10), physics (grade 11), and chemistry (grade 12) (Loepke, 2005). As noted by Chiappetta (2008), two trends dominated the science curriculum: (a) students learned what they needed in order to function in an increasingly industrial nation and (b) to prepare those who would advance to college. The presentation of knowledge in the science classroom shifted from a focus on scientific facts and information to broad generalizations. Bybee and DeBoer credit this change to science educators William Harris and Wilbur Jackman, the influence of prominent scientists, and increased focus on industry in America. Instruction of broad generalization structured in units would be a dominant instructional philosophy in science education until the 1960s (Bybee & DeBoer, 1994).

The Cardinal Principles to WWII

Early in the twentieth century the secondary school science curriculum consisted of a variety of courses, each a semester in length, with different subjects as their focus, such as astronomy, zoology, and botany (Loepke, 2005). Just prior to the 1920s, the structure and sequence of secondary school science courses shifted to an alignment similar to the current system of year-long courses. The sequence consisted of general science (grade 9), biological sciences (grade 10), chemistry (grade 11), and physics (grade 12): a sequence much the same in many high schools today (Loepke, 2005).
However, the publication of the *Cardinal Principles of Secondary Education* (NEA, 1918), “signified a gradual, 25-year shift in focus of the American curriculum from traditional subjects to personal skills” (Feldman, 2005, p. 49). It was during this period that the roots of inquiry instruction were developed, however, it would take another 40-50 years for the concept to reach fruition (Loeppke, 2005). In fact, a 1924 report from the Committee on the place of Science in Education by the American Association for the Advancement of Science (AAAS) urged the use of inquiry as an instructional approach (Chiappetta, 2008).

The shift from the traditional instructional approach to the new inquiry methods was supported by the progressive movement in education. The progressive movement in education emphasized attention to the needs and psychology of the learner (Bybee & DeBoer, 1994; DeBoer, 2000). Along with an interest in the personal psychology of the student, progressive educators also advocated for learning from experiences using the scientific method. The inquiry philosophy was supported in principle by the National Society for the Study of Education (NSSE) (1932) and its publication of *A Program for Teaching Science* (Powers, 1932). The NSSE claimed that students should study science for its “usefulness to individuals and to support their intelligent participation in a democratic society” (DeBoer, 2000). The progressive movement emphasized education that focused on the interests of the child and that education should serve the whole child (Kretchmar, 2008). However, toward the end of the 1940s, the nation’s attitude toward science education shifted. World War II was a catalyzing event in the modernization of American schooling; the technological advances during the war required education and skills of the population never before imagined (Mance, 2008).
The Impact of Sputnik

In the years immediately following World War II, an increasing number of Americans viewed science and technology education as an important resource for national security (DeBoer, 2000). Science education was viewed as a means for assuring the United States’ status as both an economic and military force throughout the world (DeBoer, 2000). The Soviets successful launch of Sputnik in 1957 brought about a magnitude of educational reform and public support for science education never before seen (Bybee, 1997; Loeppke, 2005; Parker, 1993). As Loeppke (2005) noted, “during the period of 1950-1977 science education witnessed a massive curriculum movement…that no other period has witnessed” (p. 93). The progressive educators of the early twentieth century were criticized for making students soft, and a back-to-the-basics curriculum was sought (Kretchmar, 2008), ushering in a new realm of initiatives in science education.

The initiatives in science education immediately following Sputnik were unlike the previous revisions of the science curriculum. Science education would now begin undergoing curriculum reforms (Loeppke, 2005). The first major government reform initiative was the 1958 National Defense Education Act, which aimed at improving math and science instruction in America’s schools (Harris & Miller, 2005). Educating students as scientific and technological thinkers was a critical aspect of science education reform during this period. One reformer, Joseph Schwab, noted that many teachers misrepresented science when they presented the information as fact or conclusion, and that they should have presented the major paradigms of science and allowed the learner to investigate (as cited in Chiappetta, 2008). Schawb’s idea of inquiry was in agreement with the perception that students needed to be trained to think like scientists (DeBoer, 2000). Education reformers were united in their promotion of scientific inquiry as a
major function of the science classroom and laboratory (Tamir & Lunetta, 1981). However, the inquiry utilized during this period in American education was in stark contrast to inquiry recommended through the *National Science Education Standards* (National Research Council (NRC), 1996), which was to emerge a couple decades later. The inquiries of the 1960s and 1970s were quite structured, required low levels of student inquiry, and were not implemented often (DeBoer, 1991; Kyle, 1980; Tamir & Lunetta, 1981). The failed efforts in the achievement of some of the social goals of science teaching brought about a new theme in science education during the late 1960s through the 1970s. The new theme focused on the relationship between science and society, and the study of science and its relationship to human life (DeBoer, 2000). Additionally, Loeppke (2005) noted that during the 1970s science was lost in the overall school curriculum and observed that “interest now was in teaching the basic skills of reading, mathematics, and communication” (p. 98).

*A Nation At Risk to The National Science Education Standards*

In 1983, a warning that America’s schools were producing a “rising tide of mediocrity” (National Commission on Excellence in Education, 1983) was issued. The report, *A Nation At Risk*, published by the National Commission on Excellence in Education in 1983, cited the schools for placing America’s security at great risk (Kretchmar, 2008). The report called for raising the level of academic achievement of America’s youth, especially in the areas of mathematics and science (DeBoer, 2006). There was a concern that America was not able to compete in the global economic and technological markets (Loeppkke, 2005). Following the publication of *A Nation At Risk*, more than 300 reports regarding educational reform were published, a majority of which
focused on science education (Bybee & DeBoer, 1994). *A Nation At Risk* would usher in an era of higher standards, new modes of assessment, and new systems of accountability (DeBoer, 2000). Two publications produced within the years following *A Nation At Risk* that had a major impact on the development of higher standards in science education, were *Science for All Americans* (AAAS, 1989) and the *National Science Education Standards* (NRC, 1996).

Rutherford and Ahlgren’s (1990) book, *Science for All Americans: Project 2061*, was an idea conceived in 1985 as a goal for science education for American’s living during the span of the years 1985 – 2061, which coincide with the closest approach to Earth by Halley’s Comet (Hoffman & Stage, 1993). Project 2061 was published by the American Association for the Advancement of Science (AAAS) in order to assure an attainable scientific literacy for all students by clarifying the goals of science education (DeBoer, 2000). Five criteria were used as the foundation for the core of learning in Project 2061; these five criteria are listed in Table 1. The United States government soon followed Project 2061 with its own publication of standards for science education. The *National Science Education Standards* (NRC, 1996) have been widely respected in the field of science education in the years following their publication, mainly due to the wide array of individuals who were a part of the formation of the *Standards*.

The *National Science Education Standards (NSES)*, much like Project 2061, were intended to “present a vision of a scientifically literate populace” (NRC, 1996, p. 2). The *Standards* focused on science at a conceptual level, rather than a factual level, representing a very influential vision of exemplary instruction in science education (Banilower, Smith, Weiss, & Pasley, 2006). DeBoer (2000) noted that the *National
Table 1

*Five Criteria of Science Education in Project 2061*

<table>
<thead>
<tr>
<th>#</th>
<th>Criteria Description</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Does the content enhance one’s long-term employment prospects and the ability to make personal decisions?</td>
</tr>
<tr>
<td>2</td>
<td>Does the content help one to participate intelligently in making political decisions involving science and technology?</td>
</tr>
<tr>
<td>3</td>
<td>Does the content present aspects of science, mathematics, and technology that are so important in human history or so pervasive in our culture that a general education would be incomplete without them?</td>
</tr>
<tr>
<td>4</td>
<td>Does the content help people ponder the enduring questions of human existence?</td>
</tr>
<tr>
<td>5</td>
<td>Does the content enrich children’s lives at the present time regardless of what it may lead to later in life?</td>
</tr>
</tbody>
</table>

(AAAS, 1989, as cited in DeBoer, 2000, p. 590)

Standards in order to acquire successful scientific literacy. Just as the goals of Project 2061 were identified through a series of five criteria, so, too, were the *National Science Education Standards*. The criteria used in the determination of the Standards are detailed in Table 2.

What developed from the standards and reforms in science education during the 1990s, after the publication of *A Nation At Risk*, have helped shape the current curricular trends in science education. Through the initiatives and standards of the 1990s, students
Table 2

*Five Criteria of Science Education in the NSES*

<table>
<thead>
<tr>
<th>#</th>
<th>Criteria Description</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Everyone needs to use scientific information to make choices that arise everyday.</td>
</tr>
<tr>
<td>2</td>
<td>Everyone needs to be able to engage intelligently in public discourse and debate about important issues that involve science and technology.</td>
</tr>
<tr>
<td>3</td>
<td>Everyone deserves to share in the excitement and personal fulfillment that can come from understanding and learning about the natural world.</td>
</tr>
<tr>
<td>4</td>
<td>More and more jobs demand advanced skills, requiring that people be able to learn, reason, think creatively, make decisions, and solve problems. An understanding of science and the process of science contributes in an essential way to these skills.</td>
</tr>
<tr>
<td>5</td>
<td>To keep pace in global markets, the United States needs to have an equally capable citizenry.</td>
</tr>
</tbody>
</table>

(DeBoer, 2000, p. 590)

became more active in learning science through real-world problems and aided by new learning theories and goals (Loeppke, 2005). However, as the world has moved into a new millennium, a focus of educational goals consistent with 21st Century skills has emerged. The 1990s brought about student engagement and scientific inquiry as instructional tools. 21st Century science learning will require students to not only be engaged in learning, but to apply what they have learned. More specifically, students will be required to apply their school knowledge in “situations that they cannot foresee
before graduating” and they will need to be able to apply it with a global perspective (Daggett, 2008, p. 19).

Instructional Methodologies in Science

In order to answer the research question posed in this study, the instructional methodologies of secondary school science teachers were investigated. Three categories of instruction were developed for this study: Traditional, Traditional +, and Inquiry. An exhaustive report of the literature on traditional instructional practices is unnecessary in this research. For the purpose of this research, the traditional approach can best be described as a mode of instruction that is found to be at odds with the suggestions for inquiry (Lynch, 1997) detailed in the subsequent section. This domain within the literature review, namely the descriptors for inquiry instruction, allow for a more comprehensive analysis of the participants’ methods of instruction and their homework practices, as explained in the following chapters.

*Inquiry Science Instruction*

Inquiry is far from a singular instructional approach; rather it exists on a continuum based on instructional techniques and student involvement (Sandoval, 2004). The existence of a continuum for inquiry-based instruction can be attributed to the obscurity and multiplicity of the term’s definition (Ohana, 2006). Beyond the definitions of inquiry, a variety of forms within inquiry-based instruction can also be identified, such as structured inquiry, guided inquiry, and open inquiry (Colburn, 2004). However, the foundation and support of inquiry-based instruction is supported through a range of professional science and education organizations. This section does not seek to investigate the various forms and methods of inquiry instruction, but instead to explore
the characterizations of, and standards for inquiry as described by (a) the American Association for the Advancement of Science (AAAS), (b) the National Research Council (NRC) and the National Science Education Standards (NSES), and (c) the National Science Teachers Association (NSTA).

*The American Association for the Advancement of Science*

Through the support of the American Association for the Advancement of Science (AAAS) and Project 2061, an initiative for scientific literacy sponsored by the AAAS, Rutherford and Ahlgren (1990) provided their suggestions for reforms in science, mathematics and technology education. Rutherford and Ahlgren’s (1990) suggestions for science reform were published in the book *Science for All Americans*. This book not only highlights what science students should learn, but also how science should be taught (Rutherford & Ahlgren, 1990). The authors make certain that the instructional practices of science teachers should align with the nature of scientific inquiry. Within *Science for All Americans*, an emphasis was placed on eight items that were to be identified with inquiry teaching: start with questions about nature, engage students actively, concentrate on the collection and use of evidence, provide historical perspectives, insist on clear expression; use a team approach, do not separate knowing from finding out, and deemphasize the memorization of technical knowledge (Rutherford & Ahlgren, 1990).

*The NRC and the National Science Education Standards*

The National Science Education Standards (NRC, 1996) defined inquiry instruction as an approach to instruction in which students make observations about scientific phenomena, ask questions about those phenomena, and gain an understanding of preexisting scientific knowledge. In an inquiry setting, the NSES also suggested that
students should be able to use scientific instruments in order to gather data. Students in an inquiry classroom then analyze and interpret their data, propose conclusions and/or predictions, and finally communicate their results, findings, and predictions to others. The NSES definition is also coupled with, and supported by a vision for shifting one aspect of student assessment from a student’s scientific knowledge to a student’s understanding and reasoning through scientific knowledge (NRC, 1996).

National Science Teachers Association

In October 2004, the National Science Teachers Association (NSTA) issued a position statement regarding scientific inquiry. Within their position statement, the NSTA defined inquiry as the processes and procedures used by scientists to understand the world around them. The NSTA suggested that students, just like scientists, needed to ask questions about the natural world and seek ways to gather, research and report data based on their questions (NSTA, 2004). Furthermore, the NSTA proposed six declarations aimed at scientific inquiry as an instructional approach. The six declarations focused on providing an educational environment that supports students’ use of their definition of inquiry.

Inquiry Defined

The literature suggests a definition of scientific inquiry as a process where students (Krajcik, Blumenfeld, Marx, Bass, & Fredricks, 1998; NRC 1996; NSTA, 2004; Rutherford & Ahlgren, 1990; Sandoval, 2005; White & Frederiksen, 1998):

1. Ask questions.

2. Investigate their questions through the generation of investigative strategies.
3. Produce, analyze and interpret data.

4. Formulate and communicate conclusions.

5. Create new questions based on conclusions.

This definition of inquiry will be further explored and explained in Chapter III, specifically within the explanation of the methods used to code participant data. Table 3 illustrates the suggestions offered by the three science education organizations listed within this section, as well as the above-mentioned definition of inquiry utilized within this study.

Summary

The trend of homework’s popularity and its perceived usefulness as an instructional tool has oscillated throughout the history of public education in America. Likewise, the same ebb and flow exists in science education; pedagogical philosophies tend to be popular at one point in history and the opposite at another point (DeBoer, 1991; DeBoer, 2006). For the past 10-15 years, science educators have been strongly encouraged to adapt an inquiry-based instructional approach to their classroom. However, teachers must understand how to incorporate new approaches, such as inquiry, into their instructional repertoire for substantial change to occur, this includes the homework that is assigned (Lynch, 1997).

Chapter II of this study illustrates the current lack of research related to the specific research question posed. The void of information in regard to teachers’ instructional methodologies and their respective homework assignments identifies the basis for my research. Research is needed in this field if teachers are to plan and create lessons and activities that positively and appropriately address student achievement goals.
Table 3

_Suggested Definitions for Inquiry-Based Instruction_

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>▪ Start with questions about nature</td>
<td>▪ Ask questions</td>
<td>▪ Identify and ask appropriate questions</td>
</tr>
<tr>
<td>▪ Engage students actively</td>
<td>▪ Construct explanations</td>
<td>▪ Design and conduct investigations to collect evidence to answer questions</td>
</tr>
<tr>
<td>▪ Concentrate on the collection and use of evidence</td>
<td>▪ Test explanations against current scientific knowledge</td>
<td>▪ Use appropriate equipment and tools to interpret and analyze data</td>
</tr>
<tr>
<td>▪ Provide historical perspectives</td>
<td>▪ Communicate ideas to others</td>
<td>▪ Draw conclusions and think critically and logically to create explanations based on evidence</td>
</tr>
<tr>
<td>▪ Insist on clear expression</td>
<td>▪ Consider alternate explanations</td>
<td>▪ Communicate and defend results to peers and others</td>
</tr>
<tr>
<td>▪ Use a team approach</td>
<td>▪</td>
<td></td>
</tr>
<tr>
<td>▪ Do not separate knowing from finding out</td>
<td>▪</td>
<td></td>
</tr>
<tr>
<td>▪ Deemphasize the memorization of technical vocabulary</td>
<td>▪</td>
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</tr>
</tbody>
</table>

_Research Definition of Inquiry_

▪ Ask questions
▪ Investigate their questions through the generation of investigative strategies
▪ Produce, analyze and interpret data
▪ Formulate and communicate conclusions
▪ Create new questions based on conclusions
and objectives (Epstein & Van Voorhis, 2001; Haney & Lumpe, 1995; Lynch, 1997). If homework is to continue to be used as an instructional tool, researchers and educators will need to devote attention to improving its design (Van Voorhis, 2001). With teacher’s reporting that they receive very little, if any, guidance on the design of homework in teacher education programs, the current research seems long overdue (Jensen et al., 1994; Pribble, 1993; Van Voorhis, 2001).
CHAPTER III

Introduction

Chapter III provides a detailed description of the specific research design utilized in this study. A description of the process for participant selection and the appropriate consent will be included. Procedures for the acquisition and analysis of data relevant to the study are explained. I reviewed the participants’ responses to the survey and analyzed them based on a predetermined coding system, through the use of a coding rubric. The alignment of the coding rubrics to a variety of research literature and professional science organizations is illustrated and discussed within this chapter. A discussion of the analysis and interpretation of the data, along with its reliability will be examined in Chapter IV.

Research Design

The purpose of this research is not to investigate the methodological beliefs of science teachers, but rather to gather information with respect to teachers’ self-reported instructional methodologies and their design of out-of-class work. As illustrated previously in the Teacher Beliefs Framework (Figure 1) that I developed, the design of homework assignments should be consistent with the methodological beliefs of the teacher. Haney, Lumpe, and Czerniak (2003) described an educator’s beliefs as “one’s convictions, philosophy, tenants, or opinions about teaching and learning” (p. 367). Additionally, it should be noted that research has illustrated that the methodological beliefs of a teacher shape the teacher’s attitude toward instruction and, in turn, will affect the actions of the teacher (Pajares, 1992). It is my assumption that the design of
homework assignments are included in Pajares’ (1992) term actions and the assignments are based on Haney, Lumpe and Czerniak’s (2003) description of educational beliefs.

Through a review of the literature, I discovered a relative lack of information regarding the alignment in the design of homework and teachers’ methodological beliefs. The focus of my literature then shifted to a historical perspective on homework and the role it has played in American public education. I followed this research with a similar structure for science instruction: a historical perspective and its role in American public education. The last two sections of the literature review described the rationale behind my focus on inquiry as an instructional model versus a traditional model of instruction. The review of the literature, coupled with the Methodological Beliefs Framework that I developed in Chapter I, assisted in my current research investigation.

The aforesaid information is the impetus for the research question posed in this study. Specifically, there is one focal question for the study:

1. To what degree do secondary school science teachers’ homework assignments align to their self-professed instructional methodologies?

As I mentioned in Chapter I, demographic data obtained through the survey could lead to further analysis of homework designs and instructional approaches by a number of demographic categories. The coupling of the demographic data and the qualitative responses will allow for an investigation of homework design and instruction according to:

A. the state where employed;
B. the environmental setting of the school – rural, suburban, and urban – in which the participant is employed;
C. the age range of the participant and;
D. the grade-level the participant is currently teaching: Middle School (5-8), High School (9-12), Middle-to-High (5-12), All levels (K-12), or GED/HS Equivalency courses.

The procedures used to obtain information in reference to the above research question, as well as methods used to analyze the data are explained in further detail throughout this chapter.

Participants

The participants for the current study include a purposive sample (Merriam, 2001, 2002b) of educators from across the Midwestern United States and California. Each of the participants had recently engaged in a professional development opportunity organized by the Center for Ocean Sciences Education Excellence Great Lakes (COSEE GL). COSEE GL is among a number of regional centers within a consortium known as the Center for Ocean Sciences Education Excellence (COSEE). In order to provide the most comprehensive analysis of the participants utilized in this study, I feel it is imperative to provide a more thorough description of the COSEE Network and the role of COSEE GL within that network. Additionally, a more inclusive account of the participants will follow the information regarding COSEE. Lastly, information pertaining to the consent of the participants is included in this section of Chapter III.

*The COSEE Network & COSEE GL Identified*

The Center for Ocean Sciences Education Excellence (COSEE) Network is a collaborative effort of ocean science researchers and practicing educators. The network was initiated in 2002 through funds made available from the National Science Foundation (NSF). At its inception, the COSEE Network included five regional centers, a number
that has more than doubled in six years; the COSEE Network included eleven regional centers at the time of this research. From August 2002 until October 2008, the COSEE Network secured over $34 million in awards from the National Science Foundation (NSF, 2008). Larry Clark, Director of NSF’s Division of Ocean Sciences notes that the NSF support of COSEE was due to the organization’s contribution to scientific knowledge that has been made by ocean science researchers (NSF, January 3, 2006). The collaboration incorporates a variety of regional centers in order to:

- foster the integration of ocean research into high quality educational materials,
- allow ocean researchers to gain a better understanding of educational organizations and pedagogy, provide educators with an enhanced capacity to understand and deliver high-quality educational programs in the ocean sciences, and provide material to the public that promotes a deeper understanding of the ocean and its influence on each person’s quality of life and our national prosperity. (COSEE, 2008a)

As noted earlier, there are currently 11 regional centers within the COSEE Network: California, Central Gulf of Mexico, Costal Trends, Great Lakes, Networked Ocean World, Ocean Learning Communities, Ocean Systems, Pacific Partnerships, Southeast, West, and Central Coordinating Office. The participants in this study were comprised of representatives from COSEE Great Lakes.

COSEE Participants

A database of educators who recently participated in a COSEE professional development workshop was provided to me by Dr. Howard Walters, Program & Process Evaluator for COSEE Great Lakes and Ashland University professor, with permission
from Dr. Rosanne W. Fortner, Director of COSEE GL. Initially, an electronic correspondence (e-mail) was issued to 580 educators contained within the database. This e-mail contained information regarding the research, such as the purpose of the research, the participants’ responsibilities, and the procedure for completing the survey. Along with this information, the e-mail included a link to the actual survey, which was developed through the Internet survey organization, Zoomerang.

The participants were comprised of educators from across the Midwest United States and California. The original database of 580 educators was narrowed and a new database containing names and e-mail addresses of the 57 educators completing the survey was developed. This database was further filtered for participants that were identified as secondary school science educators and who completely answered necessary items on the questionnaire. For the purpose of this study, a secondary school science educator was defined as an individual currently teaching a science course in grades 6 through 12, or an equivalent (such as a GED course). The new database of 27 science educators became the purposive sample (Merriam, 2001, 2002b) utilized in the current study. The participants’ demographic characteristics such as age range, sex, years of experience, state where employed, and type of undergraduate school (public or private) attended are provided in Chapter IV. Additionally, in Chapter IV is an analysis of characteristics of the specific schools represented within the sample: setting (rural, suburban, urban), grade levels represented, and the percentage of minority students. The identification of these various demographic parameters could have a significant impact on the generalizability of this study, a topic which will be discussed in a subsequent chapter of this dissertation.
Participant Consent

As previously mentioned, an initial e-mail was sent to a broad database of educators that recently participated in a COSEE GL professional development program. The e-mail detailed the emphasis of the research being conducted, the type of involvement that was required by participants, the purpose of the research and a link to the survey instrument. Also included at the beginning of the survey was a statement of consent indicating the process for their consent of participation in the study. This statement indicated that participant consent was granted through their participation in the completion of the survey. The confidentiality of the participants was also assured in this preliminary section of the survey instrument, as well as their ability to withdraw from the study at any time. Since the information obtained from the participants was done electronically, it was assured that their e-mail addresses would not be used in the study, nor would they be kept in a personally identifiable manner by the researcher.

Instrumentation

In order to obtain the appropriate data in the timeliest manner, I designed a questionnaire entitled *Secondary Science Instructional Methodologies & Classroom Design*. The design of the questionnaire was consistent with the definition provided by Creswell (2005) in which the participants provide answers to a series of questions along with some basic, demographic information. Therefore, the use of the questionnaire was two-fold: (a) obtain demographic data of the participants, and (b) conveniently collect qualitative data on the instructional beliefs and practices of the participants, as well as a descriptions of their homework design. The literature on teacher beliefs reveals that the utilization of surveys and/or questionnaires to attain information on teachers’ beliefs is a
common and accepted research practice (Adams & Krockover, 1997; Berg, 1998; Richardson & Simmons, 1994; Taylor, Fraser, & White, 1994; Varrella & Burry-Stock, 1997). In addition to obtaining information regarding the teacher’s instructional beliefs, descriptions of homework assignments and class lessons were obtained from the participants. Each participant was asked to provide a description of classroom and/or lab activities covering a 4-week span of time; two weeks prior to the survey and for the upcoming two weeks. A final question was posed to the participants on the survey, asking them to describe a homework assignment that followed one or more of these lessons. Participants were asked to provide examples of actual homework assignments aligned to the 4-week span of classroom activities; however, none of the participants complied with this request.

In order to assure that the questionnaire and survey were designed in a manner that was consistent with the research philosophy of Ashland University, an application to the Ashland University Human Subjects Review Board was submitted (Appendix C). Upon successful approval of the questionnaire and the research design, the e-mail containing information regarding the study and a link to the survey instrument was sent to potential participants in mid-February 2009. A total of 57 educators responded with their willingness to participate (i.e. completion of the survey).

**Questionnaire Design**

The questionnaire consisted of 12 background (Creswell, 2005) questions intended to acquire demographic information on the participants. These questions identified the participants’ personal, as well as professional, backgrounds. Personal information, such as age, gender, and race were initially obtained in the questionnaire.
The next 10 items asked each participant to identify the college or university attended as an undergraduate student and the year of graduation. Additionally, participants identified the degree conferred and undergraduate major(s) in this section. The participants were also asked to list the science course(s) that they currently teach and the state in which they are currently employed.

Background information on the school where each participant taught was also obtained in the opening section of the questionnaire. Each participant was asked to complete two descriptors of his or her respective school. The items in this section, number of minority students and the school setting (rural, suburban, urban), were inclusive of the building in which the participant was currently teaching, not the district. The first item asked the participants to identify the settings of the schools where they were employed as rural, suburban, or urban. Next, participants indicated the approximate percentage of minority students in their respective classes. The information obtained from the background data of the participants and their respective schools allowed for further extrapolation of the data based on their open-ended responses. The analysis methods and procedures used in this extrapolation are explained in a subsequent section of this chapter. The actual results can be found in Chapter IV. The design and credibility of the open-ended response questions is detailed in the next section.

Design of the Open-Response Questions

The questionnaire consisted of seven open-ended (Creswell, 2005) questions or statements to which the participant provided a written response. Six of these items were used for the determination of the teachers’ instructional beliefs and practices, and one question focused on their designs of homework assignments. Some researchers, such as
Fang (1996), who stated that “teachers (sic) written responses in these studies may reflect what should be done rather than what is actually done in class” feel that self-report is not reliable without classroom observation (p. 53). However, as indicated in Smith, Desimone, Zeidner, Dunn, Bhatt, & Rumyantseva (2007), self-reports of teaching beliefs on anonymous surveys have been correlated to a moderately high extent with classroom observations. The authors also noted an assortment of research (Mullens, 1995; Mullens & Gayler, 1999; Schmidt, McKnight, & Raizen, 1997; Shavelson, Webb, & Burstein, 1986; Smithson & Porter, 1994) that attests to the validity and reliability of one-time surveys of teachers’ self-report of instructional approaches. Therefore, based on the aforesaid information, I am reasonably confident in the accuracy of the responses given by the participants of this research.

Of these seven questions or statements, four were selected and modified from Roehrig and Kruse’s (2005) Teachers’ Beliefs Interview (TBI). Consent for the use and modification of these four TBI items was obtained through e-mail correspondence with Dr. Roehrig (Appendix D). Roehrig and Kruse (2005) developed their interview protocol through a modification of Richardson and Simmons’ 1994 Teachers’ Pedagogical Philosophy Interview. These authors indicated that their research is consistent with prior research (Guskey, 1985; Richardson, 1996; Tobin & McRobbie, 1996) which stresses that teaching beliefs have a significant impact on teaching practices. It seemed justifiable that the questions developed for my research were conducive for use in answering the research question and a pilot study was not warranted (Creswell, 2002). The remaining three open-ended items on the questionnaire were designed to obtain specific information regarding the teachers’ methodological approach to classroom instruction and homework design. Two of the items were designed in alignment with Gerber, Cavallo, & Marek
research on inquiry and non-inquiry science classrooms. These questions or statements focused specifically on activities that take place during class, i.e. instructional and/or lab activities over a course of 4 weeks. Lastly, each participant was asked to provide an example of a homework assignment that followed one or more of the activities alluded to previously.

Methodology

The questionnaire designed for this study provided insight into the instructional beliefs and methodological approaches of the participants as well as their homework techniques. Additionally, the questionnaire was used to gather demographic information about the participants and their respective school environments. This study utilized both qualitative and quantitative methods of data analysis. Initially, the qualitative research technique of coding (Creswell, 2005) was used for the categorization of the participants’ responses. The responses obtained through the open-ended questions were coded based on three predetermined coding rubrics. As Weiss (1994) suggested, some coding rubrics are designed in advance of the data analysis in order to study a particular problem or issue. I found that a predetermined coding system, as suggested by Weiss (1994), was justifiable for this research given that I was not intending to discover themes within the participants’ responses, but rather to categorize their responses. The rubrics designed to code the open-ended responses and the categories used to define the participants’ responses are explained in detail in subsequent sections of the Methodology section.

After the participants’ responses were appropriately coded and placed into their respective categories, they were assigned a nominal numerical value, based upon their respective categories, for further quantitative analysis. The categories used to define the
self-reported instructional methodologies of the participants and their homework designs were Traditional, Traditional +, and Inquiry. As mentioned previously, these three categories will be further defined in the next section of this chapter. The numerical values given to the categories are as follows: Traditional (0), Traditional + (1), and Inquiry (2). The process for coding the responses, the rubrics used for coding and the assignment of their categories is explained in detail in the next section.

A chi-square test was utilized in the analysis of the nominal values assigned to the participants’ responses to the various survey questions. Initially, a chi-square test was employed in order to determine if an association between the participants’ instructional methodologies and their respective homework designs existed. However, after analyzing the frequencies of the demographic data, additional research questions developed; these questions are identified in Chapter IV. Using the demographic information, it was then possible to investigate possible associations between the participants’ instructional methodologies, homework design, and various demographic features. In order to determine if an association existed within these different chi-square analyses, a Cramer’s V coefficient was obtained (Fraas, 2003). The results of the above mentioned data analyses are described in Chapter IV.

Coding Rubrics

Coding rubrics were designed in order to classify the participants’ responses to the open-ended items on the questionnaire. The coding rubrics were utilized in defining a participant’s teaching style, homework, and methodological philosophy as either Traditional, Traditional +, or Inquiry. The Traditional category was defined as a didactic approach to instruction, in which the teacher assumes the central role in the classroom
and students are passively engaged in the curriculum. The Traditional category is also defined as an educational environment that makes students dependent upon the teacher rather than focusing on independent thinking skills (Learn NC, 2008). The Inquiry category is defined by the National Science Education Standards (NRC, 1996), Project 2061’s guidelines for effective teaching of science (AAAS, 1990), and the National Science Teachers Association (NSTA) declarations on scientific inquiry (NSTA, 2004). An overview of the Inquiry items can be found in Appendices E, F, and G respectively. The Traditional + category is defined as a methodological approach that exhibits techniques of both the Traditional and Inquiry categories, but is not dominant in either. The next section offers a brief description of the development of each coding rubric used in the analysis of the participants’ responses.

Rubrics Defined

The coding rubrics were developed in order to assist in the categorization of the participants’ responses to the open-ended items in the questionnaire. The rubrics were designed based on a series of three different scoring measures: one for questionnaire items 1 – 3, another for items 4 - 6, and lastly item 7. The first 3 questions, which were 3 of the 4 items selected from Roehrig and Kruse’s (2005) Teachers’ Beliefs Interview (TBI), were coded using a separate rubric adapted from Luft and Roehrig’s (2007) diagrams of selected Teacher Beliefs Interview (TBI) responses. These items were then tailored to suit the needs of my research. Table 4 presents an illustration of the adaption of Luft and Roehrig’s (2007) responses and their alignment to the current research.

To properly analyze and code items 4, 5, and 6, Gerber et al. (2001) descriptors of inquiry and non-inquiry science teachers were used. The authors described an inquiry
teachers’ methodological approach as one which maintains student discovery as a central theme in the classroom, fosters discussions among students, relies heavily on questioning students, and allows students to formulate their own explanations to scientific phenomena. Whereas a non-inquiry teacher had a methodological approach which was void of these areas and tended to focus on lectures, worksheets, verification labs, etc.

Table 4

*Alignment of Luft & Roehrig (2007) to Beliefs Categories*

<table>
<thead>
<tr>
<th></th>
<th>Traditional</th>
<th>Instructive</th>
<th>Transitional</th>
<th>Responsive</th>
<th>Reform-Based</th>
</tr>
</thead>
<tbody>
<tr>
<td>Describe your role as a teacher.</td>
<td>Focus on info &amp; structure</td>
<td>Focus on experiences</td>
<td>Focus on teacher/student relationships or student understanding</td>
<td>Focus on collaboration between teacher and student</td>
<td>Focus on mediating student prior knowledge &amp; knowledge of the discipline</td>
</tr>
<tr>
<td>How do your students learn best?</td>
<td>From the teacher</td>
<td>Mimicking the teacher</td>
<td>Using guidelines</td>
<td>Interpreting phenomena</td>
<td>Construct ideas about a phenomena</td>
</tr>
<tr>
<td>How do you know when learning is occurring in your classroom?</td>
<td>Action of students during instruction; order &amp; attention</td>
<td>Correctness of the students response to a measure</td>
<td>Subjective conclusions about the student</td>
<td>Interaction w/peers or teacher about the topic. Responses are limited or preliminary.</td>
<td>Students initiate significant interactions w/one another and/or the teacher about the topic</td>
</tr>
</tbody>
</table>

Equivalent Category

| TRADITIONAL | TRADITIONAL + | INQUIRY |
Table 5 is a representative image of the alignment of Gerber et al. and the categories that I designed. The alignment of Gerber et al. and the researcher-designed categories of Traditional, Traditional +, and Inquiry was utilized as the coding rubric for items 4 – 6 from the questionnaire.

### Table 5

**Alignment of Gerber et al. (2001) to Instructional Categories**

| Adaptations to the learning environment and description of classroom activities | Lecture-based classes | Student book reports | Students complete worksheets regularly | Students watch videos | Students complete verification labs | Teacher provides explanation of concept prior to, or in place of, student discovery | Void of group work | No student discussion of ideas, concepts or results | Materials-rich | Student-discovery activities | Teacher questioning | Do not reveal concepts prior to student exploration | Students formulate explanations of phenomena | Students work in groups and discuss data and conclusions | Students present findings and discuss data in class |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Equivalent Category | TRADITIONAL | TRADITIONAL + | INQUIRY |

The final item asked participants to describe a homework assignment that followed one or more of their lessons identified in items 5 and 6 of the questionnaire. The scoring procedures for item 7 were aligned to Colburn’s (2004) description of
assessments in an inquiry science classroom. Colburn (2004) identified assessment in inquiry as methods that require students to generate their own questions, investigate a problem using scientific methods, and to also interpret a given set of data in order to form conclusions. Homework assignments that relied instead on recall of information, recitation of scientific facts, focused on drill-and-practice, lacked intellectual expansion of ideas, or simply required rote memorization skills were classified as Traditional. Again, the Traditional + category was classified as a hybrid of both Traditional and Inquiry, exhibiting some qualities of both, yet negating neither. The alignment of the assessment methods proposed by Colburn (2004) and the Traditional, Traditional +, and Inquiry categories is illustrated in Table 6.

Table 6

Alignment of Colburn (2004) to Homework Categories

<table>
<thead>
<tr>
<th>Design of the homework assignment asks students to utilize the following skills or involves the following activities</th>
<th>Equivalent Category</th>
<th>Equivalent Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matching</td>
<td>TRADITIONAL</td>
<td>TRADITIONAL +</td>
</tr>
<tr>
<td>True &amp; False</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple choice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Read a given excerpt from a textbook</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spelling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Essay question based on factual recall</td>
<td></td>
<td>Development of further investigation questions based on class or lab work</td>
</tr>
<tr>
<td>Read a given excerpt from a textbook and answer comprehension questions</td>
<td></td>
<td>Interpretation of sample data in order to formulate conclusions</td>
</tr>
<tr>
<td>Development of further investigation questions based on class or lab work</td>
<td></td>
<td>Develop a procedure to address or investigate a question or problem</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Equivalent Category</th>
<th>TRADITIONAL</th>
<th>TRADITIONAL +</th>
<th>INQUIRY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Reliability

This study employed both qualitative and quantitative methods of data analysis and, therefore, required varying protocols for reliability. First, the data obtained from the participants in regard to their instructional methodologies and homework practices were purely qualitative in nature; each participant provided a narrative response to the survey item. Merriam (2002a) noted that the reliability of qualitative analysis is not equivalent to the reliability in a quantitative analysis, where reliability is based on the replication of the results. Instead, the measure for reliability in qualitative research is that the results are consistent with the data collected and that the researcher has confidence in the results (Golafshani, 2003; Lincoln & Guba, 1985; Merriam, 2002a). Merriam (2002a) also suggested that reliability in qualitative analysis “lies in others concurring that given the data collected, the results make sense” (p. 29). In this manner, reliability of the analysis of the narrative responses becomes a difficult concept to justify. However, the triangulation (Creswell, 1998; Golafshani, 2003; Merriam, 2002a) of the information used in the development of the coding rubrics and the three coding categories, along with the data obtained from the narrative responses, promoted an increased level of reliability in the qualitative data.

Summary

Chapter III provided a detailed account of the research design, research methodology, and data analysis procedures for this study. Furthermore, a description of the participants and the database utilized to obtain their information was provided within this chapter. In order to best describe the sample used in the research, the demographic data of the participants obtained from the questionnaire was collected. The qualitative
data obtained from the participants’ responses to the questionnaires was coded in order to determine the instructional methodology of the participant. Likewise, the participant responses were also coded in order to determine the style of homework they developed: Traditional, Traditional +, or Inquiry. This information was then used to determine the existence of an alignment between the participants’ instructional methodologies and their homework designs. The results of the alignment between the teachers’ self-professed instructional methodologies and their homework assignments, and the results of various correlations among the demographic data and the open-ended responses are presented in Chapter IV.
CHAPTER IV

Introduction

This study sought to explore the alignment of secondary school science teachers’ homework assignments and the teachers’ instructional methodologies. This chapter provides an extensive profile of the participants, including relevant demographic characteristics of the participants and their representative school settings. Additionally, the participants’ responses to the open-ended questions from the survey are interpreted and reported within this chapter. The analysis of the open-ended responses includes information on the participants’ instructional methodologies and practices, as well as their homework assignments. Most significant for the purpose of this study, the alignment of the participant’s instructional methodologies and the respective homework assignments are also reported within this chapter. Finally, the qualitative results are further examined using the demographic data to determine if any correlations and associations exist among the participants and their responses.

Demographic Analysis

The demographic data obtained in the survey were inputted into an SPSS® database (version 13.0) and used to determine statistical frequencies. The data obtained regarding the participants’ demographics are reported in the subsequent section. The initial research question did not necessitate any statistical analyses of the demographic data beyond the determination of participant frequencies. However, additional research questions, based on the demographic data, developed during the analysis of the participants responses to the open-ended survey items. The additional questions, as well
as the statistical analysis used in answering these questions are addressed in a subsequent section of this chapter.

**Participant Profile**

A total of 57 science educators completed the survey, 35 of which were identified as current secondary school science educators as defined earlier in this study. Twenty-seven of those classified as secondary school science educators completed all of the open-response survey items, and therefore were utilized as the participants for this study. Of the 27 participants, 67% (n = 18) were high school teachers (grades 9-12), 22% (n = 6) were middle school teachers (grades 5-8), 7% (n = 2) were integrated between middle school and high school (grades 6-12), and 4%, or one participant, was teaching a GED course.

Within the collection of 27 participants, 56% (n = 15) were female and 44% (n = 12) were male. The specific age of each participant was not solicited; rather each participant was offered an age range to choose from within the survey. A similar method was also used in the identification of the participants’ years of experience in the classroom; participants were given various ranges to choose from rather than indicating a specific amount of years for their experience. Each of the ranges, age and years of experience, and their corresponding participant frequencies are located in Table 7.

The participants were asked to identify the type of school setting in which they were employed as either rural, suburban, or urban. 48% (n = 13) of the participants were employed in a suburban school district, 30% (n = 8) were employed in an urban school district, and 22% (n = 6) were employed in a rural school district. Participants also
identified the approximate number of minority students within their respective classrooms. Forty-eight percent (n = 13) of the participants reported a minority student enrollment of 1-20 percent, 33% (n = 9) indicated a minority student population of 21-50 percent, 7% (n = 2) reported a 51-80 percent minority student population, 7% (n = 2) reported a minority student population of over 80 percent, and one participant did not respond. Table 8 indicates the various school settings represented within the study, as well as their respective minority populations.

Eight states were represented within the participant population, the largest contingent (n = 15) was comprised of teachers employed in the state of Michigan. Three states, California, New Jersey, and New York were each represented by one participant. Table 9 indicates each of the states represented by the participants in this study.

<table>
<thead>
<tr>
<th>Age Range</th>
<th>0 – 3</th>
<th>4 – 10</th>
<th>11 – 15</th>
<th>16 – 20</th>
<th>20+</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 – 30</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>31 – 40</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>41 – 50</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>51 – 60</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>61 – 70</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 7

*Age Range and Years of Experience of Participating Teachers*

<table>
<thead>
<tr>
<th>Age Range</th>
<th>0 – 3</th>
<th>4 – 10</th>
<th>11 – 15</th>
<th>16 – 20</th>
<th>20+</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 – 30</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>31 – 40</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>41 – 50</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>51 – 60</td>
<td>0</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>61 – 70</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 8

*School Setting and Respective Percentage of Minority Students*

<table>
<thead>
<tr>
<th>% Minority</th>
<th>Rural</th>
<th>Suburban</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – 20</td>
<td>5</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>21 – 50</td>
<td>1</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>51 – 80</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>80+</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

*Note.* One participant did not respond.

Table 9

*Location of Participants*

<table>
<thead>
<tr>
<th>State</th>
<th>Frequency</th>
<th>State</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>1</td>
<td>New York</td>
<td>1</td>
</tr>
<tr>
<td>Illinois</td>
<td>3</td>
<td>Ohio</td>
<td>2</td>
</tr>
<tr>
<td>Michigan</td>
<td>15</td>
<td>Pennsylvania</td>
<td>2</td>
</tr>
<tr>
<td>New Jersey</td>
<td>1</td>
<td>Wisconsin</td>
<td>2</td>
</tr>
</tbody>
</table>

*Complete Participant Information*

In order to provide a substantive and complete depiction of the participants, Table 10 identifies each of the participants individually. The demographic information in the preceding sections of this chapter is included in this table. In order to protect the anonymity of the participants, each participant has been designated by a numerical
Table 10

**Complete Participant Demographic Information**

<table>
<thead>
<tr>
<th>Participant</th>
<th>Gender</th>
<th>Age (years)</th>
<th>Experience (years)</th>
<th>Teaching Level</th>
<th>Location</th>
<th>Setting</th>
<th>Minority Pop. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F</td>
<td>51-60</td>
<td>20+</td>
<td>MS</td>
<td>PA</td>
<td>urban</td>
<td>21-50</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>31-40</td>
<td>16-20</td>
<td>HS</td>
<td>MI</td>
<td>suburban</td>
<td>21-50</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>20-30</td>
<td>4-10</td>
<td>HS</td>
<td>MI</td>
<td>urban</td>
<td>21-50</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>31-40</td>
<td>4-10</td>
<td>HS</td>
<td>OH</td>
<td>suburban</td>
<td>80+</td>
</tr>
<tr>
<td>5</td>
<td>M</td>
<td>51-60</td>
<td>20+</td>
<td>HS</td>
<td>IL</td>
<td>suburban</td>
<td>21-50</td>
</tr>
<tr>
<td>6</td>
<td>M</td>
<td>31-40</td>
<td>4-10</td>
<td>HS</td>
<td>MI</td>
<td>rural</td>
<td>21-50</td>
</tr>
<tr>
<td>7</td>
<td>M</td>
<td>31-40</td>
<td>11-15</td>
<td>HS</td>
<td>MI</td>
<td>suburban</td>
<td>1-20</td>
</tr>
<tr>
<td>8</td>
<td>M</td>
<td>51-60</td>
<td>20+</td>
<td>HS</td>
<td>OH</td>
<td>suburban</td>
<td>51-80</td>
</tr>
<tr>
<td>9</td>
<td>F</td>
<td>31-40</td>
<td>4-10</td>
<td>HS</td>
<td>MI</td>
<td>suburban</td>
<td>1-20</td>
</tr>
<tr>
<td>10</td>
<td>M</td>
<td>51-60</td>
<td>20+</td>
<td>HS</td>
<td>MI</td>
<td>rural</td>
<td>1-20</td>
</tr>
<tr>
<td>11</td>
<td>F</td>
<td>31-40</td>
<td>16-20</td>
<td>GED/HS</td>
<td>WI</td>
<td>suburban</td>
<td>21-50</td>
</tr>
<tr>
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<td>F</td>
<td>51-60</td>
<td>11-15</td>
<td>HS</td>
<td>NJ</td>
<td>suburban</td>
<td>21-50</td>
</tr>
<tr>
<td>13</td>
<td>F</td>
<td>51-60</td>
<td>11-15</td>
<td>HS</td>
<td>MI</td>
<td>urban</td>
<td>1-20</td>
</tr>
<tr>
<td>14</td>
<td>M</td>
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<td>11-15</td>
<td>MS</td>
<td>PA</td>
<td>urban</td>
<td>51-80</td>
</tr>
<tr>
<td>15</td>
<td>M</td>
<td>61-70</td>
<td>20+</td>
<td>MS</td>
<td>IL</td>
<td>suburban</td>
<td>1-20</td>
</tr>
<tr>
<td>16</td>
<td>F</td>
<td>41-50</td>
<td>20+</td>
<td>MS</td>
<td>MI</td>
<td>urban</td>
<td>80+</td>
</tr>
<tr>
<td>17</td>
<td>F</td>
<td>51-60</td>
<td>11-15</td>
<td>MS</td>
<td>MI</td>
<td>rural</td>
<td>1-20</td>
</tr>
<tr>
<td>18</td>
<td>F</td>
<td>51-60</td>
<td>11-15</td>
<td>MS</td>
<td>MI</td>
<td>rural</td>
<td>1-20</td>
</tr>
<tr>
<td>19</td>
<td>M</td>
<td>41-50</td>
<td>20+</td>
<td>HS</td>
<td>MI</td>
<td>urban</td>
<td>21-50</td>
</tr>
</tbody>
</table>
Table 10 (continued)

**Complete Participant Demographic Information**

<table>
<thead>
<tr>
<th>Participant</th>
<th>Gender</th>
<th>Age (years)</th>
<th>Experience (years)</th>
<th>Teaching Level</th>
<th>Location</th>
<th>Setting</th>
<th>Minority Pop. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>M</td>
<td>51-60</td>
<td>4-10</td>
<td>HS</td>
<td>MI</td>
<td>suburban</td>
<td>1-20</td>
</tr>
<tr>
<td>21</td>
<td>F</td>
<td>20-30</td>
<td>4-10</td>
<td>HS</td>
<td>IL</td>
<td>suburban</td>
<td>1-20</td>
</tr>
<tr>
<td>22</td>
<td>F</td>
<td>31-40</td>
<td>0-3</td>
<td>HS</td>
<td>CA</td>
<td>urban</td>
<td>1-20</td>
</tr>
<tr>
<td>23</td>
<td>F</td>
<td>41-50</td>
<td>4-10</td>
<td>6-12</td>
<td>MI</td>
<td>urban</td>
<td>-</td>
</tr>
<tr>
<td>24</td>
<td>F</td>
<td>51-60</td>
<td>20+</td>
<td>HS</td>
<td>WI</td>
<td>rural</td>
<td>1-20</td>
</tr>
<tr>
<td>25</td>
<td>M</td>
<td>41-50</td>
<td>20+</td>
<td>HS</td>
<td>MI</td>
<td>suburban</td>
<td>1-20</td>
</tr>
<tr>
<td>26</td>
<td>M</td>
<td>51-60</td>
<td>20+</td>
<td>HS</td>
<td>NY</td>
<td>rural</td>
<td>1-20</td>
</tr>
<tr>
<td>27</td>
<td>F</td>
<td>31-40</td>
<td>11-15</td>
<td>MS</td>
<td>MI</td>
<td>suburban</td>
<td>21-50</td>
</tr>
</tbody>
</table>

*Note.* GED/HS=high school equivalency course, HS=high school (grades 9-12), MS=middle school (grades 5-8). Missing data values indicate a non-response from the participant.

Analysis of Participants’ Instructional Methodologies

Participants were asked to respond to a series of questions regarding their instructional beliefs and practices, along with a description of classroom activities that had taken place over a 4-week period of time. The responses were placed into a
Microsoft Word data table, analyzed using the coding rubrics identified in Chapter III, and placed into the appropriate instructional and beliefs categories. An example of the Microsoft Word data table used in the coding and analysis of the responses is illustrated in Table 11. Each of the survey responses were coded and analyzed in a manner consistent with the previous explanation. After each question had been appropriately coded, the data was organized by participant and an overall categorical placement of the participant’s responses was created.

Table 11

Example of Microsoft Word Data Table Used for Coding Instructional Responses

<table>
<thead>
<tr>
<th>Participant ID</th>
<th>Notes</th>
<th>Question/Rationale</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>280038453</td>
<td>Mediating prior knowledge and knowledge of the discipline</td>
<td>Teaching the wonder of science; helping students to see how science affects their daily lives; learning by doing and asking questions/searching for answers.</td>
<td>Inquiry</td>
</tr>
</tbody>
</table>
Traditional Category

Teachers placed in the Traditional category focused their attention on the dissemination of scientific information. They indicated their role within the classroom as the means by which students received information and scientific knowledge. These teachers associated student learning with the behaviors of students during class, or with the student’s ability to provide a correct response to a question. Both of these items were identified on the coding rubric based on the work of Luft and Roehrig (2007). The 4-week lessons provided by the Traditional teachers were in alignment with Gerber, et al. (2001) and focused on classroom lectures, verification labs, simple observations of scientific processes and worksheet material. Table 12 provides examples of responses categorized as Traditional for the four questions regarding the participants’ instructional methodologies, as well as an example of a 4-week lesson categorized as Traditional. Of the 27 participants involved in this study, 26% (n = 7) provided responses that I determined to be consistent with the Traditional category, as described by the literature represented within the coding rubrics. A complete listing of the responses for each participant categorized as Traditional can be found in Appendix E.

Inquiry Category

The literature in Chapter II identified that, given the variety of definitions assigned to the term inquiry (Ohana, 2006), inquiry instruction should be thought of existing on a continuum based on instructional techniques and student involvement (Colburn, 2004; Sandoval, 2005). The definition for inquiry utilized in this study was an instructional method where students asked questions; investigated their questions through the generation of investigative strategies; produced, analyzed and interpreted data;
Table 12

*Traditional Category Examples as Presented by Respondents*

<table>
<thead>
<tr>
<th>Survey Item</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role as a science teacher</td>
<td>My role has been defined by my employer- to master the curriculum established by the State of Michigan. G.L.C.E.</td>
</tr>
<tr>
<td>How do students best learn science?</td>
<td>activities directly related to reading and quizzes</td>
</tr>
<tr>
<td>What are the indicators that learning is occurring in your classroom?</td>
<td>Students are actively engaged in learning, with minimal disruption and behavior problems</td>
</tr>
<tr>
<td>How have you adapted teaching to reflect the discipline of science?</td>
<td>My teaching of science reflects the discipline of science in that I present data, ask questions, state what is learned by scientists and why methods were used to learn it, and apply it to the real world. In a sense, I apply the Scientific Method to my teaching of science.</td>
</tr>
<tr>
<td>4-week lesson description of lessons</td>
<td>Practice with metric measurements. Practice with data tables and graphing the results of classroom experiments.</td>
</tr>
</tbody>
</table>
formed conclusions and communicated their results; and created new questions based on their conclusions (Krajcik, et al., 1998; NRC, 1996; NSTA, 2004; Rutherford & Ahlgren, 1990; Sandoval, 2005; White & Frederiksen, 1998). Teachers assigned to the inquiry category must have clearly described an inquiry approach to instruction that was aligned with the aforesaid definition of inquiry, as well as with the three coding rubrics for the inquiry category.

Teachers in the Inquiry category described that their roles were to engage students in the process of science and to facilitate student discovery about scientific concepts. The Inquiry teachers identified that students learned best by doing science, by analyzing science concepts, and by relating classroom work to the world outside the classroom. Many of these teachers classified student questioning as a means for determining student understanding (i.e. students were learning when they were asking probing questions about a concept). The Inquiry category teachers’ beliefs described previously was aligned to Luft and Roehrig (2007), as identified on the coding rubric in Figure 3 in Chapter III. Lastly, the classroom activities described by the Inquiry teachers involved student discovery of concepts, student-led investigations, and the application of scientific knowledge in order to solve a problem. Again, these descriptors were identified on the coding rubric and aligned to Gerber, et al. (2001) in the literature.

After an analysis of the 27 participant responses, a total of 30% (n = 8) of the participants were categorized as Inquiry. Examples of survey responses provided by participants identified in the Inquiry category are found in Table 13. A complete listing of the responses for each participant categorized as Inquiry can be found in Appendix F.
Table 13

Inquiry Category Examples as Presented by Respondents

<table>
<thead>
<tr>
<th>Survey Item</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role as a science teacher</td>
<td>Teaching the wonder of science; helping students to see how science affects their daily lives; learning by doing and asking questions/searching for answers.</td>
</tr>
<tr>
<td>How do students best learn science?</td>
<td>Hands-on investigations - trying to solve a big picture question.</td>
</tr>
<tr>
<td>What are the indicators that learning is occurring in your classroom?</td>
<td>Students ask the questions that lead you to the next topic. Kids can take laboratory results and connect them to make questions to make sense of an investigation.</td>
</tr>
<tr>
<td>How have you adapted teaching to reflect the discipline of science?</td>
<td>My teaching of science reflects the discipline of science in that I present data, ask questions, state what is learned by scientists and why methods were used to learn it, and apply it to the real world. In a sense, I apply the Scientific Method to my teaching of Science.</td>
</tr>
<tr>
<td>4-week lesson description of lessons</td>
<td>I have students draw what they think science is and write a definition of science in their own words. Then we share our science with each other.</td>
</tr>
</tbody>
</table>
Traditional + Category

The definition of the Traditional + category provided within this study can best be described as a conglomeration of both the Traditional and Inquiry categories. Teachers placed into this category illustrated no clear distinction between the utilization of inquiry instructional methods or traditional methods; a balance between the two types appeared to be evident. The teachers placed in the Traditional + category can best be described by their utilization of both traditional and inquiry approaches to instruction, and their beliefs were not strongly influenced by one methodology or the other.

Forty-four percent (n = 12) of the participants were identified and placed in the Traditional + category; Table 14 provides a summary of all the instructional categories and their respective frequencies and percentages. As indicated in Table 15, the responses from the participants include inquiry items, traditional items, and some combinations of both. Appendix G provides the complete survey item responses for each of the participants identified in the Traditional + category.

Table 14

<table>
<thead>
<tr>
<th>Category</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional</td>
<td>7</td>
<td>26%</td>
</tr>
<tr>
<td>Inquiry</td>
<td>8</td>
<td>30%</td>
</tr>
<tr>
<td>Traditional +</td>
<td>12</td>
<td>44%</td>
</tr>
</tbody>
</table>
Table 15

*Traditional + Category Examples as Presented by Respondents*

<table>
<thead>
<tr>
<th>Survey Item</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Role as a science teacher</td>
<td>To get my students excited about science and inspire them to pursue science in their futures or at least understand their environment and become better citizens.</td>
</tr>
<tr>
<td>How do students best learn science?</td>
<td>Students learn best by actually doing science. They have to see, hear, smell, and touch the things that they are learning about.</td>
</tr>
<tr>
<td>What are the indicators that learning is occurring in your classroom?</td>
<td>If they continue discussion as they leave the room. If they bring questions into the room.</td>
</tr>
<tr>
<td>How have you adapted teaching to reflect the discipline of science?</td>
<td>I give opportunities for experimental design and presentation of results.</td>
</tr>
<tr>
<td>4-week lesson description of lessons</td>
<td>Observations of mystery materials and identifying components in a mixture. Conservation of mass experiment where the lab needs to be adapted to capture evolved gas.</td>
</tr>
</tbody>
</table>
Analysis of Participants’ Homework Descriptions

The final question on the survey asked participants to describe a homework assignment that followed one or more of the 4-week span of lessons provided earlier on the survey. Similar to the responses in the previous section, these responses were placed into a Microsoft Word data table, analyzed using a coding rubric aligned to Colburn (2004) for homework, which was identified in Chapter III, and placed into the appropriate homework category. An example of the Microsoft Word data table used in the coding and analysis of the homework responses is illustrated in Table 16. After each response had been appropriately coded, the data was organized by participant and an overall categorical placement of the participants’ responses was identified. This section provides the results of the coding and analysis of the participants’ responses.

Table 16

*Example of Microsoft Word Data Table Used for Coding Homework Responses*

<table>
<thead>
<tr>
<th>Participant ID</th>
<th>Notes</th>
<th>Question/Rationale</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>280015696</td>
<td>Interpretation, analysis and explanation</td>
<td><em>Reflect upon the lesson and describe what you have learned.</em></td>
<td>Inquiry</td>
</tr>
</tbody>
</table>

*Homework Coding and Analysis Results*

First, the traditional category for homework was characterized by the following types of assignments: multiple choice, matching, and basic reading of a textbook chapter or excerpt without application or interpretation, and the spelling of terms. This category
was clearly dominant among the descriptions provided by the participants. 52% (n = 14) of the participants described their homework assignments in a manner that was consistent with the Traditional category.

The Traditional + category represented work that required students to complete essay questions based on factual recall of information, complete comprehension questions based on a given reading, or assignments of a similar method. Whereas the Traditional category assignments required students to use rote memorization, or look up an answer in a text book in order complete a given task, the Traditional + category assignments required students to apply comprehension skills. Of the participants in this study, 33% (n = 9) described their homework assignments with an approach that was consistent with that Traditional + category.

The category represented by the least amount of participants was the Inquiry category. 15% (n = 4) of the participants described their homework assignments in alignment with the inquiry category from the coding rubric. These assignments focused on the interpretation of information by the students. Students were also asked to develop new questions or hypotheses as a means to further explore ideas that were presented in class. Reflection upon the daily lesson was also identified within the assignments categorized as Inquiry.

In order to more clearly represent the information obtained from the participants in the descriptions of their homework assignments, examples of each category of homework assignments are provided within Table 17; complete results of homework responses are available in Appendix H.
Table 17

*Example Descriptions of Homework Assignments by Category as Presented by Respondents*

<table>
<thead>
<tr>
<th>Category</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional</td>
<td>Students received a worksheet of energy calculation problems during a unit on energy conservation</td>
</tr>
<tr>
<td></td>
<td>Practice in scientific notation.</td>
</tr>
<tr>
<td></td>
<td>We read related articles, generally from the newspaper.</td>
</tr>
<tr>
<td>Traditional +</td>
<td>Homework involves reading the text and answering text questions.</td>
</tr>
<tr>
<td></td>
<td>We have prepared reading guides for each chapter in our Earth systems science class that helps the students practice reading comprehension skills and strengthen their interpretation of technical writing.</td>
</tr>
<tr>
<td>Inquiry</td>
<td>Students will create a story that mimics protein synthesis in the cell, providing characters or objects to represent the various organelles.</td>
</tr>
</tbody>
</table>

**Analysis of Instructional Methodology and Homework**

This section first investigates the determination of the degree of association between the participants’ self-professed instructional methodologies and their homework designs. Following that investigation, there is an analysis of questions that were developed after the frequency analysis of the demographic data. Specifically, the following questions were developed from the demographic data:
1. Does an association exist for the amount of years of classroom experience for a participant and the alignment of their instructional methodology and homework design?

2. Does an association exist between the alignment of the participants’ instructional methodologies and homework design based on their geographic location?

3. Does an association exist between the alignment of participants’ instructional methodologies and homework design based on their classroom grade-level of instruction?

**Analysis of Alignment**

The coding of the participants’ responses to the survey, and their placement into an appropriate category was critical in order to properly answer the original research question posed for this study. The original research question was as follows:

To what degree do secondary school science teachers’ homework assignments align to their self-professed instructional methodologies?

In order to answer this question, the categorical data obtained from coding the participants’ responses was placed into an SPSS® database (version 13.0). Each of the categories was issued a nominal value: Traditional = 0; Traditional + = 1; and Inquiry = 2. A chi-square test was then used in order to determine the degree of association (Creswell, 2005; Fraas, 2003; Shannon & Davenport, 2001) between the participants’ self-professed instructional methodologies and their respective homework designs. The degree of association was based on the determination of a Cramer’s V coefficient (Fraas, 2003).
The degree of association between the participants’ self-professed instructional methodologies and their respective homework design, represented by Cramer’s V, was equal to .352 with a probability of .153. This represents a relatively medium association between the two variables (Fraas, 2003; Green, Salkind, & Akey, 1997), instructional methodology and homework. However, based on the preset alpha of .10, this effect was not statistically significant due to the p-value of .153. It is important to note that the generally accepted alpha level of .05 was not utilized for this study due to the exploratory nature of the study and the subjectivity of the qualitative data presented within the participants’ responses.

Likewise, the probability value of .153 indicates that the researcher failed to reject the null hypothesis, stating that an alignment among the participants’ self-professed instructional methodologies and the design of their homework assignments did not exist. The results of the alignment of the participants’ self-professed instructional methodologies and their homework design are listed in Table 18.

Table 18

<table>
<thead>
<tr>
<th>Instruction</th>
<th>Traditional</th>
<th>Traditional +</th>
<th>Inquiry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Traditional +</td>
<td>6</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Inquiry</td>
<td>4</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>
Additional Research Questions

The first question that developed from the demographic data examined the possibility of an association between the participants’ years of experience and the alignment of their instructional methodologies and homework designs (referred to from this point on as simply alignment). A chi-square test was used to measure the degree of association between the two variables, years of experience and alignment. The degree of association between the participants’ years of experience and their alignment was determined using Cramer’s V, which for this association measured .322 with a probability value of .593. These results indicated a moderate association (Fraas, 2003; Green, Salkind, & Akey, 1997); however, the association was not statistically significant due to the high probability value (.593) relative to an alpha set at .10. Table 19 provides an illustration of the various age ranges of the participants and the respective frequencies of participants categorized as aligned or aligned in their instructional methodologies and homework designs.

Table 19

<table>
<thead>
<tr>
<th>Years of Experience</th>
<th>Aligned</th>
<th>Unaligned</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 3</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>4 – 10</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>11 – 15</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>16 – 20</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>20+</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>
The next question that arose during the analysis of the participants’ demographic data investigated the geographic location of the participants and their alignment. Specifically, the question asked if there is an association among the alignment of the participants and their geographic location. A chi-square test was conducted, which resulted in a Cramer’s V coefficient equal to .468 and a probability value of .551. The results of this chi-square test (.468) represented a relatively large effect size (Fraas, 2003; Green, Salkind, & Akey, 1997); however, these results were, again, not statistically significant given the large probability value (.551) when compared to alpha (.10). A state-by-state analysis of alignment is presented in Table 20.

The final question that was developed from the demographic data investigated the grade-level that each of the participants was currently teaching. A chi-square test was utilized to determine if an association existed between the participant’s alignment and the grade level the participant was currently teaching. The results indicate a Cramer’s V coefficient equal to .409 and a probability value of .210. A moderate association was exhibited by the value of the Cramer’s V coefficient (.409), yet the probability value (.210) was slightly higher than alpha (.10), indicating that the results were not statistically significant. Table 21 provides the complete data for the participants’ alignment of instructional methodologies and their homework designs, based on the grade-level the participants currently teach.

Summary

This chapter provided a description of the qualitative and quantitative data used in response to the initial research question. Three additional research questions,
Table 20

*State Where Currently Employed and Alignment*

<table>
<thead>
<tr>
<th>State where employed</th>
<th>Aligned</th>
<th>Unaligned</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Illinois</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Michigan</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>New Jersey</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>New York</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Ohio</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 21

*Participants’ Instructional Grade Level and Alignment*

<table>
<thead>
<tr>
<th>Grade-level</th>
<th>Aligned</th>
<th>Unaligned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle School</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>High School</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>6 - 12</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>GED/HS Equivalency</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
which were developed during an analysis of the demographic data, were also presented within this chapter, along with their results. Chapter IV began with a detailed description of the educators participating in this study. A variety of demographic features of the participants, and their particular school environments were presented. Also, within this chapter was an analysis of the qualitative coding procedures utilized in the categorical placement of the participants’ responses to the open-ended items on the survey. Examples of various participant responses and their respective category placements were also presented within this chapter.

The quantitative data used to answer the initial research question followed the description of the qualitative coding and category placement procedures. The quantitative procedures and results for the additional three research questions also followed the qualitative procedures. It is through the analysis of the data presented within this chapter that discussions and recommendations can be formulated in order to inform professionals on the design and alignment of homework assignments to instruction.
CHAPTER V

The purpose of this chapter is to summarize the results of the research findings presented in Chapter IV. In addition to a summary of the results, a discussion on the possible implications of the results is also found within the current chapter. I also feel that it is relevant, and helpful, to review the initial research problem and subsequent questions that were developed from the demographic data. A brief review of the methodology is also described prior to the discussion of the results.

Research Study Revisited

The Methodological Beliefs Framework (Figure 1) that I proposed earlier in Chapter I illustrated an alignment of a variety of teachers’ instructional areas to their methodological beliefs. Of those areas, homework may be one area that teachers have little training on how to appropriately align its design to suit their instructional methods (Jensen, et al., 1994; Pribble, 1993; Van Voorhis, 2001) This study explored the alignment of teachers’ instructional methodologies and the designs of their homework. The framing research question for this study was as follows:

1. To what degree do secondary school science teachers’ homework assignments align to their self-professed instructional methodologies?

Three additional questions also arose while analyzing the demographic data of the participants, namely:

1. Does an association exist for the amount of years of classroom experience for a participant and the alignment of his or her instructional methodology and homework design?
2. Does an association exist between the alignment of the participants’ instructional methodologies and homework designs based on their geographic locations?

3. Does an association exist between the alignment of participants’ instructional methodologies and homework designs based on their classroom grade-level of instruction?

Methodology

The design of homework assignments and its alignment to the instructional methodology of secondary school science teachers was examined in this study utilizing a mixed-methods design (Creswell, 2005). A survey was distributed to the participants in order to (a) obtain demographic information about the participants and their respective schools, and (b) to gather qualitative data of the participants’ instructional methods, as well as the designs of their homework assignments. Coding rubrics were developed in order to identify themes within the participants’ survey responses and to then place them into an appropriate category: Traditional, Traditional +, or Inquiry. The categories were then given nominal values and the quantitative procedure of chi-square tests were used to determine the degree of association between the variables. The demographic data was compiled, reported, and utilized in order to answer the three additional research questions.

Summary of the Results

The guiding research question for this study investigated the alignment of the instructional methodology and homework design for secondary school science educators. The data for this question did not suggest that a statistically significant association
existed between the participants’ instructional methodologies and their homework designs. Overall, thirteen participants were found to have alignment between the two variables, while fourteen were determined to be unaligned. Additional questions regarding the alignment of instructional methodology and homework design developed from the demographic information obtained from the participants.

Although an association did not exist among the participants as a whole, the first additional research question investigated an association based on the years of experience of the participant. The data did not produce a statistically significant association for alignment and the years of experience of the participants. No clear pattern for years of experience was found to exist within the data. In the 4-10 years of experience range, four participants were identified as aligned, while three were unaligned. Results were similar at the other end of the age range spectrum; six participants with over 20 years of experience were identified as aligned, while four were not.

The next question investigated the participants’ alignment and their geographic locations. While the association was moderate, the results were again not statistically significant in order to state that an association existed. Low participant figures for the majority of the geographic locations could have impacted the results of this analysis. Likewise, the disproportionate amount of participants representing the state of Michigan could have also affected the results.

The last question explored the association between alignment and the grade level the participant was teaching. Again, no statistically significant association was discovered. Among the four grade levels examined (middle school, high school, grades 6-12, and GED/HS equivalent), only the middle school level produced seemingly interesting results. Of the six participants in the middle school classification, five were
found to be unaligned in their instructional methodologies and the designs of their homework, while a lone middle school participant was determined to be in alignment between these two variables.

Discussion

In this study, the alignment of instruction and homework design was investigated through a variety of demographic variables, as well as the overall alignment of the participants. The overall alignment results and the alignment results for each demographic characteristic produced similar findings; alignment was not consistently observed throughout the participants. This section investigates two assumptions based on this question and some possible implications.

Homework and Instruction

The first assumption that can be made, based on the results of this study, is that secondary school science teachers do not consistently view homework as a learning tool that needs to be aligned with their methodological approaches to instruction. At this point in the discussion, it seems logical to refer to the Framework of Methodological Beliefs that I developed in Chapter I. Within the Framework of Methodological Beliefs, the design of a homework assignment is aligned with all other forms of instructional methods and tools used by the teacher. The results of this study suggest that the design of homework assignments is not aligned with other instructional tools. Instead, it would appear that homework is an activity that, although it may support instruction, is not designed with a particular methodological approach. Several examples of such an approach to homework design are evident in the responses of unaligned participants. These participants described their instruction and their beliefs in a manner consistent with
one category (Traditional, Traditional +, Inquiry), yet their homework descriptions conformed to another. Three examples, one from each category, are provided in the subsequent sections.

**Traditional Example.** A middle school teacher from Michigan (Participant 27) described her role within the classroom as a guide for “students to question nature and discover answers.” She added that students learn best by “hands-on, discovery learning.” Both of these responses are found to align with the Inquiry category on the coding rubrics, and based on the synthesis of her answers to the survey, she was categorized as an Inquiry teacher. However, her homework assignment included a Metric System packet that simply required students to “write down correct measurements.” Although she does state that students need to observe figures and measure items as well, this is far from an inquiry activity and, based on the coding rubrics, was categorized as a Traditional homework assignment.

**Traditional + Example.** Participant 26, a male high school teacher from New York with over twenty years of classroom experience, provided another perspective of an unaligned teacher. In reference to his instructional methodology, Participant 26 was categorized as Traditional +. He stated that his role is to “create individuals that are independent thinkers and problem solvers,” adding that he tries to have his students “critically analyze information, data charts…in order to answer questions and/or solve a problem.” The activities Participant 26 described as taking place in his class are a clear combination of traditional lecture-based instruction, along with hands-on lab activities. The homework assignments that correspond to his lessons, however, are aligned to the Traditional category, as described in the coding rubric. The assignments he described
were “annotated” reading assignments and worksheets for vocabulary and concept application.

*Inquiry Example.* Participant 8 was a male high school teacher from Ohio with over twenty years of experience in the classroom. His instruction was classified as Traditional, yet his homework design was classified as Inquiry. This was one of the more surprising categorizations that I discovered during my analysis. Of all the participants determined to be unaligned, he was the only one to have his homework design classified as Inquiry. This participant was quite succinct in his responses and depicted a Traditional environment, as described in the coding rubrics. He indicated that students learned best by “lecture with lab” and identified student learning with “tests, quizzes, [and] lab reports.” Furthermore, he described the adaptation of his teaching style to best represent the field of science as simply “lab reports.” However, his homework was identified as an analysis of the lab data compiled in class. Student analysis of data is identified as a skill that should be fostered by teachers within an inquiry setting (NSTA, 2004).

*Teacher Education and Training*

The second assumption that can be made based on the data within this study is that a lack of training exists in the field of homework design. As indicated in the literature (Jensen, et al., 1994; Pribble, 1993; Van Voorhis, 2001), there is little emphasis on the design of homework in teacher education programs in the postsecondary curriculum. Though not indicated in the literature, an assumption can be made that the same is true in the realm of professional development; adequate training on the design of homework is not currently sufficient. Epstein and Van Voorhis (2001) indicated that when teachers design homework, they need to consider the purpose of the homework and
the format of the homework. To me, both the purpose and the format indicate that an alignment with the instructional methodology of the teacher must exist in order for the homework to be meaningful. But do classroom teachers learn the skills necessary to create this type of homework?

The results presented within this study indicate that a gap exists in the professional development opportunities of science educators, as well as homework design in undergraduate teacher education programs. The inconsistency with which alignment is seen among the participants over (a) a broad geographic region, (b) a blend of various age ranges, and (c) a variety of grade levels being taught indicates that homework design is a neglected realm. Three conclusions can be surmised based on the results of the demographic data:

A. State standards, curriculum guides, mandates and policies among the Great Lakes states do not specifically address the design of homework or the role of homework as an instructional tool.

B. At no point within the last 20-30 years has homework design and its alignment to instruction been a major aspect of teacher education and/or training.

C. Secondary school science teachers at all levels of instruction have not received adequate training in the design of homework and its alignment with instructional methodologies.

Contradictory conclusions to those previously mentioned about teacher education and the design of aligned homework seem difficult to sustain based on the data presented within this study. The demographic characteristics used in the analysis of alignment were chosen based on the possibility that a pattern may emerge from within these categories.
The lack of an association within these demographic categories substantiates the claim that teacher education is deficient in homework designs, as it relates to an alignment with instructional methodologies.

Implications

The following implications are based on the two assumptions explained in the preceding sections. The implications based on the discussion of the alignment of instructional methodologies and the requisite homework designs are discussed initially. Following this section are the possible implications on teacher education.

Instruction and Homework Design

The results of this study indicate that agreement in the alignment of science teachers’ homework assignments and classroom instruction is inconsistent. The previous examples of unaligned homework design illustrate that homework is not intentionally designed to be consistent with the methodological approach of the teacher. It appears that homework is not designed in a purposeful manner with regard to instructional methodology, but rather is used as a tool to reinforce instructional information. This indicates that homework does not appear to be consciously aligned to the instructional methods of the teacher, but rather to the instructional material.

Based on the outcome of this study, I developed Figure 2 to provide an illustrative perspective of the role of homework within the instructional methodology of the teacher. Whereas the Framework of Methodological Beliefs (Figure 1) depicts the design of homework in alignment with the instructional methodology of the instructor, the opposite is somewhat representative in Figure 2, *The Role of Homework within an Instructional Methodology*. What is seen in Figure 2, and can be surmised based on the data in this
study: the instructional methodology of a secondary school science teacher directly influences classroom instruction, exams, quizzes and tests, in-class work, and laboratory work and projects. However, homework is not directly influenced by the instructional methodology, but rather the activities taking place during class. Therefore, homework is not directly aligned to the instructional methodology of the teacher, but instead is directly affected by the activities that take place during class. Although the activities that take place during class are directly aligned to the teacher’s instructional methodology, it appears, through the results of this study, that homework design is not consistently designed in a similar manner.

Figure 2. The Role of Homework within an Instructional Methodology
A question that may quickly come into one’s mind when reading the above section is “Should homework always be aligned to the instructional methodology?” As I see the role of homework in classroom instruction, the answer is quite simply, yes. It is logical that teachers may employ various instructional methodologies from day-to-day, depending on their instructional goals; however, the work that is completed in class, and following instruction (i.e. homework) should align to the methodology as indicated in the Framework of Methodological Beliefs. The results of this study, as depicted by Figure 2, illustrate a contrasting picture to homework design than I presented earlier in Figure 1. The perspective I present within this study is that an alignment of the daily instructional goal, instructional methodology, and homework design should exist. An illustration of this alignment is offered in Figure 3, where the instructional goal determines the methodological approach the teacher employs and the assessment (tests, quizzes, labs, homework, etc) aligns to the instructional methodology.

<table>
<thead>
<tr>
<th><strong>INSTRUCTIONAL GOAL</strong></th>
<th>What should the students learn?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DETERMINES</strong></td>
<td></td>
</tr>
<tr>
<td><strong>INSTRUCTIONAL METHODOLOGY</strong></td>
<td>What is the best method of presenting the material to be learned?</td>
</tr>
<tr>
<td><strong>DIRECTLY ALIGNS</strong></td>
<td></td>
</tr>
<tr>
<td><strong>ASSESSMENT</strong></td>
<td>How will students demonstrate knowledge?</td>
</tr>
</tbody>
</table>

*Figure 3. Instructional Alignment*
**Implications on Teacher Education**

As indicated previously in this paper, teachers note that they receive little or no training in homework design during their postsecondary education (Jensen, et al., 1994; Pribble, 1993; Van Voorhis, 2001). However, the responsibility for assuring that teachers receive training in the design of homework cannot be left to postsecondary educators alone. Training teachers and teacher educators to design homework that is aligned to a specific instructional methodology must be addressed in three avenues:

A. Postsecondary training: Methods courses during undergraduate education

B. School districts: New teacher induction programs

C. Professional organizations: Workshops, training, and conferences

The responsibility to train teachers on the design of homework must be a shared responsibility among the three entities previously mentioned: postsecondary, school districts, and professional organizations. Each entity serves a varied role in the education and training of teachers and prospective teachers in the alignment of homework to instructional methodologies.

Postsecondary educators are responsible for training future teachers on the methods and techniques utilized in designing aligned homework. Educators at the postsecondary level have the opportunity to critique aspiring teachers’ example homework assignments and to strengthen their design skills. Individual school districts need to be concerned with the design of aligned homework in terms of their respective educational community. This could mean making certain adaptations, modifications and enhancements to what (a) a teachers new to the field were taught in their undergraduate programs, and (b) experienced teachers have learned while working in other districts. Lastly, professional organizations should be providing continuing education for current
teachers in order to strengthen their skills in designing aligned homework. Professional organizations can also offer opportunities for postsecondary educators to enhance their knowledge of designing aligned homework.

Figure 4 illustrates the association between postsecondary education, individual school districts, and professional organizations as I view their respective roles in the training on homework design. The illustration shows that postsecondary educators have two responsibilities: (1) to train pre-service, novice teachers in designing aligned homework, and (2) to obtain, maintain, and contribute to the professional knowledge needed to appropriately inform pre-service, novice teachers of homework design methods. Individual school districts have the responsibility of educating novice teachers,

Figure 4. Roles in Aligned Homework Education and Training
as well as teachers new to the district, of the district’s expectations of quality homework design. Lastly, professional education organizations have a responsibility to offer development and continuing education programs for practicing educators, and for postsecondary educators as well.

From personal experience, I can attest that postsecondary teacher education programs are not currently addressing the design of homework. I received no training in homework design during my undergraduate program, and through casual, informal conversations with several teacher education professors, the same seems to be true elsewhere. As a current secondary school administrator, I see firsthand the issues that can face a new teacher in regard to homework. As is illustrated in Figure 10, the job of informing educators of the methods and procedures to designing quality, aligned homework does not rest in the hands of postsecondary educators alone. The need for the three entities named to begin the conversation and the process of informing, educating, and researching this paradigm is evident.

Summary of Discussion and Implications

A single study of 27 participants cannot provide an all-encompassing perspective on homework’s alignment with secondary school science teachers’ instructional methodology. However, a number of implications can still be construed from the data. Likewise, a study of this degree can initiate further research on the design of homework and its alignment to instructional methodologies. The preceding sections offered my perspective based on the data obtained within this study. A summary of my analyses are as follows:
1. Homework appears to be designed in alignment with classroom activities. Although the activities tend be aligned with the instructional methodology of the instructor, the design of homework is not; homework appears to be designed without consideration of the instructional methodology of the teacher.

2. Teacher education and training should include the design of aligned homework. Three venues for this education and training exist and overlap: postsecondary education, professional workshops and conferences, and individual school district induction programs.

A third analysis can also be made from the review of the literature, coupled with the results of the data. The third analysis is that a need for additional research in the area of homework design is evident, specifically as it relates to its alignment with instructional methodology. The literature largely reflects the ebb and flow of public and scholarly opinions on the role and relevance of homework. Little, if anything, is discussed about homework’s design throughout history or its alignment with other curricular areas of instruction. Marzano and Pickering (2007) suggested that as the battle over the use of homework continues, the strategies and methods used in the design of homework need to be improved upon in order to maintain its educational quality. Furthermore, Gill and Schlossman (2004) also addressed the need to make the design of homework a more integral aspect of conversation in the educational community. Suggestions for further research are included in a succeeding section in this chapter.
Unexpected Findings

I was not surprised that an association between the design of homework and the instructional methodology of the participants could not be clearly defined. As a former secondary school science teacher, I remember the lack of attention that was given to instructional methods during my undergraduate education. The majority of the emphasis was placed on content knowledge rather than curricular and methodological alignment. Also, I received no training or education on the design of homework assignments. I have also had the opportunity to travel to a number of professional conferences and workshops around the country, and have yet to find a session that discusses the role of homework in the curriculum or its design.

However, one unexpected non-result of this study was that no demographic category produced an association among the participant group and the alignment of their homework. I was surprised that no one group (age range, school setting, years of experience, grade level) illustrated a clear association, positive or negative, in homework alignment. After evaluating the alignment data for all of the participants, I expected to find that one demographic group would have been statistically significantly more aligned than some of the others. Yet, this was not the case, and homework alignment was not visible within any subgroup of the participants.

Recommendations for Future Research

My attempt to discover research pertinent to the alignment of homework to the instructional methodology of teachers was quite disappointing, as I found no such studies to exist. It is apparent that there is a gap in the homework research, specifically in the investigation of the role that homework has within the framework of an educator’s
instructional repertoire. This study focused exclusively on secondary school science teachers and their homework designs. It would be prudent to investigate subject area concentrations, such as history, mathematics, literature and reading. Would the same study in a different subject area produce similar results?

The replication of this study on a larger scale would be justified. The current study, though issued to a population of approximately 900 science educators from a large geographic area, produced only 27 subjects in a 9-state region. Would similar results exist with a greater number of participants in each of the various demographic categories (i.e. age range) years of experience, location, etc?

In order to extend upon the current research study, I offer one final recommendation for future research in this area: observation and artifact analysis. This study relied upon the participants to provide the information for analysis. Performing classroom observations of the participants and analyzing their homework assignments using the same coding rubrics identified within this study could add a significant dimension to the findings. It was unfortunate that I did not have the financial resources, or the time needed to accomplish this extension of the research. However, this would be highly recommended in order to build upon the knowledge obtained in this study.

Conclusion

Homework has long been a part of schooling, and it is not likely to disappear anytime in the near future. The purposes of homework are vast and varied, from practicing skills to introducing a new lesson or concept. Currently homework design appears to exist in alignment to classroom activities, but not in alignment to the teacher’s instructional methodology. The importance of the design of homework can be
overlooked easily, especially in the era of high stakes testing. However, homework is still considered an instructional tool, and therefore, should be aligned to the instructional methodology of the classroom teacher.

The debate is likely to continue as to whether or not homework should be given, if homework has an impact on achievement, and the purposes for which homework should be assigned. If homework is to continue to be used as an instructional tool, its alignment to the methods utilized in the classroom should be further explored. The relative lack of literature on homework’s alignment to instructional methodologies suggests that this is an area for future research.

What is apparent from the results of this study is that the design of homework exists separately from the instructional methods utilized by the teacher, rather than complimented by them. Teachers’ instructional methodologies are apparent in the way they organize, manage, and operate their classes. Laboratory assignments, projects, and exams typically align to their methodology as well. Homework, which is an extension of a teacher’s classroom, should also represent the instructional methodology of the teacher in its design. If battles over homework’s educational purposes and benefits are to continue, so should the research and the refinement of homework’s design.
REFERENCES


http://www.nsf.gov/awardsearch/progSearch.do?SearchType=progSearch&page=2&QueryText=Centers+for+Ocean+Science+Education+Excellence&ProgOrganization=&ProgOfficer=&ProgEleCode=&BooleanElement=false&ProgRefCode=&BooleanRef=false&ProgProgram=Centers+for+Oceans+Science+Education+Excellence%0D%0A%CENTRES+FOR+OCEAN+SCI+EDU+EXCE&ProgFoaCode=&Search=Search#results


Richardson, L., & Simmons, P. (1994). *Self-Q research method and analysis, teacher pedagogical philosophy interview: Theoretical background and samples of data*. Athens, GA: Department of Science Education, University of Georgia.


APPENDIX A

COSEE GREAT LAKES PARTNERS & COLLABORATORS
<table>
<thead>
<tr>
<th>PARTNERS</th>
<th>COLLABORATORS</th>
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<tr>
<td>Michigan Sea Grant (SG)</td>
<td>Bathysphere Underwater Bio Lab</td>
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<td></td>
<td>COSEEs California, Mid-Atlantic, Southeast, Northeast, and West</td>
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<td>Duluth Schools Indian Ed Program</td>
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<td>Grand Valley State University</td>
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<td>Inland Seas Education Association</td>
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<td>Michigan Technological University</td>
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<tr>
<td>Cooperative Institute for Limnological and Ecosystem Research (CILER)</td>
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<td>Thunder Bay NMS</td>
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<td>USDI Fish &amp; Wildlife Service</td>
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</table>

Source: COSEE Great Lakes (2006)
APPENDIX B

COSEE GREAT LAKES GOALS & OBJECTIVES
COSEE GREAT LAKES GOALS

- Inspire citizens to become more scientifically literate and environmentally responsible through standards-based science curricula and programs that bridge the ocean and freshwater sciences
- Create dynamic linkages between the education and research communities

*Add value to the National COSEE Network by:*

- Adding critical freshwater components through the inclusion of the Great Lakes
- Improving ocean/Great Lakes sciences education throughout the Great Lakes region
- Improving regional Tribal educational institutions, teachers and students in enhancing ocean/Great Lakes sciences literacy

COSEE GREAT LAKES OBJECTIVES

- Facilitate collaboration between Great Lakes researchers and educators and students (grades 4 – 10)
- Assist research scientists to gain better access to educational organizations and use appropriate pedagogy in relating the Great Lakes/ocean science story
- Enhance teacher capabilities for accessing science information and delivering high quality educational programs in Great Lakes/ocean sciences
- Integrate ocean and Great Lakes research into existing high quality science education materials
- Make current research findings about the Great Lakes available to the public to encourage public science literacy and appreciation of water resources
- Increase access to Great Lakes/ocean science information for underrepresented groups
- Facilitate direct student connections to Great Lakes/ocean science experiences
- Collaborate with existing COSEEs in uniquely synergistic ways

Source: COSEE Great Lakes (2008)
APPENDIX C

HUMAN SUBJECTS REVIEW BOARD CONSENT
The Graduate School

TO: Paul Mark Lucas
FROM: Randy Gearhart, Chair
DATE: October 24, 2008
RE: Human Subjects Review Board Approval

The Human Subjects Review Board has approved the research proposal you submitted. You may proceed with the project.

The primary function of the HSRB is to ensure protection of human research subjects. As a result of this mandate, we ask that you pay close attention to the fundamental ethical principles of autonomy, justice, and beneficence when establishing your research proposal. These ethical principles pertain specifically to the issues of informed consent, fair selection of subjects, and risk/benefit considerations.

If you have any questions, please contact me.

Sincerely,

Randy Gearhart
Phone: 419-207-6198
Fax: 419-289-5460
E-mail: rgearhar@ashland.edu
APPENDIX D

TEACHER BELIEFS INTERVIEW CONSENT
The image below is of an email correspondence with Dr. Gillian Roehrig of the University of Minnesota, providing me the consent to adapt a variety of questions from the Teacher Beliefs Interview developed by Luft & Roehrig’s (2007).

---

Re: Teacher Beliefs Interview

Subject: Re: Teacher Beliefs Interview

To: [Email Address]

From: [Email Address]

I am pleased to provide you with the consent to adapt a variety of questions from the Teacher Beliefs Interview developed by Luft & Roehrig’s (2007).

Please feel free to adapt and modify for your study – if you have any other questions just let me know.

Grill

Lucas, Paul wrote:
> Dr. Gillian,
> By now you are Paul Lucas, I am a doctoral student at Ashland University, currently working on my dissertation. My dissertation is an investigation of the alignment of secondary science teachers' instructional methodologies and their homework practices. I was given permission by the Center for Ocean Sciences Excellence in Educational Research (COSEE) to access a database of educators nationwide that have participated in one of their workshops.
> Given the scope of their geographic locations, I felt the best way to obtain information on their instructional methodology was to issue a survey instrument. Four of my questions on the survey have been adapted from your Teacher Beliefs Interview, that you describe in "The Role of Teachers' Beliefs and Knowledge in the Adoption of a Reform-Based Curriculum".
> I am assuming that the TP1 you created is a copyrighted instrument and therefore I would like to ask you permission to use the following four questions, adapted from your protocol:
> 1. Describe your role as a science teacher.
> 2. How do you believe your students learn science best?
> 3. What are some of the indicators to you that learning is occurring in your classroom?
> 4. How have you adapted your teaching to best reflect the discipline of science?
> Two of your articles have played a major role in my dissertation and the development of my research: the aforementioned article and "Capturing Science Teachers' Epistemological Beliefs: The Development of the Teacher Beliefs Interview". Your permission to use the above questions would be greatly appreciated and will greatly contribute to my research.

I know you time is valuable and I apologize for the lengthy email. I look forward to hearing from you soon.

Sincerely,
Paul N. Lucas

Paul N. Lucas, Assistant Principal
Orange High School
2000 Calumet Blvd.
Topper Pike, Ohio 44246
Phone: 216.631.0600 ext. 2004
---

Gillian Roehrig
Associate Professor
Dept. of Curriculum and Instruction
APPENDIX E

PARTICIPANT RESPONSES: TRADITIONAL INSTRUCTION CATEGORY
Participant Responses: Traditional Instruction Category

Participant: 5

Item: Describe your role as a science teacher.
Teaching the scientific method and critical thinking applied to current issues.

Item: How do you believe that your students best learn science?
Various

Item: What are the indicators to you that learning is occurring in your classroom?
Student responses.

Item: How have you adapted your teaching to best reflect the discipline of science?
Increased technology—use the main one.

Item: Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.
Students have been preparing to participate in a "citizen science" study on birds.

Item: Please provide a brief description of classroom and lab activities that will take place during the next two weeks.
Introduction to a new unit on climate change will begin next.

Participant: 8

Item: Describe your role as a science teacher.
I teach students the method & knowledge of science

Item: How do you believe that your students best learn science?
lecture with lab

Item: What are the indicators to you that learning is occurring in your classroom?
tests, quizzes, & lab reports

Item: How have you adapted your teaching to best reflect the discipline of science?
Lab reports

Item: Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.
Last week we analyzed the relative diffusion of potassium permanganate & methylene blue in BIO1040. In BIO1060, we surveyed the bacteria, archaea, & protista

Item: Please provide a brief description of classroom and lab activities that will take place during the next two weeks.
In BIO1040, we will compare the respiration of humans to soybeans. In BIO1060, we will survey fungi

Participant: 9

Item: Describe your role as a science teacher.
Every child can learn and be successful given the opportunity.

Item: How do you believe that your students best learn science?
1) Multiple Intelligences - vary teaching style to meet everyone's needs (lecture, lab, drawings, models, acting)
2) Differentiated Instruction - give students choices (sometimes) as to how they approach an assignment (notes, pictures, verbal, Powerpoint, etc.)

Item: What are the indicators to you that learning is occurring in your classroom?
Frequent informal assessment (quick checks, Bellringer questions, ticket-out-the-door forms, etc.) and formal assessment (tests, quizzes, projects).

Item: How have you adapted your teaching to best reflect the discipline of science?
I try a lot of different activities. If they don't work, I scrap them or tweak them. I am not one to stick to the same lesson plans each year. Most of my students learn best by doing activities.

Item: Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.
Cell Division Unit: Diagram of the cell cycle, notes on the structures/ phases of mitosis, mitosis cartoon flipbook, mitosis cell stage microscope lab, pipe cleaner manipulative activity to demonstrate hands-on mitosis, notes on cancer, magazine article on cancer genes and treatments
Participant: 9, cont.
Item: Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks. (response continued from previous page)
of cancer, end of unit review and formal test assessment. I also use the data projector to present slides and internet sites that show pertinent simulations or movie clips.

Item: Please provide a brief description of classroom and lab activities that will take place during the next two weeks.
Meiosis Unit- notes on the stages of meiosis, meiosis drawings, demos using giant magnetic foam chromosomes, egg/sperm cell formation, Baby Rebops Lab (chromosomal inheritance), stem cells movie clips and current magazine articles, chromosomal mutations due to nondisjunction in meiosis (Down Syndrome, Turner’s Syndrome, etc.), unit review and formal test assessment.

Participant: 11
Item: Describe your role as a science teacher.
A science teacher should be establishing foundation skills. A science teacher should be connecting concepts to real life

Item: How do you believe that your students best learn science?
hands on

Item: What are the indicators to you that learning is occurring in your classroom?
use of appropriate vocabulary
transferring skills to other areas

Item: How have you adapted your teaching to best reflect the discipline of science?
not very well, science often takes a back seat to reading and math

Item: Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.
just finished food chains and food webs, endangered animals, predator/prey, consumer/producer--the students used the internet to research

Item: Please provide a brief description of classroom and lab activities that will take place during the next two weeks.
We are currently exploring the periodic table. I hope to make slime. I like to do activities suitable for family literacy

Participant: 17
Item: Describe your role as a science teacher.
My role has been defined by my employer- to master the curriculum established by the State of Michigan. G.L.C.E.

Item: How do you believe that your students best learn science?
Example, demonstration, query, Labs, Lector.

Item: What are the indicators to you that learning is occurring in your classroom?
Besides testing, students asking questions that show understanding but lead them into further wonder/questions

Item: How have you adapted your teaching to best reflect the discipline of science?
I'm unclear what you are asking.

Item: Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.
NA

Item: Please provide a brief description of classroom and lab activities that will take place during the next two weeks.
heat difference between water and sand (radiation), example of convection, and conduction. Another class we will do an exercise to see the amount of iron in cereal.

Participant: 19
Item: Describe your role as a science teacher.
NA

Item: How do you believe that your students best learn science?
Most would say hands on but I believe a combination of all styles are best
Participant: 19, cont.

Item: **What are the indicators to you that learning is occurring in your classroom?**
- Discussions with explanations
- Test
- Stewardship projects

Item: **How have you adapted your teaching to best reflect the discipline of science?**
- Different styles and assignments to meet more diverse needs

Item: **Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.**
- Vital capacity lab
- Heart rate Lab
- Rock ID lab

Item: **Please provide a brief description of classroom and lab activities that will take place during the next two weeks.**
- Fetal Pig dissection
- Probes for water chemistry

Participant: 25

Item: **Describe your role as a science teacher.**
I consider myself a facilitator that provides direction, content, and evaluations for my students.

Item: **How do you believe that your students best learn science?**
A mix of discovery based activities; content based lectures, and directed labs.

Item: **What are the indicators to you that learning is occurring in your classroom?**
Through objective evaluations (tests), lab practical, lab reports, and the "questions" asked by students during lab activities.

Item: **How have you adapted your teaching to best reflect the discipline of science?**
I teach science!

Item: **Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.**
Anatomy: Human bone labs, connective tissue histology lab, lab practicals, 2 reading quizzes.

Environmental Science- Intro to course, Ecosystem Management discussion, Environmental issues in North America discussion. Using Yellowstone national park as a model for the ecosystem approach to management activity.

Item: **Please provide a brief description of classroom and lab activities that will take place during the next two weeks.**
Anatomy- Muscle histology lab, Muscle physiology lectures/assignments. Begin cat dissection of hind limb musculature

Environmental Science- Basic Plant ID, Conifer lab outside, basic ecosystem terminology/concepts, biodiversity activity/discussion/ Biogeochemical cycles, mans impact on them, Test on Chapter 5
APPENDIX F

PARTICIPANT RESPONSES: INQUIRY INSTRUCTION CATEGORY
Participant Responses: Inquiry Instruction Category

Participant: 1

Item: Describe your role as a science teacher.
To engage students in learning science processes and content

Item: How do you believe that your students best learn science?
Inquiry science activities

Item: What are the indicators to you that learning is occurring in your classroom?
Participation by students in discussion and written reflection of their learning

Item: How have you adapted your teaching to best reflect the discipline of science?
I have recently added the 5 E model into my science teaching

Item: Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.
A set of 3 photosynthesis activities that the students set up with plants and a variety of materials that each group decided upon.

Item: Please provide a brief description of classroom and lab activities that will take place during the next two weeks.
Building a roller coaster to show Newton Laws of Motion

Participant: 2

Item: Describe your role as a science teacher.
Constructivist - Facilitating students so they construct knowledge through scientific investigations

Item: How do you believe that your students best learn science?
Hands-on investigations - trying to solve a big picture question.

Item: What are the indicators to you that learning is occurring in your classroom?
Students ask the questions that lead you to the next topic. Kids can take laboratory results and connect them to make questions to make sense of an investigation.

Item: How have you adapted your teaching to best reflect the discipline of science?
No textbook. Investigations to get at objectives

Item: Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.

Item: Please provide a brief description of classroom and lab activities that will take place during the next two weeks.
Cell Bio: Analysis of electron microscope picture of cell with radio-tagged amino acids to show purpose of organelles, comparison of virus to eukaryotes to prokaryotes.

Participant: 4

Item: Describe your role as a science teacher.
Teaching the wonder of science; helping students to see how science affects their daily lives; learning by doing and asking questions/searching for answers.

Item: How do you believe that your students best learn science?
By doing; hands-on with demos and manipulatives; real world situations.

Item: What are the indicators to you that learning is occurring in your classroom?
Body language/facial expressions; success on standardized assessments; successful application of acquired knowledge to new situations.

Item: How have you adapted your teaching to best reflect the discipline of science?
all inquiry based; everyday there is a question we are trying to answer

Item: Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.
Classification Unit:
intro with students classifying beanie babies and PowerPoint on how to make dichotomous keys; students use keys to id sharks; students create own keys with Great Lakes fish; students self \

Participant: 4, cont.

Item: Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks. (response continued from previous page)
assess with practice fish/trading keys; formal assessment with multiple choice/extended response questions as well as having students create a key with 5 beanie babies

Item: Please provide a brief description of classroom and lab activities that will take place during the next two weeks.
cladograms - how to read them; overview of taxonomic kingdoms and characteristics; introduction to levels of organization (ind, pop, comm, ecosys) - scavenger hunt to create murals of each; begin populations: predator prey activities with daphnia, lynx hare game, Oh Deer activity (abiotic/biotic factors)

Participant: 7

Item: Describe your role as a science teacher.
A science teacher should be helping student understand how the world them works at various scales/levels, and at the same time inspiring students to pursue more study on their own.

Item: How do you believe that your students best learn science?
My students learn best when their interest and curiosity has been sparked, when the lesson is personally meaningful, and when I am passionate about the topic.

Item: What are the indicators to you that learning is occurring in your classroom?
Indicators include: students asking extension questions, students returning to class the next day/days later with a connection to what was learned previously, and student demonstrating understanding of free response/essay type questions that probe the how's and why's of science.

Item: How have you adapted your teaching to best reflect the discipline of science?
I have tried to include more hands-on investigations that reflect science as experience oriented.

Participant: 13

Item: Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.
Lesson 1 was on the nitrogen cycle. Student modeled nitrogen atoms moving through 11 different N reservoirs. At each stop, they collected a stamp for the reservoir and explained what happened for them to get there. Lab 1 was Iron Ore Mining. Students extracted magnetite ore from beach sand samples from different areas using magnetic separation. This modeled how iron ore is extracted.

Item: Please provide a brief description of classroom and lab activities that will take place during the next two weeks.
Acid rain lab: students will test the effect that different rock types have on neutralizing acid precipitation. I will use granite, limestone, and slate to represent different building materials. Students will expose each rock type to weak acid; calculate % mass change and pH change.

Item: Describe your role as a science teacher.
My role is to ensure that I provide a solid science curriculum for all students in my classroom and also provide them with the tools to be successful.

Item: How do you believe that your students best learn science?
Students learn when they take ownership for their learning.

Item: What are the indicators to you that learning is occurring in your classroom?
When students are engaged, actively involved, and asking good questions, I know science learning is going on.

Item: How have you adapted your teaching to best reflect the discipline of science?
I do my best to stay current in science and monitor what I teach and how I teach it to best reach the students.

Item: Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.
Biology: students did an inquiry lab on cellular respiration (the floating leaf disk assay) in which they decided as a team what variable they were going to test. Experimentation took 2.5 blocks. After they wrote a lab report.
Environmental Biology: Students are working on a bioassay of lettuce seeds with various potential pollutants that might enter and impact the groundwater. They are also using groundwater flow models to examine what happens to pollutants once they become part of the groundwater. Both labs will be linked together and applied to a historic contamination that occurred 26 years ago in our city.
Participant: 13, cont.

Item: Please provide a brief description of classroom and lab activities that will take place during the next two weeks.
   Biology: Students will be doing a DNA extraction and gel electrophoresis.
   Environmental Biology: students will begin building and planning a lab around living machines.

Participant: 22

Item: Describe your role as a science teacher.
   help students reach their full potential, help connect students to the natural world

Item: How do you believe that your students best learn science?
   interactive, hand's on, related to their world

Item: What are the indicators to you that learning is occurring in your classroom?
   questions asked, participation in lecture/lesson, improvement lab skills through the year, students that bring in their experiences and relate to science topic they have learned

Item: How have you adapted your teaching to best reflect the discipline of science?
   hand's on, interactive, using technology,

Item: Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.
   1. A Mole Lab that Actually Works! Hands on lab that helps students calculate and experience stoichiometry, theoretical yield, percent yield
   2. Semester long research project on any topic the student finds interesting as long as it relates to chemistry

Participant: 23

Item: Describe your role as a science teacher.
   A science teacher should be an effective teacher by bringing science into the classroom and making it real for the student. Practical application is key to understanding the concepts taught.

Item: How do you believe that your students best learn science?
   Hands-on. Many students are visual learners. It isn't enough to simply present the topics- student should not be encouraged to just memorize information presented. They need to process the information, learn to think, share ideas with their peers, and present their understanding of the concept. They also need to link topics together to understand how things are related to one another and why a particular topic is important.

Item: What are the indicators to you that learning is occurring in your classroom?
   In addition to good test scores, students are asking good questions that indicate they understand the material presented. As a whole, many students struggle processing some science concepts and applying them to the real world. When they ask good questions it is an indication that they are thinking and starting to relate different topics together. Furthermore, another indication that learning is occurring is when students are able to answer questions posed by other students and myself.

Item: How have you adapted your teaching to best reflect the discipline of science?
   My teaching of science reflects the discipline of science in that I present data, ask questions, state what is learned by scientists and why methods were used to learn it, and apply it to the real world. In a sense, I apply the Scientific Method to my teaching of Science.

Item: Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.
   Laboratory activities first include a powerpoint where information and weekly topics are introduced and discussed. Part two of the lab involves hands-on activities at work stations. A 20 questions multiple choice quiz is given each week with three levels of questions. First, a few straight forward definitional questions are asked. The majority of the questions are application questions, and the last four questions are devoted to physically identifying rock samples.

   The last three weeks were devoted to each of the three rock types including igneous, sedimentary, and metamorphic. Students are tested on different rock formation processes and they are required to identify in hand sample at random 4 of 10 samples presented of each rock type.
Participant: 23, cont.

Item: **Please provide a brief description of classroom and lab activities that will take place during the next two weeks.**

This week- Lab 6- Topographic Maps, Aerial Photographs and Remote Sensing. Students will look at various maps and learn various skills such location of objects (using latitude and longitude), finding elevations (use of topographic lines), and identifying objects and related geologic processes by analyzing aerial photos. Students will be exposed to different types of remote sensing.

Next Week- Lab 7-Crustal Deformation and Geologic Structures. Students will expand their knowledge about maps by now examining geologic maps including strike and dip symbols, lithology (rock types), and geologic age symbols (map colors representing different rock ages). They will also be introduced to the different types of faults (normal, reverse, and transform) and how to recognize them. Other deformation processes and structures are presented.

Participant: 22

Item: **Describe your role as a science teacher.**

My role is to guide students to question nature and discover answers, using the scientific method.

Item: **How do you believe that your students best learn science?**

hands-on/discovery learning

Item: **What are the indicators to you that learning is occurring in your classroom?**

When students tell you that they understand, or show you by their work, you can see that learning is occurring. It is important to use a variety of assessments to check for learning.

Item: **How have you adapted your teaching to best reflect the discipline of science?**

Science is knowledge, so I help students learn more about science in many ways, although the most effective is by "self-discovery", in which students learning by doing hands-on experiments.

Item: **Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.**

I have students draw what they think science is and write a definition of science in their own words (may not use a dictionary or other resources). Then we share our science with each other. From there, we explore the Scientific Method and its importance in science. Next we get familiar with all the lab tools/equipment and use the Metric System to make measurements of various substances (solids/liquids/gases).

Item: **Please provide a brief description of classroom and lab activities that will take place during the next two weeks.**

**Answers were combined into the previous question**
APPENDIX G

PARTICIPANT RESPONSES: TRADITIONAL + INSTRUCTION CATEGORY
Participant Responses: Traditional + Instruction Category

Participant: 3

Item: **Describe your role as a science teacher.**
To get my students excited about science and inspire them to pursue science in their futures or at least understand their environment and become better citizens.

Item: **How do you believe that your students best learn science?**
Hands-on or just being motivated and excited about a topic.

Item: **What are the indicators to you that learning is occurring in your classroom?**
Asking questions or being able to explain to others, doing well on a variety of different assessments.

Item: **How have you adapted your teaching to best reflect the discipline of science?**
Encourage the asking of questions and developing ways to find answers (more inquiry-based), using data in the classroom.

Item: **Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.**
- Analyzing plant cells to find similarities and differences between different types of cells
- Dissecting a sea lamprey as a part of an invasive species unit
- Building bottle ecosystems to learn about ecosystem organization, factors, and relationships
- Building a geologic time line to scale using math and what we learning in or evolution unit

Item: **Please provide a brief description of classroom and lab activities that will take place during the next two weeks.**
- AQ: Start Great Lakes Unit: intro activity, perch dissection, stratification graphing
- ENV: Population Growth: make population pyramids, card game
- Bio: Bacteria: Bacteria growth Lab, Antibiotic effectiveness lab, looking at yogurt
- Bot: Stems: stem dissections/microscopes, capillary action lab

Participant: 6

Item: **Describe your role as a science teacher.**
My role is to facilitate the learning of my students. They are trying to understand how science is "done" and also understand the underlying principles behind the topics that they are studying.

Item: **How do you believe that your students best learn science?**
Students learn best by actually doing science. They have to see, hear, smell, and touch the things that they are learning about.

Item: **What are the indicators to you that learning is occurring in your classroom?**
Thoughtful questions, probing questions, excitement about the topic, application of a concept to other situations.

Item: **How have you adapted your teaching to best reflect the discipline of science?**
I am constantly trying to find a better way to help my students learn science. I am currently trying to incorporate more inquiry learning into my classes.

Item: **Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.**
Students were given a question "how are force and acceleration related?" The class then, as a group, developed a procedure that was used to determine the relationship between the two by using accelerometers and force sensors.

Item: **Please provide a brief description of classroom and lab activities that will take place during the next two weeks.**
Students will use similar equipment to investigate the relationship between two forces in a series of collisions.

Participant: 10

Item: **Describe your role as a science teacher.**
Sales, cheerleading, coaching and resource. I use labs to teach observing skills and concepts. I use time to coach them to use their math skills analysing lab data.

Item: **How do you believe that your students best learn science?**
Activities directly related to reading and quizzes.

Item: **What are the indicators to you that learning is occurring in your classroom?**
If they continue discussion as they leave the room. If they bring questions into the room.
Participant: 10, cont.

Item: **How have you adapted your teaching to best reflect the discipline of science?**
*Observation in lab is more important than correct results. What doesn’t work is often what teaches us most.*

Item: **Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.**
*Observations of mystery materials and identifying components in a mixture. Conservation of mass experiment where the lab needs to be adapted to capture evolved gas.*

Item: **Please provide a brief description of classroom and lab activities that will take place during the next two weeks.**
*Archimedes principle, Boyle’s law and Charles law labs. Result will be to explain the behavior of a Cartesian diver.*

Participant: 12

Item: **Describe your role as a science teacher.**
*I attempt to give students a working scientific vocabulary, an appreciation of the state of knowledge of the field, a facility with basic experimental design, and experience with selected laboratory, field and analytic tools*  

Item: **How do you believe that your students best learn science?**
*a variety of methods are needed - no one technique meets all needs. Hands-on opportunities are important, so are good visuals and computer simulations.*

Item: **What are the indicators to you that learning is occurring in your classroom?**
*Student ability to relate previous concepts to new concepts.*

Item: **How have you adapted your teaching to best reflect the discipline of science?**
*I give opportunities for experimental design and presentation of results.*

Item: **Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.**
*bacteria transformation  
gel electrophoresis  
hardy-weinberg simulation  
lectures on aspects of evolution  
student preparation time for presentations*  

Item: **Please provide a brief description of classroom and lab activities that will take place during the next two weeks.**
*student presentations on selected taxonomy  
self-guided study of plant structure*

Participant: 14

Item: **Describe your role as a science teacher.**
*Get kids to be curious, ask questions, challenge themselves and THINK*  

Item: **How do you believe that your students best learn science?**
*Hands-on, field experience*  

Item: **What are the indicators to you that learning is occurring in your classroom?**
*Kids’ input, test scores, end-of-year portfolios*  

Item: **How have you adapted your teaching to best reflect the discipline of science?**
*Any and every way I can*  

Item: **Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.**
*Hooking up flashlight bulb, battery and wires; fossil demonstration, scientific notation, cancer treatment methods.*  

Item: **Please provide a brief description of classroom and lab activities that will take place during the next two weeks.**
*Speed of sound vs. speed of light (EM); “tweaking” an AM radio with a fork and wires, constructing an electromagnet.*
Participant: 15

Item: Describe your role as a science teacher.
Understanding of concepts; use concepts to explain events in the world around them

Item: How do you believe that your students best learn science?
Hands-on experiences

Item: What are the indicators to you that learning is occurring in your classroom?
on task behavior; successful completion of lab activities; test scores

Item: How have you adapted your teaching to best reflect the discipline of science?
Hands-on experiences; students making observations; data taking; drawing conclusions

Item: Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.
6- activities with effects of friction and gravity on speed
7- chicken wing dissection, diffusion observations, examining cells under the microscope
8- determining relative humidity, determining the dewpoint, activities to show that air has pressure

Participant: 16

Item: Describe your role as a science teacher.
Get students involved in scientific inquiry and excited about it! Connect all learning to their prior knowledge and make it relevant to their world while giving them the necessary analytical skills to thrive in 21st century.

Item: How do you believe that your students best learn science?
Well designed learning events that include a "grabber" to get their attention, background knowledge (vocabulary, history of current understandings, etc) as the process evolves, and guided inquiry activities to engage them in "real" science NOT TEXTBOOKS AND WORKSHEETS TO DEATH!

Item: What are the indicators to you that learning is occurring in your classroom?
Enthusiasm --- inquisitiveness --- more and more questions --- kids who bring in related examples (I know we were studying X and I found this at my aunt's house that made me think . . . )

Item: How have you adapted your teaching to best reflect the discipline of science?
Oh yeah and that's much more work to accomplish than tossing papers at them, but the level of participation and depth of learning makes the HOURS and HOURS of prep worthwhile.

Item: Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.
Swabbing areas of school (student choice) to test for bacteria
Moon phases by charting a month of viewing and using Oreos to nibble thru the phases

Item: Please provide a brief description of classroom and lab activities that will take place during the next two weeks.
Geology finds us tinkering with three class sets of rocks -- igneous samples one day, metamorphic the next, sedimentary on third day, then begin comparing/contrasting, then have a mixed gravel set for them to sort. Use foods to simulate rocks (rice krispie treats would be sedimentary, taffy is igneous, etc . . . ) that students bring in as samples.

Participant: 18

Item: Describe your role as a science teacher.
Ideally, the science teacher should help the students develop a curiosity that makes them want to find out more about science. How it can help them in the future whether in college or choosing a career.

Item: How do you believe that your students best learn science?
Student's best learn science with hands on activities and cross curricular projects.
Participant: 18, cont.

Item: **What are the indicators to you that learning is occurring in your classroom?**
When you see the excitement about a certain subject and they have lots of questions and want to learn more.

Item: **How have you adapted your teaching to best reflect the discipline of science?**
Some science concepts are very difficult for students to understand, especially in the middle school. So it is important that the students are provided with activities/labs that reinforce the work.

Item: **Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.**
Sect 1 Biology is Working on Heredity & Genetics - Activities included Demonstration of Mendel’s 1st & 2nd Principles; Monohybrid Crosses; Probability; Genetic Inheritance in a Family - Baby Project; Genetics of Taste; Interpreting a Karyotype; Researching Genetic disorders, making a powerpoint presentation and presenting the information to the class.

Participant: 20

Item: **Describe your role as a science teacher.**
Teach state expectations, expose students to a variety of science topics, get students to start to question and think for themselves

Item: **How do you believe that your students best learn science?**
hands-on experiences, computer experiences

Item: **What are the indicators to you that learning is occurring in your classroom?**
students are enjoying science, students can lead the discussion

Item: **How have you adapted your teaching to best reflect the discipline of science?**
added more activities to get students to see how different parts of science work

Item: **Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.**
Students worked on the Virtual Earthquake activity (www.sciencecourseware.org). We have worked on some of the http://classzone.com activities that relate to plate tectonics. We have done some paper labs showing sea floor spreading (including math applications within the exercise). Hands on mineral identification lab.

Item: **Please provide a brief description of classroom and lab activities that will take place during the next two weeks.**
Hands on rock identification lab. Paper labs about hydrogeology. Activities about water budgets.

Participant: 21

Item: **Describe your role as a science teacher.**
To expose students to the dynamic functions of our planet and the relationships that exists between the various parts of the whole. This is accomplished through the use of hands on activities, lecture, collaborative group activities, individual assignments, etc.

Item: **How do you believe that your students best learn science?**
I believe that students' best learn science through hands on activities, collaborative group work, visual aids/demonstrations, and direct experiences with which they have a direct connection/relation.

Item: **What are the indicators to you that learning is occurring in your classroom?**
“Ah ha” moments, strong grades, positive attitudes, positive social interactions, questions being asked

Item: **How have you adapted your teaching to best reflect the discipline of science?**
I have always tried to keep my teaching fresh by finding new ways with which to share scientific content with my students. This typically involves hands on lab activities so the kids can be directly involved in the learning process and work through scientific problems to determine the results on their own. It also comes in the form of trying to incorporate science and literacy together to help strengthen their abilities with technical reading and writing that is found in science texts, magazines, and journals.
**Participant: 21, cont.**

**Item:** Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.
Guided notes lecture, jigsaw poster activities, lab book-based lab assignments, visual/critical thinking demos, webquests, reading assignments, large group quiz review activities, individual assessments (quizzes), large group discussions

**Item:** Please provide a brief description of classroom and lab activities that will take place during the next two weeks.
Visual/critical thinking demos, guided notes lecture, pencil/paper lab activity, large group quiz review activity, individual assessment, hands on lab activities, data collection and interpretation, reading assignments

**Participant: 24**

**Item:** Describe your role as a science teacher.
Make students aware they are part of the problem and part of the solution. Future health depends on them.

**Item:** How do you believe that your students best learn science?
Hands on
Connect to something relevant in their lives

**Item:** What are the indicators to you that learning is occurring in your classroom?
Excitement to be there
Wanting to know what will come next
Problem solving

**Item:** How have you adapted your teaching to best reflect the discipline of science?
Search and find
Problem solve for themselves
Connect each subject to relevant concepts

**Item:** Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.
Population summaries on line
Genetic problems and solutions seen on line
Use of star maps to find stars in sky

**Item:** Please provide a brief description of classroom and lab activities that will take place during the next two weeks.
On line activity to understand sizes (sun, solar system, universe)
Paper dots (black and white) to show natural selection
Time line of Earth to scale through school hallways.
Game of cards to determine populations of countries the students will govern

**Participant: 26**

**Item:** Describe your role as a science teacher.
My focus is to create individuals that are independent thinkers and problem solvers. In Regents Earth Science I try and have my students "critically analyze" information, data, charts, in order to answer questions and/or solve a problem.

**Item:** How do you believe that your students best learn science?
For most students it is through a combination of presentations which include lecture, videos, computer software, and hands-on investigations. I believe that they learn best when I provide them with "Hands-On" problem solving activities.

**Item:** What are the indicators to you that learning is occurring in your classroom?
Results from a variety of assessments which include homework, quizzes and tests, as well as Laboratory write ups. The overall indicator becomes the Regents exam in June.

**Item:** How have you adapted your teaching to best reflect the discipline of science?
I believe that I have tried.

**Item:** Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks.
Over the last two weeks we have concluded the topic on Climates and introduced the Unit on Rocks and Minerals. In class we spent time reviewing what climate is and the many factors that affect
Please provide a brief description of classroom and lab activities that have taken place with your students during the past two weeks. (response continued from previous page)
and/or modify the climate of a region. In lab we completed a summary activity that had students identify the factor(s) that affected the climate and how that factor was changing the climate. I then provided the students with an assessment. We then introduced the concept of minerals using lecture and student notes, class worksheets on identifying mineral properties, and hands-on lab activities that had students applying the information to ID unknown mineral samples.

Please provide a brief description of classroom and lab activities that will take place during the next two weeks.
We will continue with the Unit on Rocks and Minerals looking at the Rock Cycle, Igneous Rocks, Sedimentary Rocks and Metamorphic Rocks. Again, through lecture and the completion of student notes, class worksheets, Review and Study Guides as well as hands-on activities in lab I will present the concepts.
APPENDIX H

PARTICIPANT RESPONSES: ALL HOMEWORK CATEGORIES
<table>
<thead>
<tr>
<th>Participant</th>
<th>Response</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reflect upon the lesson and describe what you have learned.</td>
<td>Inquiry</td>
</tr>
<tr>
<td>2</td>
<td>Students will create a story that mimics protein synthesis in the cell, providing characters or objects to represent the various organelles.</td>
<td>Inquiry</td>
</tr>
<tr>
<td>3</td>
<td>I don’t really assign homework…they have note packets for each unit that have notes, questions, activities, etc...</td>
<td>Traditional +</td>
</tr>
<tr>
<td>4</td>
<td>Reading with questions; practice OGT extended response questions related to classification; practice key with birds</td>
<td>Traditional +</td>
</tr>
<tr>
<td>5</td>
<td>Students will attend a lecture on global warming from a college professor.</td>
<td>Traditional</td>
</tr>
<tr>
<td>6</td>
<td>Students are currently working on a set of problems that use the relationship F=ma to answer questions about different situations, including friction, acceleration on an incline and other types of problems.</td>
<td>Traditional +</td>
</tr>
<tr>
<td>7</td>
<td>Iron Ore Lab: students used their iron ore measurements to calculate % ore found in different samples.</td>
<td>Traditional</td>
</tr>
<tr>
<td>8</td>
<td>Students analyze their lab data for homework.</td>
<td>Inquiry</td>
</tr>
<tr>
<td>9</td>
<td>Iron Ore Lab: students used their iron ore measurements to calculate % ore found in different samples.</td>
<td>Traditional</td>
</tr>
<tr>
<td>10</td>
<td>Homework involves reading the text and answering text questions. We are using the Holt physical science text for 9th grade physical science.</td>
<td>Traditional +</td>
</tr>
<tr>
<td>11</td>
<td>They need to finish researching an element and be prepared to share with the class.</td>
<td>Traditional +</td>
</tr>
<tr>
<td>12</td>
<td>Students received a worksheet of energy calculation problems during a unit on energy conservation</td>
<td>Traditional</td>
</tr>
<tr>
<td>13</td>
<td>Students write lab reports or complete data analysis in lab notebooks after a lab.</td>
<td>Inquiry</td>
</tr>
<tr>
<td>14</td>
<td>Practice in scientific notation.</td>
<td>Traditional</td>
</tr>
<tr>
<td>15</td>
<td>We read related articles, generally from the newspaper.</td>
<td>Traditional</td>
</tr>
<tr>
<td>16</td>
<td>The moon charting (mentioned above) is a four week assignment that is done from home.</td>
<td>Traditional</td>
</tr>
<tr>
<td>17</td>
<td>I had students do a lab activity, using scientific methods that tied in direct variation, with distance traveled by a car as the rise/run changed. Students where to complete a table, and graph results, and compare results of different rises</td>
<td>Traditional +</td>
</tr>
<tr>
<td>Participant</td>
<td>Response</td>
<td>Category</td>
</tr>
<tr>
<td>------------</td>
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</tr>
<tr>
<td>18</td>
<td>Students took taste tester papers home and made a pedigree of tasters/non-tasters in their family.</td>
<td>Traditional +</td>
</tr>
</tbody>
</table>
| 19         | Readings  
Answering questions from book                                                                                                       | Traditional |
| 20         | Homework is usually finishing activities started in class.                                                                                  | Traditional |
| 21         | We have prepared reading guides for each chapter in our Earth systems science class that helps the students practice reading comprehension skills and strengthen their interpretation of technical writing. | Traditional + |
| 22         | Problems to review stoichiometry, limiting reactants, theoretical yield, and percent yield                                                   | Traditional |
| 23         | A sample homework assignment included presenting the Rock Cycle in either poster format or powerpoint format. The student then is asked to present and explain the process in class. | Traditional |
| 24         | What do you think? How would you address the problems?  
Essay  
Understanding of time of humans is short and time for evolution is long.  
Vocabulary, worksheets, essay, problem solving | Traditional + |
| 25         | After covering Symbiosis the students are given 20 examples and they have to determine the type of organism interaction.                     | Traditional |
| 26         | My homework assignments vary from annotated reading assignments, to Vocabulary worksheets, as well as worksheets that focus on applying the concepts taught for a specific set of concepts. ie: Igneous Rock Worksheet | Traditional |
| 27         | After studying the Metric System, students receive a Metric System packet that consists of them looking at various figures and either measuring an item using a specific tool and/or writing down correct measurements. | Traditional |